Basilicata

Renna, P.CAPACITY INVESTMENT DECISION BY MONTE CARLO APPROACH IN A COOPERATION NETWORK

*International Journal of Production Research, Volume 51, Issue 21, 1 November 2013, Pages 6455-6469*Capacity expansion; collaboration; Collaborative network; Cooperation networks; Monte Carlo approach; Monte Carlo simulators; Negotiation protocol; Simulation environment Engineering controlled terms: Discrete event simulation; Expansion; Information analysis; Investments Engineering main heading: Monte Carlo methods *This paper proposes a Monte Carlo approach to make the capacity investment decision. The environment concerns the capacity expansion issue for independent plants operating in a collaborative network. The plants that compose the network can share capacity through a negotiation protocol in order to balance under and over utilisation due to the customer demand. The plants apply the capacity expansion process following a periodic review policy. The generic plant makes the decision using a Monte Carlo approach that takes into account the information of the plant and the information of the collaboration with the plants of the network. The Monte Carlo simulator provides the information to each plant to support the capacity investment decision. The proposed approach is compared with a case characterised by information sharing among the plants proposed in literature and a case without information sharing. A simulation environment based on the JAVA package has been developed in order to test the approach in several market conditions. Several customer demand scenarios have been tested. The simulation results highlight these main findings: the robustness of the proposed approach; the reduction of the capacity investment keeping the same level of total profit performance; and the higher utilisation of the cooperation with the other plants of the network.*

Argoneto, P., Renna, P.CAPACITY SHARING IN A NETWORK OF ENTERPRISES USING THE GALE-SHAPLEY MODEL

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 5-8, 2013, Pages 1907-1916*Capacity allocation; Capacity sharing; Discrete simulations; Distributed approaches; Environment conditions; Multiagent architecture; Private information; Utility functions Engineering controlled terms: Discrete event simulation; Game theory; Multi agent systems Engineering main heading: Industry *In this paper, we analyze a model of capacity sharing for a set of independent firms, geographically distributed, that often have to implement an opportune tool to integrate their resources and demand forecasts in order to gather a specific production objective. We formulate the problem as a cooperative game and identify a capacity sharing solution using the Gale-Shapley model. The allocation rule takes into account the utility functions of the involved firms, and we show how the capacity allocation rule can be designed to induce all firms to report truthfully their information. Moreover, we show that, under this*

allocation rule, truth telling is a dominant strategy, with each firm reporting truthfully its private information, regardless of the reporting decisions of other firms. Moreover, the proposed research develops a distributed approach able to facilitate the capacity sharing process by using a multi-agent architecture; then a discrete simulation environment has been developed to compare the proposed approach with a centralized one. Several simulation scenarios were conducted to analyze the performances' trends in various environment conditions.

Renna, P.CONTROLLABLE PROCESSING TIME POLICIES FOR JOB SHOP MANUFACTURING SYSTEM

*International Journal of Advanced Manufacturing Technology, Volume 67, Issue 9-12, 2013, Pages 2127-2136*Controllable processing time; Dynamic condition; Job shop; Job shop manufacturing; Multiagent architecture; Process time reduction; Processing time; Simulation environment Engineering controlled terms: Discrete event simulation Engineering main heading: Manufacture *The research presented concerns the policy to manage a job shop in which the machines have controllable processing times. A controllable processing time means that it can be reduced processing time by using additional resources. The model proposed is based on a multi-agent architecture that supports the manufacturing system. The policy proposed concerns the evaluation of the workload of the resources. It is necessary to define the following issues for the controllable time process of a resource: the condition of start and the duration of the process time reduction. Two approaches are proposed to assign the resources to the machines. The first approach concerns the reduction of the processing time one machine at time, while the second approach distributes the additional resources proportionally among the machines. A simulation environment is developed to test the proposed approach in several dynamic conditions. The simulation results show that the control of the processing times proposed allows to improve significantly the performance.*

Renna, P.DECISION MODEL TO SUPPORT THE SMES DECISION TO PARTICIPATE OR LEAVE A COLLABORATIVE NETWORK

*International Journal of Production Research, Volume 51, Issue 7, 1 April 2013, Pages 1973-1983*Collaboration process; Collaborative network; Decision models; Dynamic network; Extended enterprise; Information and Communication Technologies; Information sharing; Local information; Market changes; Rapid response; Regional clusters; Set of rules; Short term; Simulation environment; Virtual organisations Engineering controlled terms: Artificial intelligence; Decision support systems; Industry; Information analysis; Information technology; Models; Plants (botany) Engineering main heading: Competition *Enterprises need to adopt new business paradigms in order to make a rapid response to market changes and improve the competitiveness. The development of information and communication technology allows the support of new business paradigms such as extended enterprises, virtual organisations, regional clusters, etc. The research proposed concerns the study of a dynamic network in which the*

partners change in short term periods. The model proposed supports the enterprises in the decisions to participate or exit in a network of enterprises. The model is based on the definition of a set of rules that operate with local information to take the decisions. The local information is the output of the collaboration process; this means that the approach proposed integrates the collaboration methodology and the decision model. This environment is related to independent plants that cooperate with reduced information sharing. A simulation environment is developed to test the approach proposed. The simulation results show that the proposed approach is a very promising tool to support the enterprise's participation decisions.

Renna, P., Magrino, L., Zaffina, R.DYNAMIC CARD CONTROL STRATEGY IN PULL MANUFACTURING SYSTEMS

*International Journal of Computer Integrated Manufacturing, Volume 26, Issue 9, 1 September 2013, Pages 881-894*Constant work in process; Control methodology; CONWIP; Discrete simulations; Dynamic controls; kanban; Performance measure; Simulation environment Engineering controlled terms: Manufacture Engineering main heading: Controllers *The dynamic control of cards in pull systems can improve the performance of a manufacturing system in a turbulent demand condition. The traditional fixed card approach can reduce the performance of a system in some cases. This article presents a dynamic card control methodology in order to keep a high level of performance measures. The proposed methodology is based on the observation of customer demand in order to detect the fluctuations and adjust the number of cards. The demand fluctuations is evaluated based on two moving average: the first on a medium horizon and the second on a short horizon. The comparison between the two moving averages is the signal of the controller developed. A simulation environment has been developed to test the proposed methodology in both kanban and Constant Work In Process (CONWIP) systems. The simulations conducted in several scenarios highlight the better performance obtained using the controller. The main performance measures investigated are: the throughput, the queue of orders waiting to be processed, the throughput time of the orders, the number of cards used and the orders delayed. The benefits are more relevant in the case reliability reduction of the manufacturing system.*

Carlucci, D., Renna, P., Schiuma, G.EVALUATING SERVICE QUALITY DIMENSIONS AS ANTECEDENTS TO OUTPATIENT SATISFACTION USING BACK PROPAGATION NEURAL NETWORK

Health Care Management Science, Volume 16, Issue 1, 2013, Pages 37-44 EMTREE medical terms: article; artificial neural network; health services research; human; outpatient; patient satisfaction; quality control; statistical model MeSH: Health Services Research; Humans; Models, Statistical; Neural Networks (Computer); Outpatients; Patient Satisfaction; Quality Control Medline is the source for the MeSH terms of this document. *Nowadays the ability to provide outpatient services with exceptional quality is paramount to long-term survival of*

hospitals, as the revenues from outpatient services are predicted to equal or exceed inpatient revenues in the near future. Identifying the relative weight of different dimensions of healthcare quality service which concur together to determine outpatients satisfaction is very important, as it can help healthcare managers to allocate resources more efficiently and identify managerial actions able to guarantee higher levels of patients' satisfaction. This study proposes the use of Artificial Neural Network (ANN) as a knowledge discovery technique for identifying the service quality factors that are important to outpatient. An ANN model is developed on data from a panel of outpatients of public healthcare services.

Renna, P.ORDER RELEASE STRATEGIES FOR CUSTOMER ORDER SCHEDULING PROBLEMS IN DYNAMIC ENVIRONMENTS

*Business Strategies and Approaches for Effective Engineering Management, 2013, Pages 1-21*CONWIP, Customer Order Scheduling, Discrete Event Simulation, Finished Goods, Fuzzy Logic, Order Release, Scheduling*The research proposes two strategies to release the parts in a job shop environment to handle the customer order-scheduling problem. The first strategy is based on the evaluation of a dynamic conwip level to take the decision. The second strategy tries to anticipate the production of components of a generic order when the utilization of the manufacturing system is low. In this strategy, a fuzzy approach is proposed to decide how many components to release. A simulation environment has been developed to test the proposed approaches. Two benchmark models are used to compare the performance measures: no order release strategy and classical conwip. Moreover, the simulations are conducted in a very dynamic environment. The simulation results show how the fuzzy approach leads to the better results in all conditions tested with a relevant reduction of the inventory level.*

Renna, P.VIRTUAL JOB SHOP APPROACH BASED ON RECONFIGURABLE MACHINES

*International Journal of Services and Operations Management, Volume 14, Issue 4, 2013, Pages 445-465*multi-agent systems; MAS; agent-based systems; reconfiguration policy; dynamic environment; discrete event simulation; virtual job shops; reconfigurable machines; reconfigurable manufacturing systems; RMS*The manufacturing companies need to rapid response to the market changes (product fluctuations, mix changes, etc.) in order to stay competitive. Reconfigurable machines allow to support the development of reconfigurable manufacturing systems (RMS). Reconfigurable machines are able to rapid change of hardware and software components in order to adjust the production capacity and adapt to new products. The performance measures of RMSs depend strongly by the design and control approaches used. This paper proposes a control policy to reconfigure machines in order to obtain a virtual job shop, because the machines of the job shop can be dispersed in the manufacturing system. A simulation environment has been developed in order to test the proposed methodology in different dynamic conditions: production fluctuations, mix change and the dynamicity level of the environment. The simulation results show the benefits of the proposed approach in a very dynamic environment. Copyright*

Bergamo

Ceretti, E., Attanasio, A., Fiorentino, A., Giorleo, L., Giardini, C.ALUMINIUM CAN SHAPING BY HYDROFORMING: SIMULATIVE FEASIBILITY STUDY AND PROTOTYPE PRODUCTION

*International Journal of Advanced Manufacturing Technology, Volume 68, Issue 5-8, 2013, Pages 1797-1807*Deep drawing and ironing; Feasibility studies; Finite element method models; Hydroforming; Hydroforming process; Material characteristics; Material characterizations; Simulation software Engineering controlled terms: Beverages; Bottles; Computer simulation; Computer software; Cylinders (shapes); Deformation; Metal forming; Planning Engineering main heading: Aluminum *In these last years, the demand of shaped aluminium bottles and cans was continuously growing. The main problem is related to the fact that normally these objects have very thin thickness and a high strain-hardened material due to the deforming production steps (deep drawing and ironing). In the present paper, a study about the residual formability of cylindrical can is reported. In particular, a first characterization of the flow stress of the ironed component and the identification of the maximum deformation reachable with the hydroforming process were carried out. On the base of these preliminary results, the feasibility of hydroforming aluminium can, namely a small bottle for soft drink, has been investigated. The process is similar to tube hydroforming, even if the bottom part of the can is closed and air is used instead of liquid. The main problems to be solved were related with the possible breakages of the cylindrical body during hydroforming. The process success depends on the material characteristics, the diameter and thickness of the preformed cylindrical body, the shape, the geometry and the dimensions of the final part and the media pressure. The research aims to study the process feasibility and to prove the ability of the simulation software in forecasting the material behaviour. All the simulation phases are supported by experimental tests aiming at validating the finite element method model and to realize sound prototypes of Al soft drink bottles. In such a way, it is possible to have a reliable tool to help the designer in optimizing the process and in identifying new feasible shapes.*

Attanasio, A., Ceretti, E., Giardini, C.ANALYTICAL MODELS FOR TOOL WEAR PREDICTION DURING AISI 1045 TURNING OPERATIONS

*Procedia CIRP, Volume 8, 2013, Pages 218-223*Cutting parameters; Fitting techniques; Longitudinal turning; Production management; Response surface method; Response surface methodology; Tool wear; Turning operations Engineering controlled terms: Analytical models; Forecasting; Industrial management; Machining centers; Models; Neural networks; Surface properties; Tools; Tungsten carbide; Turning Engineering main heading: Wear of materials *Tool wear is one of the most important topic in cutting field. Its interest is due to the influence of tool wear on surface integrity of the final parts and on tool life, and, consequently, on the substitution*

policies and production costs. Analytical models, able to forecast the tool wear with a satisfactory accuracy, can give to the companies working in the material removal field a valid instrument to optimize the cutting processes. In the present work a comparison between response surface methodology (RSM) and artificial neural networks (ANNs) fitting techniques for tool wear forecasting was performed. For developing these predictive models, tool life tests, consisting of longitudinal turning operations of AISI 1045 steel bars using uncoated tungsten carbide inserts and variable cutting parameters, were conducted. Both flank (VB) and crater wears (KT) of the tool were monitored. The models were validated comparing the calculated tool wear values with the experimental ones, showing that ANNs model provides better approximation than RSM in the prediction of the amount of the tool wear parameters. So, from an industrial point of view, this model should be implemented into a production management software in order to correctly define the tool substitution policy during batch production. Copyright

Longo, M., Maccarini, G.CONTROL SYSTEM ALGORITHM FOR THE PREDICTION OF SPRINBACK IN AIR BENDING

*Key Engineering Materials, Volume 554-557, 2013, Pages 1382-1387*Air bending; Material information; Mathematical descriptions; Process geometries; Punch displacement; Spring-back; Springback prediction; Stress-strain law Engineering controlled terms: Algorithms; Bending brakes; Control systems; Functions; Unloading Engineering main heading: Sheet metal *The phenomenon of springback, which is ruled by strain recovery after removal of forming loads, is of remarkable interest in air bending of metal sheets. In this process, the final angle is affected by a number of parameters related to both process geometry (sheet thickness, die and punch radii) and material properties (elastoplastic stress-strain law); because of this, punch stroke has to be calculated in a nontrivial way and a number of input parameters should be taken into account. In this work the study of total load as a function of displacement is used to collect information about material stress-strain law; using this approach, load data may be exploited to fine tune the mathematical description of the material and, finally, to improve springback prediction. A customized press brake able to measure both displacement and force during bending was fabricated for this purpose. The press brake is equipped with a control system algorithm able to collect material information directly during the initial stage of the bending process. These collected data are used to feed a model based on a FEM simulation and the model output is the final punch displacement suitable to obtained a specific bending angle after unloading. The program utilized for the simulation is Deform 2D. Preliminary tests were executed on metal sheets having thickness equal to 2.5 mm. Copyright*

Giorleo, L., Ceretti, E., Giardini, C.ENERGY CONSUMPTION REDUCTION IN RING ROLLING PROCESSES: A FEM ANALYSIS

*International Journal of Mechanical Sciences, Volume 74, September 2013, Pages 55-64*Consumption reductions; FE modeling; FEM analysis; Final ring geometry; Hot forming process; Production of; Ring rolling; Very high energies Engineering controlled terms: Energy utilization; Piercing; Rolling mills Engineering main heading: Preforming *Ring Rolling is a very high energy consuming hot forming process used for the production of shaped ring, seamless and axis symmetrical workpieces. Different production steps (Upsetting, Piercing, Ring Rolling) are involved in generating the desired ring shape. In particular the Upsetting and Piercing steps generate a hollow circular preform that will be subsequently enlarged by the rolling mills (Driver, Idle and Axial Rolls) during the Ring Rolling step. In order to reduce the energy and the force needed to produce the workpiece it must be observed that they are strictly affected by the speed laws imposed to the rolling mills which depend on the preform and the final ring geometry. As a consequence the setup of the Upsetting and Piercing steps became fundamental because they impose the preform geometry of the workpiece. Starting from this assumption, in the present work different preforms geometries, characterized by different initial heights, are considered to simulate the Ring Rolling process focusing the results analysis not only on the part feasibility, but also on the energy and force required which affect the equipment dimensioning. An industrial case was considered to validate the FE model. The maximum load and the energy needed for the ring production are considered as main figures for optimizing the process.*

Monroy-Vázquez, K.P., Attanasio, A., Ceretti, E., Siller, H.R., Hendriqchs-Troeglen, N.J., Giardini, C.EVALUATION OF SUPERFICIAL AND DIMENSIONAL QUALITY FEATURES IN METALLIC MICRO-CHANNELS MANUFACTURED BY MICRO-END-MILLING

*Materials, Volume 6, Issue 4, 2013, Pages 1434-1451*Conventional theory; Coolant applications; Critical phenomenon; Geometrical features; Manufacturing process; Micro milling; Micro-fluidic devices; Minimum chip thickness Engineering controlled terms: Coolants; Fluidic devices; Fuel cells; Heat exchangers; MEMS; Surface properties Engineering main heading: Milling machines *Miniaturization encourages the development of new manufacturing processes capable of fabricating features, like micro-channels, in order to use them for different applications, such as in fuel cells, heat exchangers, microfluidic devices and micro-electromechanical systems (MEMS). Many studies have been conducted on heat and fluid transfer in micro-channels, and they appeared significantly deviated from conventional theory, due to measurement errors and fabrication methods. The present research, in order to deal with this opportunity, is focused on a set of experiments in the micro-milling of channels made of aluminum, titanium alloys and stainless steel, varying parameters, such as spindle speed, depth of cut per pass (a p), channel depth (d), feed per tooth (f z) and coolant application. The experimental results were analyzed in terms of dimensional error, channel profile shape deviation from rectangular and surface quality (burr and roughness). The micro-milling process was capable of offering quality features required on the micro-channeled devices. Critical phenomena, like run-out, ploughing, minimum chip thickness and tool wear, were encountered*

as an explanation for the deviations in shape and for the surface quality of the micro-channels. The application of coolant and a low depth of cut per pass were significant to obtain better superficial quality features and a smaller dimensional error. In conclusion, the integration of superficial and geometrical features on the study of the quality of micro-channeled devices made of different metallic materials contributes to the understanding of the impact of calibrated cutting conditions in MEMS applications.

Giorleo, L., Ceretti, E., Giardini, C.FE MODELING OF THE APPARENT SPOT TECHNIQUE IN CIRCULAR LASER HARDENING

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 9-12, December 2013, Pages 1961-1969*Apparent spot technique; Back-tempering effect; Cylindrical workpiece; FEM modeling; Laser hardening; Laser surface treatment; Numerical results; Surface temperatures Engineering controlled terms: Atmospheric temperature; Mathematical models; Regression analysis; Tempering Engineering main heading: Hardening *Circular laser hardening is the laser surface treatment used in the case of cylindrical workpieces. The singletrack treatment is a particular case of circular laser hardening used when only one revolution of the workpiece is executed since the treatment of a narrow surface is required. As a result, an annular narrow hardening track is obtained. During the laser hardening, the initial and final parts of the work-piece are overlapped and treated twice. The main drawback of this treatment is the back-tempering effect focused on the overlapping zone. This phenomenon leads to a hardness decrease in the overlapping zone. To avoid this problem, a new technique called apparent spot (AS) was introduced by the authors. The aim of the AS technique is to increase in a fictitious way the dimensions of the laser spot. In the case of circular laser hardening, this technique results into a highspeed rotation (up to 1,000 rpm) of the cylindrical workpiece instead of the traditional low speed. So, a uniform hardening zone without overlapping and back tempering is obtained. However, despite these benefits, there is still a lack of knowledge about the physics of this treatment in particular referring to the thermal cycle that affects the workpiece. In order to enhance the knowledge of this technique in this work, the AS was modeled via the FE approach. DEFORM software was used to model the circular laser hardening process. The software was firstly validated by a comparison with experimental results. Once the software reliability was tested, a regression model was estimated to predict the surface temperature within the treatments. Good agreement was found between the prediction model and the numerical results.*

D'Urso, G., Longo, M., Giardini, C.FRICTION STIR SPOT WELDING (FSSW) OF ALUMINUM SHEETS: EXPERIMENTAL AND SIMULATIVE ANALYSIS

*Key Engineering Materials, Volume 549, 2013, Pages 477-483*Alluminum sheets; Experimental evidence; Friction stir spot welding; Friction stir welding(FSW); Lap joint; Metallurgical analysis; Resistance spot welding; Traditional techniques Engineering controlled terms: Aluminum sheet; Finite element method; Friction stir welding; Joining; Quality control;

Stainless steel; Tensile testing; Welding; Welds Engineering main heading: Spot welding *Friction Stir welding (FSW) is a solid state joining process developed by TWI (The Welding Institute) in 1991. This technology is suitable for joining different materials even considered difficult to be welded using more traditional techniques and it is appropriate to weld materials in different configurations (such as butt, lap, circumferential, T-joint etc). Recently, starting from the FSW approach, a new technology called Friction Stir Spot Welding (FSSW) was developed. In this case, instead of moving along the weld seam, the tool only indents two overlapped parts. In some applications, this technology can be considered as a valid alternative for single point joining processes like resistance spot welding (RSW) and riveting processes. This work deals with an experimental study of the FSSW process for the lap-joining of thin aluminum sheets. In particular, an experimental campaign was performed on AA6060 T6 aluminum sheets having a thickness equal to 2 mm. The FSSW process was applied on couples of overlapped sheets by varying the tool rotational speed, and by keeping fixed the other process parameters, such as axial feed rate, indentation depth, and dwell time. Welding forces distributions were recorded during the process. Preliminary tensile tests and metallurgical analyses were also performed to evaluate the quality of the joints as function of the chosen process parameters. A numerical model of the FSSW process was developed and implemented using the commercial FEM code Deform 3D. The model parameters were set according to the experimental evidence.*

D'Urso, G., Longo, M., Giardini, C.MECHANICAL AND METALLURGICAL ANALYSES OF LONGITUDINALLY FRICTION STIR WELDED TUBES: THE EFFECT OF PROCESS PARAMETERS

*International Journal of Materials and Product Technology, Volume 46, Issue 2-3, 2013, Pages 177-196*Bulge tests; Experimental campaign; Friction stir welding(FSW); FSW; Metallurgical analysis; Process parameters; Technological parameters; Welding technology Engineering controlled terms: Aluminum; Computer control systems; Mechanical properties; Metallography; Strain; Tensile testing; Tubes (components); Welding Engineering main heading: Friction stir welding *Friction stir welding (FSW) is a welding technology used to join materials considered difficult to be welded. Mechanical properties of FSW joints are generally evaluated by means of tensile tests that might provide insufficient information because maximum strain obtained before necking is small and that cannot be used when the joint path is not linear or when the welds are executed on curved surfaces. The present work investigates the mechanical properties of FSW tubes by means of tube bulge tests. An experimental campaign was performed on tubular specimens (thickness equal to 3 mm, external diameter equal to 40 mm). In particular, bent plates in AA6060 alloy were longitudinally friction stir welded by means of a CNC machine tools varying the welding parameters. The burst pressure, the stress state and the wall thickness were measured for each tested tube. Finally, macro and micro analyses were carried out on the joints. Copyright*

D'Urso, G., Longo, M., Giardini, C.MICROSTRUCTURAL ANALYSIS OF AA6060-T6 FRICTION STIR WELDED

JOINTS: CORRELATION BETWEEN PROCESS PARAMETERS GRAIN SIZE

*Metallurgia Italiana, Volume 105, Issue 6, June 2013, Pages 23-30*Experimental campaign; Friction stir welded joints; Grain size; Metallurgical analysis; Metallurgical properties; Microstructural analysis; Process parameters; Solid-state welding Engineering controlled terms: Butt welding; Design of experiments; Grain size and shape; Heat affected zone; Interfaces (materials); Mechanical properties; Metallurgy; Microstructure; Tensile strength; Tensile testing; Tools Engineering main heading: Friction stir welding *The present paper reports the results of an experimental campaign aimed at the study of the microstructure of Friction Stir Welded butt joints. In this solid-state welding technology, a rotating tool moves into the material and translates along the interface of two or more parts. During this process friction heats the material which is extruded around the tool and forged by the large pressure produced by the tool shoulder. The experimental campaign was performed by means of a CNC machine tool. Butt joints were obtained on sheets having a thickness equal to 8 mm. An AA6060 aluminum alloy in the T6 artificially aged condition was used for this purpose. Sheets were welded by using a standard tool with smooth plane shoulder and cylindrical pin. The tool was fabricated using AISI 1040 steel, shoulder and pin diameters are respectively equal to 20 and 8 mm. The tilt angle, was fixed at 2.5° and the pin was inserted into the workpiece for 7.8 mm. The joints were executed by varying the process parameters, namely rotational speed (S [rev/min]) and feed rate (f [mm/min]). The selection of the parameter values was based on a DOE (Design of Experiments) approach. The metallurgical analysis was carried out to evaluate the microstructure of the joints transverse section as a function of the process parameters and to evaluate the grain size in the different regions of the joints: Nugget, HAZ - Heat Affected Zone, TMAZ - Thermo Mechanical Affected Zone. The grain count was executed according to the standard ASTM E 112-96(2004). The ratio between feed rate and rotational speed resulted to be a significant parameter for the control of the joints grain size. The Nugget showed a microstructure with very small grains with an average dimension equal to one third with respect to the grains of the base material. The grain size linearly decreases for increasing values of the f/S ratio. The TMAZ is characterized by strongly elongated grains, oriented in a different way with respect to the ones of the other regions. Also in this case, an almost linear correlation between grain size and f/S ratio was observed. On the opposite, in the HAZ, the grain size decreases for increasing values of the f/S ratio. A tensile test campaign was also carried out to evaluate the mechanical properties of the joints. Specimens having a width and a thickness equal respectively to 18 mm and 8 mm were tested orthogonally with respect to the welding direction by means of a Galdabini machine. Except for the joints containing defects, the rupture always occurred in the HAZ. The increase of UTS was observed for increasing values of the ratio between feed rate and rotational speed (f/S). An inverse behaviour was observed for the strain at rupture. Finally, the quality of the joins, in terms of tensile strength, was compared with the metallurgical properties observed on the joints. The tensile strength resulted to increase for decreasing values of the grain size.*

D'Urso, G., Longo, M., Giardini, C.MICROSTRUCTURE AND MECHANICAL PROPERTIES OF FRICTION STIR WELDED AA6060-T6 TUBES

*Key Engineering Materials, Volume 554-557, 2013, Pages 977-984*Circumferential welding; Conventional fusion welding process; Environmental performance; Experimental campaign; Friction stir welding(FSW); Microstructure and mechanical properties; Minimal distortion; Solidification defects Engineering controlled terms: Aluminum; Electric welding; Environmental management; Friction stir welding; Mechanical properties; Microhardness; Microstructure; Tensile testing; Tools; Welds Engineering main heading: Tubes (components) *Friction stir welding (FSW) has received increasing attention in recent years thanks to its advantages over traditional welding processes, reducing distortion and eliminating solidification defects. Since melting does not take place and joining occurs below the melting temperature of the material, this welding process allows to obtain a weld characterized by very high quality with low heat input, minimal distortion, no filler material, and no fumes. FSW is also highly efficient and it is characterized by improved environmental performance if compared to traditional welding methods. For instance, FSW is particularly advantageous in the pipeline industry because this innovative welding process usually entails reduction in energy usage of up to 80% if compared to conventional fusion welding processes. Moreover, also alloys normally difficult to be welded can be considered with this technique. The objective of the present study is to establish and to study the weldability of aluminum tubes by means of FSW process. The study shows preliminary results on circumferential FSW of AA6060-T6 aluminum tubes and the influence of the welding process on weld quality. The experimental campaign was performed on tubes having a thickness equal to 5 mm and an external diameter equal to 80 mm. Tubes were welded by means of a four axes CNC machine tool. Particular care was paid to the fabrication of the inner support for the tube. The mandrel was designed in order to guarantee limited bending during the welding process. Some preliminary tests were carried out by varying the welding parameters, namely feed rate (f) and rotational speed (S). A tool having conical shoulder and cylindrical pin was used. The weld quality investigation was based on tensile tests, microhardness and macrostructure analysis of the joints. Copyright*

Giorleo, L., Ceretti, E., Giardini, C.SPEED ROLL LAWS INFLUENCE IN A RING ROLLING PROCESS

*Key Engineering Materials, Volume 554-557, 2013, Pages 337-344*Complex hot forming; Deformation process; FE modeling; Industrial case study; Industrial environments; Numerical approaches; Ring rolling; Technological process Engineering controlled terms: Industrial applications; Mechanical properties; Rolls (machine components) Engineering main heading: Milling (machining) *Ring Rolling is a complex hot forming process used for the production of shaped rings, seamless and axis symmetrical workpieces. The main advantage of workpieces produced by ring rolling, compared to other technological processes, is given by the size and orientation of grains, especially on the worked surface which give to the final product excellent mechanical properties. In this process different rolls (Idle, Axial, Guide and Driver) are involved in generating the desired ring shape. Because each roll is characterized by a speed law that could be set independently by the speed law imposed to the other rolls an optimization is more critical compared with other deformation processes. Usually in industrial environment a milling curve is introduced in order to correlate the Idle and Axial roll displacement, however it must be underlined that different milling curves lead to different loads and energy for ring realization. In this work an industrial case study was modeled by a numerical approach: different milling*

curves characterized by different Idle and Axial roll speeds laws (constant, linear and quadratic) were designed and simulated. The results were compared in order to identify the best set of Idle and Axial roll speed laws that guarantee a good quality produced ring (lower fishtail) with lower manufacturing loads and energy. Copyright

Fiorentino, A., Ceretti, E., Giardini, C.THE THF COMPRESSION TEST FOR FRICTION ESTIMATION: STUDY ON THE INFLUENCE OF THE TUBE MATERIAL

*Key Engineering Materials, Volume 549, 2013, Pages 423-428*Compression tests; Friction coefficients; Friction estimation; Hardening coefficient; High-pressure liquid; Process parameters; Simulation studies; Tube hydroforming Engineering controlled terms: Compression testing; Finite element method; Friction; High pressure engineering; Sheet metal; Strength of materials; Tribology Engineering main heading: Tubes (components) *In the Tube Hydroforming (THF) process, a tube, placed in closed dies, is expanded by a high pressure liquid and two punches push its edges in order to feed the material into the expansion zones. Because of the high pressure and the contact area involved in the process, high friction stresses act on the tube walls restricting the material flow so reducing the amount of fed material, the part formability and affecting the soundness of the final part and its geometry. In fact, previous studies showed that the lower the friction coefficient at the tube-die interface, the more uniform the friction distribution and, therefore, the more uniform the stresses acting on the tube walls. The tube deformation being dependent on the stresses, its final thickness is influenced by friction. Starting from this premise, the authors proposed a reference test which is able to highlight the effect of friction on the final tube thickness. In this test, namely the THF Compression Test, a tube is placed in a cylindrical die having the same diameter as the outside of the tube, it is pressurized and then compressed by the punches. In this way, the tube has no expansion and its final thickness depends on the process parameters (tube material, pressure, punch stroke, tube material and geometry). Using FE simulations, it is possible to express the friction coefficient as a function of the process conditions and to use it in combination with experimental results. In the present paper, the previously validated FE model is used to investigate the influence of the tube material on the compression test results. Therefore, a simulation study was performed using different values of strength and hardening coefficients showing how the method is affected by the tested material thereby giving further indication of the test sensitivity.*

D'Urso, G., Maccarini, G., Merla, C.THE DOWNSIZING EFFECTS IN EDM DRILLING OF MICRO HOLES

*Key Engineering Materials, Volume 549, 2013, Pages 503-510*Dimensional properties; Downsizing effects; Frequency parameters; Manufacturing technologies; Micro drilling; Micro EDM; Micro electrical discharge machining; Sophisticated system Engineering controlled terms: Carbides; Drills; Electrodes; Manufacture; MEMS; Microoptics; Oil well drilling; Scanning electron microscopy; Sheet metal Engineering main heading: Micromachining *The recent*

miniaturization trend in manufacturing, has enhanced the production of new and highly sophisticated systems in various industrial fields. In recent years, machining of the so called "difficult to cut" materials has become an important issue in several sectors. Micro Electrical Discharge Machining (micro-EDM) thanks to its contactless nature, is one of the most important technologies for the machining of this type of materials and it can be considered as one of the most promising manufacturing technologies for the fabrication of micro components. One of the most relevant applications of micro-EDM is micro-drilling. Micro holes in fact, are widely used for example in micro-electromechanical systems (MEMS), serving as channels or nozzles to connect two micro-features, and in micro-mechanical components. The present study is about micro drilling of metal plates by means of micro-EDM technology. In particular, the aim of this work is to investigate the effects of the "downsizing" of the micro holes diameter on the drilling performances. The influence of the reduction of the diameters in terms of both process performances (e.g., tool wear, taper rate, diametrical overcut) and general quality of the holes was investigated. Steel plates having thickness equal to 0.8 mm were taken into account. The drilling process was carried out using a micro-EDM machine Sarix SX 200 with carbide electrodes having diameter equal to 300, 200, 100 and 50 μm. Since the standard electrodes adopted in this study had a diameter equal to 300 μm, a wire EDM unit was used to obtain the other electrodes. The relationship between the process parameters considered the most significant and the final output, was studied. Furthermore, the geometrical and dimensional properties of the micro-holes were analyzed using both optical and scanning electron microscopes. In particular, it is demonstrated that the diameter size has a significant influence on the final value of the diametrical overcut while peak current and frequency parameters have a negligible effect.

Attanasio, A., Ceretti, E., Giardini, C., Cappellini, C.TOOL WEAR IN CUTTING OPERATIONS: EXPERIMENTAL ANALYSIS AND ANALYTICAL MODELS

*Journal of Manufacturing Science and Engineering, Transactions of the ASME, Volume 135, Issue 5, 2013, Article number 051011*Cutting operations; Experimental analysis; Experimental values; Fitting techniques; Longitudinal turning; Multidimensional regression; Response surface methodology; Tool wear Engineering controlled terms: Forecasting; Neural networks; Tools; Turning Engineering main heading: Wear of materials *The possibility of predicting the amount of the tool wear in machining processes is an interesting topic for industries, since tool wear affects surface integrity of the final parts and tool life is strictly connected with substitution policy and production costs. The definition of models able to correctly forecast the tool wear development is an important topic in the research field. For this reason in the present work, a comparison between response surface methodology (RSM) and artificial neural networks (ANNs) fitting techniques in tool wear forecasting was performed. For developing these predictive models, experimental values of tool wear, obtained by longitudinal turning operations with variable cutting parameters, were collected. Once selected, the best configuration of the two previously mentioned techniques, the resultant errors with respect to experimental data were estimated and then compared. The results showed that the developed models are able to predict the amount of wear. The comparison demonstrated that ANNs give better approximation than RSM in the prediction of the amount of the flank wear (VB) and of the crater wear (KT) depth. The obtained*

results are interesting not only from a scientific point of view but also for industries. In fact, it should be possible to implement the best model into a production manager software in order to correctly define the tool change during the lot production.

Attanasio, A., Ceretti, E., Maccarini, G.TUBE HYDROFORMING (THF): PROCESS OPTIMIZATION OF AN AUTOMOTIVE COMPONENT

*Key Engineering Materials, Volume 549, 2013, Pages 141-148*Automotive component; Experimental test; FEM simulations; Process parameters; Side impact; Thickness reduction; Tube hydroforming; Tube hydroforming process Engineering controlled terms: Curve fitting; Finite element method; Optimization; Sheet metal Engineering main heading: Tubes (components) *This paper reports the results obtained during a research project funded by the Italian Government and involving several Italian Universities (PRIN INTEMA). The activities have been focused on side impact bar manufacturing by means of Tube Hydroforming process (THF). Punch movement paths and fluid pressure curve were optimized by means of FEM software (LS-DYNA) to guarantee tube sealing and material feeding during the tube deformation. The side impact bar geometry was optimized till reaching the shape guaranteeing the obtainment of safe parts with the best compromise in terms of final part geometry and thickness reduction. Different fluid pressure and punch movement paths were investigated. Once accomplished all the simulations and identified the best working solution, experimental tests were performed setting the process parameters according to the values defined during the simulation phase. Good agreement between FEM and experimental results were highlighted.*

Fiorentino, A., Ceretti, E., Giardini, C.TUBE HYDROFORMING COMPRESSION TEST FOR FRICTION ESTIMATION - NUMERICAL INVERSE METHOD, APPLICATION, AND ANALYSIS

*International Journal of Advanced Manufacturing Technology, Volume 64, Issue 5-8, February 2013, Pages 695-705*Finite element modeling; Nonferrous materials; Sliding friction; Thickness; Tube hydroforming Engineering controlled terms: Compression testing; Estimation; Finite element method; Inverse problems; Tribology; Tubes (components) Engineering main heading: Friction *Friction plays an important role in forming processes, in fact it influences the material flow and therefore it affects the process and part characteristics. In particular, friction is a very influencing factor in tube hydroforming (THF), where high die-part contact pressure and area make the material sliding very difficult. As a consequence, the material hardly flows to the expansion zones and the part formability can be compromised. To obtain sound parts, FEM models allow the study of the process and optimize its parameters, but they require the right definition of the friction at tube-die interface. For these reasons, friction represents a key-point in THF processes and its knowledge and prediction are very important even if, nowadays, a comprehensive friction test for THF is not available in literature. With this paper, the authors want to propose and evaluate a method to estimate friction for THF processes. In particular, a*

numerical inverse method allowing the estimation of the Coulombian friction coefficient combining experimental test and FE simulation results will be described. The method is based on the effects of friction on the tube final thickness distribution when it is pressurized and compressed by two punches under different lubrication conditions without expansion. In particular, how the use of few and fast FE simulations allows to estimate an analytical function that takes into account the process conditions and that can be used in combination with experimental results in order to estimate the friction coefficient in THF processes will be shown.

Giorleo, L., Giardini, C., Ceretti, E.VALIDATION OF HOT RING ROLLING INDUSTRIAL PROCESS 3D SIMULATION

*International Journal of Material Forming, Volume 6, Issue 1, 2013, Pages 145-152*3D simulations; A-RINGS; Anti-friction; Automotive energy; Deform 3D software; Experimental approaches; Experimental validations; FE model; Hot forming process; Hot ring rolling; Industrial processs; Material cost; Material quality; Nonlinear problems; Numerical results; Physical aspects; Process configuration; Process parameters; Production of; Production time; Ring rolling Engineering controlled terms: Aerospace applications; Energy conservation; Industrial plants; Software testing; Three dimensional computer graphics Engineering main heading: Hot rolling *Ring rolling is a hot forming process used in the production of railway tyres, anti friction bearing races and different ring shaped work pieces for automotive energy production and aerospace applications. The advantages of ring rolling process include short production time, uniform quality, closed tolerances, good material quality and considerable saving in material cost. Despite the benefits some problems still exist according to a correct selection of the process parameters. Due to the nature of the process different rolling mills (driving, idle and axial rolls) are involved and the correct selection of the process parameters is not so feasible. Moreover an experimental approach to solve this problem risks to be more expensive. Actually FE codes are available to simulate the non linear problem that characterizes a ring rolling process. In this work a FE model, based on Deform 3D software, was tested versus experimental results acquired from an industrial plant. The accuracy of the FE model was analyzed through a dual comparison: by geometrical and by physical aspects. A good agreement was found between experimental and numerical results for both comparisons and, as a consequence, this code could be used in order to investigate and optimize the process parameters that characterize the ring rolling process in a virtual not expensive environment. The validated model will allow the studies of more environment-friend process configurations.*

Bologna

Cuccolini, G., Orazi, L., Fortunato, A.5 AXES COMPUTER AIDED LASER MILLING

*Optics and Lasers in Engineering, Volume 51, Issue 6, June 2013, Pages 749-760*Computer aided; Free-form surface; Freeforms; Galvanometric scanning; Laser displacement; Laser

manufacturing; Laser paths; Working areas Engineering controlled terms: Electrical engineering; Magnetic materials; Textures Engineering main heading: Milling (machining) *In this paper a 5 axes CAM procedure for the laser milling of free form surfaces has been developed and experimentally verified. The laser beam is deflected by a galvanometric scanning head and is directly moved on the working surface by the CNC controlled axes of a machine center. The procedure has been implemented in a software called CALM (computer aided laser manufacturing) able to generate the laser paths and the movements of the controlled axes reducing the defects on the workpiece. The approach is based on the sequential overlapping of the scanning passes on the working area. The different working areas in every laser displacement are obtained directly from the triangulation of the whole surface to machine.*

Fortunato, A., Ascari, A., Liverani, E., Orazi, L., Cuccolini, G.A COMPREHENSIVE MODEL FOR LASER HARDENING OF CARBON STEELS

*ASME 2013 International Manufacturing Science and Engineering Conference Collocated with the 41st North American Manufacturing Research Conference, MSEC 2013, Volume 1, 2013, Article number MSEC2013-1094*Beam characteristics; Comprehensive model; Computational time; Hypo-eutectoid carbon steel; Integrated approach; Laser transformation hardening; Manufacturing process; Physical constants Engineering controlled terms: Carbon steel; Manufacture; Mathematical models; Models Engineering main heading: Industrial research *This article illustrates the development of a complete and exhaustive mathematical model for the simulation of laser transformation hardening of hypo-eutectoid carbon steels. The authors propose an integrated approach aimed at taking into consideration all the the phenomena involved in this manufacturing process, with particular attention to implementing easy mathematical models in order to optimize the trade-off between the accuracy of the predicted results and the computational times. The proposed models involve the calculation of the 3D thermal field occurring into the workpiece and predict the microstructural evolution of the target material exploiting an original approach based on the definition of thermodynamic thresholds which can be considered as a physical constant of the material itself. Several parameters and phenomena are taken into consideration in order to accurately simulate the process: laser beam characteristics, fast austenization of the steel and tempering effect due to mutually interacting beam trajectories. Copyright*

Fortunato, A., Orazi, L., Cuccolini, G., Ascari, A.AN EXHAUSTIVE MODEL FOR THE LASER HARDENING OF HYPO EUTECTOID STEEL

*Proceedings of SPIE - The International Society for Optical Engineering, Volume 8603, 2013, Article number 86030F*Beam characteristics; Beam trajectories; Computational time; Hypo-eutectoid carbon steel; Laser hardening; Mathematical formulas; Scanning strategies; Target materials Engineering controlled terms: Carbon steel; Laser materials processing; Lasers; Mathematical models; Models Engineering main heading: Hardening *This article presents an*

exhaustive mathematical model for the simulation of hypo-eutectoid carbon steel transformations during laser hardening. The proposed model takes into consideration all the the phenomena involved in the process with particular attention to implementing easy mathematical formulas in order to optimize the trade-off between the accuracy of the predicted results and the computational times. The proposed model calculates the 3D thermal field occurring into the workpiece and predicts the microstructural evolution of the target material exploiting an original approach based on the de nition of thermodynamic thresholds. Several parameters and phenomena are taken into consideration in order to accurately simulate the process: laser beam characteristics, scanning strategy of the target and tempering e ect due to mutually interacting beam trajectories.

Ascari, A., Campana, G.APPLICATION OF LASER IN JOINING ALUMINUM FOAM HYBRID MATERIALS

*ASME 2013 International Manufacturing Science and Engineering Conference Collocated with the 41st North American Manufacturing Research Conference, MSEC 2013, Volume 1, 2013, Article number MSEC2013-1057*Application of laser; Controlled heating; Energy density; Experimental campaign; Global feasibility; High energy densities; Overall quality; Thermal actions Engineering controlled terms: Hybrid materials; Joining; Manufacture Engineering main heading: Industrial research *This article illustrates an experimental campaign aimed at assessing preliminary guidelines for the application of the laser in joining cellular-structured hybrid materials. In particular the target specimens exploited were all characterized by the presence of an aluminum foam core and by an external skin, made in aluminum or in stainless steel. The goal of the present paper is to underline a global feasibility of laser joining of these materials pointing out the role of the main process parameters and to suggest some original techniques which could be adopted in order to improve the overall quality of the joint. The experience described pointed out that, when dealing with this kind of materials, the role of the laser can be dual: in case of high energy density applications it can be used for local fusion of the work-piece, as in traditional welding, while in low energy density ones the radiation can be exploited as a controlled heating source for promoting local thermal actions particularly on the cellular portion of the material. Copyright*

Poodts, E., Minak, G., Dolcini, E., Donati, L.FE ANALYSIS AND PRODUCTION EXPERIENCE OF A SANDWICH STRUCTURE COMPONENT MANUFACTURED BY MEANS OF VACUUM ASSISTED RESIN INFUSION PROCESS

*Composites Part B: Engineering, Volume 53, 2013, Pages 179-186*E. Resin film infiltration (RFI); Fibre volume fraction; Innovative approaches; Manufacturing technologies; Polymer Matrix Composites (PMCs); Resin flows; Trial-and-error approach; Vacuum assisted resin infusions Engineering controlled terms: Curve fitting; Laminates; Polymer matrix composites; Resins; Sandwich structures; Ships; Vacuum Engineering main heading: Polyvinyl chlorides

Vacuum assisted resin infusion process (VARI) is a high performance and cost effective manufacturing technology usually applied to produce large structures made of composite materials. In the industrial practice, trial and error approach is usually applied for the definition of injection locations and strategies during VARI processing thus generating a high risk of failure during the early stages of production of a new component. The present article deals with the development and validation of the FE analysis by means of the PAM-RTM code of a ship runway through the definition of a standardized experiment for the characterization of the laminates to obtain reliable permeability data. Indeed the assessment of laminate permeability proprieties (K) during the process is the major concern for reliable FE application: a procedure to obtain these characteristic values with few experimental tests is presented starting initially with a classic characterization at constant fibre volume fraction (V f) and then extending the approach for the construction of a Pressure-V f dependant curves. The tests were realized with carbon fibres fabrics, epoxy for infusion resin and PVC perforated core. Moreover the article provides an innovative approach for the computation of sandwich structures when perforated cores are used: the obtained data are finally applied with success for the validation of the simulation of the production phases of the ship runway characterized by the sandwich structure.

Donati, L., Segatori, A., El Mehtedi, M., Tomesani, L.GRAIN EVOLUTION ANALYSIS AND EXPERIMENTAL VALIDATION IN THE EXTRUSION OF 6XXX ALLOYS BY USE OF A LAGRANGIAN FE CODE

*International Journal of Plasticity, Volume 46, July 2013, Pages 70-81*Abnormal grain growth; Dislocation densities; Empirical equations; Experimental observation; Experimental validations; Finite Element; Geometric dynamic recrystallization; Static recrystallization Engineering controlled terms: Deformation; Dynamic recrystallization; Grain boundaries; Grain growth; Lagrange multipliers; Optical microscopy Engineering main heading: Extrusion *The grain size and shape evolution of 6XXX aluminum alloys during hot metal forming processes are investigated by experimental observations and numerical analysis. A unified model is developed to simulate the grain evolution during deformation and subsequent static recrystallization. First, an experimental set reproducing a small scale direct extrusion was realized in order to identify the grain deformation modes and the empirical equations that model the evolution. The equations were then linked with modified formulations of static recrystallization available in literature and then implemented in the lagrangian FE code Deform through user-routines. The developed model innovatively computes all the phases of the phenomena by considering not only the static recrystallization but also the previous deformation phase. Effects of geometric dynamic recrystallization, influence of subgrain size, the dislocation densities distribution and the stored energy on subsequent grain static recrystallization were considered. Then, a reduced scale backward extrusion experiment was performed at different Zener-Hollomon levels, in order to check the model after deformation and after a fully static recrystallization. The model properly predicts both the deformed state of the grains (immediate quenching) and the fully recrystallized state but still miss to predict abnormal grain growth.*

Foydl, A., Segatori, A., Ben Khalifa, N., Donati, L., Brosius, A., Tomesani, L., Tekkaya, A.E.GRAIN SIZE EVOLUTION SIMULATION IN ALUMINIUM ALLOYS AA 6082 AND AA 7020 DURING HOT FORWARD EXTRUSION PROCESS

*Materials Science and Technology (United Kingdom), Volume 29, Issue 1, January 2013, Pages 100-110*Die design; Extrudates; Extrusion experiments; Extrusion ratio; Finite element simulations; Forward extrusion; Grain evolution; Grain shapes; Grain size; Industrial scale; Material Flow; Numerical results; Predictive algorithms; Predictive equations; Processing steps; Ram speed; Recrystallisation; Reduced scale; Small scale; Strain paths Engineering controlled terms: Algorithms; Aluminum; Aluminum alloys; Experiments; Finite element method; Grain size and shape; Industry; Microstructure; Models Engineering main heading: Extrusion *The present paper investigates the grain size evolution in aluminium alloys AA 6082 and AA 7020 during hot forward extrusion process. The aim of the present work is the definition and implementation of a predictive algorithm that is able to compute the evolution of the grain shape during the process within the finite element method code Deform. Extrusion experiments were performed at two levels: at reduced scale for investigating and identifying the predictive equations and at industrial scale for validating the developed algorithm. At small scale extrusion, a complete factorial plan was performed for two alloys at three different temperatures, three extrusion ratios and two ram speeds: the discards and extrudates from the experiments were quenched immediately in order to avoid any potential recrystallisation, hence allowing measurements of transitional processing steps. At the industrial scale, instead, the 7020 alloy was extruded with two different die designs, thus producing a 20 mm diameter round bar under different extrusion ratios and strain paths. Finite element simulations were initially validated over visioplastic investigations in order to establish an accurate computation of the material flow, then experimental and numerical results were coupled, thus allowing the definition of the grain evolution model that was successfully integrated and validated on industrial scale trials.*

Campana, G., Ascari, A., Fortunato, A.LASER FOAMING FOR JOINING ALUMINUM FOAM CORES INSIDE A HOLLOW PROFILE

*Optics and Laser Technology, Volume 48, 2013, Pages 331-336*Aluminum foam; Aluminum precursors; Beam energies; Beam power; Foaming process; Hollow steel; Interaction time; Joining process; Process parameters; Qualitative evaluations; Solid precursors Engineering controlled terms: Aluminum; Joining; Laser heating Engineering main heading: Lasers *This paper investigates the feasibility of the joining process of two aluminum foam cores contained in a tubular profile exploiting laser foaming of a solid precursor. The aim is to examine the foaming process by means of external laser irradiation of a hollow steel profile, which contains two separated aluminum foam cores intermingled by a foamable solid aluminum precursor. The*

experimental activity showed that three process parameters should be taken into account in order to obtain a sound foam: interaction time, laser beam power density and total amount of beam energy delivered to the work-piece. A numerical simulation allowed the qualitative evaluation of the temperature field inside the solid precursor with the purpose of better understanding the effect of the chosen parameters on the process itself.

Ascari, A., Fortunato, A., Orazi, L.LASER MICRO-WELDING OF HIGH CARBON STEELS

*Rivista Italiana della Saldatura, Volume 65, Issue 4, July 2013, Pages 507-513*Crack susceptibilities; Influencing factors; Mechanical industry; Micro-joining; Micro-scale components; Nanosecond pulsed laser; Process parameters; Sheet Engineering controlled terms: Carbon steel; Cracks; Dynamic positioning; Efficiency; Electric welding; Heat affected zone; Industry; Laser beam welding; Mechanical properties; Precision engineering; Pulsed lasers; Weldability Engineering main heading: MEMS *High carbon steels are commonly used in modern mechanical industry due to their good mechanical properties and to their relatively low cost. Unfortunately, when dealing with welding processes, these materials must be set aside because of their very high crack susceptibility and more refined and expensive steels must be taken into consideration, such as HSLA, DP and TRIP ones, thanks to their lower carbon equivalent and similar, or even better, mechanical properties. In micro-scale components industry the use of high carbon steels is also very common, in particular in precision mechanics, watch and MEMS industry. Considering the very low thicknesses typical of these components and the intrinsic welding difficulty related to the material, several studies stressed on the possibility to exploit nanosecond pulsed lasers in welding this kind of steels. These sources, taking advantage from the short duration of the pulse and from a repetition rate as high as I MHz, allow a very accurate control of the heat input delivered to the material and pave new ways in micro-welding of medium and high carbon steels. The present paper deals with the exploitation of a 20 W nanosecond pulsed laser source in welding low thickness C70 (AISI1070) plain carbon steel. The process is studied by evaluating the influence of the main parameters on its feasibility. The activity pointed out that, by properly selecting the main parameters, it is possible to achieve sound and crack-free weld beads with a maximum penetration as high as 200 μm and a very small heat affected zone. The main interesting point concerning this specific welding process is related to the fact that, by simply selecting the proper process parameters, it is possible to achieve high productivity working cycles involving laser cutting, welding and marking on the same machine and exploiting the same workpiece positioning.*

Fortunato, A., Orazi, L., Cuccolini, G., Ascari, A.LASER SHOCK PEENING AND WARM LASER SHOCK PEENING: PROCESS MODELING AND PULSE SHAPE INFLUENCE

*Proceedings of SPIE - The International Society for Optical Engineering, Volume 8603, 2013, Article number 86030G*Abrupt expansions; Compressive residual stress; High power density;

Laser peening; Laser shock peening; Mechanical components; Process Modeling; simulation Engineering controlled terms: Fatigue of materials; Laser materials processing; Mechanical properties Engineering main heading: Residual stresses *Laser shock peening is a well-known technology able to enhance the fatigue life of mechanical components by means of the introduction of residual stresses on their surface. These stresses are induced by means of the recoil pressure caused by the abrupt expansion, in a confining medium, of a laser-vaporized coating layer. If high power densities are used the recoil pressure can be high enough to induce compressive residual stresses on the target surface and to modify its mechanical properties. These mechanical properties can be predicted if the recoil pressure of the ablating layer is determined. In this paper the influence of the laser pulse shape on the recoil pressure is determined by means of a proper modeling of the whole process and the difference between "cold" and "warm" laser shock peening is pointed out.*

Di Sante, R., Bastianini, F., Donati, L.LOW-COHERENCE INTERFEROMETRIC MEASUREMENTS OF OPTICAL LOSSES IN AUTOCLAVE CURED COMPOSITE SAMPLES WITH EMBEDDED OPTICAL FIBERS

*Proceedings of SPIE - The International Society for Optical Engineering, Volume 8794, 2013, Article number 87942V*Autoclave curing; Embedded optical fibers; Fiber Bragg Grating Sensors; High spatial resolution; Interferometric measurement; Low-coherence reflectometer; OLCR; Optical low-coherence reflectometry Engineering controlled terms: Autoclaves; Composite materials; Fiber Bragg gratings; Fiber optic sensors; Light sources; Michelson interferometers; Optical losses; Sensors Engineering main heading: Fibers PaperChem Variable: Composites; Curing; Fiber Optics; Interferometry; Light Sources; Reflectometers; Sensors *In this work a high-performance optical low-coherence reflectometer (OLCR) has been used to estimate the optical losses in optical fibers and fiber Bragg grating sensors embedded into CFRP material samples. An ASE tunable narrowband light source coupled to a Michelson interferometer allowed the high spatial resolution localization of both the concentrated and the distributed loss for different fiber coatings and type. In particular, acrylate- and polyimidecoated fibers and bend-insensitive fibers were tested. By using the OLCR it was possible to locate and identify the sources of optical loss introduced by the CFRP manufacturing process, therefore obtaining useful information on the efficiency of the embedding process.*

Reggiani, B., Segatori, A., Donati, L., Tomesani, L.PREDICTION OF CHARGE WELDS IN HOLLOW PROFILES EXTRUSION BY FEM SIMULATIONS AND EXPERIMENTAL VALIDATION

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 5-8, 2013, Pages 1855-1872*Arbitrary Lagrangian Eulerian; Charge welds; Experimental and numerical studies; Experimental validations; High hydrostatic pressure; Length determination;

Microstructural analysis; Numerical sensitivity Engineering controlled terms: Billets (metal bars); Extrusion; Finite element method; Hydrostatic pressure; Industrial management; Mechanical properties; Optimization; Seam welding; Welding Engineering main heading: Welds *In direct extrusion of aluminum alloys, billets are discretely loaded into the press and joined by the high hydrostatic pressure field. The contamination of the billet-to-billet interface by oxides, dust, or lubricant produces a welded zone (charge weld) with reduced mechanical properties that requires profile discharge. For an efficient material scrapping, both the position of the transition zone and its extent in the profile must be accurately identified. In industrial practice, in relation to a lack of experimental and numerical studies on this specific matter, the determination of the zone to be discarded is still performed mainly by experience or labor-intensive analyses. The aim of the present study is to bridge this gap by investigating the evolution of the charge welds inside an industrial multi-profiles and determining their exact position and extension by experimental microstructural analyses coupled with comprehensive 3D FE simulations performed with the Arbitrary Lagrangian-Eulerian code HyperXtrude®. Skin and rest defects are also experimentally investigated and a numerical sensitivity study on the influence of the friction model selection is performed. Comparison between numerical and experimental results shows a good agreement both in terms of general trend and exhausting points of the charge welds. The results prove that the FE code is a reliable tool in assisting and driving the die and process design stages, not only for process optimization as reported in literature but also for the scrap length determination. Finally, a process efficiency index is defined and, for the specific case study, it is found to be increased from 82.6 %, as resulting from the actual industrial practice, to a 88.3 % as optimized by the performed coupled experimental and numerical activities.*

Di Sante, R., Donati, L.STRAIN MONITORING WITH EMBEDDED FIBER BRAGG GRATINGS IN ADVANCED COMPOSITE STRUCTURES FOR NAUTICAL APPLICATIONS

*Measurement: Journal of the International Measurement Confederation, Volume 46, Issue 7, 2013, Pages 2118-2126*Advanced composite structures; Carbon fiber reinforced; Embedded fiber bragg gratings; Fiber Bragg Grating Sensors; Fiber Bragg gratings (FBGs); Light transmission characteristics; Mechanical strain; Optical time domain reflectometry Engineering controlled terms: Composite materials; Fiber optic sensors; Intelligent structures; Polyimides; Tensile testing Engineering main heading: Fiber Bragg gratings PaperChem Variable: Composites; Diffraction; Fiber Optics; Polyimides; Tensile Tests *Methods to effectively and reliably embed Fiber Bragg Grating sensors in the composite material have been investigated in this work, with particular regard to a sailing boat mast manufacturing process by means of bagging technique in autoclave. Small samples were produced in order to investigate the effect of the curing process parameters on the light transmission characteristics of the embedded optical fibers. Polyimide and acrylate coated optical fibers were tested measuring the relative coefficient of attenuation by Optical Time Domain Reflectometry. In particular, carbon fiber reinforced epoxy laminas with embedded FBGs were manufactured and specimens for tensile tests extracted from the laminas. Each specimen was instrumented with FBG and conventional electrical strain gage*

bonded on the surface. The comparison between the FBG and SG measurements recorded during static tensile tests permitted to assess the strain monitoring capability of the FBGs and their sensitivity and accuracy.

Fortunato, A., Ascari, A.THE VIRTUAL DESIGN OF MACHINING CENTERS FOR HSM: TOWARDS NEW INTEGRATED TOOLS

*Mechatronics, Volume 23, Issue 3, April 2013, Pages 264-278*Alternative designs; Computer aided technique; Dynamic performance; Gantry machining centers; Machine tool dynamics; Modeling and simulation; Operator interfaces; Virtual design Engineering controlled terms: Computer simulation; Digital storage; Finite element method; Machining centers; Optimization; Tools Engineering main heading: Design *The virtual design of machining centers is a modern and well-known computer aided technique. Several modeling and simulation architectures, based on the lumped mass approach and on finite element method, are now well established and widely exploited worldwide. These solutions rapidly allow the basic setup of the kinematics of the feed drives and make possible a dynamic optimized dimensioning of all the main subsystems and structures of the machining center. This paper deals with research efforts aimed at developing an innovative and open design platform which allows the integration, in a user friendly framework, of the main procedures cited above with other design tools and facilities. An operator interface procedure and a package of input-output graphic routines, managed through a multilevel data base, are now active in this framework and interact with lumped mass and finite elements modules. According to these considerations the proposed tool allows to quickly and easily analyze alternative design solutions and makes possible to optimize the dynamic performances of the machine tool, helping the designer in the definition of the optimum machine tool characteristics before the manufacturing of the physical prototype. In order to demonstrate the potential of the proposed platform an example concerning the mass optimization of the Y axis of a gantry machining center is presented. Copyright*

Brescia

Passera, S., Baylón, K., Fiorentino, A., Ceretti, E., Elías, A., Rodríguez, C.A PRELIMINARY MATERIAL MODEL TO PREDICT STRESS SOFTENING AND PERMANENT SET EFFECTS OF HUMAN VAGINAL TISSUE

Procedia Engineering, Volume 59, 2013, Pages 150-157In this paper the authors modified an available material model to account the stress softening and permanent set effects exhibit by human vaginal tissue during simple uniaxial tests. The preliminary model is based on four material parameter values i.e., the stress-like material constants, the stress softening and the permanent set effect material parameter constants. To assess the accuracy of the proposed model, the authors compared theoretical predictions with available simple uniaxial experimental

data. It is shown that the proposed modifications describe well experimental data with 99% of accuracy.

Ceretti, E., Attanasio, A., Fiorentino, A., Giorleo, L., Giardini, C.ALUMINIUM CAN SHAPING BY HYDROFORMING: SIMULATIVE FEASIBILITY STUDY AND PROTOTYPE PRODUCTION

*International Journal of Advanced Manufacturing Technology, Volume 68, Issue 5-8, 2013, Pages 1797-1807*Deep drawing and ironing; Feasibility studies; Finite element method models; Hydroforming; Hydroforming process; Material characteristics; Material characterizations; Simulation software Engineering controlled terms: Beverages; Bottles; Computer simulation; Computer software; Cylinders (shapes); Deformation; Metal forming; Planning Engineering main heading: Aluminum *In these last years, the demand of shaped aluminium bottles and cans was continuously growing. The main problem is related to the fact that normally these objects have very thin thickness and a high strain-hardened material due to the deforming production steps (deep drawing and ironing). In the present paper, a study about the residual formability of cylindrical can is reported. In particular, a first characterization of the flow stress of the ironed component and the identification of the maximum deformation reachable with the hydroforming process were carried out. On the base of these preliminary results, the feasibility of hydroforming aluminium can, namely a small bottle for soft drink, has been investigated. The process is similar to tube hydroforming, even if the bottom part of the can is closed and air is used instead of liquid. The main problems to be solved were related with the possible breakages of the cylindrical body during hydroforming. The process success depends on the material characteristics, the diameter and thickness of the preformed cylindrical body, the shape, the geometry and the dimensions of the final part and the media pressure. The research aims to study the process feasibility and to prove the ability of the simulation software in forecasting the material behaviour. All the simulation phases are supported by experimental tests aiming at validating the finite element method model and to realize sound prototypes of Al soft drink bottles. In such a way, it is possible to have a reliable tool to help the designer in optimizing the process and in identifying new feasible shapes.*

Attanasio, A., Ceretti, E., Giardini, C.ANALYTICAL MODELS FOR TOOL WEAR PREDICTION DURING AISI 1045 TURNING OPERATIONS

*Procedia CIRP, Volume 8, 2013, Pages 218-223*Cutting parameters; Fitting techniques; Longitudinal turning; Production management; Response surface method; Response surface methodology; Tool wear; Turning operations Engineering controlled terms: Analytical models; Forecasting; Industrial management; Machining centers; Models; Neural networks; Surface properties; Tools; Tungsten carbide; Turning Engineering main heading: Wear of materials *Tool wear is one of the most important topic in cutting field. Its interest is due to the influence of tool wear on surface integrity of the final parts and on tool life, and, consequently, on the substitution*

policies and production costs. Analytical models, able to forecast the tool wear with a satisfactory accuracy, can give to the companies working in the material removal field a valid instrument to optimize the cutting processes. In the present work a comparison between response surface methodology (RSM) and artificial neural networks (ANNs) fitting techniques for tool wear forecasting was performed. For developing these predictive models, tool life tests, consisting of longitudinal turning operations of AISI 1045 steel bars using uncoated tungsten carbide inserts and variable cutting parameters, were conducted. Both flank (VB) and crater wears (KT) of the tool were monitored. The models were validated comparing the calculated tool wear values with the experimental ones, showing that ANNs model provides better approximation than RSM in the prediction of the amount of the tool wear parameters. So, from an industrial point of view, this model should be implemented into a production management software in order to correctly define the tool substitution policy during batch production. Copyright

Ceretti, E., Özel, T.EDITORIAL: MANUFACTURING TECHNOLOGIES AND SYSTEMS FOR MEDICAL DEVICES

International Journal of Mechatronics and Manufacturing Systems, Volume 6, Issue 3, 2013, Pages 213-214[No abstract available]

Giorleo, L., Ceretti, E., Giardini, C.ENERGY CONSUMPTION REDUCTION IN RING ROLLING PROCESSES: A FEM ANALYSIS

*International Journal of Mechanical Sciences, Volume 74, September 2013, Pages 55-64*Consumption reductions; FE modeling; FEM analysis; Final ring geometry; Hot forming process; Production of; Ring rolling; Very high energies Engineering controlled terms: Energy utilization; Piercing; Rolling mills Engineering main heading: Preforming *Ring Rolling is a very high energy consuming hot forming process used for the production of shaped ring, seamless and axis symmetrical workpieces. Different production steps (Upsetting, Piercing, Ring Rolling) are involved in generating the desired ring shape. In particular the Upsetting and Piercing steps generate a hollow circular preform that will be subsequently enlarged by the rolling mills (Driver, Idle and Axial Rolls) during the Ring Rolling step. In order to reduce the energy and the force needed to produce the workpiece it must be observed that they are strictly affected by the speed laws imposed to the rolling mills which depend on the preform and the final ring geometry. As a consequence the setup of the Upsetting and Piercing steps became fundamental because they impose the preform geometry of the workpiece. Starting from this assumption, in the present work different preforms geometries, characterized by different initial heights, are considered to simulate the Ring Rolling process focusing the results analysis not only on the part feasibility, but also on the energy and force required which affect the equipment dimensioning. An industrial case was considered to validate the FE model. The maximum load and the energy needed for the ring production are considered as main figures for optimizing the process.*

Monroy-Vázquez, K.P., Attanasio, A., Ceretti, E., Siller, H.R., Hendriqchs-Troeglen, N.J., Giardini, C.EVALUATION OF SUPERFICIAL AND DIMENSIONAL QUALITY FEATURES IN METALLIC MICRO-CHANNELS MANUFACTURED BY MICRO-END-MILLING

*Materials, Volume 6, Issue 4, 2013, Pages 1434-1451*Conventional theory; Coolant applications; Critical phenomenon; Geometrical features; Manufacturing process; Micro milling; Micro-fluidic devices; Minimum chip thickness Engineering controlled terms: Coolants; Fluidic devices; Fuel cells; Heat exchangers; MEMS; Surface properties Engineering main heading: Milling machines *Miniaturization encourages the development of new manufacturing processes capable of fabricating features, like micro-channels, in order to use them for different applications, such as in fuel cells, heat exchangers, microfluidic devices and micro-electromechanical systems (MEMS). Many studies have been conducted on heat and fluid transfer in micro-channels, and they appeared significantly deviated from conventional theory, due to measurement errors and fabrication methods. The present research, in order to deal with this opportunity, is focused on a set of experiments in the micro-milling of channels made of aluminum, titanium alloys and stainless steel, varying parameters, such as spindle speed, depth of cut per pass (a p), channel depth (d), feed per tooth (f z) and coolant application. The experimental results were analyzed in terms of dimensional error, channel profile shape deviation from rectangular and surface quality (burr and roughness). The micro-milling process was capable of offering quality features required on the micro-channeled devices. Critical phenomena, like run-out, ploughing, minimum chip thickness and tool wear, were encountered as an explanation for the deviations in shape and for the surface quality of the micro-channels. The application of coolant and a low depth of cut per pass were significant to obtain better superficial quality features and a smaller dimensional error. In conclusion, the integration of superficial and geometrical features on the study of the quality of micro-channeled devices made of different metallic materials contributes to the understanding of the impact of calibrated cutting conditions in MEMS applications.*

Giorleo, L., Ceretti, E., Giardini, C.FE MODELING OF THE APPARENT SPOT TECHNIQUE IN CIRCULAR LASER HARDENING

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 9-12, December 2013, Pages 1961-1969*Apparent spot technique; Back-tempering effect; Cylindrical workpiece; FEM modeling; Laser hardening; Laser surface treatment; Numerical results; Surface temperatures Engineering controlled terms: Atmospheric temperature; Mathematical models; Regression analysis; Tempering Engineering main heading: Hardening *Circular laser hardening is the laser surface treatment used in the case of cylindrical workpieces. The singletrack treatment is a particular case of circular laser hardening used when only one revolution of the*

workpiece is executed since the treatment of a narrow surface is required. As a result, an annular narrow hardening track is obtained. During the laser hardening, the initial and final parts of the work-piece are overlapped and treated twice. The main drawback of this treatment is the back-tempering effect focused on the overlapping zone. This phenomenon leads to a hardness decrease in the overlapping zone. To avoid this problem, a new technique called apparent spot (AS) was introduced by the authors. The aim of the AS technique is to increase in a fictitious way the dimensions of the laser spot. In the case of circular laser hardening, this technique results into a highspeed rotation (up to 1,000 rpm) of the cylindrical workpiece instead of the traditional low speed. So, a uniform hardening zone without overlapping and back tempering is obtained. However, despite these benefits, there is still a lack of knowledge about the physics of this treatment in particular referring to the thermal cycle that affects the workpiece. In order to enhance the knowledge of this technique in this work, the AS was modeled via the FE approach. DEFORM software was used to model the circular laser hardening process. The software was firstly validated by a comparison with experimental results. Once the software reliability was tested, a regression model was estimated to predict the surface temperature within the treatments. Good agreement was found between the prediction model and the numerical results.

Fiorentino, A.FORCE-BASED FAILURE CRITERION IN INCREMENTAL SHEET FORMING

*International Journal of Advanced Manufacturing Technology, Volume 68, Issue 1-4, 2013, Pages 557-563*Costs reduction; Failure criteria; Force; Forming forces; High flexibility; Incremental sheet forming; Rupture criteria; Sheet material Engineering controlled terms: Formability; Technology Engineering main heading: Industrial engineering *In incremental sheet forming, a hemispherical tool deforms a sheet moving along a predefined path. The process, useful for making prototypes or small series, is characterized by high flexibility and development times and costs reduction. The part feasibility is strongly influenced by the adopted tool path and, in particular, tool path corrections are requested to obtain the final geometry and to prevent the sheet rupture. To save time and costs, sheet failure criteria are therefore essential. In this paper, a real time force-based sheet rupture criterion is presented and tested on steel, aluminum, and titanium alloys. In particular, it will be shown that the sheet rupture can be related with the tangential forming force, the geometry of the component to be realized, and the sheet material characteristics.*

Fiorentino, A., Zarattini, G., Pazzaglia, U., Ceretti, E.HIP PROSTHESIS DESIGN. MARKET ANALYSIS, NEW PERSPECTIVES AND AN INNOVATIVE SOLUTION

*Procedia CIRP, Volume 5, 2013, Pages 310-314*Customized solutions; Design specification; Manufacturing industries; Manufacturing process; Market analysis; Mechanical resistance; Performance characteristics; Stem Engineering controlled terms: Biocompatibility; Biological materials; Commerce; Design; Economics; Health care; Hip prostheses; Medicine; Product design; Quality function deployment; Surveys Engineering main heading: Investments *Life expectancy and quality raise have increased the request of better and customized solutions for*

patients. On the other side, while the health care market is continuously raising, the manufacturing industry, specially the automotive one, is facing a strongly negative trend under production and sales point of view. In this panorama, the development of biomedical devices represents a big chance for both patient's health care and manufacturing industry being an interesting opportunity for investments. In order to design a new product, it is necessary to take into account the market needs and requests, especially when it is high-tech and involves human needs. Unfortunately, it often happens that the languages and research approaches of the parts involved in the market, supply and demand, are different which makes the communication more difficult, especially when Medicine and Engineering are involved. For example, requirements such as biocompatibility, life service or biological integration have to be translated in terms of material, manufacturing process or treatment. In order to correlate performance characteristics and design choice, tools like QFD (Quality Function Deployment) are available. In particular, they use results of market investigations on existing products and market requests to identify the improvement areas, to correlate them with design specifications so outlining the features of new products able to satisfy the market requests. Within this approach, the present paper shows the results of a market analysis focused on hip prosthesis improvement. Therefore, using questionnaires sent to specialized physicians and medical centers, it was possible to collect information about pro and cons of existing devices identifying their criticalness' with particular attention to stem osteointegration. In fact, compiling a QFD table, it was possible to design new concepts of the prosthesis stem which are here described and their mechanical resistance was tested using FEM simulations.

Astarita, A., Armentani, E., Ceretti, E., Giorleo, L., Mastrilli, P., Paradiso, V., Scherillo, F., Squillace, A., Velotti, C.HOT STRETCH FORMING OF A TITANIUM ALLOY COMPONENT FOR AERONAUTIC: MECHANICAL AND MODELING

*Key Engineering Materials, Volume 554-557, 2013, Pages 647-656*Aircraft manufacturers; Airframe components; Commercial aircraft; Consistent quality; Experimental campaign; Forming techniques; HSF; Simulation Engineering controlled terms: Aircraft; Airframes; Elasticity; Mechanical properties; Structural design; Titanium Engineering main heading: Structural frames *The development of Hot Stretch Forming (HSF) by the Cyril Bath Company was in response to airframe designers needing to use Titanium airframe components in new commercial aircraft. Many of the airframe component structures are designed to fit against the inside radius of the fuselage curvature. By combining traditional stretch forming technology with hot titanium forming techniques, the HSF guarantees a saving in material and machining time, which are two serious cost issues for today's aircraft manufacturers. In addition, the process allows for consistent quality in a productively efficient manner, assuring the sustainable attainment of delivery and build schedules. The HSF is an innovative process on the cutting edge of the technologies, so focused research is needed in order to better understand this technology and develop new applications for this process. in this paper the HSF process is investigated: The machine and the different steps that characterized the process were described and the results of a preliminary experimental campaign was discussed focusing the attention on the metallurgical*

aspect. Moreover a modeling of the process was executed in order to study the stresses and strains undergone by the material among the deformation. Copyright

Giorleo, L., Ceretti, E., Giardini, C.SPEED ROLL LAWS INFLUENCE IN A RING ROLLING PROCESS

*Key Engineering Materials, Volume 554-557, 2013, Pages 337-344*Complex hot forming; Deformation process; FE modeling; Industrial case study; Industrial environments; Numerical approaches; Ring rolling; Technological process Engineering controlled terms: Industrial applications; Mechanical properties; Rolls (machine components) Engineering main heading: Milling (machining) *Ring Rolling is a complex hot forming process used for the production of shaped rings, seamless and axis symmetrical workpieces. The main advantage of workpieces produced by ring rolling, compared to other technological processes, is given by the size and orientation of grains, especially on the worked surface which give to the final product excellent mechanical properties. In this process different rolls (Idle, Axial, Guide and Driver) are involved in generating the desired ring shape. Because each roll is characterized by a speed law that could be set independently by the speed law imposed to the other rolls an optimization is more critical compared with other deformation processes. Usually in industrial environment a milling curve is introduced in order to correlate the Idle and Axial roll displacement, however it must be underlined that different milling curves lead to different loads and energy for ring realization. In this work an industrial case study was modeled by a numerical approach: different milling curves characterized by different Idle and Axial roll speeds laws (constant, linear and quadratic) were designed and simulated. The results were compared in order to identify the best set of Idle and Axial roll speed laws that guarantee a good quality produced ring (lower fishtail) with lower manufacturing loads and energy. Copyright*

Fiorentino, A., Ceretti, E., Giardini, C.THE THF COMPRESSION TEST FOR FRICTION ESTIMATION: STUDY ON THE INFLUENCE OF THE TUBE MATERIAL

*Key Engineering Materials, Volume 549, 2013, Pages 423-428*Compression tests; Friction coefficients; Friction estimation; Hardening coefficient; High-pressure liquid; Process parameters; Simulation studies; Tube hydroforming Engineering controlled terms: Compression testing; Finite element method; Friction; High pressure engineering; Sheet metal; Strength of materials; Tribology Engineering main heading: Tubes (components) *In the Tube Hydroforming (THF) process, a tube, placed in closed dies, is expanded by a high pressure liquid and two punches push its edges in order to feed the material into the expansion zones. Because of the high pressure and the contact area involved in the process, high friction stresses act on the tube walls restricting the material flow so reducing the amount of fed material, the part formability and affecting the soundness of the final part and its geometry. In fact, previous studies showed that the lower the friction coefficient at the tube-die interface, the more uniform the friction distribution and, therefore, the more uniform the stresses acting on the tube walls. The tube*

deformation being dependent on the stresses, its final thickness is influenced by friction. Starting from this premise, the authors proposed a reference test which is able to highlight the effect of friction on the final tube thickness. In this test, namely the THF Compression Test, a tube is placed in a cylindrical die having the same diameter as the outside of the tube, it is pressurized and then compressed by the punches. In this way, the tube has no expansion and its final thickness depends on the process parameters (tube material, pressure, punch stroke, tube material and geometry). Using FE simulations, it is possible to express the friction coefficient as a function of the process conditions and to use it in combination with experimental results. In the present paper, the previously validated FE model is used to investigate the influence of the tube material on the compression test results. Therefore, a simulation study was performed using different values of strength and hardening coefficients showing how the method is affected by the tested material thereby giving further indication of the test sensitivity.

Pola, A., Attanasio, A., Ceretti, E., Marina La Vecchia, G.THIXOFORGING OF ULTRASOUND TREATED 6060 ALUMINUM ALLOY

*Key Engineering Materials, Volume 554-557, 2013, Pages 572-581*Conventional forgings; High-pressure diecasting; Influence of process parameters; Low melting point alloy; Metallurgical analysis; Semi-solid processing; Thixoforging; Ultrasound treatments Engineering controlled terms: Casting; Finishing; Forging; High pressure engineering; Materials; Quality control; Ultrasonics Engineering main heading: Aluminum alloys *In the last years researches on thixotropic materials have been developed in order to introduce this new technology in manufacturing processes. Considering high pressure die-casting, several applications are present in literature mainly related with low melting point alloys (Al and Mg) because of the limited die life experienced when casting higher melting materials. In the case of conventional forging, semi-solid processing needs higher performance materials and/or coatings for the mould because of the working temperatures; however, the advantages of obtaining near net shape part in a single step, with reduced machining and finishing costs are evident. These returns, combined with the lower required forces that reduce the mechanical wear, make the semi-solid forging technology competitive. The present paper deals with the thixoforging of aluminum 6060 alloy, whose semi-solid microstructure was obtained by ultrasound treatment. The aim of the research was to investigate the influence of process parameters on the final forged part quality. Different pre-heating billets temperatures, corresponding to different liquid fractions, were used and the needed forging forces were monitored by using load cells and compared to that obtained during drop forging. A metallurgical analysis of the forged parts was also performed in order to evaluate their quality and properties. Copyright*

Attanasio, A., Ceretti, E., Giardini, C., Cappellini, C.TOOL WEAR IN CUTTING OPERATIONS: EXPERIMENTAL ANALYSIS AND ANALYTICAL MODELS

*Journal of Manufacturing Science and Engineering, Transactions of the ASME, Volume 135, Issue 5, 2013, Article number 051011*Cutting operations; Experimental analysis; Experimental values; Fitting techniques; Longitudinal turning; Multidimensional regression; Response surface methodology; Tool wear Engineering controlled terms: Forecasting; Neural networks; Tools; Turning Engineering main heading: Wear of materials *The possibility of predicting the amount of the tool wear in machining processes is an interesting topic for industries, since tool wear affects surface integrity of the final parts and tool life is strictly connected with substitution policy and production costs. The definition of models able to correctly forecast the tool wear development is an important topic in the research field. For this reason in the present work, a comparison between response surface methodology (RSM) and artificial neural networks (ANNs) fitting techniques in tool wear forecasting was performed. For developing these predictive models, experimental values of tool wear, obtained by longitudinal turning operations with variable cutting parameters, were collected. Once selected, the best configuration of the two previously mentioned techniques, the resultant errors with respect to experimental data were estimated and then compared. The results showed that the developed models are able to predict the amount of wear. The comparison demonstrated that ANNs give better approximation than RSM in the prediction of the amount of the flank wear (VB) and of the crater wear (KT) depth. The obtained results are interesting not only from a scientific point of view but also for industries. In fact, it should be possible to implement the best model into a production manager software in order to correctly define the tool change during the lot production.*

Attanasio, A., Ceretti, E., Maccarini, G.TUBE HYDROFORMING (THF): PROCESS OPTIMIZATION OF AN AUTOMOTIVE COMPONENT

*Key Engineering Materials, Volume 549, 2013, Pages 141-148*Automotive component; Experimental test; FEM simulations; Process parameters; Side impact; Thickness reduction; Tube hydroforming; Tube hydroforming process Engineering controlled terms: Curve fitting; Finite element method; Optimization; Sheet metal Engineering main heading: Tubes (components) *This paper reports the results obtained during a research project funded by the Italian Government and involving several Italian Universities (PRIN INTEMA). The activities have been focused on side impact bar manufacturing by means of Tube Hydroforming process (THF). Punch movement paths and fluid pressure curve were optimized by means of FEM software (LS-DYNA) to guarantee tube sealing and material feeding during the tube deformation. The side impact bar geometry was optimized till reaching the shape guaranteeing the obtainment of safe parts with the best compromise in terms of final part geometry and thickness reduction. Different fluid pressure and punch movement paths were investigated. Once accomplished all the simulations and identified the best working solution, experimental tests were performed setting the process parameters according to the values defined during the simulation phase. Good agreement between FEM and experimental results were highlighted.*

Fiorentino, A., Ceretti, E., Giardini, C.TUBE HYDROFORMING COMPRESSION TEST FOR

FRICTION ESTIMATION - NUMERICAL INVERSE METHOD, APPLICATION, AND ANALYSIS

*International Journal of Advanced Manufacturing Technology, Volume 64, Issue 5-8, February 2013, Pages 695-705*Finite element modeling; Nonferrous materials; Sliding friction; Thickness; Tube hydroforming Engineering controlled terms: Compression testing; Estimation; Finite element method; Inverse problems; Tribology; Tubes (components) Engineering main heading: Friction *Friction plays an important role in forming processes, in fact it influences the material flow and therefore it affects the process and part characteristics. In particular, friction is a very influencing factor in tube hydroforming (THF), where high die-part contact pressure and area make the material sliding very difficult. As a consequence, the material hardly flows to the expansion zones and the part formability can be compromised. To obtain sound parts, FEM models allow the study of the process and optimize its parameters, but they require the right definition of the friction at tube-die interface. For these reasons, friction represents a key-point in THF processes and its knowledge and prediction are very important even if, nowadays, a comprehensive friction test for THF is not available in literature. With this paper, the authors want to propose and evaluate a method to estimate friction for THF processes. In particular, a numerical inverse method allowing the estimation of the Coulombian friction coefficient combining experimental test and FE simulation results will be described. The method is based on the effects of friction on the tube final thickness distribution when it is pressurized and compressed by two punches under different lubrication conditions without expansion. In particular, how the use of few and fast FE simulations allows to estimate an analytical function that takes into account the process conditions and that can be used in combination with experimental results in order to estimate the friction coefficient in THF processes will be shown.*

Giorleo, L., Giardini, C., Ceretti, E.VALIDATION OF HOT RING ROLLING INDUSTRIAL PROCESS 3D SIMULATION

*International Journal of Material Forming, Volume 6, Issue 1, 2013, Pages 145-152*3D simulations; A-RINGS; Anti-friction; Automotive energy; Deform 3D software; Experimental approaches; Experimental validations; FE model; Hot forming process; Hot ring rolling; Industrial processs; Material cost; Material quality; Nonlinear problems; Numerical results; Physical aspects; Process configuration; Process parameters; Production of; Production time; Ring rolling Engineering controlled terms: Aerospace applications; Energy conservation; Industrial plants; Software testing; Three dimensional computer graphics Engineering main heading: Hot rolling *Ring rolling is a hot forming process used in the production of railway tyres, anti friction bearing races and different ring shaped work pieces for automotive energy production and aerospace applications. The advantages of ring rolling process include short production time, uniform quality, closed tolerances, good material quality and considerable saving in material cost. Despite the benefits some problems still exist according to a correct selection of the process parameters. Due to the nature of the process different rolling mills (driving, idle and axial rolls) are involved and the correct selection of the process parameters is not so feasible. Moreover an experimental approach to solve this problem risks to be more*

expensive. Actually FE codes are available to simulate the non linear problem that characterizes a ring rolling process. In this work a FE model, based on Deform 3D software, was tested versus experimental results acquired from an industrial plant. The accuracy of the FE model was analyzed through a dual comparison: by geometrical and by physical aspects. A good agreement was found between experimental and numerical results for both comparisons and, as a consequence, this code could be used in order to investigate and optimize the process parameters that characterize the ring rolling process in a virtual not expensive environment. The validated model will allow the studies of more environment-friend process configurations.

Noritomi, P.Y., Lopes Da Silva, J.V., Ardoz Dellai, R.C., Fiorentino, A., Giorleo, L., Ceretti, E.VIRTUAL MODELING OF A FEMALE PELVIC FLOOR AND HYPOTHESIS FOR SIMULATING BIOMECHANICAL BEHAVIOR DURING NATURAL DELIVERY

*Procedia CIRP, Volume 5, 2013, Pages 300-304*Bio-CAD; Biomechanical simulation; Computational simulation; Finite elements analysis; Image processing applications; Medical examination data; MRI (magnetic resonance imaging); Natural birth delivery Engineering controlled terms: Biomechanics; Diagnosis; Floors; Geometry; Image processing; Magnetic resonance imaging; Muscle Engineering main heading: Three dimensional *The study of the mechanical behavior of the muscles constituting the pelvic floor is a challenge that demands multidisciplinary efforts. To achieve biomechanical simulation a representative geometric model of the related anatomy and hypotheses for a simplified study involving in a natural delivery process are demanded. There are many muscles included in the pelvic floor region and one of the first simplifications is the choice of the most affected muscle due to delivery. This selection was made based in MRI (Magnetic Resonance Imaging) examination data of a female volunteer with normal anatomy. The MRI images were segmented using InVesalius in order to achieve a 3D surface model. This file represents a very noisy image, with excessive detail, which can be simplified in a controlled way using BioCAD approach, developed at DT3D/CTI Brazil. Starting from it, a computational simulation can be carried out in order to represent virtually the mechanical phenomena related to the child natural delivery, providing information for the understanding of post pregnancy and even natural changes related to it. Despite the fact that the main information to obtain such model is usually available from three dimensional medical examination data, it is not simple to use these data and even more difficult to hold all the information together inside an engineering useful model. Much of the heavy work to achieve a very good representation of an anatomical structure is related to image processing applications, which are responsible for providing filters and features to separate, in the front, signal from noise on the raw image. One of the main parts of this work lies on the achievement of such 3D geometrical model, in order to have a reliable reference from where the virtual modeling and biomechanical simulations starts. Once the appropriated 3D geometrical model of the pelvic floor was available, it was started the 3D finite elements model, in order to simulate a study case related to the child natural delivery, considering the head of the child as a perfect sphere and all the material properties found in literature. The final result showed the predicted displacement of*

the sphere considered as the child head and the related deformation of the pelvic floor muscle, showing the main stressed regions.

Cagliari

Ascione, R., Moroni, G., Petrò, S., Romano, D.ADAPTIVE INSPECTION IN COORDINATE METROLOGY BASED ON KRIGING MODELS

*Precision Engineering, Volume 37, Issue 1, January 2013, Pages 44-60*Adaptive sampling; Coordinate metrology; Geometric errors; Jackknife variance; Kriging model Engineering controlled terms: Geometry; Inspection; Interpolation; Random processes; Technology transfer; Units of measurement Engineering main heading: Coordinate measuring machines *The paper describes a model-based statistical methodology to design adaptive inspection plans for the geometric control of mechanical parts with Coordinate Measuring Machines (CMM). The inspection is adaptive because the design and measurement phases are not separate in time, as they usually are. Rather, they are carried out in a combined way: first designing the next measurement location, then measuring at that location and so on. This strategy is most informative as it allows for the exploitation of all of the currently available measurements. The next measurement point is selected by using predictions and prediction uncertainty of geometric deviations provided by non-parametric statistical models, known as kriging models. Based on stationary Gaussian stochastic processes, their merit is the ability to vary flexibly at each added point. The methodology is demonstrated in an illustrative case study, then its performance is compared to that of two statistical non adaptive plans, and two deterministic adaptive plans proposed in the literature. In each comparison kriging-based plans have proved to be superior in terms of the accuracy of the predicted geometric error and the inspection cost. The method is sufficiently general to enable technology transfer to different metrological sectors.*

Ascione, R., Moroni, G., Polini, W., Romano, D.ADAPTIVE INSPECTION PLANS IN COORDINATE METROLOGY BASED ON GAUSSIAN PROCESS MODELS

*Procedia CIRP, Volume 10, 2013, Pages 148-154*Adaptive designs; CMM; Computer-controlled machines; Gaussian process models; Industrial metrology; Kriging model; Predictive capabilities; Statistical experiments Engineering controlled terms: Coordinate measuring machines; Design of experiments; Experiments; Gaussian distribution; Gaussian noise (electronic); Geometry; Interpolation; Technology transfer; Units of measurement Engineering main heading: Inspection *The paper describes a successful technology transfer of Gaussian Process (GP) modelling, also known as kriging, to the field of industrial metrology. Product compliance to geometrical specifications typically requires an automated inspection cycle operated by a computer controlled machine which sequentially probes the part surface at a small sample of locations. Then the geometric error is computed from the set of point coordinates*

provided by the machine. Although the inspection plan can be naturally regarded as a statistical experiment, industrial practice generally relies on a deterministic logic both to choose the sample and to compute the geometric error. Opposed to this, we build the inspection plan as an adaptive experiment where the next probing location is selected by criteria based on predictions obtained from a GP model estimated at each step of the procedure. Results show that the good predictive capability of GP models assures an improvement over the current state of the art both in terms of quality of the estimated error and cost of the inspection.

Velotti, C., Astarita, A., Buonadonna, P., Dionoro, G., Langella, A., Paradiso, V., Prisco, U., Scherillo, F., Squillace, A., Tronci, A.FSW OF AA 2139 PLATES: INFLUENCE OF THE TEMPER STATE ON THE MECHANICAL PROPERTIES

*Key Engineering Materials, Volume 554-557, 2013, Pages 1065-1074*AA 2139; Friction stir welding(FSW); FSW; Innovative materials; Joining techniques; Mechanical performance; Research activities; Transport industry Engineering controlled terms: Aerospace applications; Aluminum alloys; Butt welding; Fiber reinforced materials; Heat treatment; Mechanical properties Engineering main heading: Friction stir welding *Nowadays the fibre reinforced materials are finding more and more widespread use in aeronautic field due to their features of lightness, high strength and flexibility of manufacturing systems. The only way for metals to remain competitive for the aerospace applications is to improve new technologies and alloys in order to realize lighter and more resistant structures. The development of new alloys (lighter and stronger) and technologies will allow to use metals also in the future for aerospace applications. In this scenario the research activity has a fundamental importance, and the key point is to work simultaneously on both innovative materials and new technologies that allow to obtain the best performances with the innovative alloys. Welding is nowadays playing a fundamental role in transport industry thanks to the important advantages it allows. Friction Stir Welding (FSW) [1] is one of the most promising welding techniques, particularly suitable for applying to light alloys. FSW in butt joint configuration allows to achieve very high mechanical performances, often absolutely superior to those achievable with all other joining techniques, and lots of researches and results are now available [2]. The AA 2139 is an innovative Al-Cu-Ag alloy that has higher mechanical performances than the conventional 2xxx series aluminum alloys. The AA 2139 is designed to work in service in T8 temper condition, but is simplest to work in T3 temper condition. The aim of this work is to compare the performances of AA 2139 butt joints welded in T8 temper conditions, presented in a previous work [3], with the ones of joints welded in T3 condition and heat treated post welding in order to achieve the T8 temper condition. Copyright*

Cassino

Giuliano, G.AA5083 ALUMINIUM ALLOY CONSTANTS IDENTIFICATION THROUGH INVERSE ANALYSIS OF THE ERICHSEN TEST

*Applied Mechanics and Materials, Volume 271, Issue PART 1, 2013, Pages 208-211*Erichsen test; Experimental test; Inner surfaces; Inverse analysis; Load-displacement curve; Material constant; Power law relationship; Sheet material Engineering controlled terms: Design; Finite element method; Manufacture Engineering main heading: Sheet metal *In this paper, considering an isotropic rheological law of the sheet material and the power law relationship between the stress and the plastic strain, the Erichsen test is used to identify the material constants of AA5083 aluminium alloy coupling experimental tests results with numerical ones obtained by using the finite element method. The function which is minimized by inverse analysis includes simultaneously the load-displacement curve of the punch, the normalized thickness measured at the bulge apex and the distance measured between the thinnest area of the metal sheet and the inner surface of the blankholder.*

Ascione, R., Moroni, G., Polini, W., Romano, D.ADAPTIVE INSPECTION PLANS IN COORDINATE METROLOGY BASED ON GAUSSIAN PROCESS MODELS

*Procedia CIRP, Volume 10, 2013, Pages 148-154*Adaptive designs; CMM; Computer-controlled machines; Gaussian process models; Industrial metrology; Kriging model; Predictive capabilities; Statistical experiments Engineering controlled terms: Coordinate measuring machines; Design of experiments; Experiments; Gaussian distribution; Gaussian noise (electronic); Geometry; Interpolation; Technology transfer; Units of measurement Engineering main heading: Inspection *The paper describes a successful technology transfer of Gaussian Process (GP) modelling, also known as kriging, to the field of industrial metrology. Product compliance to geometrical specifications typically requires an automated inspection cycle operated by a computer controlled machine which sequentially probes the part surface at a small sample of locations. Then the geometric error is computed from the set of point coordinates provided by the machine. Although the inspection plan can be naturally regarded as a statistical experiment, industrial practice generally relies on a deterministic logic both to choose the sample and to compute the geometric error. Opposed to this, we build the inspection plan as an adaptive experiment where the next probing location is selected by criteria based on predictions obtained from a GP model estimated at each step of the procedure. Results show that the good predictive capability of GP models assures an improvement over the current state of the art both in terms of quality of the estimated error and cost of the inspection.*

Giuliano, G., Samani, F.EFFECT OF LUBRICATION ON THE ERICHSEN TEST

*Applied Mechanics and Materials, Volume 365-366, 2013, Pages 425-428*5083 Al-Mg alloy; Al-Cu alloys; Die surface; Experimental materials; Lateral surface; Load-displacement curve Engineering controlled terms: Formability; Industrial engineering; Lubrication; Machine design; Manganese Engineering main heading: Aluminum *This study analyzes experimentally the influence of the friction between the sheet metal and the die surfaces on the results of the Erichsen test in terms of load-displacement curve of the punch, the normalized thickness measured at the specimen apex and the distance measured between the thinnest area of the specimen and the lateral surface of the blankholder. Two types of aluminium alloys, AA 2017 Al-Cu alloy (Al-4.5%Cu-1.0%Mn-1.0%Mg) and AA 5083 Al-Mg alloy (Al-4.5%Mg-1.0%Mn-0.15%Cr), with thickness of 1.0 mm are selected as the experimental materials for Erichsen test.*

Giuliano, G.EVALUATION OF THE COULOMB FRICTION COEFFICIENT BY THE ERICHSEN TEST

*Applied Mechanics and Materials, Volume 365-366, 2013, Pages 1190-1193*5083 Al-Mg alloy; Al-Cu alloys; Coulomb friction coefficient; Coulomb friction models; Experimental materials; Experimental test; Friction coefficients; Lateral surface Engineering controlled terms: Aluminum; Finite element method; Industrial engineering; Machine design; Sheet metal Engineering main heading: Friction *In this study, the Erichsen test is used to identify the friction coefficient of the Coulomb friction model coupling experimental tests results with numerical ones. The evaluation of the Coulomb friction coefficient is based on the distance measured between the thinnest area of the specimen and the lateral surface of the blankholder. Two types of aluminium alloys, AA 2017 Al-Cu alloy and AA 5083 Al-Mg alloy, with thickness of 1.0 mm are selected as the experimental materials for Erichsen test. Specimens are tested in unlubricated condition as well as using two different lubricants, namely Grease LB4 and Mexmoly.*

Armillotta, A., Moroni, G., Polini, W.TO ANALYTICALLY ESTIMATE THE 3D POSITION DEVIATION OF A HOLES PATTERN DUE TO FIXTURING

*Procedia CIRP, Volume 10, 2013, Pages 186-193*3D positions; Application examples; Fixturing; Gaussian probability density functions; Optimal positioning; Six-point locating principle; Statistical positioning; Tolerance control Engineering controlled terms: Probability density function; Three dimensional Engineering main heading: Location *This work considers how deviation on fixturing elements propagate on location tolerance of a holes' pattern. The 3-2-1 locating principle has been adopted. The position of each locator is represented by a Gaussian probability density function and, consequently, the probability the holes pattern falls inside the location tolerance, centred around each hole nominal position, is estimated as the product of the probabilities due to each hole. The optimal positioning of the locators is designed by minimising the deviation in holes pattern positioning during drilling due to locators inaccuracy. 3D parts have been considered as application examples.*

Catania

Fichera, S., Cappadonna, F., Costa, A., Fichera, A.A SIMULATED ANNEALING ALGORITHM FOR SINGLE MACHINE SCHEDULING PROBLEM WITH RELEASE DATES, LEARNING AND DETERIORATING EFFECTS

*Lecture Notes in Engineering and Computer Science, Volume 1 LNECS, 2013, Pages 584-586*Deteriorating; Heuristic; Learning; Release date; Single- machines; Workforce Engineering controlled terms: Deterioration; Heuristic algorithms; Scheduling; Simulated annealing Engineering main heading: Problem solving *In this paper the single machine total weighted completion time scheduling problem is studied. The jobs have non zero release time and processing time increases during the production due to the effect of deterioration on the machine. The processing time can decrease due the learning capacity of the worker. A simulated annealing heuristic algorithm is proposed to solve the scheduling problem, and their efficiency is evaluated on a benchmark.*

Costa, A., Cappadonna, F.A., Fichera, S.A DUAL ENCODING-BASED META-HEURISTIC ALGORITHM FOR SOLVING A CONSTRAINED HYBRID FLOW SHOP SCHEDULING PROBLEM

*Computers and Industrial Engineering, Volume 64, Issue 4, 2013, Pages 937-958*Exploration and exploitation; Hybrid flow shop; Hybrid flow shop scheduling; Manufacturing environments; Meta heuristic algorithm; Meta heuristics; Mixed integer linear programming model; Random search algorithm Engineering controlled terms: Decoding; Encoding (symbols); Genetic algorithms; Heuristic algorithms; Optimization; Scheduling Engineering main heading: Problem solving *Though scheduling problems have been largely investigated by literature over the last 50 years, this topic still influences the research activity of many experts and practitioners, especially due to a series of studies which recently emphasized the closeness between theory and industrial practice. In this paper the scheduling problem of a hybrid flow shop with m stages, inspired to a truly observed micro-electronics manufacturing environment, has been investigated. Overlap between jobs of the same type, waiting time limit of jobs within inter-stage buffers as well as machine unavailability time intervals represent just a part of the constraints which characterize the problem here investigated. A mixed integer linear programming model of the problem in hand has been developed with the aim to validate the performance concerning the proposed optimization technique, based on a two-phase metaheuristics (MEs). In the first phase the proposed ME algorithm evolves similarly to a genetic algorithm equipped with a regular permutation encoding. Subsequently, since the permutation encoding is not able to investigate the overall space of solutions, a random search algorithm equipped with an m-stage permutation encoding is launched for improving the algorithm strength in terms of both exploration and*

exploitation. Extensive numerical studies on a benchmark of problems, along with a properly arranged ANOVA analysis, demonstrate the statistical outperformance of the proposed approach with respect to the traditional optimization approach based on a single encoding. Finally, a comprehensive comparative analysis involving the proposed algorithm and several metaheuristics developed by literature demonstrated the effectiveness of the dual encoding based approach for solving HFS scheduling problems.

Costa, A., Fichera, S., Cappadonna, F.A.A GENETIC ALGORITHM FOR SCHEDULING BOTH JOBS FAMILIES AND SKILLED WORKFORCE

International Journal of Operations and Quantitative Management, Volume 19, Issue 4, December 2013, Pages 221-247Generally, solving a regular group scheduling problem consists of sequencing both jobs within each group and groups themselves, with the aim of optimizing a specific performance indicator. However, one cannot but notice that human resources are getting more and more critical in production systems, and it is not enough to concentrate only on the physical resources in order to expect a reasonable solution. This paper studies how the allocation of M differently skilled workers to machines may affect the makespan minimization for a M-machines flow-shop group scheduling problem with sequence dependent setup times. In particular, a team of heterogeneous workers have to be assigned to machines for executing setup tasks between one group and another, thus affecting the response of a work cell with a flow shop layout. A twofold objective characterizes the proposed research: 1) since the problem is NP-hard, finding the best heuristic optimization strategy to run both group/job sequencing and worker allocation problems; to this aim, three distinct genetic algorithm-based approaches have been tested on the basis of a properly designed benchmark of test cases. 2) Making full use of the best metaheuristics to evaluate the impact of the workers' skills on both manpower cost and makespan.

Costa, A., Cappadonna, F.A., Fichera, S.A HYBRID GENETIC ALGORITHM FOR JOB SEQUENCING AND WORKER ALLOCATION IN PARALLEL UNRELATED MACHINES WITH SEQUENCE-DEPENDENT SETUP TIMES

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 9-12, December 2013, Pages 2799-2817*Hybrid genetic algorithms; Makespan minimisation; Optimisation procedures; Parallel machine; Sequence-dependent setup time; Sequencing; Unrelated parallel machines; Worker allocations Engineering controlled terms: Genetic algorithms; Linear programming; Mathematical models; Optimization; Scheduling algorithms Engineering main heading: Encoding (symbols) *In this paper, the unrelated parallel machine scheduling problem with sequence-dependent setup times and limited human resources is addressed with reference to the makespan minimisation objective. Workers needed for setup*

operations are supposed to be a critical resource as their number is assumed to be lower than the number of workstations. In addition, each worker is characterised by a specific skill level, which affects setup times. Firstly, a mathematical model able to optimally solve small instances of the problem in hand is illustrated. Then, to deal with large-sized test cases, three different optimisation procedures equipped by different encoding methods are proposed: a permutation encoding-based genetic algorithm (GA), a multi-encoding GA and a hybrid GA that properly moves from a permutation encoding to a multi-encoding once a given threshold on the number of generations is achieved. In particular, three different hybrid GAs featured by different encoding switch thresholds were implemented. An extensive benchmark including both small-and large-sized instances was generated with the aim of both calibrating the genetic parameters and comparing the alternative GAs through distinct ANOVA analyses. Numerical results confirm the effectiveness of the hybrid genetic approach whose encoding switch threshold is fixed to 25 % of the overall generations. Finally, a further analysis concerning the impact of multi-skilled workforce on the performance of both production system and optimisation strategy is presented.

Castagliola, P., Celano, G., Fichera, S.COMPARISON OF THE $\bar{X}$ CHART AND THE T CHART WHEN THE PARAMETERS ARE ESTIMATED

*Quality Technology and Quantitative Management, Volume 10, Issue 1, March 2013, Pages 1-16*ARL; Control charts; Parameters estimation; SDRL; Statistical performance Engineering controlled terms: Estimation; Flowcharting; Statistics Engineering main heading: Parameter estimation *The estimation of the process parameters is an important issue to be fixed before starting a control chart implementation in a manufacturing process: in fact, correctly estimating the in-control mean and standard deviation of the quality parameter to be monitored can prevent from an unwanted deterioriation of the statistical performance of the control chart. Usually, the distribution parameters estimation is performed during the Phase I implementation of the control chart and is based on a finite number m of preliminary samples, each having size n, which is as large as the manufacturing environment can afford. This paper presents a comparison between the statistical properties of the Shewhart $\bar{X}$ chart and the Shewhart t chart when the process parameters are estimated from a Phase I data set having finite size. Mathematical expressions for the ARL and SDRL are suggested for both the charts. Tables of the design parameters selected for the two charts are provided for different numbers of Phase I samples m and sample sizes n. A comparison between the statistical performances of the two charts with estimated parameters is discussed for process instability conditions shifting the process mean and/or standard deviation during the Phase II implementation of the chart.*

Celano, G., Faraz, A., Saniga, E.CONTROL CHARTS MONITORING PRODUCT'S LOSS TO SOCIETY

Quality and Reliability Engineering International, 2013Taguchi introduced a new philosophy in quality control that accounts for the economic loss associated to process variation measured by deviations from the target value of a product quality characteristic. The Taguchi loss function has been considered in the design of control charts only for the computation of costs associated

with nonconformities. This paper considers sample statistics based on the Taguchi loss function as a means to implement Shewhart control charts monitoring both the deviation from the target and dispersion of normally distributed quality characteristics. The aim of this proposed control chart is to perform on-line quality control of a process by monitoring its quality loss cost performance over time. To compute the quality loss performance, we consider a nominal-the-best quality characteristic. The statistical performance of the proposed control charts has been evaluated and compared with that of widely used control charts. Implementing target costing philosophy by means of one of the proposed charts is also discussed. An example illustrates the Taguchi control chart in a practical implementation.

Cappadonna, F.A., Costa, A., Fichera, S.MAKESPAN MINIMIZATION OF UNRELATED PARALLEL MACHINES WITH LIMITED HUMAN RESOURCES

*Procedia CIRP, Volume 12, 2013, Pages 450-455*Computational burden; Makespan; Makespan minimization; Mixed integer linear programming model; Numerical experiments; Parallel machine; Quality of solution; Unrelated parallel machines Engineering controlled terms: Industrial engineering; Linear programming; Scheduling; Scheduling algorithms Engineering main heading: Personnel *This paper addresses the unrelated parallel machine scheduling problem with limited human resources. Firstly, the formulation of a Mixed Integer Linear Programming (MILP) model for optimally solving the problem is provided. Then, a proper genetic algorithm (GA) is presented aiming to cope with larger sized issues. Numerical experiments put in evidence how both the number of workers and the number of machines employed within the production system play a key role in minimizing makespan. Moreover, obtained results highlight the effectiveness and the efficiency of the proposed GA, under the quality of solution and the computational burden viewpoints.*

Castagliola, P., Achouri, A., Taleb, H., Celano, G., Psarakis, S.MONITORING THE COEFFICIENT OF VARIATION USING A VARIABLE SAMPLING INTERVAL CONTROL CHART

*Quality and Reliability Engineering International, Volume 29, Issue 8, December 2013, Pages 1135-1149*Applied statistics; Average time to signal; Coefficient of variation; Quality characteristic; Shewhart control charts; Statistical properties; Variable sampling interval control charts; Variable sampling intervals Engineering controlled terms: Flowcharting; Statistical process control Engineering main heading: Statistical methods *The coefficient of variation (CV) is a quality characteristic that has several applications in applied statistics and is receiving increasing attention in quality control. Few papers have proposed control charts that monitor this normalized measure of dispersion. In this paper, an adaptive Shewhart control chart implementing a variable sampling interval (VSI) strategy is proposed to monitor the CV. Tables are provided for the statistical properties of the VSI CV chart, and a comparison is performed*

with a Fixed Sampling Rate Shewhart chart for the CV. An example illustrates the use of these charts on real data gathered from a casting process. Copyright

Castagliola, P., Achouri, A., Taleb, H., Celano, G., Psarakis, S.MONITORING THE COEFFICIENT OF VARIATION USING CONTROL CHARTS WITH RUN RULES

*Quality Technology and Quantitative Management, Volume 10, Issue 1, March 2013, Pages 75-94*Average run lengths; Coefficient of variation; Comparative studies; Control charts; Metal sintering; New efficient method; Run rules; Run-length properties Engineering controlled terms: Markov processes; Sintering; Statistical methods; Statistical process control Engineering main heading: Flowcharting *Monitoring the coefficient of variation (CV) is a successful approach to Statistical Process Control when the process mean and standard deviation are not constant. In recent years the CV has been investigated by many researchers as the monitored statistic for several control charts. Viewed under this perspective, this paper presents a new efficient method to monitor the CV by means of Run Rules (RR) type charts. Tables are provided to show the statistical run length properties of Shewhart-γ, RR 2,3-γ RR 3,4-γ and RR 4,5-γ control charts for several combinations of in control CV values γ 0 , sample size n and shift size T . Indeed, comparative studies have been performed to find the best control chart for each combination. An example illustrates the use of these charts on real data gathered from a metal sintering process.*

Celano, G., Castagliola, P., Fichera, S., Nenes, G.PERFORMANCE OF T CONTROL CHARTS IN SHORT RUNS WITH UNKNOWN SHIFT SIZES

*Computers and Industrial Engineering, Volume 64, Issue 1, 2013, Pages 56-68*Control charts; CUSUM; EWMA; Shewhart; Short production runs Engineering controlled terms: Flowcharting; Quality control Engineering main heading: Statistical process control *Abstract Recently, control charts plotting a statistic having a Student's t distribution have been proposed as an efficient solution to perform Statistical Process Control (SPC) in short production runs where the shift size of the in-control process mean from l0 to l1 is known a priori. The shift size is usually measured as a multiple d of the in-control process standard deviation r0: but in practice, at the beginning of the production run, both the value of next shift d and r0 are unknown. As a consequence, when the actual shift size differs from the value assumed at the chart design stage, the performance of the control chart can be seriously affected. To overcome this problem, this paper investigates the statistical performance of the Shewhart, EWMA and CUSUM t charts for short production runs when the shift size is unknown and modeled by means of a statistical distribution. An extensive numerical analysis allows the properties of the three charts to be compared and discussed when uniform and triangular distributions are used by quality practitioners to fit the unknown shift size. An illustrative example is utilized to demonstrate a practical implementation of the best performing among the three investigated charts.*

Celano, G., Castagliola, P., Faraz, A., Fichera, S.STATISTICAL PERFORMANCE OF A CONTROL CHART FOR INDIVIDUAL OBSERVATIONS MONITORING THE RATIO OF TWO NORMAL VARIABLES

Quality and Reliability Engineering International, 2013Statistical Process Control monitoring of the ratio Z of two normal variables X and Y has received too little attention in quality control literature. Several applications dealing with monitoring the ratio Z can be found in the industrial sector, when quality control of products consisting of several raw materials calls for monitoring their proportions (ratios) within a product. Tables about the statistical performance of these charts are still not available. This paper investigates the statistical performance of a Phase II Shewhart control chart monitoring the ratio of two normal variables in the case of individual observations. The obtained results show that the performance of the proposed chart is a function of the distribution parameters of the two normal variables. In particular, the Shewhart chart monitoring the ratio Z outperforms the (p=2) multivariate T 2 control chart when a process shift affects the in-control mean of X or, alternatively, of Y and the correlation among X and Y is high and when the in-control means of X and Y shift contemporarily to opposite directions. The sensitivity of the proposed chart to a shift of the in-control dispersion has been investigated, too. We also show that the standardization of the two variables before computing their ratio is not a good practice due to a significant loss in the chart's statistical performance. An illustrative example from the food industry details the implementation of the ratio control chart.

Faraz, A., Celano, G., Saniga, E., Heuchenne, C., Fichera, S.THE VARIABLE PARAMETERS T {MATHEMATICAL EXPRESSION} CHART WITH RUN RULES

Statistical Papers, 2013, Pages 1-18The Hotelling's {Mathematical expression}control chart with variable parameters (VP {Mathematical expression} has been shown to have better statistical performance than other adaptive control schemes in detecting small to moderate process mean shifts. In this paper, we investigate the statistical performance of the VP {Mathematical expression} control chart coupled with run rules. We consider two well-known run rules schemes. Statistical performance is evaluated by using a Markov chain modeling the random shock mechanism of the monitored process. The in-control time interval of the process is assumed to follow an exponential distribution. A genetic algorithm has been designed to select the optimal chart design parameters. We provide an extensive numerical analysis indicating that the VP {Mathematical expression} control chart with run rules outperforms other charts for small sizes of the mean shift expressed through the Mahalanobis distance.

Castagliola, P., Celano, G., Fichera, S., Nenes, G.THE VARIABLE SAMPLE SIZE T CONTROL CHART FOR MONITORING SHORT PRODUCTION RUNS

*International Journal of Advanced Manufacturing Technology, Volume 66, Issue 9-12, June 2013, Pages 1353-1366*Adaptive control charts; Adaptive parameters; Control charts; Manufacturing environments; Mean and standard deviations; Numerical investigations; Shift size; Statistical performance Engineering controlled terms: Sampling; Statistical process control Engineering main heading: Flowcharting *Starting the online monitoring of a quality characteristic by means of a control chart at the beginning of a short production run is often a challenging issue for quality practitioners: in fact, the frequent absence of preliminary information prevents from getting a precise estimate of the characteristic mean and standard deviation. Furthermore, for short runs having a finite rolling horizon, the number of inspections scheduled within the run can be too small to get sufficient samples allowing the phase I implementation of the chart to be completed. Recently, t control charts have been proposed as efficient means to overcome this problem because they do not need any phase I tentative control limits definition or preliminary process knowledge. In this paper, a variable sample size (VSS) version of the t chart is proposed. Adaptive control charts have been implemented with success in long runs: here, the performance of the variable sample size strategy is investigated for a chart used in a short run. The statistical performance of the VSS t chart is compared with the one of the fixed-parameter (FP) t chart for both scenarios of fixed and unknown shift size, with the latter situation being frequent in short-run manufacturing environments. An extensive numerical investigation reveals the potential benefits of the proposed chart. When the statistical design is optimized with respect to a fixed value of the shift size δ, the VSS t chart has a better statistical performance than the FP t chart for moderate to large values of δ. Conversely, for the unknown shift size condition, the VSS t chart always outperforms the FP t chart for in-control average sample sizes ASS 0 > 7. An illustrative example shows the implementation of the VSS during the production of a finite lot of mechanical parts.*

E-campus

Forcellese, A., Martarelli, M., Pandarese, G., Simoncini, M.SIMILAR AND DISSIMILAR FSWED JOINTS IN LIGHTWEIGHT ALLOYS: HEATING DISTRIBUTION ASSESSMENT AND IR THERMOGRAPHY MONITORING FOR ON-LINE QUALITY CONTROL

*Key Engineering Materials, Volume 554-557, 2013, Pages 1055-1064*Dissimilar joints; Experimental evaluation; Friction stir welded joints; FSW; Heating distributions; Light weight alloys; Non-contact measurement systems; On-line quality control Engineering controlled terms: Friction stir welding; Mechanical properties; Nondestructive examination; Quality assurance;

Quality control; Surface defects; Thermocouples; Thermography (imaging); Welding; Welds Engineering main heading: Aluminum alloys *The heating distribution assessment on similar and dissimilar friction stir welded joints in AA6082 and AA5754 aluminium alloy sheets was investigated. The FSW experiments were carried out using constant rotational and welding speeds of 1500 rpm and 60 mm/min, respectively. Temperature was locally measured by means of K-type thermocouples inserted into thin grooves located on the bottom side of the sheets, in fixed positions, very close to the welding line. It was observed that the mechanical properties of joints are related to the heat distribution. In order to obtain a completely non intrusive temperature monitoring, that was able to follow the process dynamic, a non-contact measurement system based on infrared thermography was also developed. Such system, used for the experimental evaluation of temperature on the upper surface of the joints, is also able to detect the presence of flow defects with a non-destructive method, demonstrating its effectiveness as a diagnostic instrument for the on-line quality control of welded joints. Copyright*

Ferrara

Savio, G., Meneghello, R., Concheri, G., D'Angelo, L.PROCESS OPTIMIZATION IN GLASS POLISHING BASED ON A MATERIAL REMOVAL MODEL

Advanced Science Letters, Volume 19, Issue 2, February 2013, Pages 539-542In the industrial world there are different production processes for the manufacturing of spectacle lens. Nowadays casting is the most common lens manufacturing method. Here, the mould production is based on three stages: grinding, polishing and hardening, where, in the second step, different sets of process parameters play a key role in quality, time and cost. To optimize the polishing process of moulds a model for the correlation between the material removal and the process parameters is proposed. The model is developed for CNC ball polishing of free-form surfaces, where the pad, made of a polyurethane layer superimposed to a rubber bulk, moves along a scanning path, in a suspension of cerium oxide. The material removal can be derived through pressure and sliding velocity between polishing pad and workpiece and consequently can be related to the CAD-CAM- CNC parameters e.g., tool and workpiece shape, dimension and modulus of elasticity, feed rate, feed step, tool rotational speed and radial tool deformation. The model has been validated on ground glass flat samples polished varying the process parameters and it shows a satisfactory estimation of material removal as a function of the process parameters.

Firenze

Scippa, A., Grossi, N., Campatelli, G.MILLED SURFACE GENERATION MODEL FOR CHIP THICKNESS DETECTION IN PERIPHERAL MILLING

*Procedia CIRP, Volume 8, 2013, Pages 450-455*Cross sectional area; Cutting force model; End-milling operations; Milled surfaces; Milling simulations; Time-domain simulations; Uncut chip thickness; Vibration Engineering controlled terms: Cutting; Forecasting; Machining centers; MATLAB; Milling (machining); Numerical models; Surface roughness; Time domain analysis; Tools Engineering main heading: Surfaces *Prediction of forces between tool and workpiece is essential in order to optimize machining and preserve process stability. In the last decades different predictive approaches have been developed: mainly mechanistic and numerical models. Mechanistic models could be applied to a wide range of cutter geometry and workpiece combination, even if a specific tuning, depending on material and application, is always needed. Numerical models could take in account many operative conditions than analytical ones, and allow predicting other parameters like stress, strain rate, temperature distribution, etc., but the computational time required is often unacceptable. The paper presents an innovative hybrid numerical-analytical approach for uncut chip cross-sectional area calculation in 2.5 axis end milling operations. The proposed model uses a mechanistic cutting force model to couple tool and workpiece finite element (FE) models: FE time domain simulations provide to predict effective paths of tool teeth relative to the workpiece, taking into account the dynamics of the entire system; while an appropriate algorithm, developed in Matlab®, allows to achieve a more realistic uncut chip area, from which it is possible to calculate the cutting forces. This approach provides an accurate representation of the machined surface. Simulation is compared with experimental results. Copyright*

Genova

Lertora, E.COMPARISON OF AA 2024 T3 FRICTION STIR WELDED AND RIVETED OVERLAP JOINTS WITH THE ADDITION OF A PRESSURIZATION TEST

*Materials and Design, Volume 49, August 2013, Pages 259-266*Aa 2024-t3; Aviation regulations; Cyclic pressurization tests; Fatigue strength; Flat panel; Friction stir; Friction stir welding(FSW); FSW joint; Identified parameter; Innovative character; Mechanical tests; Microstructural investigation; Monitoring the temperatures; Overlap joints; Scale models; Tensile tests; Typical structures; Welded panels; Welding parameters Engineering controlled terms: Aerodynamics; Mechanical properties; Pressurization; Tensile testing; Welding Engineering main heading: Friction stir welding *The aim of this work is to investigate the Friction Stir Welding (FSW) process applicability to a typical aeronautical joint: the union of the stiffeners to sheets constituting the fuselage. To do this analysis FSW parameters of flat overlapped sheets were first identified by monitoring the temperature reached using thermography. 1.3. mm thick AA 2024 T3 overlapped sheets were welded with success and the thermal effect due to the use of different welding parameters was compared with the results of mechanical tests and microstructural investigations. FSW joint mechanical properties were compared with those detected by performing tensile tests of joints made by riveting, showing absolutely comparable values. FSW identified parameters were used to make overlap joints between flat panels and stiffeners, so as to realize a typical structure of the aeronautical sector and to compare, by pressurization tests, the resistance of such panels with similar riveted. The*

innovative character of this research is represented by cyclic pressurization tests, conducted as indicated by the FAR (Federal Aviation Regulation) rules on a scale model. Thus it was possible to verify that the fatigue strength of welded panels is such as to overcome the acceptability limits fixed in the aeronautical field.

Mandolfino, C., Lertora, E., Gambaro, C.EFFECT OF SURFACE PRETREATMENT ON THE PERFORMANCE OF ADHESIVE-BONDED JOINTS

*Key Engineering Materials, Volume 554-557, 2013, Pages 996-1006*Adhesive bonded joints; Epoxy adhesives; Experimental campaign; Mechanical characteristics; Mechanical interlocking; Mechanical treatments; Surface pretreatment; Systematic investigations Engineering controlled terms: Mechanical properties; Substrates; Surface roughness; Surface treatment Engineering main heading: Adhesive joints *This paper presents a systematic investigation of the influence of sandblasting pretreatment parameters on the surface roughness and mechanical characteristics of adhesivebonded joints. The preliminary surface treatment in a bonding process has two important aims: first of all, it eliminates contaminants (dust, grease, humidity and corrosion products) which can modify the wettability of the substrate, then it increases surface roughness and, consequently, the contact area between substrate and adhesive, creating a mechanical interlocking that maximizes adhesion. To enhance the strength and avoid the de-adhesive failure of the joint, it is therefore advisable to increase the contact substrate-adhesive by a mechanical treatment of sanding, grinding or preferably sandblasting, usually considered one of the most effective methods to control the desired level of surface roughness and joint strength. This process, apparently easy to manage, is controlled by a great number of operating parameters, which all contribute to creating a good result. With the aim of evaluating the influence that some of these parameters have on the mechanical characteristics of adhesive-bonded joints, an experimental campaign was carried out. In particular, a steel substrate, an epoxy adhesive and various types of sand, different in nature and granulometry were used. The variable parameters for the execution of blasting are sand, impact angle and pressure. The assessments departed from an investigation into their effect on surface roughness and thereafter the mechanical properties of the bonded joints were analyzed. Copyright*

Lertora, E., Mandolfino, C., Gambaro, C.EFFECT OF WELDING PARAMETERS ON AA8090 AL-LI ALLOY FSW T-JOINTS

*Key Engineering Materials, Volume 554-557, 2013, Pages 985-995*Aircraft performance; Aluminum lithium alloy; High strength aluminum alloys; Micro-structural characterization; Plasticized materials; Structural reinforcement; T-joints; Tensile characteristics Engineering controlled terms: Aerospace industry; Aircraft; Aluminum alloys; Binary alloys; Butt welding; Lithium; Lithium alloys Engineering main heading: Friction stir welding *In aeronautics and aerospace construction, whenever a seam is needed between aluminum alloy parts, riveting, nailing or bolting are the preferred methods of junction. Friction stir welding technology has*

made possible the realization of high strength aluminum alloy joints, which are normally considered non-weldable with conventional welding techniques. FSW technology allows you to reduce time and cost of realization, and also increases the process joining efficiency. FSW is also a filler-free process, which would considerably lighten the structure. Currently, most of the studies regarding FSW have primarily been on butt joints. In the aircraft industry, there are a considerable number of structural reinforcements that are realized by T-joints. FSW technique T-joint realization has the advantage of welding the parts by an external single pass from the outside. This allows you to avoid fillet welds in the internal corner of the junction or to eliminate the rivets completely. The material used in this study is a 5 mm thick aluminum-lithium AA8090 T8 alloy, typically used in the aerospace industry due to its lightness. This low density alloy is attractive to the aerospace industry, since the structural weight reduction that it allows leads to an improvement of aircraft performance. First, a welding fixture realized to support the pieces to be welded and capable of withstanding the welding tool vertical force was studied and realized. Particular attention was paid to the shape in the corner areas of the welded pieces, thanks to the rounded shape of the supports in contact with the plasticized material. This expedient is necessary to avoid the presence of sharp edges, lethal for the fatigue survival of the coupling. In the second part of the work, welding parameters were optimized first with butt joints then with Tjoints, in order to identify the correct welding ratio (WR = rotation speed / welding speed). After the welding tests, a first visual examination was carried out to verify the presence of any surface defects and the surface finishing. After the first examinations had been made, macro and microstructural characterizations were performed to assess the morphology of the joint and analyze the grain size. Moreover, mechanical tests were conducted, useful to know the tensile characteristics and joint hardness. Finally, a correlation was sought between the butt joint welding parameters and those used for the T-joints. Copyright

Pedemonte, M., Gambaro, C., Lertora, E., Mandolfino, C.FATIGUE ASSESSMENT OF AA 8090 FRICTION STIR BUTT WELDS AFTER SURFACE FINISHING TREATMENT

*Aerospace Science and Technology, Volume 27, Issue 1, June 2013, Pages 188-192*AA 8090; Aircraft manufacturers; Environmental conditions; Fatigue assessments; Fatigue failures; Safety and efficiencies; Surface finishing; Surface irregularities Engineering controlled terms: Aircraft; Fatigue of materials; Finishing; Friction stir welding; Surface treatment; Welding Engineering main heading: Welds *Combining great performances with high standards of safety and efficiency is the challenge for most aircraft manufacturers. Aircraft are subjected to extraordinary loads, repeated for millions of cycles also in extreme environmental conditions, hence every component must be designed and manufactured to maximize its fatigue resistance. Friction Stir Welding of aluminium alloys and surface finishing process as might be a good solution to reach this goal. The high performances reached in this field with the use of this technique could be further increased reducing the welded surface irregularity, which might promote the development of a dangerous fatigue failure mechanism. In this work, the effect of the welded surface finishing treatment on the fatigue behavior of AA8090 FSW butt joints was assessed. The results obtained*

from the dynamic tests highlighted the higher fatigue resistance of finished specimens, with respect to the as-welded joints. Copyright

Bruzzone, A.A.G., Costa, H.L.FUNCTIONAL CHARACTERIZATION OF STRUCTURED SURFACES FOR TRIBOLOGICAL APPLICATIONS

*Procedia CIRP, Volume 12, 2013, Pages 456-461*Engineered surfaces; Functional characterization; Functional surfaces; Micro geometry; Structured surfaces; Surface analysis techniques; Technological development; Tribological applications Engineering controlled terms: Industrial applications; Industrial engineering; Surface analysis; Surfaces; Textures Engineering main heading: Tribology *Engineered surfaces obtained by modification of surface topography have important industrial applications, many involving tribology. Nevertheless there is still lack of knowledge about fundamental aspects involved in the improvement of surface behaviour. Recent technological developments now permit us to texture surfaces in a flexible way and to assess the tribological efficiency of different microtopologies. Moreover, advances in surface analysis techniques provide methodologies that do not limit the investigation to microgeometry but allow the functional characterization of surfaces. This paper proposes functional surface parameters in order to capture the tribological efficiency of structured surfaces.*

L'aquila

Lambiase, F., Di Ilio, A.A CLOSED-FORM SOLUTION FOR THERMAL AND DEFORMATION FIELDS IN LASER BENDING PROCESS OF DIFFERENT MATERIALS

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 1-4, 2013, Pages 849-861*Bending mechanism; Laser bending; Laser-forming; Temperature gradient mechanism; Temperature prediction; Thin sheet Engineering controlled terms: Analytical models; Conductive materials; Finite element method; Forming; Optimization Engineering main heading: Deformation *An analytical solution for temperature and deformation fields produced by laser forming is derived. The effects of process parameters are investigated on samples of different materials and thicknesses. Experimental tests were carried out using a high-power diode laser on a poorly conductive material (AISI 304) and a highly conductive one (AA 6013) to evaluate the accuracy of the proposed model. A 2D FEM is developed to calibrate and validate the new model. The model predictions are in good agreement with experimental measurements even under low scanning speed due to the effect of conductive heat exchange of the irradiated zone with surrounding material. Based on the achieved results, a simple method for optimizing the process productivity is also discussed.*

Paoletti, A.AN EXPERIMENTAL INVESTIGATION ON METAL SURFACE TREATMENT BY MEANS OF DIODE LASER BEAMS

*WIT Transactions on Engineering Sciences, Volume 78, 2013, Pages 205-214*Experimental investigations; Industrial branches; Laser treatment; Microhardness measurement; Minimum distortions; Selective hardening; Surface hardening; Workpiece materials Engineering controlled terms: Computational methods; Deformation; Experiments; Hardening; Scanning electron microscopy; Semiconductor lasers; Surface treatment Engineering main heading: Laser materials processing *Surface treatment of steel, for a higher wear resistance, is necessary in all industrial branches that deal with steel. One of the most effective methods of metal surface heat treatment is represented by laser hardening. In general, compared to other techniques, laser hardening needs a much lower heat input into the material. Compared with other conventional processes, diode laser treatment allows us to obtain some advantages, such as minimum distortion in the parts and selective hardening of specific areas of components. In this paper, an experimental investigation on the surface thermal treatment of different steels by means of a diode laser has been carried out. Experimental tests have been performed on three types of steels, selecting different values of beam power and workpiece speed. Hardness and micro-hardness measurements have been executed on the treated samples in order to assess the influence of laser machining parameters and of workpiece materials on the treatment process. Experimental results have been compared with those obtained by using a monodimensional thermal model. The morphology of the heat affected zone of the specimens has been investigated by scanning electron microscopy.*

Lambiase, F., Di Ilio, A., Paoletti, A.AN EXPERIMENTAL INVESTIGATION ON PASSIVE WATER COOLING IN LASER FORMING PROCESS

*International Journal of Advanced Manufacturing Technology, Volume 64, Issue 5-8, February 2013, Pages 829-840*AISI-304 stainless steel; Bending angle; Cooling media; Cooling time; Effect of water; Experimental investigations; Finite element models; Laser beam power; Laser bending; Laser forming process; Laser scanning speed; Laser scans; Laser-forming; Main process; Minimum time; Multiple lasers; Parametric approach; Production time; Sheet thickness; Stress and deformation; Thin sheet; Water cooling Engineering controlled terms: Cooling; Finite element method; Forming Engineering main heading: Bending (deformation) *The effect of passive water cooling in laser forming of thin sheets made of AISI 304 stainless steel is experimentally investigated. Indeed, since each laser scan can produce only small bending angles, multiple laser scans are required to produce a given deformation with a significant increase of production time due to cooling between consecutive scans. Therefore, passive water cooling is tested to verify its influence on minimum time between consecutive scans (cooling time), bending angle, and surface quality. A parametric approach is involved in the investigation and main process parameters are changed among the experiments by varying laser scanning speed, laser beam power, sheet thickness, and cooling media among several levels. It was*

discovered that the employment of passive water cooling in laser forming of thin sheets would be beneficial since the capability to dramatically reduce the cooling time and oxidation of both irradiated and cooled surfaces. In addition, the bending angle is only marginally affected by employment of water cooling. The effect of water cooling on stress and deformations are discussed by developing a numerical model based on finite element model.

Sfarra, S., Ibarra-Castanedo, C., Santulli, C., Paoletti, A., Paoletti, D., Sarasini, F., Bendada, A., Maldague, X.FALLING WEIGHT IMPACTED GLASS AND BASALT FIBRE WOVEN COMPOSITES INSPECTED USING NON-DESTRUCTIVE TECHNIQUES

*Composites Part B: Engineering, Volume 45, Issue 1, February 2013, Pages 601-608*Comparative studies; E-glass; Enhanced vision; Falling weight; Falling weight impact; Fibre reinforced composites; Hysteresis cycles; Impact behaviour; Impact damages; Impact performance; Integrated applications; Low velocity impact; Non destructive testing; Non-destructive technique; Woven composite; Woven fabric composites Engineering controlled terms: Basalt; Glass fibers; Nondestructive examination Engineering main heading: Fibers *A limited number of comparative studies on falling weight impact properties of different composites exist, especially using non-destructive techniques (NDTs). In this work, two types of woven fabric composites, reinforced respectively with E-glass fibres and basalt fibres, were subjected to low velocity impact at different energies (7.5, 15 and 22.5 J). Comparative indications were offered by impact hysteresis cycles and the integration of data between different enhanced vision methods, namely interferometric and IR thermographic techniques. The integrated application of these techniques suggests that the increased directionality of impact damage observed in basalt fibre reinforced composites, though their impact performance appears to be slightly superior, may represent a limitation on the predictability of their behaviour.*

Lambiase, F., Di Ilio, A.FINITE ELEMENT ANALYSIS OF MATERIAL FLOW IN MECHANICAL CLINCHING WITH EXTENSIBLE DIES

*Journal of Materials Engineering and Performance, Volume 22, Issue 6, June 2013, Pages 1629-1636*Axial asymmetries; clinching; Clinching process; Finite element models; Mechanical fastening; Quality criteria; Sheet thickness; Tensile shear test Engineering controlled terms: Finite element method; Joining Engineering main heading: Dies *An investigation of the material flow during the clinching process with extensible dies is carried out. Clinched joints were produced under different forming loads to evaluate the evolution of the joints' profile experimentally. Tensile-shear tests were conducted to evaluate the influence of the forming load on mechanical strength of the clinched joint. Since the joints' strength depends on the joints' profile, which in turn depends on the punch-die cavity volume, an analysis of the forces acting on*

the extensible dies was carried out. A finite element model was developed and validated by comparing the predicted and measured material flow and quality criteria (e.g., neck thickness and undercut). Therefore, the FE model was utilized to analyze the evolution of contact forces acting on the die sectors during the joining process. Furthermore, the main causes of the asymmetry in the cross section of such joints have been studied. It turned out that the axial asymmetry due to material flow within the gap between consecutive die sectors increases with the punch force and the sheet thickness.

Lambiase, F.INFLUENCE OF PROCESS PARAMETERS IN MECHANICAL CLINCHING WITH EXTENSIBLE DIES

*International Journal of Advanced Manufacturing Technology, Volume 66, Issue 9-12, June 2013, Pages 2123-2131*3D finite element model; Clinching; FE analysis; Influence of process parameters; Lap joint; Mechanical characteristics; Mechanical fastening; Processing condition Engineering controlled terms: Finite element method; Joining Engineering main heading: Dies *The influence of clinching tool design in joining metal sheets by the clinching process with extensible dies is investigated. The material flow during the clinching process was examined experimentally and numerically. The geometrical and mechanical characteristics of joints produced under different processing conditions, that is, forming loads, were used to calibrate and validate a 3D finite element model of the clinching process. Then, the model was utilized to evaluate the influence of clinching tool design parameters, namely the punch diameter, the punch corner radius, the fixed die depth, the fixed die diameter, and the die corner radius. The effects of design parameters on the cross section of a clinched joint, the required forming load and the joint strength were analysed and the appropriate processing window was determined. According to the achieved results, the main benefits and drawbacks of each configuration are discussed.*

Lambiase, F.OPTIMIZATION OF SHAPE ROLLING SEQUENCES BY INTEGRATED ARTIFICIAL INTELLIGENT TECHNIQUES

*International Journal of Advanced Manufacturing Technology, Volume 68, Issue 1-4, 2013, Pages 443-452*ANN; FEM analysis; Hybrid design; Process simulations; Rod rolling; Roll pass design; Shape rolling Engineering controlled terms: Calibration; Design; Expert systems; Neural networks; Optimization; Process planning; Rolling Engineering main heading: Genetic algorithms *The present work introduces an expert system that automatically selects and designs rolling sequences for the production of square and round wires. The design strategy is aimed at reducing the overall number of passes assuming a series of process constraints, e.g., available roll cage power and torque, rolls groove filling behaviors, etc. The method is carried out into two steps: first a genetic algorithm is used to select the proper rolling sequence allowing to achieve a desired finished product; then, an optimization roll pass design tool is utilized for proper design of roll passes. Indeed, an artificial neural network (ANN) is utilized to predict the*

main geometrical characteristics of the rolled semi-finished product and technological requirements. The ANN was trained with a non-linear finite element (FE) model. The proposed methodology was applied to some industrial cases to show the validity of the proposed approach in terms of reduction of number of passes and search robustness.

Lambiase, F., Di Ilio, A.OPTIMIZATION OF THE CLINCHING TOOLS BY MEANS OF INTEGRATED FE MODELING AND ARTIFICIAL INTELLIGENCE TECHNIQUES

*Procedia CIRP, Volume 12, 2013, Pages 163-168*Artificial intelligence techniques; Artificial neural network models; FE model; FE-simulation; Joint strength; Mechanichal fastening; Optimization tools; Tool geometry Engineering controlled terms: Finite element method; Genetic algorithms; Geometry; Industrial engineering; Joining; Locks (fasteners); Neural networks; Optimization Engineering main heading: Tools *In the present work, an optimization of the clinching tools involving extensible dies is performed to increase the clinched joints strength. The clinched joint strength is influenced by the lock parameters, which in turn depend on the clinching tool geometry. A finite element model is developed to predict the effect of the clinching tool geometry on lock parameters and recursively optimize the tool geometry. In order to reduce the number of FE simulation runs, an artificial Neural Network (ANN) model is utilized to predict the behavior of clinched joints produced with a given clinching tools configuration. The ANN is trained and validated by using the results of the finite element model produced under different clinching tools configurations. Finally, an optimization tool based on a Genetic Algorithm tool was developed to demonstrate the effectiveness of the proposed approach.*

Lambiase, F., Di Ilio, A.M., Paoletti, A.PREDICTION OF LASER HARDENING BY MEANS OF NEURAL NETWORK

*Procedia CIRP, Volume 12, 2013, Pages 181-186*Experimental test; Industrial components; Laser hardening; Optimized strategies; Process parameters; Surface layers; Thermal profiles; Treatment conditions Engineering controlled terms: Expert systems; Heat conduction; Industrial engineering; Mechanical properties; Models; Optimization Engineering main heading: Hardening *Laser hardening is a surface treatment process characterized by a high level of performance. The resulting physical, chemical, and mechanical properties of the surface layers can be accurately designed by modifying the process parameters i.e., scanning speed, frequency and laser power. Thus, the development of the laser hardening technology requires considerable preliminary work, including the determination of the range of components that may be hardened, the selection of proper treatment conditions and the identification of optimized strategies to employ such a technology for real industrial components. The present research aimed to provide a deep understanding of the laser hardening process. The effect of process parameters i.e., the laser power, the scanning speed, the number of scans and the overlapping, has been assessed by means of a campaign of experimental tests. Thus, an attempt to predict the effect of process*

parameters of treated components was carried out by developing an expert system using a neural network.

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Matt, D.T., Krause, D., Rauch, R.ADAPTATION OF THE VALUE STREAM OPTIMIZATION APPROACH TO COLLABORATIVE COMPANY NETWORKS IN THE CONSTRUCTION INDUSTRY

*Procedia CIRP, Volume 12, 2013, Pages 402-407*Applied research; Automation technology; Collaborative network; Collaborative projects; Company network; Customization; Lean manufacturing; Value stream maps Engineering controlled terms: Aerospace industry; Industrial engineering; Processing; Production Engineering main heading: Construction industry *While in the automotive or aerospace industry the use of automation technology and processes and the application of lean manufacturing methods are common nowadays, the construction industry is lagging behind these developments. In this context, with the help of value stream design, largely known in mass production but recently also in variant intensive manufacturing, the process flows within single companies but especially amongst the partners in such a collaborative network can be designed in a highly customer-oriented and efficient way [1]. Therefore, this paper describes in detail a methodology to design an integrated and customized value stream map for construction industries requirements. The approach was developed and verified based on a collaborative project of applied research.*

Matt, D.T., Rauch, E.DESIGN OF A NETWORK OF SCALABLE MODULAR MANUFACTURING SYSTEMS TO SUPPORT GEOGRAPHICALLY DISTRIBUTED PRODUCTION OF MASS CUSTOMIZED GOODS

*Procedia CIRP, Volume 12, 2013, Pages 438-443*Critical success factor; Design method; Design parameters; Distributed productions; Functional requirement; Industrial production; Mass customization; Theoretical framework Engineering controlled terms: Industrial engineering; Industry; Large scale systems; Manufacture Engineering main heading: Design *In our globalized economic system, industrial production has to step outside the boundaries of individual enterprises and single production units [1]. The increasing globalisation, new models for growth and Internationalization like Franchising, a high level of responsiveness as well as rising fuel costs and therefore higher logistics costs are significant for the development versus geographically distributed production sites. The purpose of this paper is to examine a best practice company case to identify the critical success factors and guidelines for the design of networks of scalable modular manufacturing systems to support geographically distributed production of mass customized goods. Information was collected through multiple site visits and*

semiect, as well as examination of relevant company documentations. With the help of the Axiomatic Design (AD) approach, the information was structured into a multi-level tree of relations between functional requirements (FR) and suitable design parameter (DP). The structured AD based analysis of the design pathway helped to identify a theoretical framework of guidelines for production system designers. An industrial case is taken to illustrate the single design steps and the relative outcomes.

Matt, D.T.DESIGN OF A SCALABLE ASSEMBLY SYSTEM FOR PRODUCT VARIETY: A CASE STUDY

*Assembly Automation, Volume 33, Issue 2, 2013, Pages 117-126*Alternative designs; Assembly systems; Axiomatic design; Conceptual approaches; Design of assemblies; Design/methodology/approach; Industrial case study; Product variety Engineering controlled terms: Assembly; Customer satisfaction; Industrial applications; Industrial research; Riveting; Scalability Engineering main heading: Product design *Purpose-The purpose of this paper is to develop and test a design approach based on the investigation of the sensitivity of assembly systems to volume fluctuations as part of the selection process of alternative design solutions for scalable assembly systems on the basis of a real industrial case study. Design/methodology/approach - A conceptual approach for the (re-)design of a scalable assembly system is developed on the basis of an industrial case research using axiomatic design (AD) for the top level structuring of the framework incorporating useful methods and insights obtained from a thorough literature review and from previous research work. Findings - The findings of this research are limited due to the focused nature of a case study based research. However, the obtained results encourage assuming its transferability to similar problems. Originality/value - Significant research has been done in the design of assembly systems for high product variety, but the review of literature in this field still identifies many opportunities for future research. This paper responds to the clearly identified research need of a methodological guidance regarding the design of scalable assembly systems and offers a practically proven help to improve the efficiency of the design process and the quality of the design results.*

Matt, D.T.EXTENSION OF THE VALUE STREAM MAPPING APPROACH TO THE COMPREHENSIVE DESIGN OF A LEAN SHEET METAL MANUFACTURING SYSTEM: AN INDUSTRIAL CASE STUDY

*Key Engineering Materials, Volume 549, 2013, Pages 537-544*Comprehensive designs; Industrial case study; Integrated optimization; Lean manufacturing systems; Metal manufacturing system; Optimized production; Production logistics; Value stream mapping Engineering controlled terms: Cables; Industrial applications; Industrial plants; Manufacture; Mapping; Optimization; Research; Sheet metal Engineering main heading: Product design *This paper reports the practical experiences made with extending the Value Stream Mapping (VSM) approach to the comprehensive design of a lean manufacturing system for the series production*

of sheet metal cable tray systems. The use of VSM for analyzing the production of repetitive units has proven to be successful in different industries. It is based on a classification of all products into product families and creates one current and future state map for each product family. This approach and the related guidelines for future state optimization are very helpful but not sufficient for a comprehensive manufacturing system (re)design, because the relation between product families' value streams, the overall material flow optimization, as well as the segmentation and layout of factory remains unclear. Thus, the purpose of this paper is to develop a design procedure based on the investigation of an industrial case that allows the integrated optimization of the single value streams, their compilation in material-flow optimized production segments, and finally the (re)design of production logistics and factory layout. The findings of this research are limited due to the focused nature of a case study based research. However, the obtained results encourage assuming its transferability to similar problems.

Ciarapica, F.E., Matt, D.T., Luccarelli, M., Rossini, M., Spena, P.R.FACTORS AFFECTING FUTURE SCENARIOS FOR ALTERNATIVE VEHICLES MARKET

*Advanced Materials Research, Volume 608-609, 2013, Pages 1607-1612*Alternative vehicles; Diverse range; Market penetration; Roadmap; Strategic goals Engineering controlled terms: Electric vehicles; Gas emissions; Hybrid vehicles; Hydrogen; Sustainable development Engineering main heading: Commerce *In the literature, many foresight methods have been used to cope with uncertainty concerning the future demand for electric, hydrogen, and plug-in hybrid vehicles. As a result, different scenarios and roadmap have been provided, often with contrasting outcomes. This paper is a short review of the existing literature aiming to summarize the main results obtained so far, describing the diverse ranges of possible development of these alternative vehicles over the next 40 years. This paper then addresses some key questions through the answers provided by the literature: what are the drivers of an alternative vehicles economy? What are the principal barriers and the strategic goals? When will an economy of alternative vehicles emerge? What does an alternative vehicle economy attain?*

Matt, D.T., Rauch, E.IMPLEMENTATION OF LEAN PRODUCTION IN SMALL SIZED ENTERPRISES

*Procedia CIRP, Volume 12, 2013, Pages 420-425*Critical success factor; Introduction and implementations; Lean production principles; Manufacturing enterprise; Medium sized enterprise; Productivity improvements; Small enterprise; Small sized enterprise Engineering controlled terms: Automotive industry; Industrial applications; Industrial economics; Industrial engineering; Manufacture; Productivity Engineering main heading: Research *The introduction and implementation of Lean Production Principles over the last twenty years has had a notable impact on many manufacturing enterprises. The practice shows that lean production methods and instruments are not equally applicable to large and small companies. After the implementation in large enterprises belonging to the automotive sector the concept of lean thinking was introduced successfully in medium sized enterprises. Small enterprises have been ignored for a long time and special investigations about this topic are rarely. Considering*

statistical data and analysis about the economic importance of small enterprises we can see, that they are numerous and create a notable part of the total value added in the non-financial business economy. This paper analysis in a first step the role and potential of small enterprises - especially in Italy - And shows then a preliminary study of the suitability of existing lean methods for the application in this type of organization. The research was combined with an industrial case study in a small enterprise to analyse the difficulties in the implementation stage and to identify the critical success factors. The results of this preliminary study should illustrate the existing hidden potential in small enterprises as well as a selection of suitable methods for productivity improvements. This research will be the base for a further and more detailed research project.

Firrao, D., Matteis, P., Russo Spena, P., Gerosa, R.INFLUENCE OF THE MICROSTRUCTURE ON FATIGUE AND FRACTURE TOUGHNESS PROPERTIES OF LARGE HEAT-TREATED MOLD STEELS

*Materials Science and Engineering A, Volume 559, 1 January 2013, Pages 371-383*Automotive component; Critical properties; Experimental campaign; Fatigue properties; Fracture toughness values; Microalloyed Steel; Mixed microstructures; Mold steel; Plastic mold steel; Production process; Steel grades; Toughness properties Engineering controlled terms: Age hardening; Blooms (metal); Brittleness; Fatigue of materials; Fractography; Fracture mechanics; Fracture toughness; Grain boundaries; Hardness; Mechanical properties; Mold release agents; Plastic molds; Plasticity Engineering main heading: Microstructure *The standard ISO 1.2738 medium-carbon low-alloy steel has long been used to fabricate plastic molds for injection molding of large automotive components, such as bumpers and dashboards. These molds are usually machined from large pre-hardened steel blooms. Due to the bloom size, the heat treatment yields mixed microstructures, continuously varying from surface to core. Negative events (such as microcracks due to improper weld bed deposition or incomplete extraction of already formed plastic objects) or too large thermal/mechanical stresses can conceivably cause mold failure during service due to the low fracture toughness and fatigue resistance typically encountered in large slack quenched and tempered ISO 1.2738 steel blooms. Alternative steel grades, including both non-standard microalloyed steels, designed for the same production process, and precipitation hardening steels, have recently been proposed by steelworks. However, the fracture toughness and the fatigue properties of these steels, and hence their response during the service, are not well known. Results of an experimental campaign to assess the fracture toughness and fatigue properties, as well as the basic mechanical properties, of a microalloyed and a precipitation hardening plastic mold steel blooms are presented and commented, also in respect to the results previously obtained by two commercial ISO 1.2738 ones. Experimental results show that these steels generally exhibit low fracture toughness values; in the traditional quenched and tempered bloom steels the brittleness may be caused both by the presence of mixed microstructures and by grain boundaries segregation, while in the precipitation hardened one the brittleness probably stems from the precipitation phenomena. This study suggests that microalloyed and precipitation hardening steels may be used to produce large plastic mold, yet the fracture toughness still remains the most critical property.*

Spena, P.R., De Maddis, M., Lombardi, F., D'Aiuto, F.RESISTANCE SPOT WELDING OF ADVANCED HIGH STRENGTH TWIP STEELS

*Applied Mechanics and Materials, Volume 423-426, 2013, Pages 876-880*High manganese austenitic steel; Orthogonal array; Resistance spot welding; Taguchi's methods; Tensile shear test; Tensile-shear strengths; TWIP steel; Welding parameters Engineering controlled terms: Clamping devices; High strength steel; Manufacture; Plasticity; Resistance welding; Stainless steel; Welded steel structures; Welding; Welds Engineering main heading: Tensile strength *In this study, advanced high manganese austenitic steel sheets were welded by resistance spot welding at different welding parameters. The effects of welding current, clamping force, number of the current impulse, and duration of each current impulse were examined. Based on Taguchi's method, an L-27(3 13) orthogonal array was employed for carrying out resistance spot welding tests. The welded sheets were subjected to tensile-shear tests in order to determine the strength of the welded joints. Basically, the results showed that tensile-shear strength increase with clamping force at the medium and high effective welding time (>400 ms). However, the occurrence of micro cracks within the welded joints may justify the scattering of tensile-shear strength values.*

Russo Spena, P., Firrao, D.THERMOMECHANICAL WARM FORGING OF TI-V, TI-NB, AND TI-B MICROALLOYED MEDIUM CARBON STEELS

*Materials Science and Engineering A, Volume 560, 10 January 2013, Pages 208-215*Critical properties; Experimental campaign; Forged steel; Gleeble; Mechanical components; Microalloyed medium carbon steel; Microalloying elements; Microstructures and mechanical properties; Precipitation strengthening; Quenched and tempered steel; Quenching and tempering; Refined microstructure; Steel compositions; Strength and toughness; Thermo-mechanical; Thermomechanical forging; Warm temperatures Engineering controlled terms: Forgings; Grain refinement; Mechanical properties; Microstructure; Toughness Engineering main heading: Carbon steel *Conventional quenched and tempered steels have long been used to fabricate mechanical components, such as plates, shafts, and axles. All of these components are mainly fabricated employing medium carbon hot forged steels in the quenched and tempered condition. In the last decade, thermomechanical forging at intermediate (warm) temperatures of microalloyed medium carbon steels is increasingly adopted to reduce or eliminate quenching and tempering heat treatments in hot forged components. However, the use of these steels is still limited, being difficult to achieve a toughness comparable to that of fully heat treated ones. In an effort to improve toughness, an experimental campaign was performed to assess strength and toughness properties of three selected microalloyed medium carbon steels after thermomechanical forging simulations at warm temperatures, performed on a thermal and mechanical Gleeble 3800 ® apparatus. Microstructures and mechanical properties of these steels are shown to be highly dependent upon steel composition and thermomechanical schedule. The experimental results suggest that thermomechanical schedules can be designed to produce*

microalloyed medium carbon steels with refined microstructures, and therefore to realize improved strength and machinability; yet, toughness is still the most critical property as compared to that of quenched and tempered steels.

Messina

Calabrese, L., Bonaccorsi, L., Proverbio, E., Di Bella, G., Borsellino, C.DURABILITY ON ALTERNATE IMMERSION TEST OF SELF-PIERCING RIVETING ALUMINIUM JOINT

*Materials and Design, Volume 46, April 2013, Pages 849-856*Corrosion degradation; Environmental conditions; Failure map; Failure mechanism; Immersion tests; Joint resistance; Long term ageing; Mechanical joints; Self-piercing riveting; Shear tests; Single lap joints; Single lap shears; Theoretical models Engineering controlled terms: Aluminum; Corrosion; Failure (mechanical); Riveting Engineering main heading: Durability *The aim of the present work is to evaluate durability behaviour and performances of self-piercing riveting joints of aluminium alloys sheets. The investigation was extended to two different total thicknesses (i.e. 3 and 4. mm) of symmetrical or unsymmetrical joints. The joint resistance was determined, by means of shear tests of single-lap joints. Long term ageing tests were performed to evaluate the durability of the mechanical joint in critical environmental conditions. The experimental results evidenced that the corrosion degradation phenomena influenced significantly performances and failure mechanisms of the joints. The authors, furthermore, proposed a theoretical model for sake of predicting the failure modes; a simplified failure map of the failure mechanisms and the effect of the corrosion were drawn.*

Fiore, V., Alagna, F., Galtieri, G., Borsellino, C., Di Bella, G., Valenza, A.EFFECT OF CURING TIME ON THE PERFORMANCES OF HYBRID/MIXED JOINTS

*Composites Part B: Engineering, Volume 45, Issue 1, February 2013, Pages 911-918*A. Hybrid; ANOVA test; Co-cured; Co-cured joints; Co-curing; Critical parameter; Cure behavior; Curing process; Curing reactions; Curing time; E. Joints/Joining; Fluid state; Glass reinforced polymers; Joining techniques; Mechanical behavior; Mixed method; Oil pressures; Self-piercing riveting; Single lap joints Engineering controlled terms: Adhesive joints; Curing; Differential scanning calorimetry; Epoxy resins; Piercing; Resins; Riveting Engineering main heading: Rivets *The aim of this work is the study of a mixed method used for the joining of aluminum alloys with glass reinforced polymer's substrates (in the next GFRP). In particular, the technique of self-piercing riveting (in the next SPR) was applied on a co-cured joint in order to evaluate the influence of the time of inserting the rivet on the mechanical behavior of the mixed joints. Three different joints were realized: adhesive by co-curing technique, mechanical by self piercing riveting (in the next SPR) and a mixed one in which the joining techniques (i.e. adhesive and mechanical)*

were combined. In particular, to determine the optimum time to insert the rivet, three different times from the beginning of the curing reaction of the resin (i.e. after 2 h, 5 h and 24 h from the moment of mixing resin with its hardener, respectively) were chosen to insert the rivets in the co-cured adhesive joints. Moreover, for each condition, the oil pressure of the riveting system needed to optimize the performances of the joints was investigated. To determinate the times of riveting to be investigated, the curing process of the epoxy resin was previously analyzed by means of a differential scanning calorimetry (DSC) and a stress controlled rheometer. All the realized samples (i.e. five for each configuration) were characterized by single lap joint tests. The experimental results, supported by the ANOVA test, prove that the time at which the rivet is inserted is a critical parameter as it greatly influences the performances of the joints. In particular the mixed joints show higher resistance than the adhesive ones only if the rivet is inserted when the resin is in its fluid state (i.e. after 2 h) with the oil pressure equal to 180 bar or if the rivet is inserted when the resin is in its solid state (i.e. after 24 h), with the oil pressure equal to 280 bar. Vice versa if the rivet is inserted when the resin is in its rubber state (after 5 h), the resistance of the mixed joints is lower than the adhesive ones regardless of the value of the oil pressure.

Gatto, E., Matarese, G., Bella, G.D., Nucera, R., Borsellino, C., Cordasco, G.LOAD-DEFL ECTION CHARACTERISTICS OF SUPERELASTIC AND THERMAL NICKEL-TITANIUM WIRES

European Journal of Orthodontics, Volume 35, Issue 1, February 2013, Pages 115-123
EMTREE drug terms: dental alloy; Martensite; nickel; titanium; titanium nickelide EMTREE medical terms: article; chemistry; dental procedure; elasticity; heat; mechanics; methodology; orthodontic wire MeSH: Dental Alloys; Dental Stress Analysis; Elasticity; Hot Temperature; Mechanical Processes; Nickel; Orthodontic Wires; Titanium Medline is the source for the MeSH terms of this document. *The aim of this study was to investigate the mechanical properties of superelastic and thermal nickel - titanium (NiTi) archwires for correct selection of orthodontic wires. Seven different NiTi wires of two different sizes (0.014 and 0.016 inches), commonly used during the alignment phase, were tested. A.three-point bending test was carried out to evaluate the load - defl ection characteristics. The archwires were subjected to bending at a constant temperature of 37°C and defl ections of 2 and 4 mm. Analysis of variance showed that thermal NiTi wires exerted signifi cantly lower working forces than superelastic wires of the same size in all experimental tests (P.< 0.05). Wire size had a signifi cant effect on the forces produced: with an increase in archwire dimension, the released strength increased for both thermal and superelastic wires. Superelastic wires showed, at a defl ection of 2 mm, narrow and steep hysteresis curves in comparison with the corresponding thermal wires, which presented a wide interval between loading and unloading forces. During unloading at 4 mm of defl ection, all wires showed curves with a wider plateau when compared with 2 mm defl ection. Such a difference for the superelastic wires was caused by the martensite stress induced at higher deformation levels. A.comprehensive understanding of mechanical characteristics of orthodontic wires is essential and selection should be undertaken in accordance with the behaviour of the different wires. It is also necessary to take into account the biomechanics used. In low-friction*

mechanics, thermal NiTi wires are to be preferred to superelastic wires, during the alignment phase due to their lower working forces. In conventional straightwire mechanics, a low force archwire would be unable to overcome the resistance to sliding.

Di Bella, G., Galtieri, G., Pollicino, E., Borsellino, C.MECHANICAL CHARACTERIZATION OF ADHESIVE JOINTS WITH DISSIMILAR SUBSTRATES FOR MARINE APPLICATIONS

*International Journal of Adhesion and Adhesives, Volume 41, 2013, Pages 33-40*Adherends; Adhesive bonding; Adhesive layers; AISI 316; Cohesive fracture; Different substrates; Hybrid joints; Mechanical characterizations; Modified polymer; Monolithic composite; Single lap joints; Tomographic Engineering controlled terms: Adhesive joints; Adhesives; Analysis of variance (ANOVA); Design of experiments; Glass; Marine applications; Tensile testing Engineering main heading: Sealants *The simplicity and efficiency of the adhesive joints have increased more and more their use in many fields. In ship construction the need to join different materials, such as the bonding of the hull/deck, the sea chest, the portholes, the windshields, the panels of cabins, etc. leads to choosing increasingly the adhesive joints. In this work we have evaluated the effects of both SMP (Silyl Modified Polymer) based adhesives and sealants on single lap joints (SLJs) with dissimilar substrates. Three pairs of single lap joints were taken into account among dissimilar adherends: stainless steel (AISI 316) with PMMA (or Altuglas ®) and monolithic composite laminates bonded with glass or PMMA. Before tensile testing some SLJ samples were subjected to a three-dimensional computed tomographic analysis to evaluate how the presence of possible defects in the adhesive layer affects the failure mode. A design of experiments was defined in order to quantify the effect of the considered factors and their correlation. The obtained maximum tensile stress values confirm the data provided by the manufacturer, approximately between 2 and 2.5 MPa, showing generally cohesive fracture. Finally the considered SMP adhesives and sealants are well suited for the chosen different substrates, although special attention should be placed on the glass-GFRP joint as it is confirmed by statistical analysis.*

Modena e reggio emilia

Cuccolini, G., Orazi, L., Fortunato, A.5 AXES COMPUTER AIDED LASER MILLING

*Optics and Lasers in Engineering, Volume 51, Issue 6, June 2013, Pages 749-760*Computer aided; Free-form surface; Freeforms; Galvanometric scanning; Laser displacement; Laser manufacturing; Laser paths; Working areas Engineering controlled terms: Electrical engineering; Magnetic materials; Textures Engineering main heading: Milling (machining) *In this paper a 5 axes CAM procedure for the laser milling of free form surfaces has been developed and experimentally verified. The laser beam is deflected by a galvanometric scanning head and is*

directly moved on the working surface by the CNC controlled axes of a machine center. The procedure has been implemented in a software called CALM (computer aided laser manufacturing) able to generate the laser paths and the movements of the controlled axes reducing the defects on the workpiece. The approach is based on the sequential overlapping of the scanning passes on the working area. The different working areas in every laser displacement are obtained directly from the triangulation of the whole surface to machine.

Fortunato, A., Ascari, A., Liverani, E., Orazi, L., Cuccolini, G.A COMPREHENSIVE MODEL FOR LASER HARDENING OF CARBON STEELS

*ASME 2013 International Manufacturing Science and Engineering Conference Collocated with the 41st North American Manufacturing Research Conference, MSEC 2013, Volume 1, 2013, Article number MSEC2013-1094*Beam characteristics; Comprehensive model; Computational time; Hypo-eutectoid carbon steel; Integrated approach; Laser transformation hardening; Manufacturing process; Physical constants Engineering controlled terms: Carbon steel; Manufacture; Mathematical models; Models Engineering main heading: Industrial research *This article illustrates the development of a complete and exhaustive mathematical model for the simulation of laser transformation hardening of hypo-eutectoid carbon steels. The authors propose an integrated approach aimed at taking into consideration all the the phenomena involved in this manufacturing process, with particular attention to implementing easy mathematical models in order to optimize the trade-off between the accuracy of the predicted results and the computational times. The proposed models involve the calculation of the 3D thermal field occurring into the workpiece and predict the microstructural evolution of the target material exploiting an original approach based on the definition of thermodynamic thresholds which can be considered as a physical constant of the material itself. Several parameters and phenomena are taken into consideration in order to accurately simulate the process: laser beam characteristics, fast austenization of the steel and tempering effect due to mutually interacting beam trajectories. Copyright*

Fortunato, A., Orazi, L., Cuccolini, G., Ascari, A.AN EXHAUSTIVE MODEL FOR THE LASER HARDENING OF HYPO EUTECTOID STEEL

*Proceedings of SPIE - The International Society for Optical Engineering, Volume 8603, 2013, Article number 86030F*Beam characteristics; Beam trajectories; Computational time; Hypo-eutectoid carbon steel; Laser hardening; Mathematical formulas; Scanning strategies; Target materials Engineering controlled terms: Carbon steel; Laser materials processing; Lasers; Mathematical models; Models Engineering main heading: Hardening *This article presents an exhaustive mathematical model for the simulation of hypo-eutectoid carbon steel transformations during laser hardening. The proposed model takes into consideration all the the phenomena involved in the process with particular attention to implementing easy mathematical formulas in order to optimize the trade-off between the accuracy of the predicted results and the*

computational times. The proposed model calculates the 3D thermal field occurring into the workpiece and predicts the microstructural evolution of the target material exploiting an original approach based on the de nition of thermodynamic thresholds. Several parameters and phenomena are taken into consideration in order to accurately simulate the process: laser beam characteristics, scanning strategy of the target and tempering e ect due to mutually interacting beam trajectories.

Gatto, A., Bassoli, E., Denti, L., Iuliano, L.BRIDGES OF DEBRIS IN THE EDD PROCESS: GOING BEYOND THE THERMO-ELECTRICAL MODEL

*Journal of Materials Processing Technology, Volume 213, Issue 3, March 2013, Pages 349-360*Bridge effects; Cluster; Dielectric strengths; Domain-specific application; Electro discharge machining; Electrodischarges; Empirical model; Experimental evidence; Ignition model; Optimization method; Physical model; Transient phenomenon Engineering controlled terms: Chains; Titanium carbide Engineering main heading: Debris *Electro-discharge (ED) processes depend on the contemporaneous effect of many factors, which complicates process control/predictability and induced many authors in the last 60 years to work on explicative models. Studies split into two main approaches: theoretical and empirical. Theoretical works are based on the thermo-electrical theory and try to describe process phenomena by a physical model, with unavoidable assumptions and simplifications that cause a move away from veracity. On the contrary, experimentalists establish empirical models based on statistical analysis of results and optimization methods, but the findings are limited to domain-specific applications. In addition, numerous papers focus on single-spark analysis, failing in considering the interaction between successive discharges, or of transient phenomena as the presence of bubbles and debris in the gap. At present the scientific debate involves the ignition model, with two different points of view regarding the discharge-driving phenomenon: the debris bridge effect (pollutants in the dielectric drive the performances), and the dielectric strength effect (properties of the dielectric drive the performances). The paper addresses this dispute by investigating the debris formed during small-hole ED drilling of a 72 wt% Al 2 O 3 -28 wt% TiC composite. Particles are found to hollow out and pack within the gap, joining by necks. The first experimental evidence is given of the presence of chains and clusters of debris, towards a new model for electro-discharge processes that goes beyond the thermoelectric theory.*

Frontoni, E., Mancini, A., Zingaretti, P., Gatto, A.ENERGY HARVESTING FOR SMART SHOES: A REAL LIFE APPLICATION

Proceedings of the ASME Design Engineering Technical Conference, Volume 4, 2013, Article number V004T08A034 Engineering controlled terms: Design; Energy harvesting; Mobile devices Electrical energy; Electrical power; Engineering community; Human movements; Indoor localization systems; Power efficiency; Real-life applications; Technical development Engineering main heading: Shoe manufacture *Advanced technical developments have increased*

the efficiency of devices in capturing trace amounts of energy from the environment (such as from human movements) and transforming them into electrical energy (e.g., to instantly charge mobile devices). In addition, advancements in microprocessor technology have increased power efficiency, effectively reducing power consumption requirements. In combination, these developments have sparked interest in the engineering community to develop more and more applications that utilize energy harvesting for power. The approach here described aims to designing and manufacturing an innovative easy-to-use and general-purpose device for energy harvesting in general purpose shoes. The novelty of this device is the integration of polymer and ceramic piezomaterials accomplished by injection molding. In this spirit, this paper examines different devices that can be built into a shoe, (where excess energy is readily harvested) and used for generating electrical power while walking. A Main purpose is the development of an indoor localization system embedded in shoes that periodically broadcasts a digital RFID as the bearer walks. Results are encouraging and real life test are conducted on the first series of prototypes. Copyright

Bassoli, E., Sewell, N., Denti, L., Gatto, A.INVESTIGATION INTO THE FAILURE OF INCONEL EXHAUST COLLECTOR PRODUCED BY LASER CONSOLIDATION

*Engineering Failure Analysis, Volume 35, 15 December 2013, Pages 397-404*Contributory factors; Differential shrinkage; Fracture surfaces; Geometrical complexity; Layer manufacturing techniques; Manufacturing process; Metallographic sections; Non destructive inspection Engineering controlled terms: Cracks; Design; Failure (mechanical) Engineering main heading: Microstructure *Among layer manufacturing techniques, Laser Consolidation (LC) finds its ideal application in the production of thin-walled metal parts for industrial niches characterised by high innovation and product complexity. To fully exploit the technological potential, developments must be made to assess LC's repeatability and reliability. Previous studies proved that high strength parts of fine microstructure are obtained if appropriate build strategies are used. The aim of this research is to analyse a racecar exhaust collector, built in Inconel by LC, relating the failure modes and microstructure to the construction plan. The exhaust collector component was built using a custom strategy and was run on a dynamometer before failing after approximately 1200. km. An investigation of the failure mechanism was carried out by a primary macroscopic analysis, aided by an X-ray control and dye penetrant test. Metallographic sections were then sampled from the critical areas to study the microstructure and relate it to the manufacturing process. Results proved that the distribution of primary microcracks associated with internal residual stresses caused by the build strategy and aggravated by differential shrinkage during the test thermocycles was responsible for ultimate failure. This issue was a result of build strategy and the non-coaxial laser head, therefore, alternative pathways could be developed capable of removing most, if not all, of the contributory factors. The analysed case suggests that LC build strategy selection is as critical to ensure low cycle fatigue resistance as component design and confirms that LC is effective in the production of advanced technological parts with high geometrical complexity given the correct build strategy.*

Ascari, A., Fortunato, A., Orazi, L.LASER MICRO-WELDING OF HIGH CARBON STEELS

*Rivista Italiana della Saldatura, Volume 65, Issue 4, July 2013, Pages 507-513*Crack susceptibilities; Influencing factors; Mechanical industry; Micro-joining; Micro-scale components; Nanosecond pulsed laser; Process parameters; Sheet Engineering controlled terms: Carbon steel; Cracks; Dynamic positioning; Efficiency; Electric welding; Heat affected zone; Industry; Laser beam welding; Mechanical properties; Precision engineering; Pulsed lasers; Weldability Engineering main heading: MEMS *High carbon steels are commonly used in modern mechanical industry due to their good mechanical properties and to their relatively low cost. Unfortunately, when dealing with welding processes, these materials must be set aside because of their very high crack susceptibility and more refined and expensive steels must be taken into consideration, such as HSLA, DP and TRIP ones, thanks to their lower carbon equivalent and similar, or even better, mechanical properties. In micro-scale components industry the use of high carbon steels is also very common, in particular in precision mechanics, watch and MEMS industry. Considering the very low thicknesses typical of these components and the intrinsic welding difficulty related to the material, several studies stressed on the possibility to exploit nanosecond pulsed lasers in welding this kind of steels. These sources, taking advantage from the short duration of the pulse and from a repetition rate as high as I MHz, allow a very accurate control of the heat input delivered to the material and pave new ways in micro-welding of medium and high carbon steels. The present paper deals with the exploitation of a 20 W nanosecond pulsed laser source in welding low thickness C70 (AISI1070) plain carbon steel. The process is studied by evaluating the influence of the main parameters on its feasibility. The activity pointed out that, by properly selecting the main parameters, it is possible to achieve sound and crack-free weld beads with a maximum penetration as high as 200 μm and a very small heat affected zone. The main interesting point concerning this specific welding process is related to the fact that, by simply selecting the proper process parameters, it is possible to achieve high productivity working cycles involving laser cutting, welding and marking on the same machine and exploiting the same workpiece positioning.*

Fortunato, A., Orazi, L., Cuccolini, G., Ascari, A.LASER SHOCK PEENING AND WARM LASER SHOCK PEENING: PROCESS MODELING AND PULSE SHAPE INFLUENCE

*Proceedings of SPIE - The International Society for Optical Engineering, Volume 8603, 2013, Article number 86030G*Abrupt expansions; Compressive residual stress; High power density; Laser peening; Laser shock peening; Mechanical components; Process Modeling; simulation Engineering controlled terms: Fatigue of materials; Laser materials processing; Mechanical properties Engineering main heading: Residual stresses *Laser shock peening is a well-known technology able to enhance the fatigue life of mechanical components by means of the introduction of residual stresses on their surface. These stresses are induced by means of the recoil pressure caused by the abrupt expansion, in a confining medium, of a laser-vaporized*

coating layer. If high power densities are used the recoil pressure can be high enough to induce compressive residual stresses on the target surface and to modify its mechanical properties. These mechanical properties can be predicted if the recoil pressure of the ablating layer is determined. In this paper the influence of the laser pulse shape on the recoil pressure is determined by means of a proper modeling of the whole process and the difference between "cold" and "warm" laser shock peening is pointed out.

Calignano, F., Denti, L., Bassoli, E., Gatto, A., Iuliano, L.STUDIES ON ELECTRODISCHARGE DRILLING OF AN AL

*International Journal of Advanced Manufacturing Technology, Volume 66, Issue 9-12, June 2013, Pages 1757-1768*Electrical discharges; Electrical resistivity; Electro discharge machining; Electrodischarges; Independent variables; Material removal mechanisms; Performance indicators; Structural applications Engineering controlled terms: Alumina; Aspect ratio; Benchmarking; Ceramic materials; Ceramic matrix composites; Electric conductivity; Electric discharges; Phase transitions; Surface roughness Engineering main heading: Titanium carbide *Ceramic matrix composites (CMCs) can be attractive for structural applications, but their machining by conventional methods is expensive and often critical. Complex geometries on advanced ceramics require contactless processes, such as electrodischarge machining or drilling (EDD). These proved to be viable for CMCs with electrical resistivity below a critical value in the range of 1-3 Ω m. The condition is complied with by many CMCs: an example is alumina with titanium carbide. Material removal of ceramics by electrical discharges is a complex process involving different mechanisms, depending on the process setup. The paper describes an experimental study on EDD of 0.4-mm diameter holes with an aspect ratio of 20 in Al 2 O 3 -TiC, using copper electrodes. Peak current (I p), pulse-on time (t on), and pulse-off time (t off) are varied as independent variables. Four performance indicators are measured: material removal rate, electrode wear rate, overcut, and surface roughness (R a , S a). Empirical models are proposed to describe the effect of process parameters on the output indicators. The analysis is supported by the observation of the surface and subsurface morphology, with the aim of investigating the material removal mechanisms and attaining a full comprehension of macroscopic results. It is found that removal mostly occurs by melting and evaporation and that surface morphology is determined by two phenomena ruled by pulse power. A process description is proposed, built around power as the ruling factor.*

Napoli federico ii

Lopresto, V., Caprino, G., Leone, C.A NEW DAMAGE INDEX FOR THE INDENTATION DEPTH EVALUATION OF COMPOSITES UNDER LOW VELOCITY IMPACT LOADS

*Polymer Composites, Volume 34, Issue 12, December 2013, Pages 2061-2066*Composite laminate; Constraint conditions; Fiber volume fractions; Indentation depth; Low velocity impact; Low velocity impact test; Material constant; Stacking sequence Engineering controlled terms: Damage detection; Graphite epoxy composites Engineering main heading: Laminated composites *The effectiveness of a new empirical model, aiming to predict the indentation depth resulting in a composite laminate from a hemispherical tup impacting it at low velocity, is here proposed. With this simple model including only the diameter of the impactor and the ratio between the impact energy and the perforation one, a material-independent parameter characterising the indentation depth is identified. Several samples with different thicknesses, impacted by various impactor tips, are tested for estimating this parameter. To reach the above mentioned scopes, low velocity impact tests were carried out on two different composite systems with different stacking sequences, thicknesses and fiber volume fractions: (a) glass/epoxy prepreg; (b) graphite/epoxy prepreg. The samples were simply supported on steel plates or clamped and they were struck at the center by hemispherical steel noses having 16 and 19.8 mm diameters. After impact, indentation was measured according to EN 6038 standard. The CFRP indentation data were drawn from a database: about 200 test records, generated by various researchers were individuated. The advantages of the new model are that the effect of the tup diameter is explicitly accounted for. Furthermore, a single material constant has to be experimentally determined and it can be assumed as an index for the indentation sensitivity, on the basis of which different materials can be ranked. The constant was found similar for GFRP and CFRP laminates denoting independence of constraint conditions, laminate type or laminae orientation and stacking sequence.*

Pagnano, A., Höpf, M., Teti, R.A ROADMAP FOR AUTOMATED POWER LINE INSPECTION. MAINTENANCE AND REPAIR.

*Procedia CIRP, Volume 12, 2013, Pages 234-239*Abnormal conditions; Autonomous mobile platforms; Live line inspections; Power line inspections; Power lines; Rwr; Vertical take-off and landings; Vtol uavs Engineering controlled terms: Automation; Data processing; Electric corona; Electric utilities; Industrial engineering; Information management; Inspection; Unmanned aerial vehicles (UAV) Engineering main heading: Electric lines *Electrical power companies usually perform regular visual inspection to check the status of their transmission lines mainly using helicopter equipped with external gimbals housing infrared and ultraviolet camera to detect hot spots and corona discharges. This solution is quite expensive, dangerous for the crew and not very reliable. Focus of this paper is, presenting the state of the art of the most important current projects concerning the two main categories of robots offering a solution of automation, vertical take-off and landing (VTOL) unmanned aerial vehicles (UAVs) and rolling on wires robots (RWR), to create a simple roadmap that can guide researchers and industries in the implementation of a "FULLY AUTOMATED LIVE LINE POWER LINE INSPECTION CONCEPT" a rigorous live line inspection strategy based on a completely autonomous mobile platform capable of a meaningful payload and a power line data management system including specific tool for image and signal data processing to automatically detect defects or abnormal conditions.*

Nele, L., Sarno, E., Keshari, A.AN IMAGE ACQUISITION SYSTEM FOR REAL-TIME SEAM TRACKING

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 9-12, December 2013, Pages 2099-2110*Gas metal arc welding (GMAW); Gas metal arcs; Image acquisition systems; Real time measurements; Real-time information; Recognition accuracy; Seam tracking; Seam-tracking systems Engineering controlled terms: CCD cameras; Electric welding; Image acquisition; Image processing; User interfaces Engineering main heading: Gas metal arc welding *Gas metal arc welding (GMAW) process is one of the most widespread welding processes used in industries for their excellent quality, reliability, productivity, and cost-effectiveness. To develop an automatic GMAW system, vision capability in the system is a necessary component supplying real-time information about weld pool and seam tracking. In this research work, an automatic seam tracking system is presented, where the automatic tracking of welding path and torch positioning are performed by a newly developed image acquisition system. The system aims to add a vision capability to the GMAW system. A CCD camera is configured with a welding torch to acquire real-time images. The acquired images are processed through newly developed software for real-time detection of welding seam location and characteristics. The software encapsulates the acquired image input facility, image filtering technique, strategy to measure the seam gap, strategy to position torch at the starting point of welding, user interface for automatic guide, and the strategy to correct the torch movements. The seam recognition accuracy was verified during several welding experiments on linear weld seam. Real-time measurements of the seam gap and the seam tracking have achieved a high accuracy.*

Segreto, T., Caggiano, A., D'Addona, D.M.ASSESSMENT OF LASER-BASED REVERSE ENGINEERING SYSTEMS FOR TANGIBLE CULTURAL HERITAGE CONSERVATION

*International Journal of Computer Integrated Manufacturing, Volume 26, Issue 9, 1 September 2013, Pages 857-865*Cultural heritage conservation; Cultural heritages; Design modifications; Digital data acquisitions; Laser scanning; Scanning systems; System's performance; Technical development Engineering controlled terms: Computer aided instruction; Condition monitoring; Coordinate measuring machines; Models; Product design; Repair; Reverse engineering; Tools Engineering main heading: Three dimensional *The process of acquiring the geometry and shape of a part and reconstructing its digital model is known as reverse engineering (RE). This approach is usefully employed in fields as diverse as product design, design modification, geometrical inspection, worn or damaged parts repair or remanufacturing, when physical object drawings, documentation or computer models are not available. The recent scientific and technical developments of RE methods and tools have broadened the possibilities of applications in the field of cultural heritage conservation ranging from reproduction (e.g. via rapid prototyping), maintenance (e.g. computer-aided repair), multimedia tools for education and dissemination (e.g. virtual museums), to artefact condition monitoring (e.g. computer-aided*

inspection) and many more. The first stage of the RE procedure is digital data acquisition that can be carried out by means of several different tools. The selection of the 3D digitising system is crucial as it directly affects the process time and the quality of the point cloud, which determines the final digital model. In this research work, following the EC FP7 open topic on Equipment assessment for laser based applications compiled in Horizon 2020, two non-contact laser-based RE systems, respectively, based on a coordinate measuring machine and a portable 3D scanning equipment, are utilised for the digitisation and reconstruction of a free-form tangible cultural heritage artefact to comparatively assess the RE system's performance in terms of process time, accuracy and ease of use.

Astarita, A., Ducato, A., Fratini, L., Paradiso, V., Scherillo, F., Squillace, A., Testani, C., Velotti, C.BETA FORGING OF TI-6AL-4V: MICROSTRUCTURE EVOLUTION AND MECHANICAL PROPERTIES

*Key Engineering Materials, Volume 554-557, 2013, Pages 359-371*Commercial codes; Elevated temperature; High mechanical properties; Hot forming process; Micro-structure evolutions; Thermo-mechanical response; Ti-6al-4v; Ti-6Al-4V alloy Engineering controlled terms: Alloy steel; Aluminum; Carbon fiber reinforced plastics; Compression testing; Corrosion resistance; Forging; Mechanical properties; Titanium alloys Engineering main heading: Microstructure *Titanium alloys are finding an increasing use in the aeronautical field, due to their characteristics of high mechanical properties, lightness and corrosion resistance. Moreover these alloys are compatible with the carbon fibre reinforced plastics that are also finding a wide use in the aeronautical field. On the other hand the use of these alloys implies some drawbacks, for example titanium alloys are often considered more difficult to form and generally have less predictable forming characteristics than other metallic alloys such as steel and aluminum. In this paper was studied both the microstructure evolution and the mechanical properties of a Ti-6Al-4V rolled bar after hot forging. The thermo-mechanical response of a Ti-6Al-4V alloy was studied in elevated temperature compression tests (CT). Furthermore numerical simulations were carried out in order to do a comparison between numerical data and experimental results. The simulations were carried out using an implicit commercial code able to conduct coupled thermo-mechanical-microstructural analysis of hot forming processes of metal alloys. Copyright*

Caggiano, A., Teti, R.CBN GRINDING PERFORMANCE IMPROVEMENT IN AIRCRAFT ENGINE COMPONENTS MANUFACTURE

*Procedia CIRP, Volume 9, 2013, Pages 109-114*cBN grinding wheel; Cubic boron nitride (cBN); Environmental and social sustainability; Grinding fluids; Ni-base superalloys; Nickel base superalloy; Process performance; Surface integrity Engineering controlled terms: Aerospace industry; Aircraft engines; Cubic boron nitride; Grinding wheels; Manufacture; Nickel; Superalloys; Sustainable development; Tools Engineering main heading: Grinding (machining) *Cubic Boron Nitride (CBN) grinding is extensively employed in the aerospace industry as it*

allows to effectively grind high performance aerospace metal alloys such as nickel base superalloys. With reference to a real industrial case of CBN grinding for the manufacture of aircraft engine components, the aim of this paper is to improve the CBN wheel tool life and optimize the grinding process while taking into account economic, environmental and social sustainability issues. Different types of CBN grinding wheels fabricated using diverse deposition procedures are tested to compare their behavior during grinding of Ni base superalloys and assess their tool life in terms of number of parts successfully ground by a single wheel. Tests are also performed to investigate alternative coolant type applicability as well as grain size influence on surface integrity as these factors can significantly affect process performance, final workpiece quality and grinding wheel life.

Formisano, A., Gamardella, F., Mazzolani, F.M.CAPACITY AND DEMAND OF DUCTILITY FOR SHEAR CONNECTIONS IN STEEL MRF STRUCTURES

Civil-Comp Proceedings, Volume 102, 2013Shear connections are commonly employed in steel buildings to connect beams to columns because of their efficiency and reduced cost. They are usually assumed in the design scheme as real pins, but it has been observed that the rotation required for these connections under earthquakes is not negligible. Therefore, in the current paper the rotation demand of these connections has been quantified and compared with their capacity. Several case studies for steel perimeter MRF structures have been investigated. First, the US SAC Project buildings, namely 3, 9 and 20 storey constructions designed in Los Angeles, have been examined. Later on, a building having the same geometry of the SAC Project 9 storey building but designed with Italian and European codes has been considered as a further case study. For all investigated buildings, three time history analyses related to three different earthquakes (Northridge (USA), Chi-Chi (Taiwan) and Nahanni (Canada)), have been conducted. The analysis results, presented in terms of global (modal response) and local (relative rotation envelope diagrams) behaviour, have allowed the comparison between both rotation demand and capacity and Italian and American building seismic responses. In addition, the rotation demand has been quantified, it being assumed as 0.04 rad for buildings having less or equal than 9 storeys and 0.06 rad for buildings with more than 9 storeys.

Leone, C., Genna, S., Caggiano, A.COMPACT DISC LASER CLEANING FOR POLYCARBONATE RECOVERING

*Procedia CIRP, Volume 9, 2013, Pages 73-78*Compact disc lasers; Deposition layers; Experimental testing; Laser cleaning; Low energy consumption; Mechanical contact; Polymer degradation; Waste recycling Engineering controlled terms: Cleaning; Compact disks; Energy utilization; Manufacture; Polycarbonates; Polymers Engineering main heading: Pulsed lasers *In this research work, laser cleaning of Compact Discs (CDs) through the employment of a 30 W MOPFA Q-switched pulsed Yb:YAG fibre laser is investigated. The laser beam is used to ablate the metal substrate located between the polycarbonate layer and the outer serigraphy of CDs*

with the final aim to recover the polycarbonate layer and make it available for further applications. Compared to traditional cleaning processes, this method offers several advantages, including: absence of mechanical contact, reduction of secondary pollutants, low energy consumption, greater flexibility of use and possibility to work small batches. Two experimental test series were carried out. First, linear scans were executed at the maximum average power (30W) by changing scanning speed and pulse energy. The width of the ablated material was then measured on the test CDs. Furthermore, the mechanism of separation between the deposition layers and the polymer substrate is observed and described. The second experimental testing series was performed to identify the process conditions that could ensure a 100% cleaned surface without polymer degradation and to evaluate the corresponding process time. On the basis of the test results, three different conditions were observed: incomplete cleaning, complete cleaning and cleaning with polymer degradation.

Lopresto, V., Caprino, G.DAMAGE MECHANISMS AND ENERGY ABSORPTION IN COMPOSITE LAMINATES UNDER LOW VELOCITY IMPACT LOADS

*Solid Mechanics and its Applications, Volume 192, 2013, Pages 209-289*Complex mechanisms; Composite laminate; Constrain condition; Load-deflection curve; Load-displacement curve; Low velocity impact; Non-destructive technique; Penetration energy Engineering controlled terms: Dynamic loads; Kinetics; Nondestructive examination Engineering main heading: Laminated composites *An extensive study of the behaviour of composite laminates subjected to dynamic loads was carried out by the authors many years in order to understand the complex mechanisms of damage initiation and propagation under low velocity impact loads. A review of the main results is hereafter presented. The problem is that many parameters are involved in an impact and the induced damage is very complex and not always visible. The present research efforts were undertaken to supply semi empirical and analytical models for the prediction of the impact response in terms of load curve, damage, involved energies and forces, independently of the particular laminate, its thickness and stacking sequence, matrix type and content, fibre type and architecture, fibre orientations and impact conditions such as tup and support diameter, load speed. Experimental tests were carried out on different material systems varying the initial kinetic energy until the complete penetration. This allows the study of the start and propagation of the failure modes. From the load-deflection curves recorded, all the impact parameters involved like first failure and maximum load and energy, absorbed and penetration energy, were obtained. The influence of the thickness and stacking sequence so that the composite system, constrain condition and tup diameter on the impact parameters was evaluated. Destructive and non-destructive techniques were adopted to investigate the failure modes and the observed damage was correlated to the relative energies. The analysis highlighted the importance of the penetration energy, Up. An elastic solution available for circular isotropic plates loaded at the centre was modified to model the indentation and applied to the prediction of the load-displacement curve necessary to know the energy that cause the first failure. Interestingly, the force required for damage initiation under form of delamination was found to increase at the increasing of the thickness, t, following a power law whose exponent is very close to 1.5 of the contact law.*

Astarita, A., Durante, M., Langella, A., Squillace, A.ELEVATION OF TRIBOLOGICAL PROPERTIES OF ALLOY TI-6% AL-4% V UPON FORMATION OF A RUTILE LAYER ON THE SURFACE

*Metal Science and Heat Treatment, Volume 54, Issue 11-12, March 2013, Pages 662-666*High wear resistance; Low friction; Oxide layer; Rolled sheets; rutile; Thermal oxidation; Tribological characteristics; Tribological properties Engineering controlled terms: Adhesion; Aluminum; Oxide minerals; Scanning electron microscopy; Titanium; Titanium oxides; Tribology; Wear of materials; X ray diffraction analysis Engineering main heading: Titanium alloys *The surface morphology, the adhesion of the oxide layer to the substrate, and their effect on the tribological characteristics of rolled sheets from alloy Ti-6% Al-4% V are studied at different temperatures and durations of oxidation of the surface. The methods of the study are measuring of microhardness, x-ray diffraction analysis and scanning electron microscopy. The composition of the oxide layer exhibiting good adhesion to titanium, low friction factor and high wear resistance is determined.*

Astarita, A., Durante, M., Langella, A., Squillace, A.EXPERIMENTAL CHARACTERIZATION OF THERMAL SPRAYED COATINGS ON STEEL SUBSTRATE

*Metallurgia Italiana, Volume 105, Issue 9, September 2013, Pages 45-50*APS; Experimental characterization; High velocity oxygen fuels; HVOF; Mechanical components; Pin on disk; Thermal spray technology; Thermal sprayed coating Engineering controlled terms: Adhesion; Coatings; Corrosion resistance; Scanning electron microscopy; Sprayed coatings; Substrates; Wear of materials Engineering main heading: HVOF thermal spraying *Thermal spray technology are increasingly used in industry to create harder coatings on mechanical components to improve the wear properties or the corrosion resistance. In this paper two different coatings sprayed on a steel surface with two different techniques, high-velocity oxygen fuel (HVOF) and air plasma spray (APS), were studied. A whole experimental campaign was carried out in order to characterize the coatings and investigate about adhesion to the surface and wear properties in different conditions. Furthermore coatings with different thickness, in order to evaluate the attitude of these technologies to realize thick coatings, were studied. The results obtained suggest that both the coating types have an optimal internal cohesion, a good adhesion to the substrate and good wear resistance.*

Velotti, C., Astarita, A., Buonadonna, P., Dionoro, G., Langella, A., Paradiso, V., Prisco, U., Scherillo, F., Squillace, A., Tronci, A.FSW OF AA 2139 PLATES: INFLUENCE OF

THE TEMPER STATE ON THE MECHANICAL PROPERTIES

*Key Engineering Materials, Volume 554-557, 2013, Pages 1065-1074*AA 2139; Friction stir welding(FSW); FSW; Innovative materials; Joining techniques; Mechanical performance; Research activities; Transport industry Engineering controlled terms: Aerospace applications; Aluminum alloys; Butt welding; Fiber reinforced materials; Heat treatment; Mechanical properties Engineering main heading: Friction stir welding *Nowadays the fibre reinforced materials are finding more and more widespread use in aeronautic field due to their features of lightness, high strength and flexibility of manufacturing systems. The only way for metals to remain competitive for the aerospace applications is to improve new technologies and alloys in order to realize lighter and more resistant structures. The development of new alloys (lighter and stronger) and technologies will allow to use metals also in the future for aerospace applications. In this scenario the research activity has a fundamental importance, and the key point is to work simultaneously on both innovative materials and new technologies that allow to obtain the best performances with the innovative alloys. Welding is nowadays playing a fundamental role in transport industry thanks to the important advantages it allows. Friction Stir Welding (FSW) [1] is one of the most promising welding techniques, particularly suitable for applying to light alloys. FSW in butt joint configuration allows to achieve very high mechanical performances, often absolutely superior to those achievable with all other joining techniques, and lots of researches and results are now available [2]. The AA 2139 is an innovative Al-Cu-Ag alloy that has higher mechanical performances than the conventional 2xxx series aluminum alloys. The AA 2139 is designed to work in service in T8 temper condition, but is simplest to work in T3 temper condition. The aim of this work is to compare the performances of AA 2139 butt joints welded in T8 temper conditions, presented in a previous work [3], with the ones of joints welded in T3 condition and heat treated post welding in order to achieve the T8 temper condition. Copyright*

Ciliberto, S., Astarita, A., Squillace, A.FSW OF T JOINTS IN OVERLAP CONFIGURATION: PROCESS OPTIMIZATION IN JOINING DISSIMILAR ALUMINIUM ALLOYS FOR THE AERONAUTIC APPLICATION

*Surface and Interface Analysis, Volume 45, Issue 10, October 2013, Pages 1631-1637*Aeronautic applications; Fuselage panels; Hoop stress; Lap joint; Overlap joints; T joints; Welding parameters Engineering controlled terms: Joining; Mechanical properties; Optimization; Residual stresses; Welding Engineering main heading: Friction stir welding *The effect of welding parameters on the mechanical properties of friction stir-welded dissimilar aluminium alloys in overlap joint configuration was studied. Both the welding configuration and the materials chosen were a typical skin-stringer configuration, widely used for aeronautical fuselage panels. Mechanical properties were evaluated by means of both hoop stress and T-pull test. Results show that there is a great dependence of the hoop stress resistance from welding parameters;*

conversely, T-pull tests do not show the same dependence. The present work demonstrates the suitability of the x in lap configuration for joining dissimilar aluminium alloys. Copyright

D'Addona, D.M., Teti, R.GENETIC ALGORITHM-BASED OPTIMIZATION OF CUTTING PARAMETERS IN TURNING PROCESSES

*Procedia CIRP, Volume 7, 2013, Pages 323-328*Cutting conditions; Cutting parameters; Cutting parameters optimizations; Machining operations; Metal cutting process; Optimal cutting parameters; Optimal solutions; Production time Engineering controlled terms: Manufacture; Metal cutting; Optimization; Turning Engineering main heading: Genetic algorithms *An optimization paradigm based on genetic algorithms (GA) for the determination of the cutting parameters in machining operations is proposed. In metal cutting processes, cutting conditions have an influence on reducing the production cost and time and deciding the quality of a final product. In order to find optimal cutting parameters during a turning process, the genetic algorithm has been used as an optimal solution finder. Process optimization has to yield minimum production time, while considering technological and material constrains.*

Astarita, A., Armentani, E., Ceretti, E., Giorleo, L., Mastrilli, P., Paradiso, V., Scherillo, F., Squillace, A., Velotti, C.HOT STRETCH FORMING OF A TITANIUM ALLOY COMPONENT FOR AERONAUTIC: MECHANICAL AND MODELING

*Key Engineering Materials, Volume 554-557, 2013, Pages 647-656*Aircraft manufacturers; Airframe components; Commercial aircraft; Consistent quality; Experimental campaign; Forming techniques; HSF; Simulation Engineering controlled terms: Aircraft; Airframes; Elasticity; Mechanical properties; Structural design; Titanium Engineering main heading: Structural frames *The development of Hot Stretch Forming (HSF) by the Cyril Bath Company was in response to airframe designers needing to use Titanium airframe components in new commercial aircraft. Many of the airframe component structures are designed to fit against the inside radius of the fuselage curvature. By combining traditional stretch forming technology with hot titanium forming techniques, the HSF guarantees a saving in material and machining time, which are two serious cost issues for today's aircraft manufacturers. In addition, the process allows for consistent quality in a productively efficient manner, assuring the sustainable attainment of delivery and build schedules. The HSF is an innovative process on the cutting edge of the technologies, so focused research is needed in order to better understand this technology and develop new applications for this process. in this paper the HSF process is investigated: The machine and the different steps that characterized the process were described and the results of a preliminary experimental campaign was discussed focusing the attention on the metallurgical aspect. Moreover a modeling of the process was executed in order to study the stresses and strains undergone by the material among the deformation. Copyright*

Di Foggia, M., D'Addona, D.M.IDENTIFICATION OF CRITICAL KEY PARAMETERS AND THEIR IMPACT TO ZERO-DEFECT MANUFACTURING IN THE INVESTMENT CASTING PROCESS

*Procedia CIRP, Volume 12, 2013, Pages 264-269*Casting process; Economic impacts; Investment casting process; Manufacturing methods; Manufacturing operations; Product defects; Product specifications; Production methods Engineering controlled terms: Industrial engineering; Investment casting; Investments; Quality assurance Engineering main heading: Manufacture *The investment casting process and its key parameters are described in order to give a quite detailed knowledge of the main indicators of this production method, for its nature prone to have high costs of rework or scrap. Initially, a schematic flow of the main processes is provided; afterwards the main processes are discussed in more detailed manner with their manufacturing methods and product specifications. These concepts are indispensable to introduce the discussion on the critical parameters for investment casting process and some proposal to implement a few new methods for quality assurance of the processes and products. Finally a description of the economic impact of the critical manufacturing operations related to some specific case studies and possible goals have been identified.*

D'Addona, D.M., Teti, R.IMAGE DATA PROCESSING VIA NEURAL NETWORKS FOR TOOL WEAR PREDICTION

*Procedia CIRP, Volume 12, 2013, Pages 252-257*Complex problems; Cutting conditions; Image data processing; Machining efficiency; Machining operations; Machining Process; Quality of product; Working procedure Engineering controlled terms: Data processing; Image processing; Industrial engineering; Machining centers; Neural networks; Wear of materials Engineering main heading: Cutting tools *In the manufacturing systems, one of the most important issues is to estimate the rest of cutting tool life under a given cutting conditions as accurately as possible. In fact, machining efficiency is easily influenced by the kind of tool selected at each cutting process. One of the most complex problems for tool selection is that of estimating the tool life under a given cutting conditions as accurately as possible. As the quality of the cutting tool is directed related to the quality of product, the level of tool wear should be kept under control during machining operations. In order to monitor the tool wear development during machining processes, the interface chosen between the working procedure and the computer was a digital image of the cutting tool detected by an optical sensor. Images, however, are not homogeneous. Images with standard size and pixel density were produced elaborating tool images files obtained during machining tests. This paper is focused on a procedure for the processing of cutting tool images detected during tests. A methodology to design and optimized artificial neural networks for automatic tool wear recognition using standard images of cutting tool is proposed.*

Astarita, A., Durante, M., Langella, A., Squillace, A.IMPROVING OF STEEL SUPERFICIAL PROPERTIES THROUGH THERMAL SPRAYED COATINGS

*International Journal of Surface Science and Engineering, Volume 7, Issue 4, 2013, Pages 366-381*Air plasma spray; APS; High velocity oxygen fuels; HVOF; Pin on disk Engineering controlled terms: Adhesion; Coatings; Corrosion resistance; Industrial applications; Oxygen; Scanning electron microscopy; Sprayed coatings; Substrates; Wear of materials Engineering main heading: HVOF thermal spraying *In many industrial applications it could be useful to cover the mechanical components with harder coatings. For this reason, thermal spray technology is finding widespread use due to the high wear and corrosion resistance of the coatings achieved with these technologies. This paper is focused on the study of two different techniques, high-velocity oxygen fuel and air plasma spray. In particular, two different coatings sprayed on a steel surface were studied. In order to characterise the coatings a whole experimental campaign was carried out. Moreover, both the adhesion to the surface and the wear properties in different conditions were evaluated. In order to evaluate the attitude of these technologies to realise thick coatings were tested coatings with different thickness. The obtained results suggest that both the different coatings typology tested have an optimal internal cohesion, a good adhesion on the substrate and good wear resistance.*

Prisco, U., Squillace, A., Astarita, A., Velotti, C.INFLUENCE OF WELDING PARAMETERS AND POST-WELD AGING ON TENSILE PROPERTIES AND FRACTURE LOCATION OF AA2139-T351 FRICTION-STIR-WELDED JOINTS

*Materials Research, Volume 16, Issue 5, September 2013, Pages 1106-1112*AA2139-T351; Advancing side; Fracture location; Friction-stir-welded joints; Large amounts; Post-weld ageing; Welding defects; Welding parameters Engineering controlled terms: Brittle fracture; Defects; Ductile fracture; Tensile properties; Welding; Welds Engineering main heading: Friction stir welding *Tensile properties and fracture location of AA2139-T351 friction stir welded joints are studied in the as-welded and post-weld aged condition. The experimental results show that when the joints are free of welding defects, they fail on the advancing side of the HAZ exhibiting a large amount of plastic deformation. When the revolutionary pitch exceeds a threshold value, some micro-defects are formed in the weld nugget due to insufficient heat input. In this case, the joints fail near the weld center, and the fracture occurs in a mixed mode, both ductile and brittle. However, being less ductile, post-weld aged joints are less defect-tolerant and, then, they fracture closer to the weld center, showing a reduced elongation at fracture and an UTS within the order of magnitude of the as-welded joints.*

Leone, C., Papa, I., Tagliaferri, F., Lopresto, V.INVESTIGATION OF CFRP LASER MILLING USING A 30 W Q-SWITCHED YB:YAG FIBER LASER: EFFECT OF PROCESS PARAMETERS ON REMOVAL MECHANISMS AND HAZ FORMATION

*Composites Part A: Applied Science and Manufacturing, Volume 55, 2013, Pages 129-142*Carbon fibre reinforced polymer; Geometric patterns; Interaction mechanisms; Mechanical effects; Process parameters; Pulse frequencies; Scanning strategies; Two-level factorial design Engineering controlled terms: Carbon fibers; Fiber lasers; Laser beams; Q switching; Ytterbium Engineering main heading: Milling (machining) *A study on laser machining of Carbon Fibre Reinforced Polymer (CFRP) is presented. Experimental tests were carried out on a 4 mm thick CFRP sheet, using a Q-switched 30 W Yb:YAG fiber laser. The aim of the paper is to detect which process parameters and how they affect the laser beam-material interaction, and to explain the effect of the process parameters on the removal mechanisms and HAZ formation. The process parameters examined were: the laser beam scan speed, the pulse frequency, the number of repetitions of the geometric pattern, the distance between two consecutive scan lines and the scanning strategy. The ANalysis Of VAriance (ANOVA) was applied to a two-level factorial design, specifically developed for this aim. Experimental results showed the presence of different interaction mechanisms such as: ablation, matrix burning and mechanical effect. The damage mechanisms and the influence of the process parameters on the HAZ extent are discussed too.*

Astarita, A., Carrino, L., Franchitti, S., Langella, A., Paradiso, V.MANUFACTURING OF INNOVATIVE COMPONENTS FORMED USING SPF PROCESSES AND FILLED WITH ALUMINUM METAL FOAMS

*Surface and Interface Analysis, Volume 45, Issue 10, October 2013, Pages 1638-1642*Aluminum foam; Energy absorption capability; Innovative component; Innovative technology; Scientific studies; Superplastic forming; Technological feasibility; Ti-6al-4v Engineering controlled terms: Energy absorption; Foams; Impact testing; Industrial applications; Metals; Titanium alloys Engineering main heading: Manufacture *This work is part of scientific studies with the wider aim to produce components for aerospace industrial applications. Particularly, components with complex geometry are manufactured by using innovative technologies. The aim of this paper is to verify the technological feasibility of the manufacturing of components formed using Super Plastic Forming (hereinafter called SPF) process and filled with aluminum foam. The component under investigation is composed of an outer layer of a thin sheet in titanium alloy, formed by SPF technology, and a core in aluminum foam manufactured by the powder compact melting technique. Drop weight impact tests have been carried out with the aim to estimate the improvement of the innovative component in terms of energy absorption compared to the sum of the single constituents. The results have showed significant improvements in the energy absorption capability, proving that the proposed concept is technically promising. Copyright*

Astarita, A., Durante, M., Langella, A., Montuori, M., Squillace, A.MECHANICAL CHARACTERIZATION OF LOW-PRESSURE COLD-SPRAYED METAL COATINGS ON ALUMINIUM

*Surface and Interface Analysis, Volume 45, Issue 10, October 2013, Pages 1530-1535*Coating-substrate adhesion; Cold spray; Cold spray deposition; Experimental campaign; Four-point bending; Mechanical characterizations; Mechanical components; Polymeric surfaces Engineering controlled terms: Aluminum; Aluminum powder metallurgy; Bending (forming); Deposition; Metal coatings Engineering main heading: Adhesion *Metal coatings are widely used in order to improve the superficial properties of mechanical components or tools. Cold spray deposition is an attractive technology that allows to realize a reported coating on a metallic or polymeric surface. The essence of the phenomenon is that particles of ductile metals or alloys, having diameter of approximately 10-100 micron, become deformed and strongly attached to a surface when they impinge on the surface of metals, ceramics or glasses at impact velocities in the range of about 400-1200 m/s. In this manner, coatings can be formed on a substrate. In this work, mechanical tests were carried out in order to evaluate the adhesion of different metal particles on an aluminium alloy substrate, in order to characterize both the coating-substrate adhesion and the adhesion between two consecutive layers of the cold-sprayed metal coating. In particular, both bending tests and pure adhesion test were carried out in order to better understand the powder deposition mechanism. Bending tests were carried out in four-point bending configuration. On the basis of the experimental campaign, it results that the adhesion of the pure aluminum particles are very good, conversely the copper particles show a good adhesion on the aluminum substrate but have a low internal cohesion. Copyright*

Nele, L., Sarno, E., Keshari, A.MODELING OF MULTIPLE CHARACTERISTICS OF AN ARC WELD JOINT

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 5-8, 2013, Pages 1331-1341*Arc welding process; Gas metal arcs; Microcrack formation; Multiple characteristics; Multiple regression model; Neuro-Fuzzy model; Process parameters; Welding process parameters Engineering controlled terms: Adaptive control systems; Automation; Electric arc welding; Hardness; Process monitoring; Regression analysis; Welding; Welds Engineering main heading: Quality control *Process parameters modeling have always been one of the key aspects in development of an adaptive control of arc welding process. The welding process parameters are inherently nonlinear, time-delayed, and interdependent, and their on-time adjustment highly influences a sound weld bead formation and process monitoring. During the welding process, parameters control is the primary goal to leads a quality welding. Moreover, the final weld joint behavior, i.e.; residual stress, welding strength, and micro-crack formation are generally observed after cooling of the weld product. Thus, it has always been a difficult task to control mechanical properties of a final weld joint. To obtain the best mechanical properties, the final weld joint characteristics needed to be controlled and predicted during the*

process itself by precise adjustment of the process parameters. The paper presents a neuro-fuzzy modeling approach to provide adaptive control for the automatic process parameter adjustment. Three input parameters wire feed speed, welding gap, and torch speed are modeled with welding current output, providing control over weld bead formation during the welding. The same input process parameters are also modeled to predict final weld joint characteristics, i.e.; dilution ratio, hardness of weld bead, hardness of fused zone, and bead width. In order to ascertain the effectiveness of the neuro-fuzzy modeling approach, multiple regression models were also developed to compare the performances.

Caggiano, A., Teti, R.MODELLING, ANALYSIS AND IMPROVEMENT OF MASS AND SMALL BATCH PRODUCTION THROUGH ADVANCED SIMULATION TOOLS

*Procedia CIRP, Volume 12, 2013, Pages 426-431*3d motion simulations; Advanced simulation; Digital factories; Industrial manufacturing; Industrial scenarios; Performance measure; Small batch production; Utilization of resources Engineering controlled terms: Cellular manufacturing; Discrete event simulation; Flexible manufacturing systems; Industrial applications; Industrial engineering; Three dimensional; Tools Engineering main heading: Throughput *The application of advanced numerical simulation tools for modelling, analysis and improvement of existing industrial manufacturing cells is presented with reference to the development and implementation of the Digital Factory concept. Two real case studies belonging to different industrial scenarios, i.e. mass and small batch production, are simulated with the aim of improving specified performance measures related to manufacturing cells productivity, such as throughput or throughput time, and utilization of resources. Diverse advanced simulation resources, including 3D Motion and Discrete Event Simulation tools, are jointly applied to support decision making on manufacturing systems reconfiguration and improvement.*

Ferretti, S., Caputo, D., Penza, M., D'Addona, D.M.MONITORING SYSTEMS FOR ZERO DEFECT MANUFACTURING

*Procedia CIRP, Volume 12, 2013, Pages 258-263*Machining Process; Monitoring system; Production quality; Quality of production; Sensor systems; Zero defects Engineering controlled terms: Industrial engineering; Manufacture; Process monitoring Engineering main heading: Defects *In any machining process there are many parameters which should be taken under control in order to improve the quality of production. In this paper is given an overview of possible actions which could be implemented in order to reach the goal of manufacturing zero defects parts. These methodologies are here classified based on their type of interaction with the process as indirect and direct actions. Among direct actions, a particular focus is given to monitoring systems, which are the main field of activity of Montronix.*

Segreto, T., Simeone, A., Teti, R.MULTIPLE SENSOR MONITORING IN NICKEL ALLOY TURNING FOR TOOL WEAR ASSESSMENT VIA SENSOR FUSION

*Procedia CIRP, Volume 12, 2013, Pages 85-90*Cutting forces; High dimensionality; Inconel-718; Multiple sensors; Sensor fusion; State assessment; Tool wear; Vibration sensing Engineering controlled terms: Feature extraction; Industrial engineering; Neural networks; Nickel alloys; Turning; Wear of materials Engineering main heading: Sensors *A multiple sensor monitoring system comprising cutting force, acoustic emission and vibration sensing units was employed for tool state assessment during turning of Inconel 718 nickel alloy. Feature extraction was realised by processing the detected sensor signals in order to reduce the high dimensionality of the sensorial data. The extracted features were fused to realise a sensor fusion methodology based on neural network pattern recognition for decision making on tool wear condition.*

Casalino, G., Campanelli, S.L., Minutolo, F.M.C.NEURO-FUZZY MODEL FOR THE PREDICTION AND CLASSIFICATION OF THE FUSED ZONE LEVELS OF IMPERFECTIONS IN TI6AL4V ALLOY BUTT WELD

*Advances in Materials Science and Engineering, Volume 2013, 2013, Article number 952690*Bead geometry; International standards; ISO standards; Lack of penetration; Neuro-Fuzzy model; Surface imperfections; Ti-6Al-4V alloy; Welding parameters Engineering controlled terms: Carbon dioxide; Cerium alloys; Fatigue of materials; Fuzzy clustering; Laser beam welding Engineering main heading: Welds *Weld imperfections are tolerable defects as stated fromthe international standard. Nevertheless they can produce a set of drawbacks like difficulty to assembly, reworking, limited fatigue life, and surface imperfections. In this paper Ti6Al4V titanium butt welds were produced by CO 2 laser welding. The following tolerable defects were analysed: weld undercut, excess weld metal, excessive penetration, incomplete filled groove, root concavity, and lack of penetration. A neuro-fuzzy model for the prediction and classification of the defects in the fused zone was built up using the experimental data. Weld imperfections were connected to the welding parameters by feed forward neural networks. Then the imperfections were clustered using the C-means fuzzy clustering algorithm. The clusters were named after the ISO standard classification of the levels of imperfection for electron and laser beam welding of aluminium alloys and steels. Finally, a single-value metric was proposed for the assessment of the overall bead geometry quality. It combined an index for each defect and functioned according to the criterion "the-smallest-the- best." Copyright*

Formisano, A., Castaldo, C., Mazzolani, F.M.NON-LINEAR ANALYSIS OF MASONRY BUILDING COMPOUNDS: A COMPARISON OF NUMERICAL AND THEORETICAL RESULTS

Civil-Comp Proceedings, Volume 102, 2013Italian historic centers are a demonstration of centuries of civilization and culture and are currently considered as a touristic and economic irreplaceable resource. Masonry building aggregates are a large part of the Italian building heritage, which have been erected over the time without respecting seismic criteria. The current seismic Italian code defines the general principles to be followed both to individual structural units within aggregate and to take into account the interactions among adjacent buildings in terms of loads. Nevertheless, a clear calculation method to foresee static non-linear behaviour of building compounds is not provided. For this reason, in this paper a simple methodology based on the provisions of Italian Guidelines on Cultural Heritage has been established. The implemented non-linear static procedure has been calibrated using the results of two structural analysis programs, namely the 3MURI software for masonry structures and the SAP2000 finite element program, used to investigate two case studies of masonry building compounds. The difference detected in terms of base shear between calculation programs and guidelines, the latter furnishing precautionary results, has enabled the preparation of a chart, where the variation of the theoretically calculated base shear with respect to refined values has been appraised on the basis of the wall slenderness.

Paradiso, V., Astarita, A., Carrino, L., Durante, M., Franchitti, S., Scherillo, F., Squillace, A., Velotti, C.NUMERICAL OPTIMIZATION OF SELECTIVE SUPERPLASTIC FORMING OF FRICTION STIR PROCESSED AZ31 MG ALLOY

*Key Engineering Materials, Volume 554-557, 2013, Pages 2212-2220*Conventional materials; Friction stir processing; Grain refinement process; Near-net shape process; Numerical optimizations; Optimization approach; Superplastic forming; Superplastic properties Engineering controlled terms: Cerium alloys; Computer simulation; Finite element method; Magnesium alloys; Optimization Engineering main heading: Superplasticity *Superplastic forming is a near net shape process used to produce various items with complex geometry. However in many cases, only some portions of the workpiece undergo superplastic deformation. In these cases, instead of choosing expensive starting sheet material with superplastic properties, a low-cost conventional material can be chosen and a grain refinement process can be performed in the selected regions to enhance superplastic properties locally [1]. This process is known as "selective superplastic forming" [R.S. Mishra, M.W. Mahoney, US Patent 6,712,916, 2002]. In some previous works the use of Friction Stir Processing (FSP) was used to obtain locally a microstructure with ultrafine grains in the AZ31 magnesium alloys [2, 3]. In this study a modeling approach was adopted thanks to a commercial FE code and different simulations were conducted in order to correlate the experimental and numerical results for the model optimization [4, 5]. Free bulge forming tests of friction stir processed AZ31 sheets, in conjunction with numerical simulations, were used to evaluate the proposed optimization approach, with the aim to reduce the time and costs in the design of components with complex geometry. Copyright*

Velotti, C., Astarita, A., Squillace, A., Ciliberto, S., Villano, M.G., Giuliani, M., Prisco, U., Montuori, M., Giorleo, G., Bellucci, F.ON THE CRITICAL TECHNOLOGICAL ISSUES OF FRICTION STIR WELDING LAP JOINTS OF DISSIMILAR ALUMINUM ALLOYS

*Surface and Interface Analysis, Volume 45, Issue 10, October 2013, Pages 1643-1648*AA 2198; Critical issues; Dissimilar aluminum alloy; Experimental characterization; Friction stir process; FSW; Joining techniques; Lap joint Engineering controlled terms: Friction stir welding Engineering main heading: Joints (structural components) *In this article, friction stir welded lap joints of innovative dissimilar aluminum alloys have been produced and tested to investigate the feasibility of using this joining technique in this configuration. The introduction of both this new welding technique alloys, such as AA 2198, could allow making lighter and stronger structures. Some experiments, carried out previously, have shown that the fixturing device, the tool geometry, and the tilt angle play a significant role in the joint soundness. A wide experimental characterization has been carried out on friction stir welded lap joints of AA 7075 T6 extrudes to AA 2198 T351 rolled plates. The results attained are allowed to put in evidence some critical issues on the investigated configuration and can be considered as a further acquired knowledge in the understanding and the design of friction stir processes. Copyright*

Segreto, T., Karam, S., Simeone, A., Teti, R.RESIDUAL STRESS ASSESSMENT IN INCONEL 718 MACHINING THROUGH WAVELET SENSOR SIGNAL ANALYSIS AND SENSOR FUSION PATTERN RECOGNITION

*Procedia CIRP, Volume 9, 2013, Pages 103-108*Multiple sensors; Sensor fusion; Sensor monitoring; Statistical features; Stress assessment; Vibration signal; Wavelet feature vectors; Wavelet packet transforms Engineering controlled terms: Acoustic emission testing; Data fusion; Manufacture; Neural networks; Pattern recognition; Residual stresses; X ray diffraction Engineering main heading: Sensors *On-line residual stress assessment in turning of Inconel 718 was carried out through multiple sensor monitoring based on cutting force, acoustic emission and vibration signals acquisition and analysis. The detected sensor signals were processed by the wavelet packet transform technique to extract statistical features from the packet coefficients for the construction of wavelet feature vectors. The latter were used for sensor fusion pattern recognition through neural network data processing grounded on X-ray diffraction residual stress measurements on the turned part surface. The scope of the sensory data fusion approach was to achieve a robust scheme for multi-sensor monitoring decision making on machined surface integrity in terms of residual stress level acceptability.*

Simeone, A., Segreto, T., Teti, R.RESIDUAL STRESS CONDITION MONITORING VIA SENSOR FUSION IN TURNING OF INCONEL 718

*Procedia CIRP, Volume 12, 2013, Pages 67-72*Cognitive decision makings; Machined surface; Multiple sensors; Sensor fusion; Statistical evaluation; Stress condition; Stress evaluations; Vibration sensing Engineering controlled terms: Acoustic emission testing; Condition monitoring; Decision making; Feature extraction; Industrial engineering; Neural networks; Nickel alloys; Principal component analysis; Residual stresses; Signal processing Engineering main heading: Sensors *A multiple sensor monitoring system, equipped with cutting force, acoustic emission and vibration sensing units, was employed in association with advanced procedures for signal analysis, sensor fusion and cognitive decision making for residual stress evaluation in turning of Inconel 718 nickel alloy. Two signal processing and feature extraction methodologies, based respectively on sensory data statistical evaluation and Principal Component Analysis, were applied to the sensor signals generated during experimental turning tests. The extracted features were combined into sensor fusion input feature vectors to be fed to neural network based pattern recognition paradigms for decision making on machined surface integrity in terms of residual stress conditions.*

Putnik, G., Sluga, A., Elmaraghy, H., Teti, R., Koren, Y., Tolio, T., Hon, B.SCALABILITY IN MANUFACTURING SYSTEMS DESIGN AND OPERATION: STATE-OF-THE-ART AND FUTURE DEVELOPMENTS ROADMAP

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 2, 2013, Pages 751-774*Flexibility; Operational aspects; Research and development; Roadmap; State of the art; Theory and practice Engineering controlled terms: Design; Education computing; Scalability Engineering main heading: Manufacture *The paper covers the main design, management and operational aspects of scalability in manufacturing systems (MS). It promotes scalability as an area of research of MS theory and practice in order to enhance techniques and methodologies in existing MS paradigms using advanced and emerging design and management approaches and ICT, and meet challenges of emerging MS paradigms and support their promotion and effective and efficient deployment in practice. The paper presents an introduction to scalability, state-of-the art in manufacturing and computer science, and related applications including manufacturing and education and a roadmap for future research and developments.*

Indirli, M., Kouris, L.A.S., Formisano, A., Borg, R.P., Mazzolani, F.M.SEISMIC DAMAGE ASSESSMENT OF UNREINFORCED MASONRY STRUCTURES AFTER THE ABRUZZO 2009 EARTHQUAKE: THE CASE

STUDY OF THE HISTORICAL CENTERS OF L'AQUILA AND CASTELVECCHIO SUBEQUO

International Journal of Architectural Heritage, Volume 7, Issue 5, 1 January 2013, Pages 536-578The Abruzzo earthquake hit the city of L'Aquila and its surroundings on the April 6, 2009. The aim of this study is to analyze the technical features of unreinforced masonry (URM) buildings and assess their seismic behavior during the Abruzzo 2009 seismic event. The damage induced in the URM constructions of L'Aquila and the suburbs was severe and several such buildings collapsed. This study includes an overview of the dynamic characteristics of the earthquake and the seismic history of the region. The seismic performance of URM buildings is discussed on the basis of both the experience in L'Aquila and the village of Castelvecchio Subequo, during the post-emergency support to the Italian Department of Civil Protection (Dipartimento della Protezione Civile [DPC]), and the field investigation carried out with the patronage of the EU COST Action C26 and the cooperation of the PLINIVS Centre of Naples in three areas of the old city of L'Aquila. The main characteristics of URM buildings, the building behavior and damage are described and reviewed with due respect to the characteristics of the earthquake, as well as with reference to the structural and non-structural characteristics of buildings, using the Italian MEDEA procedure.

Centobelli, P., Murino, T., D'addona, D., Naviglio, G.SIMULATION AND OPTIMIZATION OF PRODUCTION SYSTEM BASED ON FUZZY LOGIC AND QUICK RESPONSE MANUFACTURING

*25th European Modeling and Simulation Symposium, EMSS 2013, 2013, Pages 60-66*Competitive strategy; Fuzzy logic approach; Lean manufacturing techniques; Manufacturing industries; New product development; Processing time; Quick response manufacturing; Simulation and optimization Engineering controlled terms: Agile manufacturing systems; Computer simulation; Fuzzy logic; Industry; Product development Engineering main heading: Industrial applications *Since 1979, european and american clients had benchmarked the performance of theirs factories with those of Japanese competitors. The differences included substantially higher productivity, better quality, significantly less inventory, less space, more flexibility and much faster throughput times. Everyone knows that time is money and mangers understand the importance of quick response to customers. Lean Manufacturing techniques can be powerful in several situations, but for companies making a large variety of products with variable demand or companies making highly engineered products, Lean Manufacturing has several drawbacks. Quick Response Manufacturing (QRM) can be more effective competitive strategy for companies targeting such markets, which focuses on lead time reduction. The importance of define the lead time required in an engineer-to-order company is critical in particular during the New Product Development (NPD) process. This paper presents how to apply Quick Response Manufacturing to a manufacturing industry through the previous calculation of product components Run Time using a Fuzzy Logic approach, in order to predict whether a decision will improve lead times.*

Astarita, A., Bitondo, C., Squillace, A., Armentani, E., Bellucci, F.STRESS CORROSION CRACKING BEHAVIOUR OF CONVENTIONAL AND INNOVATIVE ALUMINIUM ALLOYS FOR AERONAUTIC APPLICATIONS

*Surface and Interface Analysis, Volume 45, Issue 10, October 2013, Pages 1610-1618*Aeronautic applications; Applied loads; Corrosion behaviour; Friction stir; FSW; Generalized corrosion; International standards; SCC Engineering controlled terms: Aluminum alloys; Cracks; Friction stir welding Engineering main heading: Stress corrosion cracking *In this work, the stress corrosion cracking (SCC) behaviour of both innovative and conventional friction stir welded aluminium alloys was investigated. Similar butt joints were realized and tested; in particular, four different alloys for aeronautic applications were studied: AA2024 T3, AA2139 T3, AA2198 T3 and AA6056 T4. SCC tests were carried out following the international standards using a dedicated machine designed following as prescribed by the standards. The results showed that all the joints passed the tests, but pitting and generalized corrosion happens on all the specimens tested. Furthermore, an influence of the applied load on the corrosion behaviour was observed. Copyright*

Astarita, A., Scala, A., Paradiso, V., Squillace, A., Iodice, M., Indolfi, M., Monetta, T., Bellucci, F.STRUCTURAL HEALTH MONITORING OF METAL COMPONENTS: A NEW APPROACH BASED ON ELECTROCHEMICAL MEASUREMENTS

*Surface and Interface Analysis, Volume 45, Issue 10, October 2013, Pages 1570-1574*Aggressive environment; Electrochemical measurements; Electrochemical reactions; Fatigue corrosion; Finite element method analysis; Four-point bending test; Micro cell; Open circuit potential Engineering controlled terms: Aluminum alloys; Corrosion; Structural health monitoring; Water aeration Engineering main heading: Aluminum corrosion *Corrosion fatigue is defined as the sequential stages of metal damage that evolve with accumulated load cycling, in an aggressive environment, and resulting from the interaction of irreversible cyclic plastic deformation with localized chemical or electrochemical reactions. It appears then evident the need to know and understand all phenomena that are involved in pit formation and growth in the presence of both an aggressive environment and a cyclic load. Although each single effect of both fatigue and corrosion have been extensively documented for aluminium alloys, their synergic action is not thoroughly understood and it continues to be an area of considerable scientific and industrial interest. Fatigue experiments were conducted on bare AA 2024 T3 aluminium alloy specimens in the presence of an aggressive environment consisting of a water aerated solution with 3.5% of NaCl in weight. The specimen was stressed in a four-point bending test; the upper surface of the specimen, experiencing only tensile stress, was the monitored one. True strain on this surface*

was monitored by means of fibre optic Bragg grating. The strain and open circuit potential variations observed as a function of number of cycles are interpreted as a result, and taking into account the numerous and complex phenomena occurring as time goes on. The pits birth and their subsequent growth seem to play a significant role in crack initiation and subsequent propagation up to final catastrophic failure. This has been verified also by means of finite element method analysis. Copyright

Carrino, L., Squillace, A., Paradiso, V., Ciliberto, S., Montuori, M.SUPERPLASTIC FORMING OF FRICTION STIR PROCESSED MAGNESIUM ALLOYS FOR AERONAUTICAL APPLICATIONS: A MODELING APPROACH

*Materials Science Forum, Volume 735, 2013, Pages 180-191*Aeronautical applications; AZ31; Bulge forming; Evolution equations; FE-simulation; Finite element modeling; Finite element modelling; Friction stir; Friction stir processing; High specific strength; High strain rates; Low density; Low temperatures; Magnesium alloy AZ31; Model validation; Modeling approach; Numerical results; Rotational speed; Structural applications; Superplastic forming; Transportation industry; Ultra fine grain; Ultra fine grained microstructure Engineering controlled terms: Computer simulation; Magnesium alloys; Microstructure; Superplasticity Engineering main heading: Finite element method *Magnesium alloys are attractive for lightweight structural applications in the transportation industry because of their low density and high specific strength and stiffness [1]. With an ultrafine-grained microstructure, they exhibit superplasticity at relatively low temperatures and high strain rates [2]. Friction stir processing (FSP) was used to obtain a microstructure with ultrafine grains in the magnesium alloy AZ31. In this project, microstructures obtained using different rotational speeds are studied. Free bulge forming of the FSP processed AZ31 sheets are carried out to evaluate the superplastic behaviour [3]. The model and the evolution equations have been implemented into a commercial finite element modeling (FEM) code and different simulations are conducted to correlate the experimental and numerical results for the model validation [4]. The purpose of this study is to investigate the effect of the microstructure on the superplastic forming behaviour using free bulge forming and FE simulations.*

Bellucci, F., Monetta, T., Squillace, A., Montuori, M.THE VI EDITION OF THE INTERNATIONAL ALUMINIUM SURFACE SCIENCE AND TECHNOLOGY SYMPOSIUM

Surface and Interface Analysis, Volume 45, Issue 10, October 2013, Page 1429[No abstract available]

Astarita, A., Genna, S., Leone, C., Memola, C.M.F., Paradiso, V., Squillace, A.TI-6AL-4V CUTTING BY 100W FIBRE LASER IN BOTH CW AND MODULATED REGIME

*Key Engineering Materials, Volume 554-557, 2013, Pages 1835-1844*Cutting speed; Kerf geometry; Laser cutting; Main process; Process condition; Process parameters; Pulse durations; Ti-6Al-4V alloy Engineering controlled terms: Cutting; Fiber lasers; Geometry; Tungsten Engineering main heading: Titanium alloys *In this work, a 100 W fibre laser working in CW or modulated regime was used to cut Ti 6Al 4V alloy sheets 1 mm in thickness. The work is aimed at studying the effects of the main process parameters on the kerf geometry and HAZ. The tests were conducted in two steps: first, the maximum cutting speed were determined in both CW and pulsed regime changing the mean power and pulse duration. Then, for the same process conditions, tests were done decreasing the cutting speed from the maximum to the 80% of this. Finally, the effects of the process parameters on the Kerf geometry and HAZ have been analysed. Copyright*

Karam, S., Teti, R.WAVELET TRANSFORM FEATURE EXTRACTION FOR CHIP FORM RECOGNITION DURING CARBON STEEL TURNING

*Procedia CIRP, Volume 12, 2013, Pages 97-102*Cutting force signals; Decision-making systems; Pattern recognition procedures; Sensor monitoring; Statistical features; Time frequency domain; Wavelet Packet; Wavelet packet transforms Engineering controlled terms: Carbon steel; Cutting; Industrial engineering; Neural networks; Pattern recognition; Sensors; Signal processing; Wavelet decomposition Engineering main heading: Feature extraction *Cutting force sensor monitoring and wavelet decomposition signal processing were implemented for feature extraction and pattern recognition of chip form typology during turning of 1045 carbon steel. The wavelet packet transform was applied for the analysis of the detected cutting force signals by representing them in a time-frequency domain and providing for the extraction of wavelet packet statistical features. The latter were used to construct wavelet packet feature vectors, ranked according to the number of overlapping elements related to favourable or unfavourable chip forms that cause noise in the pattern recognition procedure (lower number, lower noise, higher rank). The eight highest ranked wavelet packet feature vectors were selected as inputs to a neural network decision-making system on chip form acceptability. Subsequently, a data refinement procedure was employed to improve the neural network performance in the chip form identification process.*

Padova

Yagüe-Fabra, J.A., Ontiveros, S., Jiménez, R., Chitchian, S., Tosello, G., Carmignato, S.A 3D EDGE DETECTION TECHNIQUE FOR SURFACE EXTRACTION IN COMPUTED TOMOGRAPHY FOR DIMENSIONAL METROLOGY APPLICATIONS

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 1, 2013, Pages 531-534*3d edge detections; Computed; Computed Tomography; Dimensional Metrology; Edge; Edge detection methods; Measurement uncertainty; Reference standard Engineering controlled terms: Computerized tomography; Edge detection; Extraction; Measurements; Three dimensional computer graphics; Tomography; Uncertainty analysis Engineering main heading: Units of measurement *Many factors influence the measurement uncertainty when using computed tomography for dimensional metrology applications. One of the most critical steps is the surface extraction phase. An incorrect determination of the surface may significantly increase the measurement uncertainty. This paper presents an edge detection method for the surface extraction based on a 3D Canny algorithm with sub-voxel resolution. The advantages of this method are shown in comparison with the most commonly used technique nowadays, i.e. the local threshold definition. Both methods are applied to reference standards and industrial parts and the comparison of the uncertainties obtained by both methods is presented.*

Ghiotti, A., Sgarabotto, F., Bruschi, S.A NOVEL APPROACH TO WEAR TESTING IN HOT STAMPING OF HIGH STRENGTH BORON STEEL SHEETS

*Wear, Volume 302, Issue 1-2, April 2013, Pages 1319-1326*Adhesive and abrasive wears; Al-Si coating; Boron steels; Hot-stamping; Hot-working tool steels; Laboratory environment; Parameters characterizing; Strength to weight ratio Engineering controlled terms: Aluminum; Aluminum coatings; Automotive industry; Boron; Coatings; Dies; Friction; High strength steel; Hot working; Interfaces (materials); Scanning electron microscopy; Silicon; Steel sheet; Stresses; Tool steel; Tribology; Wear of materials Engineering main heading: Stamping *Hot stamping of high strength steel sheets was developed in the automotive industry for the production of components characterized by a high strength-to-weight ratio and an increased resistance to impact. In order to avoid scaling and decarburization, the steel blanks are usually coated with an Al-Si coating that has proved a relevant influence also on their tribological behaviour during the forming stages. However, the knowledge of the influence that this coating may have on the dies wear mechanisms is still inadequate.The paper proposes a novel approach to wear testing, based on a pin-on-disk testing configuration, capable to reproduce in a laboratory environment the conditions arising at the interface between the dies and the blank, by reproducing the sliding velocities at the interface and the cyclic thermal and mechanical stresses on the die material. Investigations were carried out on a hot working tool steel sliding against high strength steel blanks coated with the Al-Si coating under dry reciprocating sliding conditions. Scanning electron microscopy and 3D profilometer analysis were utilized to evaluate the wear*

mechanisms.The presented results show that the proposed procedure can properly simulate the thermal and mechanical cycles to which the forming dies are subjected during the hot stamping process, allowing to control and vary a number of parameters characterizing the industrial process. The presence of both adhesive and abrasive wear mechanisms is highlighted and a possible explanation of their appearance is given.

Berti, G., Monti, M.A VIRTUAL PROTOTYPING ENVIRONMENT FOR A ROBUST DESIGN OF AN INJECTION MOULDING PROCESS

*Computers and Chemical Engineering, Volume 54, 11 July 2013, Pages 159-169*Integrated environment; Numerical predictions; Process fluctuations; Production measurement; Response surface methodology; Robust designs; Stochastic simulations; Virtual prototyping Engineering controlled terms: Finite element method; Stochastic models; Surface properties Engineering main heading: Injection molding *This paper proposes a new approach that enables a robust optimisation of the injection moulding process, based on the integration of numerical simulations, Response Surface Methodology and stochastic simulations in a type of integrated environment known as a virtual prototyping environment (VPE). The principal aim of the proposed approach is to include in the numerical setup of injection moulding the effects of fluctuations of process parameters.To clarify the proposed methodology, the paper details its application to the injection moulding process for the production of an engine cover. The moulded part presents some critical tolerances on different dimensions because of sealing and assembly requirements and the application of the VPE makes it possible to perform a robust setup taking into account the process fluctuations. The numerical prediction was confirmed by real production measurements on small pre-production runs performed adopting the moulding window explored in the virtual setup.*

Bruschi, S., Ghiotti, A., Novella, M.DUCTILE FRACTURE LIMITS OF THE CUZN40PB2 BRASS ALLOY DEFORMED AT ELEVATED TEMPERATURE

*Transactions of the North American Manufacturing Research Institution of SME, Volume 41, 2013, Pages 128-134*Damage; Elevated temperature; Forging temperature; Lower temperature limits; Material deformation; Material formability; Numerical techniques; Stress triaxiality factor Engineering controlled terms: Alloys; Brass; Chains; Ductile fracture; Forging; Fracture; Industrial research; Manufacture Engineering main heading: Temperature *The effectiveness of predicting the fracture occurrence in forging process chains strongly depends on the correct choice and calibration of damage and fracture laws under specific stress and strain conditions. The objective of the paper is to evaluate the fracture limits of a brass alloy deformed at elevated temperature under a wide range of stress states typical of hot forging process chains. A combined use of experimental and numerical techniques allowed determining the material fracture limits. Tensile and torsion tests at elevated temperature were conducted to investigate the influence that the stress triaxiality and the deviatoric parameter may have on the material*

formability. Numerical simulations of the above cited tests were carried out to calculate the values of the stress triaxiality factor of the tests and to correlate them with the experimentally determined strain at fracture. The CuZn40Pb2 brass alloy was taken as the reference material, being characterized by a restrict forgeability window in current hot forging processes. The obtained results state that the material deformation at fracture is greatly influenced not only by the forging temperature (allowing the determination of the lower temperature limit of the forgeability window), but also by the stress triaxiality and the deviatoric parameter, meaning that a general fracture law should be dependent on these stress parameters, as well as on the temperature.

Bruschi, S., Ghiotti, A., Bordin, A.EFFECT OF THE PROCESS PARAMETERS ON THE MACHINABILITY CHARACTERISTICS OF A COCRMO ALLOY

*Key Engineering Materials, Volume 554-557, 2013, Pages 1976-1983*Biomedical sectors; Cutting operations; Cutting parameters; Joint replacement; Machining operations; Process parameters; Surface integrity; Wear and corrosion resistance Engineering controlled terms: Biocompatibility; Cobalt alloys; Cutting; Joint prostheses; Machinability Engineering main heading: Corrosion resistance *The paper investigates the machinability characteristics of the CoCrMo alloy ASTM F1537, usually utilized for the production of joint replacements and fixation devices thanks to its high strength, good wear and corrosion resistance, and excellent biocompatibility. This research work intends to overcome the lack of literature data about this alloy machinability, even if its use in the biomedical sector is intensive and it is usually subjected to various machining operations for the implants production. Turning tests were carried out under lubricated conditions at different cutting speeds and feed rates typical of finishing cutting operations. The alloy machinability was analysed in terms of tool wear and cut surface integrity as a function of the cutting parameters. Copyright*

Sgarabotto, F., Ghiotti, A., Bruschi, S.EFFECTS OF SURFACE ROUGHNESS ON FRICTIONAL BEHAVIOUR OF SOLID ORGANIC LUBRICANTS FOR SHEET METAL FORMING PROCESSES

*Key Engineering Materials, Volume 549, 2013, Pages 381-388*Cleaning operations; Continuous improvements; Environmental-friendly; Hazardous lubricants; Metal forming industry; National legislation; Oil based lubricant; Organic lubricants Engineering controlled terms: Adhesion; Environmental impact; Friction; Lubrication; Metal forming; Sheet metal; Surface roughness Engineering main heading: Solid lubricants *In the last decades, national legislations have become even more restrictive about the application and the disposal of hazardous lubricants in sheet metal forming. As a result, metal forming industry, which traditionally has made large use of synthetic and oil-based lubricants to enhance the production rate and reducing the wear of tools, has been forced to study and develop new solutions to reduce the environmental impact of production processes. The introduction and the continuous improvement of environmental*

friendly lubrication systems has seen a continuous growth and attention, but today the usage of traditional hazardous lubricants is still significant, requiring expensive cleaning operations and harmful cleaning agents to remove them. The use of solid organic lubricants can reduce or eliminate this drawback, despite their performances may be significantly affected by specific process parameters and the presence of debris. In this paper the performances of a solid organic lubricant have been compared to traditional liquid lubricants applied to sheet metal forming applications. Different surface topographies have been reproduced and the effects in terms of frictional behaviour have been investigated.

Fiorotto, M., Lucchetta, G.EXPERIMENTAL INVESTIGATION OF A NEW HYBRID MOLDING PROCESS TO MANUFACTURE HIGH-PERFORMANCE COMPOSITES

*International Journal of Material Forming, Volume 6, Issue 1, 2013, Pages 179-185*Adhesion bonding; Basic concepts; Composite manufacturing; Engine emission; Experimental investigations; Experimental test; Fiber-reinforced; High performance composites; Hybrid composites; Hybrid process; Injection molding process; Long fiber reinforced thermoplastics; Long fiber thermoplastic materials; Molding process; Molding technologies; Reduce energy consumption; Rib structure; Short cycle; Vehicle weights Engineering controlled terms: Adhesion; Automobile manufacture; Automotive industry; Design of experiments; Energy utilization; Molds; Reinforced plastics Engineering main heading: Injection molding *Reducing vehicle weight to reduce energy consumption and engine emissions is one of the major objectives of the automotive industry. The novel molding technology, presented in this paper, is suited to meet this demand. In this process, a thermoformed fiber-reinforced thermoplastic sheet is inserted into the mold and a long-fiber reinforced thermoplastic is injected to form a rib structure. Short cycle times make the technique an economic option for the manufacturing of hybrid high performance composites. This special integrative injection molding method optimizes efficiencies and thus energy consumption. A basic concept was realized to show the manufacture procedure. The mechanism of adhesion bonding between the long fiber thermoplastic material and the formed fabric and the influence of the main injection molding process parameters on the adhesion quality was experimentally investigated according to the Design of Experiments method. Then experimental tests were used to measure the structural properties of hybrid composites.*

Bruschi, S., Ghiotti, A., Novella, M.FLOW CHARACTERISTICS OF NEW STEEL GRADES DEDICATED TO HOT STAMPING

*Key Engineering Materials, Volume 554-557, 2013, Pages 1298-1305*Austenitization temperatures; Flow charac-teristics; Fracture characteristics; Heating temperatures; Hot-stamping; Mechanical characteristics; Reduce energy consumption; Research activities Engineering controlled terms: Energy utilization; Formability; Fracture; Sheet metal; Tensile

testing Engineering main heading: Stamping *The reduction of the maximum heating temperature is one of the main goals in the research activities dedicated to hot stamping, to reduce energy consumption and decrease die wear. New steel grades are being expressly developed with the aim of reducing the austenitization temperature without losing the mechanical characteristics and the formability shown by the conventional Usibor 1500P™. In the present work, the flow behavior of four new steel grades is investigated by means of hot tensile tests at varying thermo-mechanical conditions. Results are presented and discussed in terms of obtained mechanical, ductility and fracture characteristics. Copyright*

Bruschi, S., Ghiotti, A., Michieletto, F.FORMABILITY CHARACTERISTICS OF AA5083 SHEETS UNDER HOT FORMING CONDITIONS

*Key Engineering Materials, Volume 549, 2013, Pages 356-363*Aluminum alloy components; Elevated temperature; Hot forming; Material formability; Microstructural features; Sheet forming process; Superplastic alloys; Superplastic forming Engineering controlled terms: Aluminum alloys; Automotive industry; Cerium alloys; Formability; Fracture; Microstructural evolution; Sheet metal; Superplasticity; Tensile testing Engineering main heading: Strain rate *The production of aluminum alloy components through sheet forming processes conducted at elevated temperatures is gaining more and more interest as it gives raise to the possibility of a significant enhancement of the metal formability characteristics, compared to room temperature forming. Aluminum alloy AA5083 blanks, which present a limited formability at room temperature, are usually formed through superplastic forming at elevated temperature: however, this processing route is too slow to be applicable for large batch production, typical for instance of the automotive industry. The paper is aimed at exploring the formability characteristics of the AA5083 when deformed at elevated temperature, but in a range of strain rates higher than those usually applicable in superplastic forming. To this aim, uni-axial tensile tests were carried out, in order to record the material formability characteristics as a function of temperature and strain rate, and to correlate them with the developed microstructural features. It is shown that it is possible to work at higher strain rates, still preserving a significant formability, even without using a conventional finegrained superplastic alloy.*

Jiménez, R., Ontiveros, S., Carmignato, S., Yagüe-Fabra, J.A.FUNDAMENTAL CORRECTION STRATEGIES FOR ACCURACY IMPROVEMENT OF DIMENSIONAL MEASUREMENTS OBTAINED FROM A CONVENTIONAL MICRO-CT CONE BEAM MACHINE

*CIRP Journal of Manufacturing Science and Technology, Volume 6, Issue 2, 2013, Pages 143-148*Accuracy Improvement; Computed Tomography; Correction method; Correction procedure; Dimensional measurements; Geometry features; Measurement corrections; Scale Factor Engineering controlled terms: Measurement errors; Measurements; Units of measurement

Engineering main heading: Computerized tomography *This paper describes specific correction methods applied for dimensional measurements when using a non-measuring oriented computed tomography machine. These methods were developed to correct two factors that have a predominant influence in dimensional measurements using CT systems: the threshold and the scale factor. The correction procedures were designed to correct the two factors independently, by using some of the geometry features of the parts themselves, i.e. without external help of additional reference samples or standards. The correction methods proposed here are intentionally as simple as possible, so that they can be easily applied in industry, especially in the cases when non-measuring oriented CT systems are used for metrology applications. The results obtained are presented, showing how the methods can substantially improve the accuracy by decreasing the measurement errors, on average, down to 20 times lower than the errors obtained from uncorrected measurements.*

Bruschi, S., Ghiotti, A., Novella, M.F.HOT FORMABILITY CHARACTERIZATION AND FRACTURE LOCUS DETERMINATION OF THE CUZN40PB2 BRASS ALLOY THROUGH TENSILE AND TORSION TESTING

*Computational Plasticity XII: Fundamentals and Applications - Proceedings of the 12th International Conference on Computational Plasticity - Fundamentals and Applications, COMPLAS 2013, 2013, Pages 332-342*Damage; Fracture characterization; Grain-boundary composition; Hot forging process; Rheological behaviour; Stress triaxiality factor; Three-dimensional surface; Triaxiality Engineering controlled terms: Alloys; Brass; Characterization; Ductile fracture; Forging; Formability; Grain boundaries; Metal forming; Tensile testing; Torsion testing Engineering main heading: Strain rate *The prediction of ductile fracture occurrence in hot forging processes is one of the main industrial issues, which needs damage models that have to be on one hand accurate and easily calibrated, but also easy enough to be industrially implemented an utilized. Tensile testing formability characterization, although experimentally easy, does not allow taking into account all the variables influencing the evolution of damage, making the calibration test-dependent. Besides the stress triaxiality factor effect, in hot forging processes, the stress deviatoric parameter, the temperature and strain rate must be taken into account to provide reliable and efficient models. In this work hot fracture characterization was performed on the dual-phase brass alloy CuZn40Pb2, typically used for hot forging and characterized by a narrow temperature window of formability. The values of true strain at fracture from tensile, torsion and tensile-torsion tests performed at various temperatures and strain rates are obtained. Numerical simulations of the above-cited tests were carried out in order to determine the three-dimensional surfaces of the fracture locus as a function of the stress triaxiality and deviatoric parameter. The results are critically discussed and in particular the influence of the rheological behaviour of the material on the fracture locus shape is highlighted. Optical microscopy analysis was carried out in order to assess the testing parameters influence on the phase distribution and EDS-SEM analysis to evaluate the grain boundary composition, which was recognized critical as regards the formability characteristics of the investigated alloy.*

Bariani, P.F., Bruschi, S., Ghiotti, A., Michieletto, F.HOT STAMPING OF AA5083 ALUMINIUM ALLOY SHEETS

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 1, 2013, Pages 251-254*Aluminium-alloy sheets; Automotive component; Elevated temperature; Hot-stamping; Material flow stress; Optimal combination; Process parameters; Sensitivity to temperatures Engineering controlled terms: Aluminum alloys; Formability; Sheet metal; Strain rate Engineering main heading: Stamping *The paper is aimed at proving the feasibility of producing sheet components by stamping AA5083 sheets at elevated temperature and strain rate. Laboratory tensile and Nakajima-type tests were carried out to evaluate the material flow stress, ductility and fracture limits sensitivity to temperature and strain rate, and therefore to determine the optimal combination of process parameters assuring both maximum formability and effective post-deformation mechanical properties. Industrial trials were conducted on an automotive component to validate the laboratory results.*

Bruschi, S., Ghiotti, A., Michieletto, F.HOT TENSILE BEHAVIOR OF SUPERPLASTIC AND COMMERCIAL AA5083 SHEETS AT HIGH TEMPERATURE AND STRAIN RATE

*Key Engineering Materials, Volume 554-557, 2013, Pages 63-70*Forming conditions; High temperature; Hot forming; Hot stamping process; Micro-structural; Quick-plastic forming; Sheet components; Superplastic forming Engineering controlled terms: Aluminum alloys; Automotive industry; Superplasticity; Tensile testing Engineering main heading: Strain rate *Since the last two decades, the automotive industry has dedicated an increasing attention to the manufacturing of sheet components made of high-resistant aluminium alloys; the superplastic AA5083 grade is currently utilized in both the conventional superplastic forming and the recently patented quick plastic forming, which assures higher productivity compared to that of superplastic forming, while the commercial AA5083 grade is rarely employed. The objective of the paper is to compare the hot tensile behaviour of commercial and fine-grained AA5083 sheets when processed at high temperature and strain rate, which are typical of hot stamping processes. The results are presented and commented in terms of flow stress, anisotropy, strain at failure, microstructural and hardness features as a function of temperature and strain rate. On the basis of the obtained results, the set of optimal forming conditions for the two grades is identified. Copyright*

Bosetti, P., Maximiliano, C., Bort, G., Bruschi, S.IDENTIFICATION OF JOHNSON-COOK AND TRESCA'S PARAMETERS FOR NUMERICAL MODELING OF AISI-304 MACHINING PROCESSES

*Journal of Manufacturing Science and Engineering, Transactions of the ASME, Volume 135, Issue 5, 2013, Article number 051021*Hybrid procedure; Johnson-Cook model; Machining Process; Nelder-Mead methods; Optimization algorithms; Optimized parameter; Orthogonal cutting; Thermomechanical numerical model Engineering controlled terms: Algorithms; Curve fitting; Cutting; Cutting tools; Identification (control systems); Numerical models; Optimization Engineering main heading: Parameter estimation *This paper presents a procedure for the identification of Johnson Cook model parameters and Tresca's law friction factor for orthogonal cutting of AISI 304. The process is described by a thermomechanical numerical model. The parameters are identified by minimizing the error in the prediction of cutting force, chip thickness, and chip curvature. Two optimization algorithms where tested: a pure Nelder-Mead method (NMM), and a hybrid procedure, in which the starting simplex for NMM is calculated by means of a genetic algorithm. The results emphasize the importance of the initial guess chosen in the optimization to obtain a reliable set of parameters. By using the optimized parameters in the numerical model, the cutting force, the chip thickness, and the chip curvature can be evaluated with an acceptable accuracy. The identified rheological and tribological coefficients are validated for different orthogonal cutting conditions.*

Lucchetta, G., Fiorotto, M.INFLUENCE OF RAPID MOULD TEMPERATURE VARIATION ON THE APPEARANCE OF INJECTION-MOULDED PARTS

*Strojniski Vestnik/Journal of Mechanical Engineering, Volume 59, Issue 11, 2013, Pages 683-688*Cavity surfaces; Gloss; Heat cycle; Injection mould; Innovative technology; Mould temperature; Rapid variation; Surface temperatures Engineering controlled terms: Atmospheric temperature; Injection molding; Polymer melts Engineering main heading: Molds *In this work, an innovative technology for the rapid heating and cooling of injection moulds has been developed and used to analyse the effect rapid variations of the mould temperature on the improvement of mouldings' appearance in terms of gloss. The obtained experimental results show that by maintaining an elevated mould surface temperature, the polymer melt is prevented from solidifying prematurely in the filling and packing stage, thereby improving the replication of the mirror-finished cavity surface. Furthermore, the mould cavity heating combined with the rapid cooling of the moulded part significantly contributes to contrasting the development of surface defects, such as weld line marks.*

Amiri, A., Bruschi, S., Sadeghi, M.H., Bariani, P.INVESTIGATION ON HOT DEFORMATION BEHAVIOR OF WASPALOY

*Materials Science and Engineering A, Volume 562, 1 February 2013, Pages 77-82*Equiaxed microstructures; Flow localization; Flow stress curves; Grain size; Hot compression tests; Hot deformation behaviors; Instability domains; Intergranular; Metallographic observations; Microstructural analysis; Microstructural observations; Microstructural phenomenon; Nickel-based superalloys; Processing maps; Temperature range; Triple junction; Waspaloy Engineering

controlled terms: Compression testing; Dynamic recrystallization; Hot working; Textures Engineering main heading: Strain rate *The hot deformation behavior of the Waspaloy was investigated by means of hot compression tests, metallographic observations and processing map at temperature between 950°C and 1150°C, strain rate between 0.01s -1 and 10s -1 under strain of 0.8. The processing map was developed on the basis of experimental data, showing variations of the efficiency of power dissipation related to temperature and strain rate at constant strain. The processing map shows one stable domain, in which the dynamic recrystallization is the dominating microstructural phenomenon, and one instable domain. The results of interpretation of flow stress curves and processing map were verified by microstructural observations. The efficiency peak of the processing map is 0.37 at the temperature of 1150°C and the strain rate of 10s -1 .The stable domain is within the temperature range between 1050°C and 1150°C and strain rate between 0.01s -1 and 10s -1 , and leads to recrystallized and equiaxed microstructure. The grain size in this domain increases at increasing temperature or decreasing strain rate. The instability domain is within the temperature range between 950°C and 1000°C and strain rate between 0.01s -1 and 10s -1 (the temperature of 1000°C and strain rate of 0.01s -1 is excluded). In this domain, the instability can be observed in terms of fracture, shear bands, flow localization, intergranular and triple junction cracking.*

Lutey, A.H.A., Sozzi, M., Carmignato, S., Selleri, S., Cucinotta, A., Molari, P.G.NANOSECOND AND SUB-NANOSECOND PULSED LASER ABLATION OF THIN SINGLE AND MULTI-LAYER PACKAGING FILMS

*Applied Surface Science, Volume 285, Issue PARTB, 15 November 2013, Pages 300-308*Ablation thresholds; Efficiency of materials; Layers of thickness; Magnitude reduction; Packaging industry; Process efficiency; Pulsed laser sources; Quantitative result Engineering controlled terms: Ablation; Laser ablation; Laser pulses; Paper; Plastic films; Polyethylenes; Polypropylenes Engineering main heading: Aluminum *Translating single and multi-layer packaging films are exposed to 0.5-0.8 ns laser pulses of wavelength 1064 nm and 10-12.5 ns laser pulses of wavelength 515 nm. Ablation depths and threshold fluences are reported for single-layer polyethylene (PE), polypropylene (PP) and aluminium of thickness 20-50 μm. Interaction and cut widths are reported for the same single-layer films and for four multi-layer films comprising aluminium-polypropylene and aluminium-paper. Ablation of the PE and PP films is only possible in the tested parameter range with 0.5 ns, 1064 nm pulses. Though a one order of magnitude reduction in the ablation threshold of aluminium is observed with 0.5-0.8 ns, 1064 nm pulses, the efficiency of material removal for fluences >8 J cm -2 is superior with 10-12.5 ns, 515 nm pulses. Multi-layer film response is found to be heavily dictated by the thickness of metallic layers. For multi-layer films with aluminium layers of thickness 7-9 μm, adjacent layers are removed by inter-layer heat conduction from the aluminium layer, in some cases leading to very large cut widths. For multi-layer films with aluminium layers of thickness <0.1 μm, direct ablation of all layers must take place for complete film penetration. The study provides quantitative results regarding process efficiency and quality for application of pulsed laser sources within the packaging industry.*

Sgarabotto, F., Ghiotti, A., Bruschi, S.NOVEL EXPERIMENTAL SET-UP TO INVESTIGATE THE WEAR OF COATINGS FOR SHEET METAL FORMING TOOLS

*Key Engineering Materials, Volume 554-557, 2013, Pages 825-832*Chemical vapour deposition; Diamond like carbon coatings; Metal-forming process; Optimization of process parameters; Physical vapour deposition; PVD coatings; Sputtering techniques; Tribological performance Engineering controlled terms: Chemical vapor deposition; Computer simulation; Numerical models; Physical vapor deposition; Sheet metal; Stresses; Tribology; Vapors; Wear of materials Engineering main heading: Coatings *The use of Physical Vapour Deposition (PVD) and Chemical Vapour Deposition (CVD) coatings has increased significantly thanks to the improved tribological performances they offer in many metalforming processes. Nevertheless the proper coating selection for a specific forming operation is not well established yet, being mainly based on trails and error approaches. The use of FEM-supported analyses may represent an effective support in the optimization of process parameters, but the need of testing procedures and reliable models to describe the mechanical and tribological phenomena at the interface between the dies and the workpiece is still significant. The paper presents a novel experimental set-up for the evaluation of the wear resistance of coated dies in sheet metal forming operations. A progressive stamping process was taken as reference case and analysed by numerical simulation in order to evaluate contact pressures and sliding speed at tools-blank interface. A Diamond-Like-Carbon coating (Ti-DLC) was chosen as reference and deposited by PVD magnetron sputtering technique. The novel set up was designed and tested by using the parameters obtained from the numerical simulation. The results showed a good correlation with tribological and mechanical stresses applied on the reference industrial case, allowing the evaluation of the coating performances. Copyright*

Ambrogio, G., Gagliardi, F., Bruschi, S., Filice, L.ON THE HIGH-SPEED SINGLE POINT INCREMENTAL FORMING OF TITANIUM ALLOYS

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 1, 2013, Pages 243-246*Dimensional accuracy; High speed forming; High speed machine; Incremental sheet forming; Material quality; Single point incremental forming; Suitable solutions; Target component Engineering controlled terms: Metal forming; Microstructure; Titanium; Titanium alloys Engineering main heading: Aluminum sheet *Single Point Incremental Forming processes show some limitations related to both dimensional accuracy and process slowness. The process slowness is here overcome by introducing the high speed forming, which allows a reduction to less than 1 min of execution time of target components made in Titanium alloys. The paper is aimed at analyzing the influence of the feed increasing on the material quality in order to investigate if the development of high speed machines could be a suitable solution to implement more extensively the Single Point Incremental Forming technique in practice. All the results are discussed in the paper.*

Sozzi, M., Tragni, K., Selleri, S., Cucinotta, A., Lutey, A.H.A., Molari, P.G., Carmignato, S.PICOSECOND AND NANOSECOND PULSED LASER ABLATION OF ALUMINIUM FOIL

*ASME 2013 International Manufacturing Science and Engineering Conference Collocated with the 41st North American Manufacturing Research Conference, MSEC 2013, Volume 1, 2013, Article number MSEC2013-1189*Ablation thresholds; Driving parameters; General equations; Nanosecond laser ablation; Nanosecond lasers; Nanosecond pulse; Nanosecond pulsed laser; Pico-second pulse Engineering controlled terms: Ablation; Aluminum foil; Manufacture; Three dimensional; Ultrashort pulses Engineering main heading: Industrial research *The pulsed laser ablation of 20 micron thick aluminium foil is investigated by exposing moving samples to picosecond pulses of wavelength 1064nm and nanosecond pulses of wavelength 515nm and 1030nm. Ablation thresholds and depths are determined for a range of conditions using an optical microscope and 3D optical profiler. Complete three-dimensional crater profiles for single and multiple pulses are presented. The results reveal a variation in ablation threshold with wavelength, pulse duration and the number of pulses; a large reduction is observed for picosecond pulses. Ablation rates per pulse are expressed by general equations and found to vary strongly with both laser type and the number of pulses. The green nanosecond laser is found to ablate most efficiently for fluences above 10J/cm 2 , whilst the picosecond source is instead advantageous for low fluences. A large reduction in ablation depth per pulse is observed with an increasing number of pulses. The present work affords prediction of scribe and cut parameters for the processing of thin aluminium layers and, more generally, characterises the driving parameters of pulsed picosecond and nanosecond laser ablation of metals. Copyright*

Affatato, S., Modena, E., Carmignato, S., Grupp, T.M., Taddei, P.QUANTIFICATION OF WEAR RATES AND PLASTIC DEFORMATION ON MOBILE UNICOMPARTMENTAL UHMWPE TIBIAL KNEE INSERTS

*Tribology Letters, Volume 52, Issue 1, October 2013, Pages 57-65*CMM; Creep deformations; Knee simulators; Mobile UKP; Monoclinic phase transformations; Morphology degradation; Periprosthetic osteolysis; Unicompartmental knee prosthesis Engineering controlled terms: Artificial limbs; Coordinate measuring machines; Morphology; Polyethylenes; Raman spectroscopy; Stresses; Surface defects Engineering main heading: Plastic deformation *Abstract: Experimental wear testing is an essential step in the evaluation of unicompartmental knee prostheses; the major mechanisms that dominate the wear of conventional ultra high molecular weight polyethylene tibial knee menisci are the sub-surface cracking and delamination that induce particle release by abrasion/adhesion and subsequently periprosthetic osteolysis. The aim of this study was to determine whether plastic deformation affects the wear of the polymer and to measure the magnitude of these effects. Wear test was performed using a displacement-control*

knee wear simulator with "three-plus-one" stations, in accordance with the ISO 14243-3/2. A state-of-the-art coordinate measuring machine was used to quantify the volumetric mass loss of the mobile knee polyethylene menisci as well as creep/plastic deformations. The volumetric wear measured by this method was compared to that measured by the gravimetric method. Raman spectroscopy showed morphology changes induced by mechanical stress in both the upper and lower surfaces of the menisci. The amorphous content increased at expenses of the crystalline orthorhombic content, which generally decreased in all menisci. A slight orthorhombic → monoclinic phase transformation occurred upon mechanical stress. Plastic deformation appeared as the main factor affecting the trend of the spectroscopic markers and thus the morphology degradation.

Affatato, S., Modena, E., Carmignato, S., Taddei, P.THE USE OF RAMAN SPECTROSCOPY IN THE ANALYSIS OF UHMWPE UNI-CONDYLAR BEARING SYSTEMS AFTER RUN ON A FORCE AND DISPLACEMENT CONTROL KNEE SIMULATORS

*Wear, Volume 297, Issue 1-2, 15 January 2013, Pages 781-790*Amorphous content; Anterior posteriors; Bearing systems; Clinical problems; Control mechanism; Controlled simulation; Crystallinity changes; Good correlations; In-vitro; In-vivo; Knee retrievals; Knee simulators; Knee wear; Mechanical stress; Molecular levels; Raman markers; Revision surgery; Test condition; Total knee prosthesis; UKP; Volumetric loss; Wear behaviors; Wear characteristics; Wear evaluation; Wear mechanisms; Wear rates; Wear test Engineering controlled terms: Artificial limbs; Coordinate measuring machines; Knee prostheses; Raman spectroscopy; Scanning; Simulators; Stresses; Tribology; Ultrahigh molecular weight polyethylenes; Wear of materials Engineering main heading: Displacement control *The complications associated with prosthetic failure and revision surgery still constitute the main clinical problem. The objective of wear evaluation is to determine the wear rate and its dependence on the test conditions. To obtain realistic results, a wear test can be performed to reproduce in vivo working conditions and compare the wear characteristics of various total knee prostheses designs.Two knee wear simulators with different input control mechanisms, displacement and force controlled, were used to assess the wear behavior of ultra-high molecular weight polyethylene uni-condylar knee prostheses. The differences in wear behavior were assessed using a state-of-art coordinate measuring machine; Raman spectroscopy was used to evaluate the possible crystallinity changes on the uni-condylar menisci induced by mechanical stress. These results were compared with available uni-condylar retrievals.Scratches were visible along the anterior-posterior direction emphasizing that the motion was constant during the movements under the displacement control simulation. On the contrary, different kinematics schemes were observed under the force controlled simulation. The structural Raman markers showed a good correlation with the coordinate measuring machine data, and in particular with the depth of the concavity formed upon in vitro testing or in vivo service. With regards to the in vitro tested components, the specimens tested under force controlled simulator, which underwent a higher volumetric loss, showed a higher increase of the amorphous content. At a molecular level, the wear mechanism did not appear significantly different for the three sets of specimens, with the exception of the*

amorphous content which, upon wear, increased in the in vitro tested components, while decreased in the retrievals.

Palermo

Lupo, T.A MULTI-OBJECTIVE DESIGN APPROACH FOR THE C CHART CONSIDERING TAGUCHI LOSS FUNCTION

Quality and Reliability Engineering International, 2013The present paper proposes a multi-objective design approach for the c chart, considering in the optimization process of the chart parameters both the statistical and the economic objectives. In particular, the minimization of the hourly total quality related costs is the considered objective to carry out the economic goal, whereas the statistical objective is reached by the minimization the out-of-control average run length of the chart. A mixed integer non-linear constrained mathematical model is formulated to solve the treated multi-objective optimization problem, whereas the Pareto optimal frontier is described by the ε-constraint method. In order to show the employment of the proposed approach, an illustrative example is developed and the related considerations are given. Finally, some sensitivity analysis is also performed to investigate the effects of operative and costs parameters on the chart performance.

Ingarao, G., Di Lorenzo, R.A CONTRIBUTION ON THE OPTIMIZATION STRATEGIES BASED ON MOVING LEAST SQUARES APPROXIMATION FOR SHEET METAL FORMING DESIGN

*International Journal of Advanced Manufacturing Technology, Volume 64, Issue 1-4, January 2013, Pages 411-425*Computational effort; Computer-aided optimizations; FEM simulations; Function approximation; MLS approximation; Moving least squares; Moving least squares approximation; Operations design; Optimization method; Optimization problems; Optimization strategy; Region of interest; Research challenges; Research topics; Response surface; Response surface method Engineering controlled terms: Design; Finite element method; Least squares approximations; Optimization; Research; Sheet metal; Surface properties Engineering main heading: Metal forming *Computer-aided procedures to design and optimize forming processes are, nowadays, crucial research topics since industrial interest in costs and times reduction is always increasing. Many researchers have faced this research challenge with various approaches. Response surface methods (RSM) are probably the most known approaches since they proved their effectiveness in the recent years. With a peculiar attention to sheet metal forming process design, RSM should offer the possibility to reduce the number of numerical simulations which in many cases means to reduce design times and complexity. Actually, the number of direct problems (FEM simulations) to be solved in order to reach good function approximations by RSM is a key aspect of their application in sheet metal forming operations*

design. In this way, the possibility to build response surfaces basing on moving least squares approximations (MLS) by utilizing a moving and zooming region of interest can be considered a very attractive methodology. In this paper, MLS is utilized to solve two optimization problems for sheet metal forming processes. The influence on the optimization results was analyzed basing on MLS peculiarities. The idea is to utilize these peculiarities and make the MLS approximation as flexible as possible in order to reduce the computational effort of an optimization strategy. An innovative optimization method is proposed and the results show it is possible to strongly reduce the computational effort of sheet metal forming processes optimization. In particular, the advantages, in terms of computational effort reduction, with respect to classical RSM approaches have been demonstrated and quantified.

Lupo, T.A FUZZY SERVQUAL BASED METHOD FOR RELIABLE MEASUREMENTS OF EDUCATION QUALITY IN ITALIAN HIGHER EDUCATION AREA

*Expert Systems with Applications, Volume 40, Issue 17, 2013, Pages 7096-7110*AHP; Management engineering; Reliable measurement; Service performance evaluation; Service performance levels; SERVQUAL; Student satisfaction; University of Palermo Engineering controlled terms: Education; Education computing; Fuzzy set theory; Fuzzy sets; Hierarchical systems Engineering main heading: Uncertainty analysis *In recent years, the attention that the European Community has focused on the education sector has produced a new university commitment addressed to quality aspects for all education related services. In fact, a quality oriented service requires excellence in the design and planning of service activities, as well as during its delivering and also for the adopted service performance evaluation method. However, considering that service performance evaluations are deeply based on stakeholders' judgments, they can be characterized by possible uncertainties related to incompleteness for partial ignorance, imprecision for subjectivity and even vagueness. Therefore, under these conditions, unreliable results can be obtained by widely considered service analysis methods. In the present paper, a method based on a recent extension of the ServQual model and that uses in combined manner the Fuzzy Set Theory and the Analytic Hierarchy Process method is proposed to effectively handle uncertainty in service performance analyses. In particular, the Fuzzy Set Theory is considered to deal with such uncertainty, whereas the AHP method is adopted as tool to estimate the importance weights of the strategic service attributes. Subsequently, the strategic analysis of the service value tree related to the Management Engineering program at the University of Palermo (Italy) is performed by using the proposed method. The performed service analysis allows the most influencing service performance factors to be captured and commented upon. Finally, the obtained results show that the professors' perception of service quality meaningfully influences the overall service performance level.*

Certa, A., Enea, M., Galante, G., Lupo, T.A MULTI-DECISION MAKERS APPROACH TO SELECT THE MAINTENANCE PLAN FOR A MULTI-COMPONENT SYSTEM

*Proceedings - 19th ISSAT International Conference on Reliability and Quality in Design, RQD 2013, 2013, Pages 434-438*AHP; Analytic hierarchy process (ahp); Group decision; Maintenance plans; Multi-component systems; Multi-criteria decision methods; Technique for order preference by similarity to ideal solutions; TOPSIS Engineering controlled terms: Hierarchical systems Engineering main heading: Planning *The present paper proposes an approach integrating two multi-criteria decision methods in order to select the maintenance plan for a multi-component system. The maintenance plan to be selected suggests the set of the maintenance actions to be performed at each scheduled inspection of the system within a finite time horizon. The choice has to be made among different solutions, previously determined by ensuring the simultaneous minimization of both the total maintenance cost and the system unavailability. In particular, the Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods are proposed in a multi-decisionmakers environment.*

Buffa, G., Ducato, A., Fratini, L., Micari, F.ADVANCED FEM MODELING OF FRICTION STIR WELDING OF TI6AL4V: MICROSTRUCTURAL EVOLUTIONS

*Transactions of the North American Manufacturing Research Institution of SME, Volume 41, 2013, Pages 667-676*FEM modeling; Friction stir welding(FSW); Fully coupled analysis; High-quality solutions; Phase volume fraction; Solid-state welding process; Thermo-mechanical; Thermo-mechanical analysis Engineering controlled terms: Electric welding; Friction stir welding; Hydrogen embrittlement; Manufacture; Mechanical properties; Microstructural evolution; Phase transitions; Titanium alloys Engineering main heading: Industrial research *Friction Stir Welding (FSW) is a solid state welding process patented in 1991 by TWI; initially adopted to weld aluminum alloys, is now being successfully used also for high resistant materials. Welding of titanium alloys by traditional fusion welding techniques presents several difficulties due to high material reactivity resulting in bonding with oxygen, hydrogen, and nitrogen with consequent embrittlement of the joint. In this way FSW represents a cost effective and high quality solution. The final mechanical properties of the joints are strictly connected to the microstructural evolutions, in terms of phase change, occurring during the process. In the paper a 3D FEM model of the FSW welding process, based on a thermomechanical fully coupled analysis, is presented. The model, tuned both for the thermo mechanical analysis and the phase transformation through experimental data, is able to predict the phase volume fraction of each joint typical zone at the varying of the main process parameters. The obtained results permit to assess that the tuned FEM model of the FSW process can be utilized as an effective design tool.*

Ducato, A., Fratini, L., Micari, F.ADVANCED NUMERICAL MODELS FOR THE THERMO-MECHANICAL-METALLURGICAL ANALYSIS IN HOT FORGING PROCESSES

AIP Conference Proceedings, Volume 1532, 2013, Pages 3-14In the paper a literature review of the numerical modeling of thermo-mechanical-metallurgical evolutions of a metal in hot forging operations is presented. In particular models of multiaxial loading tests are considered for carbon steels. The collected examples from literature regard phases transformations, also martensitic transformations, morphologies evolutions and transformation plasticity phenomena. The purpose of the tests is to show the correlation between the mechanical and the metallurgical behavior of a carbon steel during a combination of several types of loads. In particular a few mechanical tests with heat treatment are analyzed. Furthermore, Ti-6Al-4V titanium alloy is considered. Such material is a multi-phasic alloy, at room temperature made of two main different phases, namely Alpha and Beta, which evolve during both cooling and heating stages. Several numerical applications, conducted using a commercial implicit lagrangian FEM code are presented too. This code can conduct tri-coupled thermo-mechanical-metallurgical simulations of forming processes. The numerical model has been used to carry out a 3D simulation of a forging process of a complex shape part. The model is able to take into account the effects of all the phenomena resulting from the coupling of thermal, mechanical and metallurgical events. As simulation results strongly depend on the accuracy of input data, physical simulation experiments on real-material samples are carried out to characterize material behavior during phase transformation.

Inghilleri, R., Lupo, T., Passannanti, G.AN EFFECTIVE DOUBLE SAMPLING SCHEME FOR THE C CONTROL CHART

Quality and Reliability Engineering International, 2013In the present paper is developed a statistical process control inspection procedure based on a new simple-to-implement and effective double sampling scheme for the c control chart, aimed at the minimization of the number of inspected observation units and warranting fixed levels for the type I and II error risks. In particular, the formulations of the false alarm risk α, the power P of the chart, and the expected number of inspected observation units for the developed inspection procedure are given, whereas a macro of Microsoft Excel is adopted to solve the tackled problem. In order to illustrate the application of the developed approach and to investigate on the influence of several operating parameters, numerical examples are carried out and the related considerations are given. Finally, by comparing the performance of the developed inspection procedure with that of the related classic c chart scheme, meaningful reduction of the number of the inspected observation units can be achieved by adopting the proposed approach.

Ducato, A., Fratini, L., La Cascia, M., Mazzola, G.AN AUTOMATED VISUAL INSPECTION SYSTEM FOR THE CLASSIFICATION OF THE PHASES OF TI-6AL-4V TITANIUM ALLOY

Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), Volume 8048 LNCS, Issue PART 2, 2013, Pages 362-

*369*Automated visual inspection; Automated visual inspection systems; Computer vision techniques; Metal microstructure; SVM; Ti-6al-4v; Ti-6al-4v titanium alloys; Traditional approaches Engineering controlled terms: Aluminum; Automation; Computer vision; Friction stir welding; Image analysis; Metallography; Microstructure; Textures; Titanium Engineering main heading: Titanium alloys *Metallography is the science of studying the physical properties of metal microstructures, by means of microscopes. While traditional approaches involve the direct observation of the acquired images by human experts, Computer Vision techniques may help experts in the analysis of the inspected materials. In this paper we present an automated system to classify the phases of a Titanium alloy, Ti-6Al-4V. Our system has been tested to analyze the final products of a Friction Stir Welding process, to study the states of the microstructures of the welded material.*

Di Franco, G., Fratini, L., Pasta, A.ANALYSIS OF THE MECHANICAL PERFORMANCE OF HYBRID (SPR/BONDED) SINGLE-LAP JOINTS BETWEEN CFRP PANELS AND ALUMINUM BLANKS

*International Journal of Adhesion and Adhesives, Volume 41, 2013, Pages 24-32*Adhesive bonding; Aerospace sectors; Aluminum blanks; Carbon fiber reinforced polymer; Experimental studies; Hybrid joints; Innovative materials; Joint configuration; Joint designs; Lap joint; Mechanical components; Mechanical joints; Mechanical performance; Riveted joints; Self-piercing riveting; Single lap joints; Tensile tests; Traditional materials Engineering controlled terms: Adhesive joints; Aluminum; Bonding; Carbon fiber reinforced plastics; Carbon fibers; Riveting; Tensile testing Engineering main heading: Structural panels *The increasing use of innovative materials in manufacturing of modern mechanical components has led to the development of reliable joints between innovative (composite materials etc.) and traditional materials (steel, aluminum etc.). In the last few years, hybrid joints, combining the advantages of the adhesive joints and traditional mechanical joints as bolted or riveted joints, have been shown an increasing industrial interest especially in automotive and aerospace sectors. In the present paper a systematic experimental study of hybrid lap joints was carried out with the aim to detect the optimal joint configuration. Tensile tests on hybrid joints made by combining adhesive bonding and self-piercing riveting (SPR) were carried out. Also tensile tests of simple adhesive joints and simple SPR joints were carried out. The joints were made of AA 2024-T6 aluminum sheet and carbon fiber reinforced polymer (CFRP) laminate. Effective guidelines for an insight in the joint design are provided.*

Astarita, A., Ducato, A., Fratini, L., Paradiso, V., Scherillo, F., Squillace, A., Testani, C., Velotti, C.BETA FORGING OF TI-6AL-4V: MICROSTRUCTURE EVOLUTION AND MECHANICAL PROPERTIES

*Key Engineering Materials, Volume 554-557, 2013, Pages 359-371*Commercial codes; Elevated temperature; High mechanical properties; Hot forming process; Micro-structure evolutions; Thermo-mechanical response; Ti-6al-4v; Ti-6Al-4V alloy Engineering controlled terms: Alloy steel; Aluminum; Carbon fiber reinforced plastics; Compression testing; Corrosion resistance; Forging; Mechanical properties; Titanium alloys Engineering main heading: Microstructure *Titanium alloys are finding an increasing use in the aeronautical field, due to their characteristics of high mechanical properties, lightness and corrosion resistance. Moreover these alloys are compatible with the carbon fibre reinforced plastics that are also finding a wide use in the aeronautical field. On the other hand the use of these alloys implies some drawbacks, for example titanium alloys are often considered more difficult to form and generally have less predictable forming characteristics than other metallic alloys such as steel and aluminum. In this paper was studied both the microstructure evolution and the mechanical properties of a Ti-6Al-4V rolled bar after hot forging. The thermo-mechanical response of a Ti-6Al-4V alloy was studied in elevated temperature compression tests (CT). Furthermore numerical simulations were carried out in order to do a comparison between numerical data and experimental results. The simulations were carried out using an implicit commercial code able to conduct coupled thermo-mechanical-microstructural analysis of hot forming processes of metal alloys. Copyright*

Riccobono, F., Bruccoleri, M., Perrone, G.BUSINESS AGREEMENTS OBJECTIVES AND DECISIONS: A FIELD RESEARCH

Management Research Review, Volume 36, Issue 5, April 2013, Pages 495-527Purpose: Many research studies in operations management (OM) and strategic management (SM) investigate how different kinds of firm decisions regarding business relationships can positively affect a firm's operations performance, resource endowment, and competitive position. Very few studies exist, however, that have attempted to illuminate the actual behaviors of managers when making strategic decisions about their intercompany relationships; rather, most existing studies focus on normative theory. The purpose of this paper is to explore linkages between the "set" of strategic objectives that managers are willing to pursue, the "set" of networking decisions they make, and the "set" of business agreements they sign. Design/methodology/approach: In order to investigate and explore actual managerial behaviors with respect to networking strategy, the study adopts a field research approach based on multiple case studies. Data were collected on 13 business agreements from three manufacturing firms in the mechatronics industry in Italy. Within-case and cross-case analyses are used for theory-building purposes. Findings: The empirical data allow identification four different archetypes of networking strategy. The archetypes capture different connections between the "set" of strategic objectives that managers are willing to pursue, the "set" of networking decisions that they consider, and the "set" of strategic agreements that they actually adopt. Specifically, the identified archetypes are named multi-alignment, multi-agreement (diversification), multi-objective, and mono-alignment (focus), and these are related to different association multiplicities among objectives, decisions, and agreements. The implications related to these archetypes are three-fold. First, the multi-alignment archetype suggests a focus not just on one kind of agreement, but also on the firm's overall portfolio of agreements, in order to facilitate understanding of how different kinds of agreements and networking decisions can play a complementary role in achieving a firm's

predetermined business objective/s. Second, the multi-agreement (diversification) archetype suggests that managers can minimize the risk of losing the potentiality of network collaboration by undertaking different kinds of agreements for the same strategic objective. Third, the mono-alignment (focus) and multi-objective archetypes suggest that just one agreement can potentially pursue one or multiple strategic objectives, and thus can allow managers to minimize the cost of managing several networking relationships. Originality/value: The originality of this study lies in its exploration of linkages between objectives, decisions and networking agreements. Unlike most of the existing papers in OM and SM, however, it does not specifically focus on: vertical or horizontal relationships; operations performance (positioning school) or resource endowment (resource-based view) strategic objectives; or any specific kind of agreement contract (outsourcing, alliance, joint venture, etc.). This paper presents four different networking strategy archetypes that represent different ways of matching a "set" of networking decisions, strategic objectives and business agreements. These are not related to either vertical or horizontal relationships, operations performance or resource endowment objectives, or any specific contract agreement form.

Lupo, T.COMPARING THE ECONOMIC EFFECTIVENESS OF VARIOUS ADAPTIVE SCHEMES FOR THE C CHART

Quality and Reliability Engineering International, 2013In an attempt to improve the effectiveness of statistical process control (SPC) procedures, a variety of adaptive schemes has been developed in the last decades. However, considering control charts for attributes, relatively few works about adaptive schemes have been proposed, and most of them were proposed only recently. The common characteristic of those schemes is that one or more chart parameters are allowed to adaptively vary during the SPC operations according to the sampling information history, typically the current point plotted on the chart. In this way, the adaptive schemes are smarter than the related static ones, but they are also more complicated in terms of implementation. The purpose of the present work is to evaluate and compare the economic performance of the main adaptive schemes of a control chart for attributes, in order to derive conclusions on their relative effectiveness. In particular, the analysis is focused on the c chart that is used to monitor the total nonconformities number in an inspection unit. A numerical comparative study, based on a 2V5-1 fractional factorial design scheme, to investigate on the influence of several operating and costs parameters, is carried out, and the related considerations are given. The obtained results show that the chart parameter having the most impact on the economic performance is the sampling interval. Therefore, in most cases, the use of a c chart with adaptive sampling intervals is the better choice than other adaptive schemes, which are also more complicated in terms of implementation.

Ducato, A., Fratini, L., Micari, F.COUPLED THERMO-MECHANICAL-METALLURGICAL ANALYSIS OF AN HOT FORGING PROCESS OF TITANIUM ALLOY

*Key Engineering Materials, Volume 554-557, 2013, Pages 638-646*Complex shapes; Hot forging process; Phase distribution; Thermo-mechanical; Thermo-mechanical history; Thermo-mechanical-metallurgical; Ti-6al-4v; Ti-6al-4v titanium alloys Engineering controlled terms: Computer simulation; Finite element method; Forging; Metallurgy Engineering main heading: Titanium alloys *In the present paper a numerical FEM model for the analysis of a forming process of a complex shape component is presented. The model, developed using the commercial implicit code DEFORM™, can take into account both the thermo-mechanical evolution and the microstructural evolution of the considered material. In this case the Ti-6Al-4V titanium alloy was because it was possible to carry out a very good characterization into a FEM ambient. In particular the code can calculate the phase distribution of the main phases of the alloy as consequence of the thermomechanical history of the material during a hot forging process. At the end of the simulation the output data was showing to analyze the validity and the quality of the model by a numerical point of view. Copyright*

Buffa, G., Ducato, A., Fratini, L.DISSIMILAR MATERIAL LAP JOINTS BY FRICTION STIR WELDING OF STEEL AND TITANIUM SHEETS: PROCESS MODELING

AIP Conference Proceedings, Volume 1532, 2013, Pages 491-498In the paper a continuum based FEM model for Friction Stir Welding of different material lap joint made out of thin stainless steel and titanium sheets is proposed. The simulation campaign was made out using the 3D Lagrangian implicit code DEFORM{trade mark, serif} by means of a rigid-visco-plastic approach. The model, already set up and tuned for FSW process of similar materials and geometrical configurations takes into account the different mechanical and thermal behavior of the two materials and the microstructural evolution of the considered titanium alloy in the same joint. Additionally, it is able to predict temperature, phase, strain and strain rate distributions and evolution at the varying of the main process variables. The phase evolution models take into account only the main phases called Alpha, Beta and Alpha+Baeta so that, at the end of the simulation, the complete phase distribution in the welded zone.

Certa, A., Enea, M., Lupo, T.ELECTRE III TO DYNAMICALLY SUPPORT THE DECISION MAKER ABOUT THE PERIODIC REPLACEMENTS CONFIGURATIONS FOR A MULTI-COMPONENT SYSTEM

*Decision Support Systems, Volume 55, Issue 1, April 2013, Pages 126-134*Multi-component systems; Multi-criteria decision making; Multi-objective optimization problem; Multicriteria decision support; Non-homogeneous Poisson process; Periodic maintenance; Resolution techniques; System unavailability Engineering controlled terms: Decision support systems; Maintenance; Multiobjective optimization Engineering main heading: Decision making *The problem tackled by the present paper concerns the selection of the elements of a repairable and*

stochastically deteriorating multi-component system to replace (replacements configuration) during each scheduled and periodical system stop within a finite optimization cycle, by ensuring the simultaneous minimization of both the expected total maintenance cost and the system unavailability. To solve the considered problem, a combined approach between multi-objective optimization problem (MOOP) and multi-criteria decision making (MCDM) resolution techniques is proposed. In particular, the ε constraint method is used to single out the optimal Pareto frontier whereas the ELECTRE III multi-criteria decision support method is proposed to support the selection of the replacements configuration that represents the best compromise among the considered objectives. The proposed approach is sequentially applied at each scheduled system stop by allowing the dynamic updating of the information about the decisional context in which the decision maker has to operate. To illustrate the whole procedure a numerical case study is solved for different hypothesized scenarios related to the importance attributed by the decision maker to the system unavailability and the maintenance cost objectives.

Cannella, S., Bruccoleri, M.EDITORIAL

International Journal of Management and Decision Making, Volume 12, Issue 3, 2013, Pages 191-194[No abstract available]

Buffa, G., Fratini, L., Schneider, M., Merklein, M.EFFECT OF PROCESS PARAMETERS ON THE JOINT INTEGRITY IN FRICTION STIR WELDING OF TI-6AL-4V LAP JOINTS

*Key Engineering Materials, Volume 554-557, 2013, Pages 1083-1090*Experimental campaign; Friction stir welding(FSW); High-quality solutions; Lap joint; Microstructural transformations; Process parameters; Resistance properties; Solid-state welding process Engineering controlled terms: Chemical bonds; Corrosion resistance; Electric welding; Hydrogen embrittlement; Machine tools; Magnesium alloys; Materials; Mechanical properties; Titanium alloys; Welds Engineering main heading: Friction stir welding *Friction Stir Welding (FSW) is a solid state welding process patented in 1991 by TWI; initially adopted to weld aluminum alloys, is now being successfully used also for magnesium alloys, copper and steels. The wide diffusion the process is having is due to the possibility to weld materials traditionally considered difficult to be welded or "unweldable" by traditional fusion welding processes due to peculiar thermal and chemical material properties. Additionally, the process allows welding a wide range of sheet thickness (up to 50mm) avoiding typical fusion welding processes defects, like cavities and porosities, with no shielding gas, filling material or joint preparation. Recently, research is focusing on titanium alloys thanks to the high interest that such materials are getting from the industry due to the extremely high strength-weight ratio together with good corrosion resistance properties. Welding of titanium alloys by traditional fusion welding techniques presents several difficulties due to high material reactivity resulting in bonding with oxygen, hydrogen, and nitrogen with consequent embrittlement of the joint. In this way FSW can represent a cost effective and high quality solution. A few studies have been developed on the FSW of titanium*

alloys butt joints, while there is a complete lack of knowledge as far as different joint morphologies are regarded (lap joints, T joints, etc.). In the paper the results of an experimental campaign on lap joints made out of thin Ti-6Al-4V sheets are presented. The effect of the main process parameters on the mechanical properties has been investigated and related to the microstructural transformations occurring during the process because of the thermo-mechanical action of the tool. Copyright

Ingarao, G., Kellens, K., Behera, A.K., Vanhove, H., Ambrogio, G., Duflou, J.R.ELECTRIC ENERGY CONSUMPTION ANALYSIS OF SPIF PROCESSES

*Key Engineering Materials, Volume 549, 2013, Pages 547-554*Conventional machining; Electric energy consumption; Energy consumption analysis; Environmental footprints; Single point incremental forming; SPIF; Sustainable manufacturing; Total energy consumption Engineering controlled terms: Energy efficiency; Environmental impact; Metal analysis; Metal forming; Sheet metal Engineering main heading: Energy utilization *Manufacturing processes, as used for discrete part manufacturing, are responsible for a substantial part of the environmental impact of products, but are still poorly documented in terms of environmental footprint. A thorough analysis on the causes affecting the environmental impact in metal forming processes, especially the innovative but very energy intensive sheet metal forming technologies required to form light-weight products, is nowadays necessary. Therefore, this paper presents an energy consumption analysis, including a power and time study, of Single Point Incremental Forming (SPIF) processes. First, the influence of the most relevant process parameters (e.g. feed rate, step down) as well as the material forming itself are analysed regarding the power demand. Moreover, a comparative study and related energy efficiency assay are carried out on two different machine tools. As the forming time proves to be the dominant factor for the total energy consumption, from environmental point of view, the overall results show many similarities with conventional machining processes. Finally, this paper reports on some potential improvement measures to reduce the SPIF energy consumption.*

Ingarao, G., Kellens, K., Renaldi, R., Dewulf, W., Duflou, J.R.ELECTRICAL ENERGY ANALYSIS AND POTENTIAL ENVIRONMENTAL IMPROVEMENTS OF SHEET METAL PUNCHING PROCESSES

*Green Design, Materials and Manufacturing Processes - Proceedings of the 2nd International Conference on Sustainable Intelligent Manufacturing, SIM 2013, 2013, Pages 131-136*Electrical energy; Environmental footprints; Environmental improvements; Improvement strategies; Methodological approach; Part manufacturing; Process parameters; Production process Engineering controlled terms: Carbon dioxide; Energy utilization; Industrial engineering; Manufacture; Production engineering; Sheet metal Engineering main heading: Sustainable development *Discrete part manufacturing processes, in particular non-conventional production processes, are still poorly documented in terms of environmental footprint. Within the separating*

processes, sheet metal punching processes have not been analyzed yet from environmental point of view. The present paper aims to contribute to filling this knowledge gap. In particular, two different punching machine tool architectures were analyzed. Following the previously developed CO 2 PE methodological approach, power studies and a preliminary time study have been performed in order to understand the contribution of each sub-unit towards the total energy demand. The influence of the most relevant process parameters (e.g. sheet thickness and punch perimeter) are analyzed regarding the required punching energy. Finally, several potential improvement strategies to reduce the punching energy consumption are reported.

Buffa, G., Ducato, A., Fratini, L.FEM BASED PREDICTION OF PHASE TRANSFORMATIONS DURING FRICTION STIR WELDING OF TI6AL4V TITANIUM ALLOY

*Materials Science and Engineering A, Volume 581, 1 October 2013, Pages 56-65*FEM models; Friction stir welding(FSW); Fully coupled analysis; High-quality solutions; Phase volume fraction; Solid-state welding process; Thermo-mechanical analysis; Ti6al4v titanium alloys Engineering controlled terms: Electric welding; Friction stir welding; Hydrogen embrittlement; Intermetallics; Mechanical properties; Phase transitions Engineering main heading: Titanium alloys *Friction Stir Welding (FSW) is a solid state welding process patented in 1991 by TWI; initially adopted to weld aluminum alloys, it is now being successfully used also for high resistant materials. Welding of titanium alloys by traditional fusion welding techniques presents several difficulties due to high material reactivity with oxygen, hydrogen, and nitrogen with consequent embrittlement of the joint. In this way FSW represents a cost effective and high quality solution. The final mechanical properties of the joints are strictly connected to the microstructural evolutions, in terms of phase change, occurring during the process. In the paper a 3D FEM model of the FSW welding process, based on a thermo-mechanical fully coupled analysis, is presented. The model, tuned both for the thermo-mechanical analysis and the phase transformation through experimental data, is able to predict the phase volume fraction in the typical zones of the joints at the varying of the main process parameters. The obtained results permit to assess that the tuned FEM model of the FSW process can be utilized as an effective design tool.*

Lupo, T.HANDLING STAKEHOLDER UNCERTAIN JUDGMENTS IN STRATEGIC TRANSPORT SERVICE ANALYSES

Transport Policy, Volume 29, September 2013, Pages 54-63 GEOBASE Subject Index: fuzzy mathematics; numerical model; public transport; stakeholder; strategic approach; transportation planning; transportation policy; transportation system; uncertainty analysis; urban transport Regional Index: Italy; Palermo [Sicily]; Sicily *The quality level of services has to be constantly controlled, especially under conditions of competition increasing and limited resources. However, considering that service performance analyses are based on stakeholders' judgments,*

they can be characterized by possible uncertainties related to incompleteness for partial ignorance, imprecision for subjectivity and even vagueness. Therefore, under these conditions, unreliable results can be obtained by widely used service analysis methodologies. In the present paper, a methodology based on a recent extension of the SERVQUAL model, and that uses in combined manner the fuzzy set theory and the analytic hierarchy process method is proposed to effectively handle uncertainty in service performance analyses. In particular, the fuzzy set theory is considered to deal with such uncertainty, whereas the AHP method is adopted as tool to estimate the importance weights of the strategic service attributes.Subsequently, the Italian public transport service sector is strategically analysed, and its overall service quality structure is described and, finally, the strategic analysis of the public urban transport service delivered in Palermo (Italy) is performed by means of the proposed methodology. The performed service analysis allows the most influencing service factors to be captured and commented upon. The obtained results show that the management's perception of service quality meaningfully influences the overall service performance level.

Turrisi, M., Bruccoleri, M., Cannella, S.IMPACT OF REVERSE LOGISTICS ON SUPPLY CHAIN PERFORMANCE

International Journal of Physical Distribution and Logistics Management, Volume 43, Issue 7, August 2013, Pages 564-585Purpose: The purpose of this paper is to analyse the impact of reverse logistics on order and inventory variance amplification in a single-echelon supply chain (SC) and to propose a new order policy for dampening such amplification. Design/methodology/approach: A general review of the literature on sustainable operations and on the impact of reverse logistics on SC performance provides the foundation for the study. The authors use difference equation math approach for modelling and analysing a closed SC. A proper design of experiment and data collected from the European Union statistics validate the obtained numerical results. Findings: The variability of reverse flow in a closed loop SC increases the serviceable inventory variance. However, a proper design of the reverse flow considerably improves the global performance. To this purpose, the authors propose a new order policy, namely R-APIOBPCS, which explicitly considers the reverse flow of products. Research limitations/implications: The paper presents a math model describing a closed loop supply chain (CLSC). No empirical analysis is provided. Future researches should evaluate the impact of the proposed R-APIOBPCS on more realistic closed loop SC models. Practical implications: The paper's findings may motivate logistics and SC managers to implement CLSC when supported by innovative, suitable tools for the proper management of the information and material flow in the chain. Managers should be well acquainted that, by doing so, they not only satisfy national and international legislations but also achieve improvements in logistics performance. Originality/value: The authors propose a novel replenishment rule that accurately coordinates the upstream and downstream flows in a SC. The proposed order policy can be reasonably considered one of the advocated managerial tools for the proper management of reverse logistics: it allows reducing inventory and limiting the variability of the orders placed to suppliers in SC with reverse logistics.

Buffa, G., Campanella, D., Mirabile, R., Fratini, L.IMPROVING FORMABILITY IN SPIF PROCESSES THROUGH HIGH SPEED ROTATING TOOL: EXPERIMENTAL AND NUMERICAL ANALYSIS

*Key Engineering Materials, Volume 549, 2013, Pages 156-163*Effect of temperature; Experimental and numerical analysis; Field variables; High-speed rotating; Incremental forming; Material formability; New approaches; Process mechanics Engineering controlled terms: Aluminum alloys; Computer control systems; Finite element method Engineering main heading: Sheet metal *Single-point incremental forming (SPIF) is a quite new sheet-forming process which offers the possibility to deform complex parts without dedicated dies using a single-point tool and a standard three-axis CNC machine. Although the process mechanics enables higher strains with respect to traditional sheet-forming processes, research has been focused on further increasing the maximum forming angle. In the paper, a new approach is used to enhance the material formability through a localized sheet heating as a consequence of the friction work caused by high speed rotating tool. Numerical simulation was utilized to relate the effect of temperature with the main field variables distribution in the sheet.*

Di Franco, G., Fratini, L., Pasta, A.INFLUENCE OF PARAMETERS IN A HYBRID JOINT (SPR/BONDED) GFRP-ALUMINUM

*Key Engineering Materials, Volume 554-557, 2013, Pages 1031-1036*Adhesive bonding; Effective solution; Experimental test; Hybrid joints; Mechanical fastening; Self-piercing riveting; SPR; Static behaviors Engineering controlled terms: Automotive industry; Bonding; Riveting; Tensile strength; Tensile testing Engineering main heading: Aluminum *Self-Piercing Riveting (SPR) is receiving more recognition as a possible and effective solution to join body panels and structures. For example self-piercing riveting is still the first choice for the most well-known automotive car industries when considering the intensive use of aluminum alloy. To combine the advantages of the two joints techniques, in the last years hybrid joints combining a classical mechanical fastening (riveting) and a classical adhesive bonding, or a cocured joint, have attracted great interest. In the present paper the static behavior of single-lap hybrid joints (SPR-bonded) between GFRP and aluminum through experimental tests. In particular, tensile strength, energy absorption and failure modes of studied joints were investigated through tensile tests. Copyright*

Mori, K.-I., Bay, N., Fratini, L., Micari, F., Tekkaya, A.E.JOINING BY PLASTIC DEFORMATION

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 2, 2013, Pages 673-694*Environmental safety; Joining by forming; Joining process; Joint formation; Joint performance; Mechanical parts; State of the art Engineering controlled terms: Forming; Friction

stir welding; Plastic deformation; Product design Engineering main heading: Joining *As the scale and complexity of products such as aircraft and cars increase, demand for new functional processes to join mechanical parts grows. The use of plastic deformation for joining parts potentially offers improved accuracy, reliability and environmental safety as well as creating opportunities to design new products through joining dissimilar materials. This paper aims to provide an overview of the state of the art in such joining processes, including cold welding, friction stir welding, self-pierce riveting, mechanical clinching and joining by forming. The paper includes description of the mechanism of joint formation, and analysis of joint performance and applicability.*

Cannella, S., Bruccoleri, M., Barbosa-Póvoa, A.P., Relvas, S.METHODOLOGICAL APPROACH TO STUDY THE DYNAMICS OF PRODUCTION NETWORKS: DISCRETE-EVENT SIMULATION MODELLING

International Journal of Logistics Systems and Management, Volume 16, Issue 2, 2013, Pages 211-223This paper shows how discrete-event simulation represents an appropriate tool for approaching the dynamics of production networks. Three important factors influencing production network dynamics, specifically finite production capacity, manufacturing lead time, and its variability are discussed and a basic discrete-event simulation model is presented. Such model, which in its basic form represents a simple retail/distribution two-stage supply chain, is then extended in order to take into account those factors that can not be included in a classical control theoretical model.

Buffa, G., Fratini, L., Schneider, M., Merklein, M.MICRO AND MACRO MECHANICAL CHARACTERIZATION OF FRICTION STIR WELDED TI-6AL-4V LAP JOINTS THROUGH EXPERIMENTS AND NUMERICAL SIMULATION

*Journal of Materials Processing Technology, Volume 213, Issue 12, 2013, Pages 2312-2322*Final microstructures; Lap joint; Mechanical characterizations; Mechanical resistance; Microhardness profiles; Phase distribution; Process parameters; Temperature and strain distributions Engineering controlled terms: Finite element method; Friction stir welding; Joints (structural components); Microstructure; Numerical models; Titanium alloys Engineering main heading: Strain *Lap joints of Ti-6Al-4V were produced and the effect of the main process parameters was studied through macro and micro investigations highlighting mechanical resistance, microhardness profiles, grain size and phase distributions. A dedicated numerical model was used to link the input process parameters to temperature and strain distributions and to the final microstructure in the welded joint. It is found that the strain produced in the stir zone by proper combination of process parameters plays a fundamental role in the final microstructure and mechanical properties of the joints.*

Fratini, L., Merklein, M., Boehm, W., Campanella, D.MODELLING ASPECTS IN ACCUMULATIVE ROLL BONDING PROCESS BY EXPLICIT FINITE ELEMENT ANALYSIS

*Key Engineering Materials, Volume 549, 2013, Pages 452-459*Accumulative roll bonding; CPU time; Explicit finite element analysis; Material property; Numerical results; Severe plastic deformations; Simulation optimization Engineering controlled terms: Finite element method; Mechanical properties; Sheet metal Engineering main heading: Roll bonding *Accumulative Roll-Bonding (ARB) process is a severe plastic deformation (SPD) process, capable of developing grains below 1 μm in diameter and improving mechanical properties of the material. In this study, the authors compared two different FE-codes with respect of its applicability for numerical analysis of the ARB process. Modelling this process was achieved using the explicit code for Abaqus/CAE both in 2D and 3D. The proposed model was used to assess the impact of ARB cycles on the final material properties. The numerical results in 2D and 3D were compared and contrasted. The research work presented in this paper is focused on the simulation optimization based on CPU time minimization. The numerical simulations were also validated through a comparison with the experimental results.*

Buffa, G., Fratini, L., Pellegrino, S., Micari, F.ON THE FIELD VARIABLES INFLUENCE ON BONDING PHENOMENA DURING FSW PROCESSES: EXPERIMENTAL AND NUMERICAL STUDY

*Key Engineering Materials, Volume 549, 2013, Pages 484-491*Accumulative roll bonding; Experimental and numerical studies; FEM models; Friction stir welding(FSW); Linear friction welding (LFW); Manufacturing process; Solid state bonding; Strain and strain rates Engineering controlled terms: Bonding; Computer simulation; Roll bonding; Sheet metal; Strain rate Engineering main heading: Friction stir welding *Solid state bonding recurs in several manufacturing processes, as Friction Stir Welding (FSW), Linear Friction Welding (LFW), extrusion of hollow profiles and Accumulative Roll Bonding (ARB). The former processes are nowadays of particular industrial interest because of the specific advantages with respect to the classic welding technologies. In FSW the solid state bonding is obtained between an undeformed "cold" material, already placed in the advancing side of the joint, and the "hot" material flow incoming from the retreating side. Proper conditions of pressure, temperature, strain and strain rate are needed in order to get the final effective bonding. In the paper experimental tests on butt joints made out of AA6061-T6 aluminum alloys are used to identify the sets of process parameters resulting either in sound or poor joints. The same process conditions have been simulated used an already developed model in order to highlight the actual bonding line and the values of the main field variables determining the soundness of the joints. Finally a correlation between process parameters values, field variables values and joint effectiveness is made.*

Buffa, G., Campanella, D., Fratini, L.ON THE IMPROVEMENT OF MATERIAL FORMABILITY IN SPIF OPERATION THROUGH TOOL STIRRING ACTION

*International Journal of Advanced Manufacturing Technology, Volume 66, Issue 9-12, June 2013, Pages 1343-1351*DRX; Friction work; Incremental forming; Material formability; Metal structures; New approaches; Process mechanics; Rotational speed Engineering controlled terms: Aluminum alloys; Computer control systems; Microstructure; Thermocouples Engineering main heading: Sheet metal *Single-point incremental forming (SPIF) is a quite new sheet-forming process which offers the possibility to deform complex parts without dedicated dies using a single-point tool and a standard three-axis CNC machine. The process mechanics enables higher strains with respect to traditional sheet-forming processes, but particular attention must be given to the maximum forming angle. In this paper, a new approach is proposed to enhance the material formability through a localized sheet heating as a consequence of the friction work caused by elevated tool rotational speeds. AA1050-O, AA1050-H24, and AA6082-T6 were utilized, and the reached temperatures were recorded by thermocouples, fixed to the sheet using a metal structure. A significant increase in the material formability was observed for both materials, and new formability curves have been built at the varying of the utilized rotational speed.*

Fratini, L., Buffa, G., Cammalleri, M., Campanella, D.ON THE LINEAR FRICTION WELDING PROCESS OF ALUMINUM ALLOYS: EXPERIMENTAL INSIGHTS THROUGH PROCESS MONITORING

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 1, 2013, Pages 295-298*Bonding conditions; Experimental campaign; Frictional forces; Linear; Linear friction welding; Local softening; Solid-state joining; Temperature level Engineering controlled terms: Aluminum; Cerium alloys; Friction; Friction welding; Process monitoring; Welding Engineering main heading: Joining *Linear friction welding is a solid-state joining process for non-axisymmetric components in which joining of materials is obtained through the relative motion of two components under pressure. In the process the heat source is given by the frictional forces work decaying into heat determining a local softening of the material and eventually bonding conditions. A dedicated fixture was equipped with sensors for the in-process acquisition of variables regarding kinematics, dynamics and temperature levels. The results of an experimental campaign aimed to weld AA6082-T6 aluminum alloy parts are presented and a process window is identified for the used alloy.*

Di Franco, G., Fratini, L., Pasta, A., Ruisi, V.F.ON THE SELF-PIERCING RIVETING OF ALUMINIUM BLANKS AND CARBON FIBRE COMPOSITE PANELS

*International Journal of Material Forming, Volume 6, Issue 1, 2013, Pages 137-144*Aluminum blanks; Carbon fiber composite; Carbon fibre composites; Failure mechanics; Hybrid joints; Load carrying capability; Process mechanics; Process parameters; Residual stress state; Self-piercing riveting; Tensile tests; Transverse section Engineering controlled terms: Carbon fibers; Computer system recovery; Fusion reactor divertors; Riveting; Tensile testing Engineering main heading: Structural panels *In the present paper the possibility to join aluminium alloys blanks and carbon fibre composites panels by self-piercing riveting operation is considered. In particular a few case studies were carried out at the varying of the process parameters. The effectiveness of the obtained joints was tested through tensile tests and through fatigue ones; what is more the process mechanics was highlighted through proper macro and micro observations of the transverse sections of the joints. The failure mechanics of the obtained joints were also considered in order to highlight the mechanisms which occur and determine the lost of the load carrying capability of the joints. Finally a numerical model of the process was carried out and the residual stress state after piercing was highlighted. The developed experiments and simulations demonstrated that self-piercing riveting can be effectively used to join carbon fiber composite panels and aluminum blanks.*

Buffa, G., Campanella, D., Fratini, L.ON TOOL STIRRING ACTION IN FRICTION STIR WELDING OF WORK HARDENABLE ALUMINIUM ALLOYS

*Science and Technology of Welding and Joining, Volume 18, Issue 2, February 2013, Pages 161-168*Butt joints; Experimental campaign; FEM models; FSW; Metallurgical behavior; Numerical results; Solid state bonding; Transverse section; Welded materials; Zigzag lines Engineering controlled terms: Finite element method; Mechanical properties Engineering main heading: Friction stir welding *In the paper solid state bonding conditions obtained in friction stir welding (FSW) of AA5754-H111 butt joints are analysed, considering the so called zigzag line in the transverse section of the joints. A wide experimental campaign was carried out varying both tool advancing speed and tool rotational one. The effects of the process on the mechanical properties of the joint were highlighted and micro-and macro-observations were used in order to explain the reasons of the enhanced mechanical properties found for the welded material. Numerical results derived from a FEM model previously developed by the authors were utilised to point out the different mechanical and metallurgical behavior of the obtained joints.*

Lupo, T.STRATEGIC ANALYSIS OF TRANSIT SERVICE QUALITY USING FUZZY AHP METHODOLOGY

*European Transport - Trasporti Europei, Issue 53, April 2013*AHP method; Fuzzy sets theory; Servqual models; Transit services; Uncertainty management Engineering controlled terms: Customer satisfaction; Fuzzy sets; Hierarchical systems; Mass transportation; Quality of service; Uncertainty analysis Engineering main heading: Quality control *Customer satisfaction analyses are deeply based on customers' judgments and as consequence, they can be characterized by a certain degree of uncertainty generally ascribed to coexistence of three relevant aspects: vagueness, imprecision and subjectivity. In the present paper, a methodology able to handle such uncertainty, based on the ServQual discrepancy paradigm and that uses in combined manner the AHP method and the Fuzzy Sets Theory is proposed in order to overcome limitations of the traditional service evaluation approaches. Subsequently, by considering the Italian public transit service sector, a service quality analysis is conducted and the overall transit service quality structure is described. Finally, by using the developed methodology, the evaluation of customer satisfaction for the public urban transit service provided in the city of Palermo (Italy) is performed, and the prioritizing of its critical to quality service attributes is carried out. The obtained results show that only few service attributes play an important role in performing a quality transit service.*

Lupo, T.THE NEW NINO CAPABILITY INDEX FOR DYNAMIC PROCESS CAPABILITY ANALYSIS

Quality and Reliability Engineering International, 2013The process capability analysis is a crucial activity to evaluate if the process outcome meets the design specifications. Classically, such analysis is performed by verifying the in-control condition of the process and evaluating suitable capability indices, by assuming the process in-control steady-state condition. However, the in-control period of the process characterizes only a part of the system functioning cycle, the one with the lower defective rate. In particular, the system functioning cycle is also characterized by the out-of-control period, during which a greater defective rate is produced, and such increasing is not considered by the widely adopted capability indices. As consequence, the classical approaches to perform the process capability analysis involves an overestimation of the process capability level. For this reason, in order to overcome the previously described limitation, in the present paper it is proposed a new capability index based on the real defective rate of the process. Thus, such new index is able to estimate the real process capability level. Finally, in order to compare the new index to the conventional C p capability index, a numerical comparison study related to a process capability analysis is carried out, and the related practical considerations are given.

Lupo, T.THE OPTIMIZATION OF A MAINTENANCE POLICY RELATED TO A GLOBAL SERVICE CONTRACT

*Proceedings - 19th ISSAT International Conference on Reliability and Quality in Design, RQD 2013, 2013, Pages 260-264*Corrective maintenance; Global services; Maintenance policy; Maintenance services; Opportunistic maintenance; Optimization modeling; Practical systems; Service provider Engineering controlled terms: Contracts; Mathematical models; Optimization

Engineering main heading: Maintenance *With refer to a Global Service Contract between a Service Provider and a Logistic Company, the purpose of the present paper is to develop an optimization model aimed to minimize the maintenance related total cost. In particular, such contract requires the supplying of a mandatory set of corrective maintenance services on a set of equal vehicles, in a fixed time horizon. The considered problem is formulated by a non-linear constrained mathematical model that, for large practical systems as the one herein considered, becomes difficult or very hard to solve by mathematical resolution approach. For this reason, a specific resolution approach based on a constrained genetic algorithm is herein developed to solve the treated problem. The obtained results show that meaningful cost reductions can be achieved by using the proposed approach.*

Parma

Casoli, A., Cremonesi, P., Isca, C., Groppetti, R., Pini, S., Senin, N.EVALUATION OF THE EFFECT OF CLEANING ON THE MORPHOLOGICAL PROPERTIES OF ANCIENT PAPER SURFACE

*Cellulose, Volume 20, Issue 4, August 2013, Pages 2027-2043*Agar gel; Contact profilometry; Environmental conditions; Gellan gum; Morphological properties; Roughness of surface; Scanning electrons; Surface microtopography Engineering controlled terms: Algae; Brushes; Cellulose; Dry cleaning; Ethers; Fourier transform infrared spectroscopy; Gels; Papermaking; Pulp materials; Scanning electron microscopy; Surface roughness Engineering main heading: Surfaces PaperChem Variable: Agar; Algae; Brushes; Cellulose; Cleaning; Ethers; Fourier Analysis; Gums; Infrared Spectroscopy; Paper Making; Scanning Electron Microscopy *In the conservation field, the original morphology and texture of the paper surface represent an important aspect to be preserved as historical evidence of the papermaking process. The aim of this preliminary research is to evaluate the effects of aqueous (cellulose ethers, rigid gels of Agar and Gellan gum) and not aqueous cleaning treatments (a typical dry cleaning treatment with wishab sponge) on the original surface morphology of late nineteenth century paper. Nineteenth century newspaper paper was chosen because it is strongly affected by cellulose oxidation and depolimerization due to the rough materials (wood pulp) and the papermaking process used at the time and to the environmental conditions (light, humidity, temperature) to which such paper has been subjected. A preliminary characterization of the paper with Herzberg and Phloroglucinol reactives and Fourier Transform infrared Spectroscopy analysis was performed to understand the paper composition and the type of inorganic fillers used. The paper surface microtopography was then measured by contact profilometry to analyze the effects of the cleaning treatments on paper surface roughness. The effects of the cleaning action was qualitatively evaluated by means of stereo microscopy and scanning electron microscopy. Preliminary results suggest that the treatments which are most respectful of the original surface micromorphology of the paper are those based on the use of rigid gels (Agar and Gellan gum), because they determine the smallest variation in the roughness of surface paper, unlike the*

application of cellulose ethers by brush. This finding was confirmed by statistical analysis of the roughness results by means of ANOVA and Tukey HSD post hoc test.

Pini, S., Groppetti, R., Senin, N.NATURAL LANGUAGE MANUAL PROGRAMMING FOR PULSED FIBER LASER MICROMACHINING

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 5-8, 2013, Pages 1451-1460*CNC; Computer numerical control; Laser micro-manufacturing; Natural languages; Part programs; Programming system; Pulsed fiber lasers; Statistical knowledge Engineering controlled terms: Computer control systems; Computer systems; Fiber lasers; Knowledge based systems; Syntactics Engineering main heading: Computer systems programming *This paper proposes the use of voice commands expressed in natural language for part program generation for pulsed fiber laser micromachining. Traditionally, according to ISO G-code, a part program is an ordered list of program blocks in an ASCII formatted computer file. Each block identifies a machine operation and defines its parameters, following a predefined syntax. Under the proposed approach, such a file is replaced by natural language voice commands without any particular syntax constraints. Such an approach has the potential to facilitate the generation of part programs in domains (laser micromanufacturing, rapid prototyping, desktop computer numerical control) where traditional ISO G-code programming seems inappropriate, and the adoption and implementation of complex solutions such as STEP-NC or CAD/CAM systems could be unjustified. The input system is responsible for the recognition and interpretation of voice commands according to a statistical knowledge base learnt from examples. The proposed approach has been implemented in a prototype computer system, named smart programming system that has been validated by an application to the programming of pulsed fiber laser micromachining.* EMTREE medical terms: article; bioinformatics; chromosome; data analysis software; gene control; gene expression; gene identification; gene location; gene mapping; information processing; transcription regulation *The full understanding of the mechanisms underlying transcriptional regulatory networks requires unravelling of complex causal relationships. Genome high-throughput technologies produce a huge amount of information pertaining gene expression and regulation; however, the complexity of the available data is often overwhelming and tools are needed to extract and organize the relevant information. This work starts from the assumption that the observation of co-occurrent events (in particular co-localization, co-expression and co-regulation) may provide a powerful starting point to begin unravelling transcriptional regulatory networks. Co-expressed genes often imply shared functional pathways; co-expressed and functionally related genes are often co-localized, too; moreover, co-expressed and co-localized genes are also potential targets for co-regulation; finally, co-regulation seems more frequent for genes mapped to proximal chromosome regions. Despite the recognized importance of analysing co-occurrent events, no bioinformatics solution allowing the simultaneous analysis of co-expression, co-localization and co-regulation is currently available. Our work resulted in developing and valuating CluGene, a software providing tools to analyze multiple types of co-occurrences within a single interactive environment allowing the interactive investigation of combined co-expression, co-localization and co-regulation of genes. The use of CluGene will enhance the power of testing hypothesis and*

experimental approaches aimed at unravelling transcriptional regulatory networks. The software is freely available at http://bioinfolab.unipg.it/.

Casoli, A., Cremonesi, P., Isca, C., Groppetti, R., Pini, S., Senin, N.EVALUATION OF THE EFFECT OF CLEANING ON THE MORPHOLOGICAL PROPERTIES OF ANCIENT PAPER SURFACE

*Cellulose, Volume 20, Issue 4, August 2013, Pages 2027-2043*Agar gel; Contact profilometry; Environmental conditions; Gellan gum; Morphological properties; Roughness of surface; Scanning electrons; Surface microtopography Engineering controlled terms: Algae; Brushes; Cellulose; Dry cleaning; Ethers; Fourier transform infrared spectroscopy; Gels; Papermaking; Pulp materials; Scanning electron microscopy; Surface roughness Engineering main heading: Surfaces PaperChem Variable: Agar; Algae; Brushes; Cellulose; Cleaning; Ethers; Fourier Analysis; Gums; Infrared Spectroscopy; Paper Making; Scanning Electron Microscopy *In the conservation field, the original morphology and texture of the paper surface represent an important aspect to be preserved as historical evidence of the papermaking process. The aim of this preliminary research is to evaluate the effects of aqueous (cellulose ethers, rigid gels of Agar and Gellan gum) and not aqueous cleaning treatments (a typical dry cleaning treatment with wishab sponge) on the original surface morphology of late nineteenth century paper. Nineteenth century newspaper paper was chosen because it is strongly affected by cellulose oxidation and depolimerization due to the rough materials (wood pulp) and the papermaking process used at the time and to the environmental conditions (light, humidity, temperature) to which such paper has been subjected. A preliminary characterization of the paper with Herzberg and Phloroglucinol reactives and Fourier Transform infrared Spectroscopy analysis was performed to understand the paper composition and the type of inorganic fillers used. The paper surface microtopography was then measured by contact profilometry to analyze the effects of the cleaning treatments on paper surface roughness. The effects of the cleaning action was qualitatively evaluated by means of stereo microscopy and scanning electron microscopy. Preliminary results suggest that the treatments which are most respectful of the original surface micromorphology of the paper are those based on the use of rigid gels (Agar and Gellan gum), because they determine the smallest variation in the roughness of surface paper, unlike the application of cellulose ethers by brush. This finding was confirmed by statistical analysis of the roughness results by means of ANOVA and Tukey HSD post hoc test.*

Pini, S., Groppetti, R., Senin, N.NATURAL LANGUAGE MANUAL PROGRAMMING FOR PULSED FIBER LASER MICROMACHINING

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 5-8, 2013, Pages 1451-1460*CNC; Computer numerical control; Laser micro-manufacturing; Natural languages; Part programs; Programming system; Pulsed fiber lasers; Statistical knowledge Engineering controlled terms: Computer control systems; Computer systems; Fiber lasers;

Knowledge based systems; Syntactics Engineering main heading: Computer systems programming *This paper proposes the use of voice commands expressed in natural language for part program generation for pulsed fiber laser micromachining. Traditionally, according to ISO G-code, a part program is an ordered list of program blocks in an ASCII formatted computer file. Each block identifies a machine operation and defines its parameters, following a predefined syntax. Under the proposed approach, such a file is replaced by natural language voice commands without any particular syntax constraints. Such an approach has the potential to facilitate the generation of part programs in domains (laser micromanufacturing, rapid prototyping, desktop computer numerical control) where traditional ISO G-code programming seems inappropriate, and the adoption and implementation of complex solutions such as STEP-NC or CAD/CAM systems could be unjustified. The input system is responsible for the recognition and interpretation of voice commands according to a statistical knowledge base learnt from examples. The proposed approach has been implemented in a prototype computer system, named smart programming system that has been validated by an application to the programming of pulsed fiber laser micromachining.*

Senin, N., Colosimo, B.M., Pacella, M.POINT SET AUGMENTATION THROUGH FITTING FOR ENHANCED ICP REGISTRATION OF POINT CLOUDS IN MULTISENSOR COORDINATE METROLOGY

*Robotics and Computer-Integrated Manufacturing, Volume 29, Issue 1, February 2013, Pages 39-52*Coordinate metrology; Iterative closest point; Model fitting; Multisensor data fusion; Registration Engineering controlled terms: Algorithms; Geometry; Measurement errors; Measurements; Scanning; Signal processing; Units of measurement Engineering main heading: Coordinate measuring machines *In multisensor coordinate metrology scenarios involving the fusion of homogenous data, specifically 3D point clouds like those originated by CMMs and structured light scanners, the problem of registration, i.e. The proper localization of the clouds in the same coordinate system, is of central importance. For fine registration, known variants of the Iterative Closest Point (ICP) algorithm are commonly adopted; however, no attempt seems to be done to tweak such algorithms to better suit the distinctive multisensor nature of the data. This work investigates an original approach that targets issues which are specific to multisensor coordinate metrology scenarios, such as coexistence of point sets with different densities, different spatial arrangements (e.g. sparse CMM points vs. gridded sets from light scanners), and different noise levels associated to the point sets depending on the metrological performances of the sensors involved. The proposed approach is based on combining known ICP variants with novel point set augmentation techniques, where new points are added to existing sets with the purpose of improving registration performance and robustness to measurement error. In particular, augmentation techniques based on advanced fitting solutions promote a paradigm shift for registration, which is not seen as a geometric problem consisting in moving point sets as close as possible to each other, but as a problem where it is not the original points, but the underlying geometries that must be brought together. In this work, promising combinations of ICP and point augmentation techniques are investigated through the application to virtual scenarios involving synthetic geometries and simulated measurements. Guidelines for*

approaching registration problems in industrial scenarios involving multisensor data fusion are also provided.

Pisa

Romoli, L., Musacchio, A., Franco, A., Fierro, M.C., Dini, G.A DOUBLE-POINT MOVING SOURCE MODEL FOR PREDICTING SEAM GEOMETRY IN LASER WELDING

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 1, 2013, Pages 219-222*CW Nd:YAG laser; Geometrical features; Intermediate regimes; Keyhole welding; Moving point source; Relative distances; Superposition principle; Transitional regimes Engineering controlled terms: Forecasting; Laser beam welding; Models; Stainless steel; Welds Engineering main heading: Neodymium lasers *A theoretical double moving point source model, based on the superposition principle, is proposed for predicting the weld seam geometry produced by a CW Nd:YAG laser in a constrained overlap configuration on a martensitic stainless steel in a transitional regime between pure conduction and keyhole welding. This intermediate regime is modelled by varying the power balance between the two point sources along with their relative distance. Tests show that the main geometrical features of the weld bead (penetration depth and resistance length) are comparable to the predicted values (error less than 5%). Finally the model can be also profitably used in order to predict the temperature field around the molten pool.*

Fantoni, G., Hansen, H.N., Santochi, M.A NEW CAPILLARY GRIPPER FOR MINI AND MICRO PARTS

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 1, 2013, Pages 17-20*Adhesion forces; Adhesive force; Capillary force; Capillary grippers; Handling; Hydrophobic and hydrophilic; Micro assembly; Novel strategies Engineering controlled terms: Assembly; Hydrophilicity; Hydrophobicity Engineering main heading: Grippers *In the assembly of microproducts the grasping and releasing phases are key tasks. Since in the microdomain gravity becomes negligible in comparison with adhesion forces, several reliable grasping methods have been developed. On the contrary, the releasing phase is still very critical because the part tends to stick to the gripper. In this paper a novel strategy based on capillary forces both for grasping and releasing is proposed. This novel grasping-releasing strategy exploits the transition between hydrophobic and hydrophilic surfaces to change the grasping force. The paper starts from the releasing problem in microassembly, deals with the manufacturing of hydrophobic and hydrophilic surfaces and demonstrates the use of such structures to grasp and release delicate mini and microparts.*

Fantoni, G., Apreda, R., Dell'Orletta, F., Monge, M.AUTOMATIC EXTRACTION OF FUNCTION-BEHAVIOUR-STATE INFORMATION FROM PATENTS

*Advanced Engineering Informatics, Volume 27, Issue 3, August 2013, Pages 317-334*Automatic extraction; Design information; Engineering design; Extract informations; Function-Behaviour-Structure; Patent informatics; Regular expressions; Technical information Engineering controlled terms: Computational linguistics; Group theory; Knowledge based systems; Pattern matching; Product design; Product development; Semantics; Tools Engineering main heading: Patents and inventions *Patents contain a large quantity of technical information not available elsewhere and therefore very interesting for both academia and industry. The purpose of the research is to try to detect and extract information about the functions, the physical behaviours and the states of the system directly from the text of a patent in an automatic way. The above three categories constitute a well-known set of relevant entities in the theory of engineering design, and their study allows powerful analysis of individual artefacts as well as that of groups of products or technologies. The focus is in providing a handy tool that could speed up and facilitate human analysis and allow tackling also large corpora of documents. A second goal is to develop a protocol based on free software and database resources, so that it could be replicable with limited effort by everyone without having to rely on commercial databases. Extracting technical and design information from a document whose aim is more legal than technical, and that is written using a specific jargon, is not a trivial task. The approach chosen to overcome the various issues is to support state-of-the-art Computational Linguistic tools with a large Knowledge Base. The latter has been constructed both manually and automatically and comprises not only keywords but also concepts, relationships and regular expressions. A case study about a very recent patent describing a mechanical device has been included to show the functioning and output of the entire system.*

Leu, M.C., Elmaraghy, H.A., Nee, A.Y.C., Ong, S.K., Lanzetta, M., Putz, M., Zhu, W., Bernard, A.CAD MODEL BASED VIRTUAL ASSEMBLY SIMULATION, PLANNING AND TRAINING

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 2, 2013, Pages 799-822*CAD modeling; Computer aided design models; Digital data acquisitions; Human computer interfaces; Integrated methodology; Research and development; Simulation; Virtual assembly simulations Engineering controlled terms: Assembly; Computer simulation; Electronic data interchange Engineering main heading: Computer aided design *This paper reviews the state-of-the-art methodologies for developing computer-aided design (CAD) model based systems for assembly simulation, planning and training. Methods for CAD model generation from digital data acquisition, motion capture, assembly modeling, human-computer interface, and data exchange between a CAD system and a VR/AR system are described. Also presented is an integrated methodology for designing, planning, evaluating and testing assembly systems. The paper further describes the implementation of these methods and provides application examples of CAD model*

based simulation for virtual assembly prototyping, planning and training. Finally, the technology gaps and future research and development needs are discussed.

Fantoni, G., Gabelloni, D., Tilli, J.CONCEPT DESIGN OF NEW GRIPPERS USING ABSTRACTION AND ANALOGY

*Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, Volume 227, Issue 10, October 2013, Pages 1521-1532*Concept designs; Conceptual phase; Creativity support; Design by analogies; Design phase; Design solutions; Simple system Engineering controlled terms: Abstracting; Functional analysis; Grippers Engineering main heading: Design *Design by analogy is a powerful technique for new design solutions. In the literature, there are two possible approaches. The first is more user-friendly but is low structured. The other is more complex, which structures the problem better but is highly time-consuming. This article presents a simple system for structuring the design-by-analogy method, which is based on the abstraction of the problem. The application of these solutions resulted in an increase in design possibilities. Results were collected in a repository, whose order is based on functional logic. The proposed technique was tested on the conceptual phase in the design of novel grippers. The application resulted in the development of innovative grippers. The process can be extended to many different fields. The method can be used as a creativity support during the design phase, also creating repositories that can be enlarged and reused for different applications.*

Tincani, V., Grioli, G., Catalano, M.G., Bonilla, M., Garabini, M., Fantoni, G., Biechi, A.CONTROLLING THE ACTIVE SURFACES OF THE VELVET FINGERS: STICKY TO SLIPPY FINGERS

*IEEE International Conference on Intelligent Robots and Systems, 2013, Article number 6697152, Pages 5494-5499*Active surfaces; Contact surface; Control electronics; Grasping and manipulation; Modeling and control; Novel concept; Re-orientation; Smart grippers Engineering controlled terms: Conveyors; Grippers; Intelligent robots Engineering main heading: Silk *Industrial grippers are often used for grasping, while in-hand re-orientation and positioning are dealt with by other means. Contact surface engineering has been recently proposed as a possible mean to introduce dexterity in simple grippers, as in the Velvet Fingers smart gripper, a novel concept of end-effector combining simple under-actuated mechanics and high manipulation possibilities, thanks to conveyors which are built in the finger pads. This paper undergoes the modeling and control of the active conveyors of the Velvet Fingers gripper which are rendered able to emulate different levels of friction and to apply tangential thrusts to the contacted objects. Through the paper particular attention is dedicated to the mechanical implementation, sense drive and control electronics of the device. The capabilities of the prototype are showed in some grasping and manipulation experiments.*

Gabelloni, D., Fantoni, G.DESIGNERS' PROMISES OR USERS' EXPECTATIONS?

*Proceedings of the International Conference on Engineering Design, ICED, Volume 1 DS75-01, 2013, Pages 279-288*Design cognition; Design process; Design theory; FBS models; Formal model; Function-behavior-structure; Functional modelling; Paper models Engineering controlled terms: Engineering; Industrial engineering Engineering main heading: Design *Several frameworks describe the design process, such as the FBS model and its extensions. Some of them present a designer-centric view, while the most recent ones are more based on the user's point of view. This paper investigates and seeks to explain the different perspectives between designer and user after the first interactions with the product. In particular, the paper models how the designer's promises of functionalities match (or mismatch) the user's expectations. Thus twenty-four examples, including misuses, unperceived functions, hidden functions, failures etc., are mapped in a table. The paper provides also a formal model based on Function-Behavior-Structure approach to describe the possible cases of misunderstanding between the user and the designer. Such a model formally links the designed product, as it is conceived by the designer, and the perceived product, as it is understood and interpreted by the user. Finally a series of redesigned actions are proposed to try to overcome some of the cases of misunderstanding between the user's and the designer's perspectives.*

Santochi, M., Tincani, V., Fantoni, G.DIRECT BAR CODE WRITING IN TURNING OPERATIONS

*Procedia CIRP, Volume 9, 2013, Pages 23-28*Code-writing; Cylindrical surface; Functional characteristics; Information; Lateral surface; Manufacturing process; Micro-texture; Turning operations Engineering controlled terms: Manufacture; Turning Engineering main heading: Bar codes *The paper presents a method to store data in a workpiece directly during its manufacturing process. During turning a sort of bar code can be added to a workpiece by simply modifying its surface. The code can be written by using the same tool used for rough-turning or finishing, can be fully automatized and the new microtexture can be easily read along all the cylindrical surface. The written code involves a limited length and does not alter deeply the functional characteristic of the surface, while the wide lateral surface prevents the information to be lost as a consequence of dents and scratches.*

Venturi, F., Zinnai, A., Fantoni, G., Gabelloni, D., Razionale, A.V.GLASS AND WINE: THE INDISSOLUBLE MARRIAGE

*Proceedings of the International Conference on Engineering Design, ICED, Volume 7 DS75-07, 2013, Pages 497-506*Design Methodology; Design practice; Experimental activities; Experimental analysis; Functional modelling; Geometrical features; Industrial case study; New product development Engineering controlled terms: Functional analysis; Glass; Sensory perception; Wine Engineering main heading: Product design *The FBS model describes*

theoretically the design process of a product. Only few papers present real industrial case studies, which are generally finalized to illustrate theoretical concepts. The aim of this paper is to show a methodology and its testing on the design of new tasting glasses, based both on the FBS model and on experimental analysis. This is an interesting theme in the food design area. Indeed a tasting glass is the interface used to convey wine characteristics to human senses (sight, taste and smell). The glass influence on the evolution of sensory perception of wine is not fully understood and rarely evaluated. The analysis is composed of: (i) an experimental activity to understand the evolution of sensory profiles of a well-structured red wine maintained in different types of glasses through expert testers, (ii) the selection of one of the most important function carried on by the product, and therefore the study of the related behaviours, (iii) the identification of the correlation between the behaviours and the design parameters of the glass. Finally a method and tools to extract and measure the geometrical feature of the glass are presented.

Lanzetta, M., Iagnemma, K.GRIPPING BY CONTROLLABLE WET ADHESION USING A MAGNETORHEOLOGICAL FLUID

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 1, 2013, Pages 21-25*Damping system; Future research directions; Handling; Magneto-rheological properties; Performance analysis; Wet adhesion Engineering controlled terms: Automotive industry; Magnetorheological fluids; Models Engineering main heading: Adhesion *The magnetorheological properties of ferrofluids (or smart, or active fluids) are well known, and are currently exploited in shear in advanced damping systems in the automotive industry, robotics (prosthesis), and machine tools (chatter reduction, positioning). This paper proposes an end effector for gripping by a novel form of controllable wet adhesion inspired by gastropod pedal mucus. The design of a gripper has been proposed, along with performance analysis based on experiments on various parameters, materials and surfaces, exhibiting robustness in unknown and dirty environment, typical of disassembly. Benefits over competing handling technologies and future research directions in this new area have been addressed.*

Rossi, A., Puppato, A., Lanzetta, M.HEURISTICS FOR SCHEDULING A TWO-STAGE HYBRID FLOW SHOP WITH PARALLEL BATCHING MACHINES: APPLICATION AT A HOSPITAL STERILISATION PLANT

*International Journal of Production Research, Volume 51, Issue 8, 2013, Pages 2363-2376*Batching machine; Benchmark data; Fixed time; Flow-shops; heuristics; Hybrid flow shop; Identical parallel machines; Machine setup; Makespan; Manual operations; Mixed-integer; Number of tardy jobs; Parallel batch; parallel batching; Set-up time; Two-stage hybrid flow shop Engineering controlled terms: Business machines; Health care; Scheduling Engineering main

heading: Scheduling algorithms *The model of a two-stage hybrid (or flexible) flow shop, with sequence-independent uniform setup times, parallel batching machines and parallel batches has been analysed with the purpose of reducing the number of tardy jobs and the makespan in a sterilisation plant. Jobs are processed in parallel batches by multiple identical parallel machines. Manual operations preceding each of the two stages have been dealt with as machine setup with standardised times and are sequence-independent. A mixed-integer model is proposed. Two heuristics have been tested on real benchmark data from an existing sterilisation plant: constrained size of parallel batches and fixed time slots. Computation experiments performed on combinations of machines and operator numbers suggest balancing the two stages by assigning operators proportionally to the setup time requirements.*

Tincani, V., Grioli, G., Catalano, M.G., Garabini, M., Grechi, S., Fantoni, G., Bicchi, A.IMPLEMENTATION AND CONTROL OF THE VELVET FINGERS: A DEXTEROUS GRIPPER WITH ACTIVE SURFACES

*Proceedings - IEEE International Conference on Robotics and Automation, 2013, Article number 6630955, Pages 2744-2750*Active surfaces; Contact surface; Control electronics; Design and control; Novel concept; Robot hand; Robotic end-effectors; Smart grippers Engineering controlled terms: Algorithms; Grippers; Robotic arms; Silk Engineering main heading: Robotics *Since the introduction of the first prototypes of robotic end-effectors showing manipulation capabilities, much research focused on the design and control of robot hand and grippers. While many studies focus on enhancing the sensing capabilities and motion agility, a less explored topic is the engineering of the surfaces that enable the hand to contact the object. In this paper we present the prototype of the Velvet Fingers smart gripper, a novel concept of end-effector combining the simple mechanics and control of under-actuated devices together with high manipulation possibilities, usually offered only by dexterous robotic hands. This enhancement is obtained thanks to active surfaces, i.e. engineered contact surfaces able to emulate different levels of friction and to apply tangential thrusts to the contacted object. Through the paper particular attention is dedicated to the mechanical implementation, sense drive and control electronics of the device; some analysis on the control algorithms are reported. Finally, the capabilities of the prototype are showed through preliminary grasps and manipulation experiments.*

Gabelloni, D., Montelisciani, G., Fantoni, G.IMPLEMENTING COLLABORATIVE CROWD SOURCING IN DIFFERENT DESIGN PROBLEMS

*Proceedings of the International Conference on Engineering Design, ICED, Volume 9 DS75-09, 2013, Pages 345-354*Collaborative design; Crowdsourcing; Multi-disciplinary teams; New product design; New product development; New product development process; Open innovation; Problem-solving sessions Engineering controlled terms: Innovation; Product development; Tools Engineering main heading: Product design *The new product development process increasingly*

involves multidisciplinary teams, that frequently do not belong to the same institution. Innovation often comes from external actors, as suppliers, end-users etc., according to the paradigm of Open Innovation. Crowdsourcing is one of the new trends in the Open Innovation philosophy. The main aim of this study is to present how and for which design activities crowdsourcing is useful for the new product design. After a brief definition of benefits and limitations of collaborative crowdsourcing, the paper presents a new web platform that allows the collaborative design of new products. The main features of the platform are tools suitable to overcome some of the presented criticalities of crowdsourcing, such as an IPR tracking system. These tests have been used to evaluate the developed tools, as well as to identify the typologies of product design problems that can be advantageously solved through crowdsourcing. For each class of problems some guidelines to manage the problem solving sessions are provided.

Khan, M.M.A., Romoli, L., Dini, G.LASER BEAM WELDING OF DISSIMILAR FERRITIC/MARTENSITIC STAINLESS STEELS IN A BUTT JOINT CONFIGURATION

*Optics and Laser Technology, Volume 49, 2013, Pages 125-136*Butt joints; Energy inputs; Ferritic/martensitic; Full factorial design; Geometrical features; Incident angles; Laser power; Laser welding parameters; Limiting values; Microcrack formation; Optimal parameter; Optimization criteria; Treatment techniques; Weld bead geometry; Welded components; Welding speed Engineering controlled terms: Butt welding; Lasers; Optimization; Steel; Welded steel structures; Welds Engineering main heading: Laser beam welding *This paper investigates laser beam welding of dissimilar AISI430F and AISI440C stainless steels. A combined welding and pre-and-postweld treatment technique was developed and used successfully to avoid micro-crack formation. This paper also examined the effects of laser welding parameters and line energy on weld bead geometry and tried to obtain an optimized laser-welded joint using a full factorial design of experiment technique. The models developed were used to find optimal parameters for the desired geometric criteria. All the bead characteristics varied positively as laser power increased or welding speed decreased. Penetration size factor decreased rapidly due to keyhole formation for line energy input in the range of 15-20 kJ/m. Laser power of 790-810 W and welding speed of 3.6-4.0 m/min were the optimal parameters providing an excellent welded component. Whatever the optimization criteria, beam incident angle was around its limiting value of 15° to achieve optimal geometrical features of the weld.*

Kling, R., Dijoux, M., Romoli, L., Tantussi, F., Sanabria, J., Mottay, E.METAL MICRO DRILLING COMBINING HIGH POWER FEMTOSECOND LASER AND TREPANNING HEAD

*Proceedings of SPIE - The International Society for Optical Engineering, Volume 8608, 2013, Article number 86080F*Chemical etching; Conicity; High-power femtosecond laser;

Metallographic analysis; Repetition rate; Revolution speed; Taper; Trepanning Engineering controlled terms: Drilling; Fits and tolerances; Industrial applications; Surface roughness; Ultrafast lasers Engineering main heading: Ultrashort pulses *Trepanning heads are well known to be efficient in high aspect drilling and to provide a precise control of the hole geometry. Secondly, femtosecond lasers enable to minimize the heat effects and the recast layer on sidewalls but are typically used on thin sheet. The combination of both present a high potential for industrial applications such as injector or cooling holes where the bore sidewall topology has a major influence on the dynamics of the gas flow. In this paper we present results using this combination. The effect of pulse energy, repetition rate and revolution speed of the head on both geometry and roughness are discussed. The quality of the sidewall is checked by roughness measurement and by metallographic analysis (SEM; chemical etching, micro hardness).*

Rossi, A., Lanzetta, M.NATIVE METAHEURISTICS FOR NON-PERMUTATION FLOWSHOP SCHEDULING

Journal of Intelligent Manufacturing, 2013, Pages 1-13The most general flowshop scheduling problem is also addressed in the literature as non-permutation flowshop (NPFS). Current processors are able to cope with the {Mathematical expression} combinatorial complexity of NPFS scheduling by metaheuristics. After briefly discussing the requirements for a manufacturing layout to be designed and modeled as non-permutation flowshop, a disjunctive graph (digraph) approach is used to build native solutions. The implementation of an Ant Colony Optimization (ACO) algorithm has been described in detail; it has been shown how the biologically inspired mechanisms produce eligible schedules, as opposed to most metaheuristics approaches, which improve permutation solutions. ACO algorithms are an example of native non-permutation (NNP) solutions of the flowshop scheduling problem, opening a new perspective on building purely native approaches. The proposed NNP-ACO has been assessed over existing native approaches improving most makespan upper bounds of the benchmark problems from Demirkol et al. (1998).

Rossi, A., Lanzetta, M.NONPERMUTATION FLOW LINE SCHEDULING BY ANT COLONY OPTIMIZATION

*Artificial Intelligence for Engineering Design, Analysis and Manufacturing: AIEDAM, Volume 27, Issue 4, November 2013, Pages 349-357*Ant colony systems; Bench-mark problems; Buffer requirements; Conventional manufacturing; Mixed integer linear programming; Non-permutation flowshop; Operation sequences; Optimization criteria Engineering controlled terms: Ant colony optimization; Artificial intelligence; Benchmarking; Linear programming; Manufacture; Scheduling algorithms Engineering main heading: Scheduling *A flow line is a conventional manufacturing system where all jobs must be processed on all machines with the same operation sequence. Line buffers allow nonpermutation flowshop scheduling and job sequences to be changed on different machines. A mixed-integer linear programming model for nonpermutation flowshop scheduling and the buffer requirement along with manufacturing implication is proposed. Ant colony optimization based heuristic is evaluated against Taillard's (1993) well-known flowshop benchmark instances, with 20 to 500 jobs to be processed on 5 to 20*

machines (stages). Computation experiments show that the proposed algorithm is incumbent to the state-of-the-art ant colony optimization for flowshop with higher job to machine ratios, using the makespan as the optimization criterion.

Prieto, P.A., Fantoni, G., Campolmi, R.ON PRODUCTS SHAPES AND PERSONALITIES

*Proceedings of the International Conference on Engineering Design, ICED, Volume 7 DS75-07, 2013, Pages 217-226*CAD system; Correlation analysis; Geometrical features; Multivariate statistical techniques; Product appearance; Product personality; Relevant features; Shape designs Engineering controlled terms: Conceptual design; Multivariant analysis; Surveys Engineering main heading: Product design *In this paper, preliminary results of the first stage of a long-term research that aims at systematizing the task of product design with an intended personality are reported. A survey was conducted to detect whether there is a correlation between product shapes and personalities. In the survey people were asked to associate personalities to shapes of different types of products. The data collected from the survey were analyzed using multivariate statistical techniques and the results obtained from correlation analysis between shapes and personalities are presented. At this stage, among the different aspects of the product appearance, the focus of the survey was on the shape of the product, as it is one of its most relevant features. The aim of this stage is to detect whether a high correlation exists between product shapes and product personalities. At the next stage if such correlation exists, the numerical description of the shape will be analyzed to identify common geometrical features of products sharing the same personality. This information can later be used as input for developing a new CAD system to assist designers to develop new products with embedded personalities.*

Rossi, A., Lanzetta, M.OPTIMAL BLIND SAMPLING STRATEGY FOR MINIMUM ZONE ROUNDNESS EVALUATION BY METAHEURISTICS

*Precision Engineering, Volume 37, Issue 2, April 2013, Pages 241-247*Ant colony systems; CMM; Evaluation problems; Global solutions; Meta heuristics; Minimum zone; Non-linear methods; Number of samples; Optimal sampling; Processing time; Roundness error; Sampling strategies Engineering controlled terms: Genetic algorithms; Particle swarm optimization (PSO) Engineering main heading: Heuristic algorithms *The minimum zone tolerance is a non linear method to find a global solution to the roundness evaluation problem. Metaheuristics such as genetic algorithms, ant colony systems and particle swarm optimization concurrently process a set of solution candidates (chromosomes, ants, particles etc.) within a given search-space. Computation experiments carried out with an effective genetic algorithm have shown that the optimal sampling strategy providing sufficient accuracy at acceptable processing time represents a compromise between number of sample points and search-space size. An estimate of the neighborhood of the centroid containing the minimum zone center is given.*

Meo, A., Profumo, L., Rossi, A., Lanzetta, M.OPTIMUM DATASET SIZE AND SEARCH SPACE FOR MINIMUM ZONE ROUNDNESS EVALUATION BY GENETIC ALGORITHM

*Measurement Science Review, Volume 13, Issue 3, June 2013, Pages 100-107*CMM; Estimation algorithm; Estimation results; Experimental test; Minimum zone; Profile measurement; Roundness error; Search space size Engineering controlled terms: Coordinate measuring machines; Genetic algorithms; Space platforms Engineering main heading: Statistical tests *Roundness is one of the most common features in machining. The minimum zone tolerance (MZT) approach provides the minimum roundness error, i.e. the minimum distance between the two concentric reference circles containing the acquired profile; more accurate form error estimation results in less false part rejections. MZT is still an open problem and is approached here by a Genetic Algorithm. Only few authors have addressed the definition of the search space center and size and its relationship with the dataset size, which greatly influence the inspection time for the profile measurement and the convergence speed of the roundness estimation algorithm for a given target accuracy. Experimental tests on certified roundness profiles, using the profile centroid as the search space center, have shown that the search space size is related to the number of dataset points and an optimum exists, which provides a computation time reduction up to an order of magnitude.*

Rossi, A., Lanzetta, M.ROUNDNESS: A CLOSED FORM UPPER BOUND FOR THE CENTROID TO MINIMUM ZONE CENTER DISTANCE BY WORST-CASE ANALYSIS

*Measurement: Journal of the International Measurement Confederation, Volume 46, Issue 7, 2013, Pages 2251-2258*Centroid neighborhood; Circularity; Minimum zone; MZC evaluation; Upper Bound Engineering controlled terms: Error analysis; Genetic algorithms Engineering main heading: Data communication equipment *The minimum zone tolerance (MZT) meets the ISO 1101 definition of roundness error: it determines two concentric circles that contain the roundness profile and such that the difference in radii is the least possible value. This article provides theoretical evidence that the minimum size of the neighborhood of the centroid containing the minimum zone center is* π *-1 E C , where E C is the roundness error related to the centroid, which can be evaluated in closed form. The implications of such linear estimating are twofold: (i) locating the part center with a given tolerance, e.g. for manufacturing tasks, such as handling (peg-hole) or machining (centering) and (ii) providing a search area for minimum zone center-based algorithms, such as metaheuristics (GA, PSO, etc.).*

Rossi, A., Lanzetta, M.SCHEDULING FLOW LINES WITH BUFFERS BY ANT COLONY DIGRAPH

*Expert Systems with Applications, Volume 40, Issue 9, July 2013, Pages 3328-3340*Ant colony systems; Bench-mark problems; Meta heuristics; Non-permutation flowshop; Swarm systems Engineering controlled terms: Artificial intelligence; Directed graphs; Flexible manufacturing systems; Heuristic algorithms; Scheduling; Scheduling algorithms Engineering main heading: Ant colony optimization *This work starts from modeling the scheduling of n jobs on m machines/stages as flowshop with buffers in manufacturing. A mixed-integer linear programing model is presented, showing that buffers of size n - 2 allow permuting sequences of jobs between stages. This model is addressed in the literature as non-permutation flowshop scheduling (NPFS) and is described in this article by a disjunctive graph (digraph) with the purpose of designing specialized heuristic and metaheuristics algorithms for the NPFS problem. Ant colony optimization (ACO) with the biologically inspired mechanisms of learned desirability and pheromone rule is shown to produce natively eligible schedules, as opposed to most metaheuristics approaches, which improve permutation solutions found by other heuristics. The proposed ACO has been critically compared and assessed by computation experiments over existing native approaches. Most makespan upper bounds of the established benchmark problems from Taillard (1993) and Demirkol, Mehta, and Uzsoy (1998) with up to 500 jobs on 20 machines have been improved by the proposed ACO.*

Cascini, G., Fantoni, G., Montagna, F.SITUATING NEEDS AND REQUIREMENTS IN THE FBS FRAMEWORK

*Design Studies, Volume 34, Issue 5, September 2013, Pages 636-662*Cognitive process; Design models; FBS models; Formal approach; Industrial projects; New product development; Transformation process; Water and energies Engineering controlled terms: Energy utilization; Product design; Specifications Engineering main heading: Product development *The paper proposes an extension of Gero's Function-Behaviour-Structure (FBS) framework aimed at representing Needs and Requirements and their relationships with the Function, the Behaviour and the Structure of an artefact. Needs and Requirements are modelled as further types of variables to describe, with the same formal approach of the situated FBS model, the transformation processes, which occur in the earlier stages of design. The proposed model is clarified through an application to the information gathered within an industrial project to reduce water and energy consumption of a washing machine. By situating Needs and Requirements into the FBS framework, it is possible to properly represent all the tasks and the related cognitive processes characterising the earliest stages of the new product development.*

Santochi, M., Failli, F.SUSTAINABLE WORK FOR HUMAN CENTRED MANUFACTURING

*Green Design, Materials and Manufacturing Processes - Proceedings of the 2nd International Conference on Sustainable Intelligent Manufacturing, SIM 2013, 2013, Pages 161-166*Assembly process; Chemical substance; Industrial experience; Physical agents; Professional knowledge; Sustainable manufacturing; Sustainable work; Work organization Engineering controlled terms: Compensation (personnel) Engineering main heading: Manufacture *Sustainable manufacturing is a term mainly used with reference to processes which eliminate or reduce waste, chemical*

substances or physical agents hazardous to human health and environment, spare energy and materials as much as possible. Less attention is generally given to social problems and working conditions: but sustainable manufacturing means also sustainable work, seen as a mix of physical and mental safety, satisfaction, acceptable working times, dignitous salary, opportunity of learning, to improve one's professional knowledge and competence. After an introduction dealing with the theories on work organization and related industrial experiences, the paper outlines the main problems of the assembly work and proposes some solutions for a future sustainable workplace in assembly processes.

Rashed, C.A.A., Romoli, L., Tantussi, F., Fuso, F., Burgener, M., Cusanelli, G., Allegrini, M., Dini, G.WATER JET GUIDED LASER AS AN ALTERNATIVE TO EDM FOR MICRO-DRILLING OF FUEL INJECTOR NOZZLES: A COMPARISON OF MACHINED SURFACES

*Journal of Manufacturing Processes, Volume 15, Issue 4, October 2013, Pages 524-532*Drilling techniques; EDM; Micro-drilling; Micro-jet; Randomly distributed; Scanning probe microscopy techniques; Shear force microscopy; Water jet guided lasers Engineering controlled terms: Drilling platforms; Drills; Fuel injection; Jets; Nozzles; Scanning probe microscopy; Surface properties Engineering main heading: Jet drilling *To characterize the inner surface of the fuel injector nozzle holes drilled by EDM and water jet guided laser drilling (Laser Micro-Jet) a specifically conceived scanning probe microscopy technique with true non-contact operating mode was used. A difference in morphology of the drilled surfaces is evident from the acquired surface topography along the hole axis for the two compared drilling techniques. Results showed that the surface texture can be characterized by (i) maximum peak-to-valley distance and (ii) periodicity. Acquired maps confirm that electro-eroded surfaces are an envelope of craters randomly distributed with total excursion up to 1.7 μm with a crater size of 15 μm. While, the efficient melt expulsion and immediate cooling of water jet guided laser generates a peak to valley distance of 800 nm with a periodicity of 18 μm. Average R q derived from the measured cylindrical surfaces was 450 nm and 150 nm for EDM and Laser Micro-Jet, respectively. Water jet guided laser drilling has proved to be a reliable alternative to EDM from the point of view of repeatability of the results and surface quality to facilitate the atomization of the fuel jet.*

Politecnica delle marche

Forcellese, A., Martarelli, M., Pandarese, G., Simoncini, M.SIMILAR AND DISSIMILAR FSWED JOINTS IN LIGHTWEIGHT ALLOYS: HEATING DISTRIBUTION ASSESSMENT AND IR THERMOGRAPHY MONITORING FOR ON-LINE QUALITY CONTROL

*Key Engineering Materials, Volume 554-557, 2013, Pages 1055-1064*Dissimilar joints; Experimental evaluation; Friction stir welded joints; FSW; Heating distributions; Light weight alloys; Non-contact measurement systems; On-line quality control Engineering controlled terms: Friction stir welding; Mechanical properties; Nondestructive examination; Quality assurance; Quality control; Surface defects; Thermocouples; Thermography (imaging); Welding; Welds Engineering main heading: Aluminum alloys *The heating distribution assessment on similar and dissimilar friction stir welded joints in AA6082 and AA5754 aluminium alloy sheets was investigated. The FSW experiments were carried out using constant rotational and welding speeds of 1500 rpm and 60 mm/min, respectively. Temperature was locally measured by means of K-type thermocouples inserted into thin grooves located on the bottom side of the sheets, in fixed positions, very close to the welding line. It was observed that the mechanical properties of joints are related to the heat distribution. In order to obtain a completely non intrusive temperature monitoring, that was able to follow the process dynamic, a non-contact measurement system based on infrared thermography was also developed. Such system, used for the experimental evaluation of temperature on the upper surface of the joints, is also able to detect the presence of flow defects with a non-destructive method, demonstrating its effectiveness as a diagnostic instrument for the on-line quality control of welded joints. Copyright*

Bruni, C., Zitti, S.THE FRICTION STIR WELDING OF CYLINDRICAL COMPONENTS

*Key Engineering Materials, Volume 554-557, 2013, Pages 1075-1082*Cylindrical components; Research activities; Rotational velocity; Tangential velocities Engineering controlled terms: Aluminum alloys; Models; Tools Engineering main heading: Friction stir welding *The present research activity aims at studying different conditions for the circumferential friction stir welding of cylindrical components in aluminium alloy. Different parameters have been considered, such as the rotational velocity of the tool, the tangential velocity of the cylindrical elements and the number of welding passes. The obtained data have been analysed and the strength of each joint modelled. It has been observed a relevant effect of the combination between the rotational velocity of the tool and the tangential velocity of the cylindrical components on the strength of the joint. Copyright*

Politecnico di bari

Galantucci, L.M., Percoco, G., Lavecchia, F.A NEW THREE-DIMENSIONAL PHOTOGRAMMETRIC FACE SCANNER FOR THE MORPHO-BIOMETRIC 3D FEATURE EXTRACTION APPLIED TO A MASSIVE FIELD ANALYSIS OF ITALIAN ATTRACTIVE WOMEN

*Procedia CIRP, Volume 5, 2013, Pages 259-264*3-D feature extraction; Attractiveness; Facial attractiveness; Facial scanner; Facial soft tissues; Linear measurements; Maxillofacial surgery;

Morphometric characteristics Engineering controlled terms: Anthropometry; Biometrics; Feature extraction; Photogrammetry; Scanning; Tissue engineering Engineering main heading: Three dimensional *The authors developed a method and a specific photogrammetric 3D scanning equipment for acquiring, analyze and measure the characteristics of the facial soft tissues. The system can be used in anthropometry and for the diagnosis and monitoring of therapy for maxillofacial surgery and for orthodontics. The experiments were conducted on a sample composed of 66 female subjects (64 Caucasian, 1 Ethiopian, 1 Brazilian) finalists at an Italian national Beauty competition done in the year 2010. The subjects were submitted on the same day to the acquisition of faces, according to a new clinical protocol. Morphometric characteristics of the faces were investigated extracting linear measurements, angles, distances and relationships between angles, calculated thanks to the measurement of facial soft tissue landmarks, through which it is possible to reconstruct simplified volumetric models of faces for each candidate. These data were compared with the historical ones available in literature. Performing a statistical analysis on the average values of the samples it was possible to obtain a very interesting indication of which facial parameters are related to facial attractiveness that diversify more different samples of attractive girls. An objective was to identify the aesthetic canons in the form and dimensions of the face of the 66 subjects. The protocol standardization has made it possible to carry out the relief of the sample recreating for all subjects scanned the same conditions in a reliable and fast way. The developed scanner confirmed to be precise for measurements, robust, fast in the relief, easy in the scanning operations, and furthermore it is portable, it has a low weight, low cost, being also completely non-invasive.*

Chimienti, M., Dassisti, M.A REVIEW AND ANALYSIS OF ENERGETIC SUSTAINABILITY OF COOLING/LUBRICATION TECHNOLOGIES FOR SMALL AND DEEP HOLE DRILLING OPERATIONS

Proceedings of the 26th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems, ECOS 2013, 2013The selection of the most suitable cooling/lubrication technology to reduce the severity of machining processes represents an important issue in machining. In addition, an improvement of cooling/lubrication condition may also have a sustainability impact in terms of resource efficiency, energy consumption, environmental and human impacts, as well as waste production. In this review paper, environmentally-benign alternatives to the traditional flood coolant application and their effects on the overall machining performance (i.e., drill-wear, drill-life, hole quality, etc.), have been explored for the case of small and deep hole drilling. At the end, some suggestions for future research direction have been provided.

Dassisti, M., Carnimeo, L.A SMALL-WORLD METHODOLOGY OF ANALYSIS OF INTERCHANGE ENERGY-NETWORKS: THE EUROPEAN BEHAVIOUR IN THE ECONOMICAL CRISIS

*Energy Policy, Volume 63, December 2013, Pages 887-899*Energy data; Energy interchange; European Commission; European energy policy; Interchange energy; Security of supply; Small worlds; Sustainable energy policy Engineering main heading: Energy policy GEOBASE Subject Index: economic instability; economic relations; energy efficiency; energy planning; energy policy; energy use; financial crisis; methodology; network analysis; political relations; sustainable development Regional Index: Europe *European energy policy pursues the objective of a sustainable, competitive and reliable supply of energy. In 2007, the European Commission adopted a proper energy policy for Europe supported by several documents and included an action plan to meet the major energy challenges Europe has to face. A farsighted diversified yearly mix of energies was suggested to countries, aiming at increasing security of supply and efficiency, but a wide and systemic view of energy interchanges between states was missing. In this paper, a Small-World methodology of analysis of Interchange Energy-Networks (IENs) is presented, with the aim of providing a useful tool for planning sustainable energy policies. A proof case is presented to validate the methodology by considering the European IEN behaviour in the period of economical crisis. This network is approached as a Small World Net from a modelling point of view, by supposing that connections between States are characterised by a probability value depending on economic/political relations between countries.*

Campanelli, S.L., Casalino, G., Ludovico, A.D., Bonserio, C.AN ARTIFICIAL NEURAL NETWORK APPROACH FOR THE CONTROL OF THE LASER MILLING PROCESS

*International Journal of Advanced Manufacturing Technology, Volume 66, Issue 9-12, June 2013, Pages 1777-1784*Ablation depth; ANN modeling; Artificial neural network approach; Back propagation artificial neural network (BPANN); Experimental campaign; Optimal machining parameters; Pulse frequencies; Trained neural networks Engineering controlled terms: Ablation; Algorithms; Computer aided design; Damage detection; Laser ablation; Laser beams; Machining centers; Mechanical alloying; Neural networks; Optimization Engineering main heading: Milling (machining) *Laser milling (LM) can be classified as a layer manufacturing process in which the material is removed by a laser beam by means of the ablation mechanism. It is a laser machining process which uses a laser beam to produce 3D shapes into a wide variety of materials. It is also known as laser ablation. It shows clear advantages versus the traditional milling such as the unlimited choice of materials, the direct use of computer-aided design structure data, the high geometric flexibility, and the touchless tool. LM requires the selection of optimal machining parameters for the job. Unlike the mechanical milling and the mechanical incision, the depth of the single removed layer is chosen at the beginning as input parameter of the process. In LM, the ablated depth depends from the process parameters such as laser power, scan speed, pulse duration, and pulse frequency. This work aims to develop an algorithm that can predict the parameters necessary to execute the material removal with a preset ablation depth. Using the results of an experimental campaign, the laser milling process was modeled by means of a back-propagation artificial neural network. Then, an iterative algorithm, based on the previous trained neural network, permitted to calculate the scanning velocity and pulse frequency that approached for the best the preset ablation depth. The developed approach*

represents a mean for the rational selection of laser ablation process parameters. It can be performed in an intuitive manner since it uses simple artificial intelligence like the artificial neural network.

Di Lecce, V., Quarto, A., Galiano, A., Dassisti, M., Chimienti, M.AN AUCTION BASED AGENCY FOR DEMAND SIDE MANAGEMENT SYSTEM: AN EVALUATION

*Conference Record - IEEE Instrumentation and Measurement Technology Conference, 2013, Article number 6555385, Pages 77-82*Comfort level; Critical condition; Demand side managements; Distributed measurements; Energy plant; Management data; Network node; Public buildings Engineering controlled terms: Instruments; Intelligent agents; Measurements; Multi agent systems; Profitability; Program processors; Sensor networks Engineering main heading: Information management *Aim of this work is to present a model of an intelligent short term demand side management system (DSM) based on a distributed measurement and management data system. The system is designed to improve the profitability of modern self-production energy plants reducing the power consumption and maintaining the same comfort level for users. The DSM problem is modeled as an auction based multi-agent system. The proposed system is composed of a sensor network and a central processing unit. Each network node is handled by an agent and it is able to regulate the power consumption of a single environment (in this work a room of a public building). Each agent reacts to a new critical condition entering in competition with the others to gain the access at a shared limited resource. The competition is regulated by an auction based system. As the first experimental results are showing, the proposed system can be the consumer's key to maximize the profitability of the self-production energy plants.*

Campanelli, S.L., Casalino, G., Casavola, C., Moramarco, V.ANALYSIS AND COMPARISON OF FRICTION STIR WELDING AND LASER ASSISTED FRICTION STIR WELDING OF ALUMINUM ALLOY

*Materials, Volume 6, Issue 12, 2013, Pages 5923-5941*Friction stir welding(FSW); Hybrid lasers; Lower temperatures; Non-consumable tools; Process parameters; Solid-state joining; Welding process; Welding speed Engineering controlled terms: Electric welding; Hardness; Microstructure; Residual stresses; Welds Engineering main heading: Friction stir welding *Friction Stir Welding (FSW) is a solid-state joining process; i.e., no melting occurs. The welding process is promoted by the rotation and translation of an axis-symmetric non-consumable tool along the weld centerline. Thus, the FSW process is performed at much lower temperatures than conventional fusion welding, nevertheless it has some disadvantages. Laser Assisted Friction Stir Welding (LAFSW) is a combination in which the FSW is the dominant welding process and the laser pre-heats the weld. In this work FSW and LAFSW tests were conducted on 6mm thick*

5754H111 aluminum alloy plates in butt joint configuration. LAFSW is studied firstly to demonstrate the weldability of aluminum alloy using that technique. Secondly, process parameters, such as laser power and temperature gradient are investigated in order to evaluate changes in microstructure, micro-hardness, residual stress, and tensile properties. Once the possibility to achieve sound weld using LAFSW is demonstrated, it will be possible to explore the benefits for tool wear, higher welding speeds, and lower clamping force.

Casalino, G., Campanelli, S.L., Maso, U.D., Ludovico, A.D.ARC LEADING VERSUS LASER LEADING IN THE HYBRID WELDING OF ALUMINIUM ALLOY USING A FIBER LASER

*Procedia CIRP, Volume 12, 2013, Pages 151-156*Experimental trials; High power fiber lasers; Hybrid welding; Laser heat sources; Leading configuration; Testing process; Weld appearances; Welding sources Engineering controlled terms: Fiber lasers; Industrial engineering; Welds Engineering main heading: Laser beam welding *Hybrid welding technology can be defined as the combination of a laser heat source with a secondary welding source. In this paper a new generation of high power fiber laser was used and it was coupled with a TIG arc source. Two separate sets of experimental trials were performed. It included testing process parameters such as laser power, welding speed and arc current. Microstructure, microhardness and weld appearance were analyzed. A comparison was performed between laser leading and arc leading configuration. The experimental results showed that the laser leading configuration produces a better penetration and sounder weld. The overall investigation gave the clear input that the laser leading configuration is more convenient with respect to the arc leading one. The obtained results worth a larger investigation for a statistical prove of the here presented results.*

Eltawahni, H.A., Rossini, N.S., Dassisti, M., Alrashed, K., Aldaham, T.A., Benyounis, K.Y., Olabi, A.G.EVALAUTION AND OPTIMIZATION OF LASER CUTTING PARAMETERSFOR PLYWOOD MATERIALS

*Optics and Lasers in Engineering, Volume 51, Issue 9, September 2013, Pages 1029-1043*Cutting edges; Laser cutting; Laser process parameters; Numerical optimizations; Optimal process; Plywood panels; Process factor; Process parameters Engineering controlled terms: Atmospheric pressure; Carbon dioxide; Cutting tools; Design of experiments; Laser applications; Laser beams; Mathematical models; Optimization; Plywood Engineering main heading: Wood products *Laser process parameters influence greatly the width of kerfs and quality of the cut edges. This article reports experiments on the laser plywood-cutting performance of a CW 1.5 kW CO 2 Rofin laser, based on design of experiments (DOE). The laser was used to cut three thicknesses 3, 6 and 9 mm of plywood panels. The process factors investigated are: laser power, cutting speed, air pressure and focal point position. The aim of this work is to relate the cutting edge quality parameters namely: upper kerf (UK), lower kerf (LK), the ratio between upper to*

lower kerfs and the operating cost to the process parameters mentioned above. Mathematical models were developed to establish the relationship between the process parameters and the edge quality parameters, and special graphs were drawn for this purpose. Finally, a numerical optimization was performed to find out the optimal process setting at which both kerfs would lead to a ratio of about 1, and at which low cutting cost take place.

Sorgente, D., Palumbo, G., Scintilla, L.D., Tricarico, L.EVALUATION OF THE STRAIN BEHAVIOUR OF BUTT JOINTS ON AZ31 MAGNESIUM ALLOY THIN SHEETS WELDED BY ND:YAG LASER

*International Journal of Advanced Manufacturing Technology, Volume 67, Issue 9-12, 2013, Pages 2753-2763*AZ31 magnesium alloy; Biaxial stretch; Biaxial stretching; Digital image correlations; Laser welded joints; Morphological defects; ND : YAG lasers; Technological behaviour Engineering controlled terms: Formability; Image analysis; Laser beam welding; Magnesium alloys; Mechanical properties; Strain measurement; Welds Engineering main heading: Neodymium lasers *In this work, the mechanical and technological behaviour of AZ31 magnesium alloy laser welded joints is investigated. The forming behaviour of the joints is analysed by both tensile and biaxial stretch tests. Each test is monitored using a digital image correlation system in order to acquire the complete strain field during the whole test. Both in tensile and biaxial stretching tests, the strain maps reveal that the weld bead makes the strain path experienced by the welded specimen more critical than the one experienced by the base material, and this can be related to morphological defects of the weld bead.*

Scintilla, L.D., Tricarico, L.EXPERIMENTAL INVESTIGATION ON FIBER AND CO

*Optics and Laser Technology, Volume 46, Issue 1, March 2013, Pages 42-52*Assist gas; AZ31 magnesium alloy; AZ31 magnesium alloy sheet; Continuous wave modes; Cutting edges; Cutting efficiency; Cutting experiment; Cutting quality; Cutting speed; Edge quality; Experimental investigations; Focal positions; Laser cutting; Laser performance; Laser sources; Optimal combination; Optimal conditions; Process efficiency; Processing parameters; Thick sheets Engineering controlled terms: Argon; Argon lasers; Cutting; Cutting tools; Fiber lasers; Magnesium alloys; Optimization; Surface roughness Engineering main heading: Carbon dioxide *The influence of processing parameters and laser source type on cutting edge quality of AZ31 magnesium alloy sheets and differences in cutting efficiency between fiber and CO 2 lasers were studied. A first part of the cutting experiments compared a fiber and CO 2 laser source when cutting 1 mm thick sheets in continuous wave mode and using Argon as an assist gas. The effects of cutting speed and assist gas pressure were investigated and optimal conditions were identified. In the second part of the experimental investigation, 3.3 mm thick sheets were cut using fiber laser. Focal position and cutting speed were varied in order to detect the optimal combination of processing parameters to obtain the best edge quality. For both sheet thicknesses investigated, surface roughness, dross height, and striation pattern inclination were measured.*

Cutting quality assessment and classification was carried out according to UNI EN ISO 9013 standard. Results showed that productivity, process efficiency and cutting edges quality obtained using fiber lasers outperform CO 2 laser performances and therefore are considered suitable for application like sheet metal trimming.

Scintilla, L.D., Palumbo, G., Sorgente, D., Tricarico, L.FIBER LASER CUTTING OF TI6AL4V SHEETS FOR SUBSEQUENT WELDING OPERATIONS: EFFECT OF CUTTING PARAMETERS ON BUTT JOINTS MECHANICAL PROPERTIES AND STRAIN BEHAVIOUR

*Materials and Design, Volume 47, May 2013, Pages 300-308*Butt joints; Butt welded joint; Cut edge; Cutting edges; Cutting parameters; Digital image correlation technique; Digital image correlations; Effect of the gap; Gap values; Laser cutting; Mechanical behavior; Mechanical characterizations; Mechanical performance; ND : YAG lasers; New high; Optimal ranges; Optimal welding; Plastic behaviour; Strain analysis; Thick sheets; Ti-6al-4v; Welding operations Engineering controlled terms: Butt welding; Carbon dioxide; Cutting; Fiber lasers; Image analysis; Laser applications; Laser beams; Lasers; Milling (machining); Optimization; Strain; Strain measurement; Titanium alloys; Turning; Welding Engineering main heading: Neodymium lasers *The effect of laser cutting parameters on the mechanical behavior of laser butt welded joints whose edges were obtained by laser cutting was investigated. The paper aims to demonstrate that new high power solid-state fiber lasers not only represent a valid and reliable alternative to the most established CO 2 and Nd:YAG laser sources, but also allow to obtain cuts having edges well suited for subsequent direct laser welding. First Ti6Al4V 1mm thick sheets having edges machined by milling were laser welded. Once the optimal welding condition was determined, the mechanical characterization of sheets cut by fiber laser and then laser welded was performed. Comparative strain analysis performed by a digital image correlation technique highlighted the effect of the gap between the sheets resulting from the different cut edge quality. Experimental results showed that the correct selection of laser cutting parameters allows to obtain butt joints characterised by mechanical properties comparable with the ones obtained by milling. Cutting edge quality in the optimal range of gap values allows to obtain the best mechanical performances of the joint.*

Scaraggi, M., Mezzapesa, F.P., Carbone, G., Ancona, A., Tricarico, L.FRICTION PROPERTIES OF LUBRICATED LASER-MICRO-TEXTURED-SURFACES: AN EXPERIMENTAL STUDY FROM BOUNDARY TO HYDRODYNAMIC LUBRICATION

Tribology Letters, Volume 49, Issue 1, January 2013, Pages 117-125We present measurements of friction coefficient of lubricated laser surface textured (LST) microstructures with two different geometries. The former is made of a square lattice of microholes; the latter is constituted by a series of microgrooves. We analyze sliding velocities spanning more than two orders of magnitude to cover the entire range from the boundary to the hydrodynamic regime. In all cases, the interfacial pressure is limited to values (relevant to particular manufacturing processes) which allow to neglect macroscopic elastic deformations, piezoviscosity and oil compressibility effects. The measured Stribeck curves data are compared with those obtained for the flat control surface and show that the regular array of microholes allows to reduce friction over the entire range of lubrication regimes with a decrease of about 50 % in the hydrodynamic regime. On the contrary, the parallel microgrooves lead to an increase of friction compared to the flat control surface with a maximum increase of about 80-100 % in the mixed lubrication regime. These remarkably opposite friction results are then explained with the aid of numerical simulations. Our findings confirm that LST may have cutting edge applications in engineering, not only in classical applications (e.g., to reduce piston-ring friction losses in internal combustion engines) but also, in particular, in technological processes, such as hydroforming, superplastic forming, where the mapping of the frictional properties of the mold has a crucial role in determining the final properties of the mechanical component.

Scaraggi, M., Mezzapesa, F.P., Carbone, G., Ancona, A., Tricarico, L.FRICTION PROPERTIES OF LUBRICATED LASER-MICROTEXTURED-SURFACES: AN EXPERIMENTAL STUDY FROM BOUNDARY- TO HYDRODYNAMIC-LUBRICATION

*Tribology Letters, Volume 49, Issue 1, January 2013, Pages 117-125*Cutting edges; Different geometry; Experimental studies; Friction coefficients; Friction loss; Friction properties; Frictional properties; Hydrodynamic regime; Interfacial pressure; Laser surface; LST; Lubrication regimes; Manufacturing process; Measurements of; Mechanical components; Micro holes; Mixed lubrication; Oil compressibility; Orders of magnitude; Regular array; Sliding velocities; Square lattices; Stribeck curve; Superplastic forming; Surface-texturing; Technological process Engineering controlled terms: Bearings (structural); Control surfaces; Elastohydrodynamic lubrication; Hydrodynamics; Internal combustion engines; Laser ablation; Lubrication; Tribology Engineering main heading: Friction *We present measurements of friction coefficient of lubricated laser surface textured (LST) microstructures with two different geometries. The former is made of a square lattice of microholes; the latter is constituted by a series of microgrooves. We analyze sliding velocities spanning more than two orders of magnitude to cover the entire range from the boundary to the hydrodynamic regime. In all cases, the interfacial pressure is limited to values (relevant to particular manufacturing processes) which allow to neglect macroscopic elastic deformations, piezo-viscosity and oil compressibility effects. The measured Stribeck curves data are compared with those obtained for the flat control surface and show that the regular array of microholes allows to reduce friction over the entire range of lubrication regimes with a decrease of about 50 % in the hydrodynamic regime. On the contrary, the parallel microgrooves lead to an increase of friction compared to the flat control*

surface with a maximum increase of about 80-100 % in the mixed lubrication regime. These remarkably opposite friction results are then explained with the aid of numerical simulations. Our findings confirm that LST may have cutting edge applications in engineering, not only in classical applications (e.g.; to reduce piston-ring friction losses in internal combustion engines) but also, in particular, in technological processes, such as hydroforming, superplastic forming, where the mapping of the frictional properties of the mold has a crucial role in determining the final properties of the mechanical component.

Scintilla, L.D., Tricarico, L.FUSION CUTTING OF ALUMINUM, MAGNESIUM, AND TITANIUM ALLOYS USING HIGH-POWER FIBER LASER

*Optical Engineering, Volume 52, Issue 7, 2013, Article number 076115*Cut quality; Cutting speed; High power fiber lasers; High productivity; Laser cutting; Light weight alloys; Main process; ND : YAG lasers Engineering controlled terms: Alloys; Aluminum; Automotive industry; Carbon dioxide; Laser beam cutting; Laser beams; Magnesium; Sheet metal; Titanium; Titanium alloys Engineering main heading: Fiber lasers *The effects of cutting speed and assist gas pressure on laser cutting of 1-mm thick Al 1050, AZ31, and Ti6Al4V lightweight alloys are experimentally investigated. Fiber laser cutting of these materials is not broadly investigated and the acquisition of a new level of knowledge is of fundamental importance for applications like sheet metal trimming in automotive industry. The main process outputs are in depth compared with results reported in literature and obtained by cutting with CO 2 and Nd:YAG lasers. The good cut quality, the high productivity, and the easy delivery of the beam obtained at the same time, corroborate the advantage of using fiber lasers for thin sheets lightweight alloys cutting.*

Casalino, G., Campanelli, S., Ludovico, A.D.HYBRID WELDING OF AA5754-H111 ALLOY USING A FIBER LASER

*Advanced Materials Research, Volume 628, 2013, Pages 193-198*Arc current; Experimental design techniques; Full penetration; High power fiber lasers; Hybrid welding; Laser power; Laser-arc; Magnesium-aluminum alloys; Metal arc welding; Process parameters; Small spots; Tungsten arc welding; Welding applications; Welding parameters; Welding speed Engineering controlled terms: Efficiency; Gas metal arc welding; Industrial applications; Industrial engineering; Laser beam welding; Lasers; Magnesium; Manufacture; Microhardness; Morphology Engineering main heading: Fiber lasers *The new generation of high power fiber lasers presents several benefits for industrial application. Nevertheless, due to the small spot size of the laser, the fiber laser has difficulties in some welding applications. These shortcomings can be overcome by laser-arc hybrid welding technique such as laser-gas metal arc welding or laser-gas tungsten arc welding. In this work, a high power fiber laser was coupled to an arc welder and the AA5754-H111 magnesium aluminum alloy was welded. The trials were carried out using laser leading configuration. A new generation of high power fiber laser was used. The*

experimental trials included process parameters such as laser power, welding speed and arc current. Microstructure, microhardness and weld appearance were analyzed. The experimental results showed that laser leading configuration produces full penetration for some welding parameters. The obtained results worth a larger investigation based on the experimental design technique.

Palumbo, G.HYDROFORMING A SMALL SCALE ALUMINUM AUTOMOTIVE COMPONENT USING A LAYERED DIE

*Materials and Design, Volume 44, 2013, Pages 365-373*Finite element simulations; Hydroforming; Nonferrous metals and alloys; Rapid tooling; Selection for material properties Engineering controlled terms: Aluminum; Automobile manufacture; Metal forming; Thermal barrier coatings Engineering main heading: Aluminum alloys *The aim of this study is to investigate the possibility of manufacturing an aluminum automotive component (a small sized car door panel) using a highly reconfigurable and cheap forming process. Specifically, the sheet hydroforming process and rapid tooling technique were combined, with the objective of making the resulting process more flexible and lessexpensive. Sheet hydroforming experiments were carried out using a layered die created assembling 2D laser cut layers and testing three Al alloys (AA2024, AA5754, AA7475); process parameters (Closing Force and Pressure) were evaluated by means of finite element simulations, mainly focused on the curve defining the Closing Force as a function of the forming Pressure and on friction conditions, which have a significant effect on the distribution of sheet thickness in formed parts. Both numerical simulations and experimental tests highlighted that sound parts could be obtained if a hard enough sheet material together with the appropriate Closing Force and forming Pressure are used. The proposed approach, combiningthe hydroforming process with a rapid tooling technique, proved to be effective in rapidly manufacturing prototypes and thus in shortening the product design process.*

Dassisti, M., Dotoli, M., Chen, D.INTEROPERABILITY ANALYSIS: GENERAL CONCEPTS FOR AN AXIOMATIC APPROACH

*IEEE International Conference on Emerging Technologies and Factory Automation, ETFA, 2013, Article number 6648169*Axiomatic approach; Design phase; Enterprise system Engineering controlled terms: Factory automation Engineering main heading: Interoperability *The paper provides general criteria and evidences for the design phase of an interoperable enterprise system. The analysis of interoperability is introduced, to characterize features and criticalities for the subsequent design actions to be undertaken. An axiomatic approach is proposed to this aim, providing general principles to be followed. A simple case study is discussed.*

Scintilla, L.D., Tricarico, L., Wetzig, A., Beyer, E.INVESTIGATION ON DISK AND CO

*International Journal of Machine Tools and Manufacture, Volume 69, 2013, Pages 30-37*Analytical evaluation; Cold work tool steels; Disk lasers; Laser cutting; Power balance; Power balance equations; Process temperature; Theoretical calculations Engineering controlled terms: Fiber lasers; Laser beams; Molten materials; Tool steel Engineering main heading: Carbon dioxide *In this work the calculation of the process temperatures in fusion cutting was carried out based on the power balance approach. Cutting experiments with CO 2 and disk lasers were performed on 1, 5 and 8 mm thick cold work tool steel sheets. The experimental, numerical and analytical evaluation of the single terms of the power balance equation allowed the explanation of the observed cut quality differences between disk and CO 2 laser cuts. Lower process temperatures calculated by a power balance equation for disk laser cuts lead to the increase of viscosity of molten material. The subsequent increase in difficulty for ejection of the molten material from the cut kerf explains the worse cut quality if compared with CO 2 laser cuts. Experimental evidence and theoretical calculations showed that the additional physical mechanisms like plasma formation should be considered in the overall power balance under particular cutting conditions.*

Scintilla, L.D., Tricarico, L.LASER CUTTING OF LIGHTWEIGHT ALLOYS SHEETS WITH 1MM LASER WAVELENGTH

*Proceedings of SPIE - The International Society for Optical Engineering, Volume 8603, 2013, Article number 86030U*Cutting performance; High power fiber lasers; Laser cutting; Light weight alloys; Processing parameters; Radiation wavelength; Tailor-Welded Blanks; Thermal reactivity Engineering controlled terms: Alloys; Aluminum; Corrosion resistance; Fiber lasers; Laser beams; Laser materials processing; Magnesium; Magnesium printing plates; Molten materials; Optical fibers; Productivity; Thermal conductivity; Titanium; Trimming Engineering main heading: Titanium alloys *High power fiber laser sources, with a radiation wavelength equal to about 1 μm, offer a great potential in improving the productivity and quality of thin aluminum, magnesium and titanium alloys sheets cutting. This is due to their benefits that are of special interest for this application: power efficiency, beam guidance and beam quality. In this work, an overview regarding the phenomena that for different reasons affect the laser cutting of these materials was given. These phenomena include the formation of a heat affected zone, the chemical contamination, the change of corrosion resistance, the thermal reactivity, the effects of thermal conductivity, reflectivity and viscosity of molten material. The influence of processing parameters on 1 mm thick Al 1050, AZ31 and Ti6Al4V lightweight alloys were experimentally investigated and cutting performances in terms of cut quality, maximum processing speeds and severance energies were evaluated. The advantages of using 1 μm laser wavelength for thin sheets lightweight alloys cutting due to the good cut quality, high productivity and the easily delivery of the beam through the optical fiber, were demonstrated. Results showed that fiber lasers open up new solutions for cutting lightweight alloys for applications like coil sheet*

cutting, laser blanking, trimming and cutting-welding combination in tailor welded blanks applications.

Brandizzi, M., Satriano, A.A., Sorgente, D., Tricarico, L.LASER-ARC HYBRID WELDING OF TI6AL4V TITANIUM ALLOY: MECHANICAL CHARACTERIZATION OF JOINTS AND GAP TOLERANCE

*Welding International, Volume 27, Issue 2, February 2013, Pages 113-120*arc initiation; Butt joints; combined processes; comparisons; gap; Hardness test; influencing factors; Mechanical tests; MIG welding; Tensile tests Engineering controlled terms: Butt welding; Carbon dioxide; Deformation; Efficiency; Fits and tolerances; Laser beam welding; Mechanical properties; Optics; Tensile testing; Titanium alloys; Vickers hardness testing; Welds Engineering main heading: Lasers *This paper reports the results of a comparison between the mechanical characteristics of butt joints in 3.0 mm thick Ti6Al4V titanium alloy sheets, made by laser welding with no filler material and by laser-arc hybrid welding. Vickers hardness tests have been performed on cross-sections of the beads obtained. In particular, the influence of the gap between the sheets in test welds performed using CO 2 laser-MIG hybrid welding has been analysed. Cross-sections of the weld beads obtained with several different gap sizes have been analysed morphologically. The welded joints have been subjected to draw testing, and joint deformation behaviour has been analysed using an optical deformation measurement system based on stereoscopic image capture (ARAMIS 3D analysis system).*

Casalino, G., Campanelli, S.L., Ludovico, A.D.LASER-ARC HYBRID WELDING OF WROUGHT TO SELECTIVE LASER MOLTEN STAINLESS STEEL

*International Journal of Advanced Manufacturing Technology, Volume 68, Issue 1-4, 2013, Pages 209-216*Additive technology; High power fiber lasers; Hybrid welding; Laser-arc hybrid welding; Manufacturing process; Molten stainless steels; Selective laser melting; Weld-bead profile Engineering controlled terms: Austenitic stainless steel; Electric arcs; Fiber lasers; Mechanical properties; Product design; Stainless steel; Stress concentration; Tensile testing; Welds Engineering main heading: Laser beam welding *Selective laser melting (SLM) is a successful tool-free powder additive technology. The success of this manufacturing process results from the possibility to create complex shape parts, with intrinsic engineered features and good mechanical properties. Joining SLM steel to similar or dissimilar steel can overcome some limitations of the product design like small dimension, undercut profile, and residual stress concentration. In this way, the range of applications of the SLM process can be broadened. In this paper, the hybrid laser welding of selective laser molten stainless steel was investigated. A high-power fiber laser was coupled to an electric arc and austenitic stainless steel wrought and SLM parts were welded together. The power and speed parameters were investigated. The joints*

were analyzed in terms of weld bead profile, microstructure, microhardness, and tensile test. The efficiency of the welding process was evaluated through the line energy input versus the weld molten area.

Pirlo, G., Chimienti, M., Dassisti, M., Impedovo, D., Galiano, A.LAYOUT-BASED DOCUMENT-RETRIEVAL SYSTEM BY RADON TRANSFORM USING DYNAMIC TIME WARPING

*Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), Volume 8156 LNCS, Issue PART 1, 2013, Pages 61-70*Document image retrieval; Document management; Dynamic time warping; Mathematic morphologies; Radon Transform Engineering controlled terms: Image analysis; Information retrieval; Information services; Mathematical morphology; Mathematical transformations; Sustainable development Engineering main heading: Text processing *In the context of sustainability of document management technologies, this paper presents a new system for layout-based document retrieval specifically designed for commercial form retrieval. The system first uses a technique based on mathematical morphology to extract grid-based structural components from the document image. Successively, Radon Transform is used for document layout description. A document matching technique based on dynamic time warping is finally adopted. The experimental results carried out on real and simulated data set, demonstrate the effectiveness of the approach with respect to different classes of commercial forms.*

Contuzzi, N., Campanelli, S.L., Casavola, C., Lamberti, L.MANUFACTURING AND CHARACTERIZATION OF 18NI MARAGE 300 LATTICE COMPONENTS BY SELECTIVE LASER MELTING

*Materials, Volume 6, Issue 8, 2013, Pages 3451-3468*Cellular lattice structures; Compressive behavior; Constitutive behaviors; Lattice structures; Manufacturing process; Selective laser melting; SLM; Steel powder Engineering controlled terms: Compression testing; Compressive strength; Design; Finite element method; Functionally graded materials; Mechanical properties; Mechanical testing; Reinforced concrete; Struts Engineering main heading: Cellular manufacturing *The spreading use of cellular structures brings the need to speed up manufacturing processes without deteriorating mechanical properties. By using Selective Laser Melting (SLM) to produce cellular structures, the designer has total freedom in defining part geometry and manufacturing is simplified. The paper investigates the suitability of Selective Laser Melting for manufacturing steel cellular lattice structures with characteristic dimensions in the micrometer range. Alternative lattice topologies including reinforcing bars in the vertical direction also are considered. The selected lattice structure topology is shown to be superior over other lattice structure designs considered in literature. Compression tests are carried out in order to evaluate mechanical strength of lattice strut specimens made via SLM. Compressive*

behavior of samples also is simulated by finite element analysis and numerical results are compared with experimental data in order to assess the constitutive behavior of the lattice structure designs considered in this study. Experimental data show that it is possible to build samples of relative density in the 0.2456-0.4367 range. Compressive strength changes almost linearly with respect to relative density, which in turns depends linearly on the number of vertical reinforces. Specific strength increases with cell and strut edge size. Numerical simulations confirm the plastic nature of the instability phenomena that leads the cellular structures to collapse under compression loading.

Milutinović, B., Stefanović, G., Dassisti, M., Marković, D., Vucković, G.MULTI-CRITERIA ANALYSIS AS A TOOL FOR SUSTAINABILITY ASSESSMENT OF A WASTE MANAGEMENT MODEL

Proceedings of the 26th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems, ECOS 2013, 2013Today there are many waste management methods and technologies. To assess the sustainability of a certain waste management method, it is necessary to carry out an adequate analysis of all influential criteria: environmental, economic, social and technological. The main problem in the analysis is to determine the indicators that clearly and fully sublimate the most important influential factors. The presented study was carried out on the example of waste management in the city of Niš. The four scenarios as models of waste management have been made based on the following methods which have been considered: disposal, composting, thermal processing, recycling and anaerobic digestion of the organic waste material. One of the scenarios is created as a zero waste to landfill. The other three are created as commercial methods. The comparative results analysis of sustainability of all scenarios is presented in this paper. Sustainability assessment of each scenario was performed based on multi-criteria analysis, founded on a set of performance criteria: environmental, economic and social. Technological indicators are reflected in the choice of the waste management method. For assessing the sustainability of waste management scenario based on multi-criteria analysis the AHP method is used. The results obtained from the sustainability assessment of waste management methods can be used for benchmark purposes, and a better understanding of strategies for the development of sustainable cities will come afterward.

Campanelli, S.L., Casalino, G., Contuzzi, N.MULTI-OBJECTIVE OPTIMIZATION OF LASER MILLING OF 5754 ALUMINUM ALLOY

*Optics and Laser Technology, Volume 52, 2013, Pages 48-56*Difficult-to-machine materials; Experimental test; Flexible process; Machining productivity; Material removal; Material removal rate; Optimal selection; Statistical optimization Engineering controlled terms: Ablation; Carbides; Milling (machining); Multiobjective optimization; Neodymium lasers; Productivity; Surface properties; Surface roughness Engineering main heading: Laser materials processing

Laser milling is a new, very flexible process for micro-fabrication, suitable for machining difficult-to-machine materials, like ceramics, dielectrics, carbide and hardened steel with good productivity and surface. Optimal selection of process parameters is highly critical for successful material removal and achieving high surface quality. It is crucial for Laser Milling to enhance the productivity of the process in terms of maximization of the material removal rate (MRR), calculated as the ratio between the volume of removed material and the process time, saving at the same time a good surface quality, and to correlate this index to the ablation depth and to surface roughness. In contrast, laser ablation suffers from the usual incompatibility of high ablation depths and good surface quality. The objective of this paper was to demonstrate that the careful laser choice and process optimization can result in a satisfactory compromise for both. This goal was achieved with a simultaneous statistical analysis of ablation depth, material removal rate and surface roughness. Moreover, a multi-objective statistical optimization was performed for improving machining productivity and surface quality. The dependence of the ablation depth, MRR and surface roughness on the laser fluence was also analyzed. All experimental tests were conducted on the 5754 aluminum alloy using a nanosecond Nd:YAG laser with a wavelength of 1064 nm.

Galantucci, L.M., Lavecchia, F., Percoco, G.MULTISTACK CLOSE RANGE PHOTOGRAMMETRY FOR LOW COST SUBMILLIMETER METROLOGY

Journal of Computing and Information Science in Engineering, Volume 13, Issue 4, 2013, Article number 044501 Engineering controlled terms: Measurements; Three dimensional; Units of measurement Close range photogrammetry; Digital close range photogrammetry; Image composition; Optical; Research efforts; Robotic systems; Submillimeters; Three-dimensional surface Engineering main heading: Photogrammetry *Considerable research effort has been focused on evaluating the accuracy of meso- and macroscale digital close range photogrammetry. However, evaluations of accuracy and applications in the submillimeter scale are rare. In this paper the authors propose the development of a three-dimensional (3D) photogrammetric scanner, based on macrolens cameras, able to reconstruct the three-dimensional surface topography of objects with submillimeter features. The system exploits multifocal image composition and has been designed for installation on all types of Numerical Controlled or Robotic systems. The approach is exploitable for digitizing submillimeter features at mesoscale as well as macroscale objects. Copyright*

Casalino, G., Campanelli, S.L., Minutolo, F.M.C.NEURO-FUZZY MODEL FOR THE PREDICTION AND CLASSIFICATION OF THE FUSED ZONE LEVELS OF IMPERFECTIONS IN TI6AL4V ALLOY BUTT WELD

*Advances in Materials Science and Engineering, Volume 2013, 2013, Article number 952690*Bead geometry; International standards; ISO standards; Lack of penetration; Neuro-Fuzzy model; Surface imperfections; Ti-6Al-4V alloy; Welding parameters Engineering

controlled terms: Carbon dioxide; Cerium alloys; Fatigue of materials; Fuzzy clustering; Laser beam welding Engineering main heading: Welds *Weld imperfections are tolerable defects as stated fromthe international standard. Nevertheless they can produce a set of drawbacks like difficulty to assembly, reworking, limited fatigue life, and surface imperfections. In this paper Ti6Al4V titanium butt welds were produced by CO 2 laser welding. The following tolerable defects were analysed: weld undercut, excess weld metal, excessive penetration, incomplete filled groove, root concavity, and lack of penetration. A neuro-fuzzy model for the prediction and classification of the defects in the fused zone was built up using the experimental data. Weld imperfections were connected to the welding parameters by feed forward neural networks. Then the imperfections were clustered using the C-means fuzzy clustering algorithm. The clusters were named after the ISO standard classification of the levels of imperfection for electron and laser beam welding of aluminium alloys and steels. Finally, a single-value metric was proposed for the assessment of the overall bead geometry quality. It combined an index for each defect and functioned according to the criterion "the-smallest-the- best." Copyright*

Galantucci, L.M., Percoco, G., Lavecchia, F., Di Gioia, E.NONINVASIVE COMPUTERIZED SCANNING METHOD FOR THE CORRELATION BETWEEN THE FACIAL SOFT AND HARD TISSUES FOR AN INTEGRATED THREE-DIMENSIONAL ANTHROPOMETRY AND CEPHALOMETRY

Journal of Craniofacial Surgery, Volume 24, Issue 3, May 2013, Pages 797-804OBJECTIVES: The article describes a new methodology to scan and integrate facial soft tissue surface with dental hard tissue models in a three-dimensional (3D) virtual environment, for a novel diagnostic approach.The facial and the dental scans can be acquired using any optical scanning systems: the models are then aligned and integrated to obtain a full virtual navigable representation of the head of the patient. METHODS: In this article, we report in detail and further implemented a method for integrating 3D digital cast models into a 3D facial image, to visualize the anatomic position of the dentition. This system uses several 3D technologies to scan and digitize, integrating them with traditional dentistry records. The acquisitions were mainly performed using photogrammetric scanners, suitable for clinics or hospitals, able to obtain high mesh resolution and optimal surface texture for the photorealistic rendering of the face. To increase the quality and the resolution of the photogrammetric scanning of the dental elements, the authors propose a new technique to enhance the texture of the dental surface. RESULTS: Three examples of the application of the proposed procedure are reported in this article, using first laser scanning and photogrammetry and then only photogrammetry. Using cheek retractors, it is possible to scan directly a great number of dental elements. The final results are good navigable 3D models that integrate facial soft tissue and dental hard tissues. The method is characterized by the complete absence of ionizing radiation, portability and simplicity, fast acquisition, easy alignment of the 3D models, and wide angle of view of the scanner. CONCLUSIONS: This method is completely noninvasive and can be repeated any time the physician needs new clinical records. The 3D virtual model is a precise representation both of

the soft and the hard tissue scanned, and it is possible to make any dimensional measure directly in the virtual space, for a full integrated 3D anthropometry and cephalometry. Moreover, the authors propose a method completely based on close-range photogrammetric scanning, able to detect facial and dental surfaces, and reducing the time, the complexity, and the cost of the scanning operations and the numerical elaboration. Copyright

Scintilla, L.D., Tricarico, L.NUMERICAL AND EXPERIMENTAL EVALUATION OF ND:YAG LASER WELDING EFFICIENCY IN AZ31 MAGNESIUM ALLOY BUTT JOINTS

*Proceedings of SPIE - The International Society for Optical Engineering, Volume 8603, 2013, Article number 86030O*Absorption co-efficient; AZ31B magnesium alloys; Experimental evaluation; Finite element models; Mechanical characterizations; Morphological parameters; Nd:YAG laser welding; Volumetric heat source Engineering controlled terms: Butt welding; Computational fluid dynamics; Computer simulation; Finite element method; Industrial applications; Laser beam welding; Laser materials processing; Magnesium alloys; Mechanical properties Engineering main heading: Neodymium lasers *In this paper, energy aspects related to the efficiency of laser welding process using a 2 kW Nd:YAG laser were investigated and reported. AZ31B magnesium alloy sheets 3.3 mm thick were butt-welded without filler using Helium and Argon as shielding gases. A three-dimensional and semi-stationary finite element model was developed to evaluate the effect of laser power and welding speed on the absorption coefficient, the melting and welding efficiencies. The modeled volumetric heat source took into account a scale factor, and the shape factors given by the attenuation of the beam within the workpiece and the beam intensity distribution. The numerical model was calibrated using experimental data on the basis of morphological parameters of the weld bead. Results revealed a good correspondence between experiment and simulation analysis of the energy aspects of welding. Considering results of mechanical characterization of butt joints previously obtained, the optimization of welding condition in terms of mechanical properties and energy parameters was performed. The best condition is represented by the lower laser power and higher welding speed that corresponds to the lower heat input given to the joint.*

Palumbo, G., Piccininni, A.NUMERICAL-EXPERIMENTAL INVESTIGATIONS ON THE MANUFACTURING OF AN ALUMINIUM BIPOLAR PLATE FOR PROTON EXCHANGE MEMBRANE FUEL CELLS BY WARM HYDROFORMING

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 1-4, 2013, Pages 731-742*Bipolar plate geometries; Bipolar plates; Experimental investigations; Finite element investigation; Finite element simulations; Statistical approach; Warm hydroforming; Working temperatures Engineering controlled terms: Finite element method; Geometry;

Industrial research; Manufacture; Metal forming; Proton exchange membrane fuel cells (PEMFC); Sheet metal; Strain rate Engineering main heading: Aluminum alloys *This research study focuses on the manufacturing of a bipolar plate used in proton exchange membrane fuel cells. In particular, the authors investigate the manufacturing of the part by means of warm hydroforming, adopting an aluminium alloy (AA6061) as sheet material. Both the channel profile (the reagent channel width and the die upper radius), and the bipolar plate geometries (in terms of channel layouts) are investigated by means of finite element simulations. Preliminary experimental investigations were carried out in order to define both the mechanical (flow curves) and strain behaviours (forming limit curves) of the adopted aluminium alloy according to temperature and strain rate. Subsequent finite element investigations aimed to define the channel profile by means of 2D models: a statistical approach was used to evaluate the dimension of the reagent channel width, the die upper radius and the sheet thickness. Finally, proposed bipolar plate geometries were investigated by running 3D simulations at different working temperatures and oil pressures in order to evaluate: (1) the bipolar plate geometry able to avoid regions with critical thinning and (2) suitable parameters for the warm hydroforming process.*

Palumbo, G., Piccininni, A., Guglielmi, P., Piglionico, V., Scintilla, L.D., Sorgente, D., Tricarico, L.NUMERICAL/EXPERIMENTAL INVESTIGATIONS ABOUT THE WARM HYDROFORMING OF AN ALUMINUM ALLOY COMPONENT

AIP Conference Proceedings, Volume 1532, 2013, Pages 135-143The present work investigates the Hydro Forming process in warm conditions using a numerical/experimental approach; an Al alloy (AA6061 T6) component is used as case study. Experimental tests were carried out for characterizing the material and setting the numerical model. A preliminary experimental step based on both tensile and formability tests allowed to characterize both the mechanical and deformative characteristics of the material according to temperature, orientation and strain rate. Finite Element simulations using ABAQUS/explicit were carried out changing (according to a simulations plan created using the Design of Experiment approach) the process parameters which mostly affect the HF process in warm conditions: the forming pressure, both the initial and final Blank Holder pressure and the Temperature (oil pressure and Blank Holder pressure were related to the material yielding strength). The contour plots of an ad hoc response parameter (LN), able to take into account both the risk of rupture and the level of deformation, allowed to evaluate the regions where process parameters guarantee the optimal working conditions.

Angelastro, A., Campanelli, S.L., Casalino, G., Ludovico, A.D.OPTIMIZATION OF NI-BASED WC/CO/CR COMPOSITE COATINGS PRODUCED BY MULTILAYER LASER CLADDING

*Advances in Materials Science and Engineering, Volume 2013, 2013, Article number 615464*Ceramic-metal composite coatings; Experimental analysis; Laser cladding technique; Mechanical components; Microhardness analysis; Optimization procedures; Stainless steel substrates; Surface coating techniques Engineering controlled terms: Composite coatings; Laser cladding; Mathematical models; Multilayers; Nickel; Optimization; Silicon carbide Engineering main heading: Tungsten carbide *As a surface coating technique, laser cladding (LC) has been developed for improving wear, corrosion, and fatigue properties of mechanical components. The main advantage of this process is the capability of introducing hard particles such as SiC, TiC, and WC as reinforcements in the metallic matrix such as Ni-based alloy, Co-based alloy, and Fe-based alloy to form ceramic-metal composite coatings, which have very high hardness and good wear resistance. In this paper, Ni-based alloy (Colmonoy 227-F) and Tungsten Carbides/Cobalt/ Chromium (WC/Co/Cr) composite coatings were fabricated by the multilayer laser cladding technique (MLC). An optimization procedure was implemented to obtain the combination of process parameters that minimizes the porosity and produces good adhesion to a stainless steel substrate. The optimization procedure was worked out with a mathematical model that was supported by an experimental analysis, which studied the shape of the clad track generated by melting coaxially fed powders with a laser. Microstructural and microhardness analysis completed the set of test performed on the coatings.*

Scintilla, L.D., Tricarico, L.OPTIMIZATION OF AZ31 MAGNESIUM ALLOY LASER BEAM WELDING PARAMETERS BASED ON PROCESS EFFICIENCY CALCULATION BY FINITE ELEMENT METHOD AND JOINT MECHANICAL PROPERTIES

*Optical Engineering, Volume 52, Issue 10, 2013, Article number 105101*AZ31 magnesium alloy; AZ31B magnesium alloys; Desirability function approach; Energy parameters; Morphological parameters; Multiple response; Optimal conditions; Process efficiency Engineering controlled terms: Laser beam welding; Magnesium alloys; Mechanical properties; Numerical models Engineering main heading: Optimization *The AZ31B magnesium alloy 3.3-mm-thick sheets optimal welding condition was investigated. A three-dimensional, semistationary finite element thermal model was developed. It allowed the estimation of energy parameters like the absorbed power and the melting and welding efficiencies. The numerical model was calibrated comparing weld bead morphological parameters obtained from experiments and numerical model. The desirability function approach was used for the optimization of multiple responses both in terms of energy parameters and mechanical properties. The optimal condition was represented by the lower heat input given to the joint.*

Olabi, A.G., Alsinani, F.O., Alabdulkarim, A.A., Ruggiero, A., Tricarico, L., Benyounis, K.Y.OPTIMIZING THE CO

*Optics and Lasers in Engineering, Volume 51, Issue 7, July 2013, Pages 832-839*Box-Behnken design; Experimental plans; Optimum welding conditions; Quadratic polynomial; Response

surface methodology; Ultimate tensile strength; Welding parameters; Welding process Engineering controlled terms: Dissimilar materials; Laser beam welding; Mechanical properties; Optimization; Polynomials; Tensile strength Engineering main heading: Carbon dioxide *A dissimilar full-depth laser-butt welding of low carbon steel and austenitic steel AISI316 was investigated using CW 1.5 kW CO 2 laser. The effect of laser power, welding speed and focal point position on mechanical properties (i.e., ultimate tensile strength, UTS and impact strength, IS) and on the operating cost C was investigated using response surface methodology (RSM). The experimental plan was based on Box-Behnken design; linear and quadratic polynomial equations for predicting the mechanical properties were developed. The results indicate that the proposed models predict the responses adequately within the limits of welding parameters being used. The optimum welding conditions were found.*

Percoco, G., Diella, M.PRELIMINARY EVALUATION OF ARTIFICIAL BEE COLONY ALGORITHM WHEN APPLIED TO MULTI OBJECTIVE PARTIAL DISASSEMBLY PLANNING

Research Journal of Applied Sciences, Engineering and Technology, Volume 6, Issue 17, 2013, Pages 3234-3243The aim of this study is the first evaluation of the Artificial Bee Colony Algorithm when applied to multi objective partial disassembly planning. Several methodologies have been proposed by academic and industrial researchers for developing and implementing automated disassembly planning and the research literature is very extensive. In particular, nature-inspired heuristic techniques seem to be very promising and performing well to optimize the disassembly planning problem, among them, the Artificial Bee Colony (ABC) approach, which has not yet been tested. The authors propose the implementation of a discrete ABC algorithm to plan the disassembly sequence of products, following these steps: matrix system modelling, multi-objective function and solution search with an ABC algorithm. In particular the study provides details of the algorithm and heuristic rules, inspired by the behaviour of bees during food search, which is a very efficient natural process. Two case studies have been selected and reported to test the efficiency of the algorithm, while further research is required to compare ABC to other efficient heuristics.

Sorgente, D., Tricarico, L.PRESSURE PROFILE OPTIMIZATION ON A SUPERPLASTIC ALUMINIUM ALLOY

*Materials Science Forum, Volume 735, 2013, Pages 383-394*Conventional approach; Experimental test; Material parameter; Numerical approaches; Pressure profiles; Simulation; Strain-rate control; Superplastic alloys; Superplastic forming; Target values Engineering controlled terms: Algorithms; Aluminum; Iron; Strain rate; Superplasticity Engineering main heading: Aluminum alloys *In this work authors present a study of the influence of the pressure profile on forming time and on post-forming characteristics of superplastically formed parts. Material parameters of an aluminium superplastic alloy (ALNOVI-U) were estimated on the*

basis of experimental tests and of a numerical approach. A numerical model of the forming process was then created and used for evaluating the pressure profile able to keep the maximum strain rate value close to a target value. Pressure profiles were calculated using a strain rate control algorithm, firstly following a conventional approach and monitoring the whole sheet, and then considering only the elements most deformed at the end of the forming process. Experimental results from different numerical pressure profiles are then compared, in terms post-forming characteristics, to test the effectiveness of the approach.

Dassisti, M., Jardim-Goncalves, R., Molina, A., Noran, O., Panetto, H., Zdravković, M.M.SUSTAINABILITY AND INTEROPERABILITY: TWO FACETS OF THE SAME GOLD MEDAL

*Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), Volume 8186 LNCS, 2013, Pages 250-261*Economic sustainability; Health informatics; Information and Communication Technologies; Networked environments; Shared information; Universe of discourse Engineering controlled terms: Communication systems; Information technology; Internet; Interoperability; Manufacture; Social networking (online); Standardization Engineering main heading: Sustainable development *'To sustain is to endure' - that is, to be able to survive and continue to function in the face of significant changes. The commonly accepted concept of 'sustainability' currently encompasses three main pillars: environmental, social/ethical and economic. In a metaphor of survival, they can be seen as water, food and air; one needs all three, only with varying degrees of urgency. In today's globally networked environment, it is becoming obvious that one cannot achieve environmental, social or economic sustainability of any artefact (be it physical or virtual, e.g. enterprise, project, information system, policy, etc) without achieving ubiquitous ability of the artefact and its creators and users to exchange and understand shared information and if necessary perform processes on behalf of each other - capabilities that are usually defined as 'interoperability'. Thus, sustainability relies on interoperability, while, conversely, interoperability as an ongoing concern relies for its existence on all three main pillars of sustainability. This paper aims to test the hypothesis that interoperability and sustainability are two inseparable and inherently linked aspects of any universe of discourse. To achieve this, it applies the dualistic sustainability / interoperability viewpoint to a variety of areas (manufacturing, healthcare, information and communication technology and standardisation), analyses the results and synthesizes conclusions and guidelines for future work.*

Campanelli, S.L., Casalino, G., Contuzzi, N., Ludovico, A.D.TAGUCHI OPTIMIZATION OF THE SURFACE FINISH OBTAINED BY LASER ABLATION ON SELECTIVE LASER MOLTEN STEEL PARTS

*Procedia CIRP, Volume 12, 2013, Pages 462-467*Additive Manufacturing; Difficult-to-machine materials; Direct fabrications; Laser-material interactions; Quadratic loss functions; Selective laser melting; Selective laser molten parts; Taguchi optimizations Engineering controlled terms: Carbides; Industrial engineering; Laser ablation; Optimization; Powder metals; Surface roughness; Taguchi methods Engineering main heading: Steel foundry practice *Laser ablation consists in laser-material interaction which causes the vaporization of material from the work-piece being machined. It is proper for difficult-to-machine materials, like carbides, ceramics and hardened steels and it is very flexible at micro-fabrication of moulds and other micro-system devices. The material is ablated by a laser beam through a layer-by-layer mechanism. Some recent studies investigated into the possibility to use this process to improve surface quality of selective laser molten steel parts. The selective laser melting (SLM) process is a layered additive manufacturing technique for the direct fabrication of functional parts by fusing together metal powder particles. The focus of this study was to perform a Taguchi statistical analysis of laser ablation main process parameters in order to s elect those which reduce the surface roughness of selective laser molten parts. Taguchi proposed a quadratic loss function as the objective function for optimizing a product or process design. The laser speed, power, focus and the number of removed layer were studied through a reduced experimental plan. Some significant evidences were found on the sensitiveness of the process to those parameters so optimal strings of laser parameters were selected versus the number of removed layer.*

Spina, R., Spekowius, M., Küsters, K., Hopmann, C.THERMAL SIMULATION OF POLYMER CRYSTALLIZATION DURING POST-FILLING

*Key Engineering Materials, Volume 554-557, 2013, Pages 1699-1706*Crystallization models; Dimensional accuracy; Experimental analysis; Isotactic polypropylene; Polymer crystallization; Polymer microstructures; Processing condition; Transformation rates Engineering controlled terms: Computer simulation; Crystallization kinetics; Finite element method; Polymer melts; Software testing Engineering main heading: Injection molding *Crystallization from polymer melt is one of the most fundamental phenomena of material phase transformations. The possibility of controlling crystallization kinetics is essential to achieve the proper polymer microstructure and consequently obtain desired material properties, reducing undesired effects such as excessive anisotropy of shrinkage, warpage and insufficient dimensional accuracy. Due to the high transformation rate, the experimental analysis of crystallization is critical. For this reason, it is more convenient to evaluate this phenomenon by using a finite element commercial software under several testing and processing conditions. The work investigates the crystallization evolution in post-filling, mainly induced by thermal gradients, and its effect on the final properties of an injection molding part. The numerical scheme, crystallization models and their implementation into commercial software are described as well as the experimental data for isotactic Polypropylene. Copyright*

Deli, R., Galantucci, L.M., Laino, A., D'Alessio, R., Di Gioia, E., Savastano, C., Lavecchia, F., Percoco, G.THREE-

DIMENSIONAL METHODOLOGY FOR PHOTOGRAMMETRIC ACQUISITION OF THE SOFT TISSUES OF THE FACE: A NEW CLINICAL-INSTRUMENTAL PROTOCOL

Progress in Orthodontics, Volume 14, Issue 1, 2013 EMTREE medical terms: accuracy; anatomic landmark; anthropometric parameters; article; body position; Brazilian; Caucasian; data processing; digital imaging; esthetics; Ethiopian; ethnic group; face; face profile; facial expression; female; human; human experiment; image analysis; image processing; normal human; photography; portable equipment; priority journal; reliability; reproducibility; soft tissue; standardization; three dimensional imaging *Background The objective of this study is to define an acquisition protocol that is clear, precise, repeatable, simple, and fast and that is useful for analysis of the anthropometric characteristics of the soft tissue of the face. Methods The analysis was carried out according to a new clinical-instrumental protocol that comprises four distinct phases: (1) setup of portable equipment in the space in which field analysis will be performed, (2) preparation of the subject and spatial positioning, (3) scanning of the subject with different facial expressions, and (4) treatment and processing of data. The protocol was tested on a sample comprising 66 female subjects (64 Caucasian, 1 Ethiopian, and 1 Brazilian) who were the finalists of an Italian national beauty contest in 2010. To illustrate the potential of the method, we report here the measurements and full analysis that were carried out on the facial model of one of the subjects who was scanned. Results This new protocol for the acquisition of faces is shown to be fast (phase 1, about 1 h; phase 2, about 1.5 min; phase 3, about 1.5 min; phase 4, about 15 min), simple (phases 1 to 3 requiring a short operator training period; only phase 4 requires expert operators), repeatable (with direct palpation of anatomical landmarks and marking of their positions on the face, the problem of identification of these same landmarks on the digital model is solved), and reliable and precise (average precision of measurements, 0.5 to 0.6 mm over the entire surface of the face). Conclusions This standardization allows the mapping of the subjects to be carried out following the same conditions in a reliable and fast process for all of the subjects scanned.*

Dassisti, M., Maddalena, F., Brancolini, A., Chimienti, M., Granieri, L.VARIATIONAL TECHNIQUES FOR ASSESSING THE TECHNOLOGICAL SIGNATURE OF FLAT SURFACES

*Optimization and Engineering, Volume 14, Issue 1, 2013, Pages 155-174*Calculus of variations; Flat surfaces; Manufacturing cycle; Manufacturing operations; Manufacturing process; Quality assessment; Technological process; Technological signature Engineering controlled terms: Industrial engineering; Production engineering; Variational techniques Engineering main heading: Manufacture *The quality assessment of manufacturing operations performed to obtain given flat surfaces is always a problem of comparing the substitute model (approximating the features of the true manufactured part) to the nominal specifications, at any stage of the*

manufacturing cycle. A novel methodology, based on applications of classical tools of Calculus of Variations, is here presented with the aim of assessing the output quality of manufactured flat surfaces based on the information available on transformation imposed by technological processes. By assuming that any manufacturing process operates under equilibrium states, the proposed variational methodology allows to account for the traces left by different stages of manufacturing processes. A simple two-dimensional case is here discussed, to give the flavor of the methodology and its future potential developments.

Mezzapesa, F.P., Scaraggi, M., Carbone, G., Sorgente, D., Ancona, A., Lugarà, P.M.VARYING THE GEOMETRY OF LASER SURFACE MICROTEXTURING TO ENHANCE THE FRICTIONAL BEHAVIOR OF LUBRICATED STEEL SURFACES

Physics Procedia, Volume 41, 2013, Pages 677-682We experimentally investigate and theoretically interpret the effect of varying the microstructure geometry introduced by laser surface texturing (LST), on the frictional properties of interacting components. The ability to control the coefficient of friction under lubricated conditions is demonstrated. Particularly, the LST optimization of a regular pattern of microholes on steel allows to reduce friction over the entire range of sliding velocities with respect to the untextured case. Moreover, we measure the Stribeck curves on a range of sliding velocity covering the entire lubrication range, i.e. from the boundary to the hydrodynamic regime under the so called iso-viscous rigid condition. Our measurements show a friction reduction up to 50% in the hydrodynamic regime.

Politecnico di milano

Demir, A.G., Previtali, B.A COMPARATIVE STUDY OF FEMTOSECOND AND NANOSECOND LASER MICROCUTTING OF AZ31 MAGNESIUM ALLOY STENTS

European Cells and Materials, Volume 26, Issue SUPPL.6, 2013, Page 144 EMTREE drug terms: alloy; magnesium EMTREE medical terms: biodegradation; comparative study; controlled study; femtosecond laser; laser; nanosecond laser; nanotechnology; note; stent; temperature; vaporization *[No abstract available]*

Colledani, M., Gershwin, S.B.A DECOMPOSITION METHOD FOR APPROXIMATE EVALUATION OF

CONTINUOUS FLOW MULTI-STAGE LINES WITH GENERAL MARKOVIAN MACHINES

Annals of Operations Research, Volume 209, Issue 1, October 2013, Pages 5-40In this paper, a decomposition method for evaluating the performance of continuous flow lines with machines characterized by general Markovian fluid models and finite capacity buffers is proposed. This study uses the exact solution of general two-stage Markovian fluid models as a building block. Decomposition equations are provided to propagate the effect of partial and complete blocking and starvation phenomena throughout the system. A decomposition algorithm that solves the new decomposition equations is proposed. Numerical results prove the good accuracy of the developed method. In particular, a comparison with existing techniques shows that our method is generally more accurate, especially in the estimation of the average buffer levels. Moreover, additional information can be collected by the application of our approach which enables a deeper analysis of the system behavior. Finally, the generality of the approach allows for modeling and studying many different system configurations within a unique framework, also including several previously uninvestigated layouts.

Colledani, M.A DECOMPOSITION METHOD FOR THE ANALYSIS OF LONG BUFFERED PRODUCTION SYSTEMS WITH DISCRETE GENERAL MARKOVIAN MACHINES

*IFAC Proceedings Volumes (IFAC-PapersOnline), 2013, Pages 1644-1649*Decomposition approach; Decomposition equations; Discrete time Markov chains; Finite buffer; Markovian; Multi-stage; Multi-stage production systems; Performance evaluation Engineering controlled terms: Production engineering Engineering main heading: Manufacture *This paper presents a new decomposition method for the approximate performance evaluation of buffered multi-stage production systems where machines are modeled as generally complex discrete time Markov chains with reward. The method is based on the exact solution of smaller two-machine sub-systems, also referred as building blocks, with machines that also feature such general characteristics. A decomposition approach is developed that propagates all the possible interruptions of flow due to starvation and blocking conditions throughout the pseudo-machines of each building block. In order to deal with such general settings, new decomposition equations are developed. A new algorithm is proposed for solving these decomposition equations. The proposed method proves to be very fast and accurate over a wide range of test cases, partly reported in this paper. To prove the generality of the framework, reported cases are focused on systems with generally distributed up and down times and systems with degrading machines. This method paves the way to the analysis of a wider class of previously un-investigated systems.*

Armillotta, A.A METHOD FOR COMPUTER-AIDED SPECIFICATION OF GEOMETRIC TOLERANCES

*CAD Computer Aided Design, Volume 45, Issue 12, 2013, Pages 1604-1616*Assembly operations; Datum reference frames; Datum selection; Geometric reasoning; Geometric tolerance; Inspection process; Tolerance specifications; Tolerancing Engineering controlled terms: Specifications Engineering main heading: Fits and tolerances *The paper describes a method for the generation of tolerance specifications from product data. The problem is nontrivial due to the increasing adoption of geometric dimensioning criteria, which call for the use of many types of geometric tolerances to completely and unambiguously represent the design intent and the many constraints deriving from manufacturing, assembly and inspection processes. All these issues have to be modeled and explicitly provided to a generative specification procedure, which may thus need a large amount of input data. The proposed approach tries to avoid this difficulty by considering that most precision requirements to be defined relate to the assembly process, and can be automatically derived by analyzing the contact relations between parts and the assembly operations planned for the product. Along with possible user-defined additional requirements relating to function, assembly requirements are used in a rule-based geometric reasoning procedure to select datum reference frames for each part and to assign tolerance types to part features. A demonstrative software tool based on the developed procedure has allowed to verify its correctness and application scope on some product examples.*

Wolf, M.I., Colledani, M., Gershwin, S.B., Gutowski, T.G.A NETWORK FLOW MODEL FOR THE PERFORMANCE EVALUATION AND DESIGN OF MATERIAL SEPARATION SYSTEMS FOR RECYCLING

*IEEE Transactions on Automation Science and Engineering, Volume 10, Issue 1, 2013, Article number 6241450, Pages 65-75*Complex materials; Engineering perspective; Environmental concerns; Highly integrated; Industrial benefits; Material cost; Material mixture; Material recovery; Material recycling; Material separation; Multi-stage separation; Multistage system; Network flow model; Optimal system configuration; Performance evaluation; Recycling systems; Separation systems; Waste electrical and electronic equipment Engineering controlled terms: Automation; Environmental regulations; Materials; Optimization; Recycling Engineering main heading: Separation *Interest in recycling has surged due to increasing material costs, environmental concerns over material production and disposal, and laws designed to improve material recycling rates. In response, recycling systems are becoming more complex as increasing material recovery is required from products with complicated material mixtures such as waste electrical and electronic equipment (WEEE) and ELVs. To increase performance and process complex material mixtures, separation systems are typically organized as highly integrated multistage systems. However, the problem of estimating the performance and designing multistage separation systems has rarely been tackled from a systems engineering perspective, resulting in poor integration and suboptimal configuration of industrial multistage separation systems. This paper presents a new approach to modeling, analyzing, and designing multistage separation systems to meet specified performance goals in terms of recovery/grade. Results can be used to generate maps of optimal system configurations for different requirements. The industrial benefits are illustrated by a real case study.*

Grasso, M., Goletti, M., Annoni, M., Colosimo, B.M.A NEW APPROACH FOR ONLINE HEALTH ASSESSMENT OF ABRASIVE WATERJET CUTTING SYSTEMS

*International Journal of Abrasive Technology, Volume 6, Issue 2, 2013, Pages 158-181*Abrasive waterjet cutting; Displacement signals; Health assessments; Information sources; MANOVA; Multivariate analysis of variances; Performance degradation; Pressure conditions Engineering controlled terms: Condition monitoring; Multivariant analysis Engineering main heading: Online systems *In waterjet/abrasive waterjet (WJ/AWJ) cutting systems, the components of both the ultra high-pressure (UHP) intensifier and the cutting head are subject to faults and performance degradation. Abrasive particles are responsible for focusing tube wear and orifice breakage, whereas challenging pressure conditions are responsible for the wear and cracks of UHP pump components. The impact of these factors on quality and productivity leads to the need for reliable condition-monitoring systems in WJ/AWJ shop floors. This paper investigates a new approach for the online health condition assessment of both UHP pump and cutting head components by using a single type of information source, i.e., the plunger displacement signal. A multivariate analysis of variance (MANOVA) was performed to study the effects of actual faulty components on the acquired signals during AWJ cutting. The results demonstrate that plunger displacement signals are suitable for detecting and identifying critical faults in WJ/AWJ cutting systems. Copyright*

Albertelli, P., Goletti, M., Monno, M.A NEW RECEPTANCE COUPLING SUBSTRUCTURE ANALYSIS METHODOLOGY TO IMPROVE CHATTER FREE CUTTING CONDITIONS PREDICTION

*International Journal of Machine Tools and Manufacture, Volume 72, 2013, Pages 16-24*Connection stiffness; Experimental dynamics; Experimental methodology; Finite element models; High speed machining; Receptance coupling substructure analysis; Regenerative chatters; Rotational degrees Engineering controlled terms: Estimation; Finite element method; Plastic deformation Engineering main heading: Machine tools *The cutting process stability depends on machine tool dynamics that is strongly influenced by the tool. Receptance coupling substructure analysis (RCSA) can be used to estimate the tool tip dynamic compliance and consequently the chatter free cutting conditions when the machine is equipped with a tool that has not been previously tested. This methodology can be particularly useful on real shop-floors where a lot of different tool-tool holder configurations are generally used. RCSA typically combines experimental dynamic compliance measurements performed on a machine equipped with a selected tool and the finite element (FE) models of both the already tested tool and the new ones. This paper presents a new receptance coupling substructure analysis (RCSA) approach that overcomes the drawbacks in the estimation of the receptances that contain rotational and moment contributes. This indeed often limits the accuracy of the RCSA techniques presented in other scientific works. The proposed formulation allows to better estimate both the matrices of receptances of the spindle-tool holder assembly and the tool-tool holder connection*

stiffness. Those quantities are used, together with the FE model of the new tool, to predict the unknown tool tip dynamic compliance. Some useful guidelines to implement the proposed RCSA are also defined: they allow to manage the procedure accuracy considering the experimental methodology typically used to measure dynamic compliances. The proposed innovative RCSA is experimentally tested and validated.

Radke, A.M., Tolio, T., Tseng, M.M., Urgo, M.A RISK MANAGEMENT-BASED EVALUATION OF INVENTORY ALLOCATIONS FOR MAKE-TO-ORDER PRODUCTION

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 1, 2013, Pages 459-462*Inventory; Inventory allocation; Inventory planning; Make-to-order productions; Manufacturing companies; Production schedule; Scheduling risks; Stochastic nature Engineering controlled terms: Manufacture; Planning; Production control; Risk management Engineering main heading: Scheduling *Today's manufacturing companies offer products catered to customers' needs within tight schedules and stringent cost control. Commonly make-to-order strategies are employed for which production is frequently scheduled ahead of order commitment while considering the stochastic nature of modern manufacturing systems. Inventory at the right stage may reduce the entailed risk of tardiness. But today's inventory planning approaches don't fully consider scheduling risk. This paper addresses this shortcoming, presenting an evaluation of inventory allocations along the risks of production schedule and stock out allowing identification of critical items to mitigate delays. A case study in the machine tools industry verifies applicability.*

Ascione, R., Moroni, G., Petrò, S., Romano, D.ADAPTIVE INSPECTION IN COORDINATE METROLOGY BASED ON KRIGING MODELS

*Precision Engineering, Volume 37, Issue 1, January 2013, Pages 44-60*Adaptive sampling; Coordinate metrology; Geometric errors; Jackknife variance; Kriging model Engineering controlled terms: Geometry; Inspection; Interpolation; Random processes; Technology transfer; Units of measurement Engineering main heading: Coordinate measuring machines *The paper describes a model-based statistical methodology to design adaptive inspection plans for the geometric control of mechanical parts with Coordinate Measuring Machines (CMM). The inspection is adaptive because the design and measurement phases are not separate in time, as they usually are. Rather, they are carried out in a combined way: first designing the next measurement location, then measuring at that location and so on. This strategy is most informative as it allows for the exploitation of all of the currently available measurements. The next measurement point is selected by using predictions and prediction uncertainty of geometric deviations provided by non-parametric statistical models, known as kriging models. Based on stationary Gaussian stochastic processes, their merit is the ability to vary flexibly at each added point. The methodology is demonstrated in an illustrative case study, then its performance is compared to that of two statistical non adaptive plans, and two deterministic adaptive plans*

proposed in the literature. In each comparison kriging-based plans have proved to be superior in terms of the accuracy of the predicted geometric error and the inspection cost. The method is sufficiently general to enable technology transfer to different metrological sectors.

Ascione, R., Moroni, G., Polini, W., Romano, D.ADAPTIVE INSPECTION PLANS IN COORDINATE METROLOGY BASED ON GAUSSIAN PROCESS MODELS

*Procedia CIRP, Volume 10, 2013, Pages 148-154*Adaptive designs; CMM; Computer-controlled machines; Gaussian process models; Industrial metrology; Kriging model; Predictive capabilities; Statistical experiments Engineering controlled terms: Coordinate measuring machines; Design of experiments; Experiments; Gaussian distribution; Gaussian noise (electronic); Geometry; Interpolation; Technology transfer; Units of measurement Engineering main heading: Inspection *The paper describes a successful technology transfer of Gaussian Process (GP) modelling, also known as kriging, to the field of industrial metrology. Product compliance to geometrical specifications typically requires an automated inspection cycle operated by a computer controlled machine which sequentially probes the part surface at a small sample of locations. Then the geometric error is computed from the set of point coordinates provided by the machine. Although the inspection plan can be naturally regarded as a statistical experiment, industrial practice generally relies on a deterministic logic both to choose the sample and to compute the geometric error. Opposed to this, we build the inspection plan as an adaptive experiment where the next probing location is selected by criteria based on predictions obtained from a GP model estimated at each step of the procedure. Results show that the good predictive capability of GP models assures an improvement over the current state of the art both in terms of quality of the estimated error and cost of the inspection.*

Grasso, M., Albertelli, P., Colosimo, B.M.AN ADAPTIVE SPC APPROACH FOR MULTI-SENSOR FUSION AND MONITORING OF TIME-VARYING PROCESSES

*Procedia CIRP, Volume 12, 2013, Pages 61-66*Industrial implementation; Multivariate spc; Multivariate statistical process control; Nonsteady-state conditions; Reliability and robustness; Sensor fusion; Tool breakage detection; Tool condition monitoring Engineering controlled terms: Industrial applications; Industrial engineering; Machine tools; Principal component analysis; Process monitoring; Sensors; Statistical process control Engineering main heading: Data handling *The effort to achieve in-process manufacturing process monitoring capabilities that are compliant with industrial implementation constraints is leading to a continuously growing development of multi-sensor approaches. In this frame, sensor fusion techniques may allow the achievement of required monitoring performances in terms of reliability and robustness to both disturbance factors and changing cutting conditions, and the approach becomes even more attractive when exploitable information is already available on-board, like spindle and axis drive currents and power signals. The paper presents a study aimed at dealing with the problem of monitoring the condition of the tool by using Multivariate Statistical Process Control (SPC)*

techniques to extract the relevant information content from multiple current signals acquired from spindle and axis drives. Usage of features that are as far as possible independent from cutting parameters, coupled with adaptive control charting methods, is proposed to cope with non-steady state conditions and signal pattern modification with different dynamics. Both static and adaptive Principal Component Analysis (PCA) based approaches are discussed, for tool breakage detection in milling of hard-to-cut materials.

Albertelli, P., Goletti, M., Monno, M.AN IMPROVED RECEPTANCE COUPLING SUBSTRUCTURE ANALYSIS TO PREDICT CHATTER FREE HIGH SPEED CUTTING CONDITIONS

*Procedia CIRP, Volume 12, 2013, Pages 19-24*Experimental dynamics; Frequency response functions; High Speed; Innovative approaches; Receptance coupling; Receptance coupling substructure analysis; Regenerative chatters; Subtructuring analysis Engineering controlled terms: Estimation; Frequency response; Industrial engineering; Plastic deformation Engineering main heading: Machine tools *This paper presents a new Receptance Coupling Substructure Analysis (RCSA) approach. The technique represents a valid instrument to predict Frequency Response Function, and consequently chatter free cutting conditions, of a not previously tested mill. The proposed RCSA methodology exploits experimental dynamic compliance measurements and the Finite Element (FE) model of a tool to estimate, through a new defined formulation, both the matrices of receptances of the spindle-tool holder assembly and the tool-tool holder connection stiffness. These data, together with the FE model of any new desired mill, can be used to estimate the relative tool tip dynamic compliance. The suggested formulation basically overcomes the drawbacks in the estimation of "rotation/ torque" receptances that often limits the accuracy of the classical RCSA. The proposed innovative approach was experimentally tested and validated.*

Demir, A.G., Previtali, B., Ge, Q., Vedani, M., Wu, W., Migliavacca, F., Petrini, L., Biffi, C.A., Bestetti, M.BIODEGRADABLE MAGNESIUM CORONARY STENTS: MATERIAL, DESIGN AND FABRICATION

International Journal of Computer Integrated Manufacturing, 2013Biodegradable cardiovascular stents in magnesium (Mg) alloys constitute a promising option for a less intrusive treatment, due to their high compatibility with the body tissue and intrinsic dissolution in body fluids. The design and fabrication aspects of this medical device require an integrated approach considering different aspects such as mechanical properties, corrosion behaviour and biocompatibility. This work gathers and summarises a multidisciplinary work carried out by three different research teams for the design and fabrication of Mg stents. In particular, the paper discusses the design of the novel stent mesh, the deformability study of the Mg alloys for tubular raw material and laser microcutting for the realisation of the stent mesh. Although, the

results are not fully validated as the device has not been fully tested, they show the feasibility of the used approaches, as the first prototype stents in Mg alloy were produced successfully.

Strano, M., Chiappini, E., Tirelli, S., Albertelli, P., Monno, M.COMPARISON OF TI6AL4V MACHINING FORCES AND TOOL LIFE FOR CRYOGENIC VERSUS CONVENTIONAL COOLING

*Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, Volume 227, Issue 9, September 2013, Pages 1403-1408*Coefficient of frictions; Cryogenic machining; Cutting forces; Cutting parameters; Industrial conditions; Scientific literature; Tool wear; Turning of ti6al4v Engineering controlled terms: Aerospace industry; Cooling; Cryogenics; Cutting; Emulsification; Friction; Liquid nitrogen; Titanium; Tools Engineering main heading: Turning *The benefits of cryogenic cooling by liquid nitrogen in cutting of titanium alloys have often been evaluated as a comparison to dry machining conditions. However, it is more interesting to quantitatively assess the performance of cryogenic conditioning of the process with respect to standard industrial conditions, that is, with respect to flood emulsion cooling. The technical and scientific literature is scarce and somehow contradictory, especially in terms of cutting forces and coefficient of friction. The aim of this article is to enrich the common base of experimental data, by conducting a comparison of traditional and cryogenic turning of Ti6Al4V in a region of cutting parameters particularly relevant to the aerospace industry, where no previous data are available. This study confirms that cryogenic machining is able to increase the tool life, even with respect to wet cutting. Besides, the results show that not only cutting forces are reduced but also a small, albeit significant, reduction can be achieved in the coefficient of friction at the tool-workpiece interface.*

Colombo, D., Colosimo, B.M., Previtali, B.COMPARISON OF METHODS FOR DATA ANALYSIS IN THE REMOTE MONITORING OF REMOTE LASER WELDING

*Optics and Lasers in Engineering, Volume 51, Issue 1, January 2013, Pages 34-46*Comparison of methods; Gap values; Laser sources; Monitoring approach; Monitoring methods; Monitoring strategy; Multivariate data analysis; Online monitoring; Optical combiners; Optical emissions; Remote monitoring; Statistical significance; Variance analysis; Visible emissions; Wavelength domains; Wavelength ranges; Wavelength resolution; Weld seam; Welding defects; Welding process; Zinc-coated steel Engineering controlled terms: Diodes; Electric welding; Laser beam welding; Light emission; Monitoring; Principal component analysis; Spectroscopic analysis; Spectroscopy; Steel fibers; Wavelength; Welds; Zinc coatings Engineering main heading: Multivariant analysis *A proven solution for the on-line monitoring of the gap in remote fibre laser welding of overlapped zinc-coated steel is based on the analysis of the visible optical emission that the welding process generates. Traditionally, different monitoring approaches are used, such as monitoring the overall emission or parts of the emission with filtered photodiodes*

or spectroscopic analysis of the wavelength domain. In the monitoring of welding defects, these approaches can lead to different performance results. In the present paper, different methods to monitor and analyse the visible emission are compared. The monitoring strategy uses an hardware known as Through Optical Combiner Monitoring (TOCM) that allows the signal emitted by the welding to be acquired directly at the laser source. The paper aims to evaluate the ability of monitoring methods to identify the effects of variable factors, such as the gap between the plates and the location inside the weld seam at which the variation of the gap occurs, on the monitored emission. The optical emission from 400 nm to 800 nm is monitored during remote laser welding from the optical combiner of the fibre laser source. First, the entire optical emission is examined with a spectroscope with a wavelength resolution of 0.57 nm. Second, multivariate data analysis is used to evaluate different indicators, such as the overall emission in the considered range, the emissions in separated wavelength ranges according to physical evaluations of the welding process or the entire spectrum. For each of the obtained indicators, variance analysis is performed, and the statistical significance of the gap value and its location in the weld seam are used to compare the performance of the tested methods.

Goletti, M., Grasso, M., Annoni, M., Colosimo, B.M.CONDITION MONITORING OF AN ULTRA HIGH PRESSURE INTENSIFIER FOR WATER JET CUTTING MACHINES

*Procedia CIRP, Volume 12, 2013, Pages 193-198*Condition based maintenance; Correlation analysis; Critical component; Cutting temperature; Monitoring approach; Multi sensor; Ultrahigh pressure; Water jets Engineering controlled terms: Condition monitoring; Cutting; Industrial engineering; Machinery; Sensors; Statistical process control Engineering main heading: Jets *The most important advantages of water jet are the capability to cut nearly every material, the low cutting temperature and the negligible cutting forces. When end users are interviewed, most of them point out that the most critical problem of water jet machines is the reliability of the system components, together with the difficulty in estimating their life time. As far as the UHP (Ultra High Pressure) intensifier is concerned, there are several components that work under extreme fatigue conditions, as the pressure inside the cylinders can reach 400 or even 600 MPa. Nearly every critical component is located into the UHP intensifier, but different failure scenarios can be envisaged, leading to different pattern deviations from nominal behavior conditions. In this paper a correlation analysis on multiple signal features with the health status of the machine is presented. Then a multi-sensor based monitoring approach is discussed and tested on a real case study: it is based on the usage of control charts for in-control region definition and possible detection of faults.*

Demir, A.G., Furlan, V., Lecis, N., Previtali, B.CONTROLLING WETTING PROPERTIES OF AZ31 MG ALLOY VIA LASER SURFACE STRUCTURING

European Cells and Materials, Volume 26, Issue SUPPL.6, 2013, Page 149 EMTREE drug terms: alloy; magnesium EMTREE medical terms: adhesion; biodegradability; chemical structure; contact angle; hydrophilicity; laser; laser surface structuring; material coating; microtechnology; note; polymerization; surface property; wetting property *[No abstract available]*

Armillotta, A., Semeraro, Q.CRITICAL OPERATING CONDITIONS FOR ASSEMBLIES WITH PARAMETER-DEPENDENT DIMENSIONS

*Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, Volume 227, Issue 5, May 2013, Pages 735-744*Assembly designs; Dimensional tolerance; Functional requirement; Operating parameters; Operating windows; Parameter dependents; Tolerance analysis; Tolerance specifications Engineering controlled terms: Thermal expansion Engineering main heading: Fits and tolerances *This article deals with the analysis of tolerances for an assembly that is bound to meet some functional requirements over a specified range of operating parameters (e.g. temperature, pressure and speed). These can influence part dimensions due to physical effects such as thermal expansion, deformation and wear. When these influences are added to manufacturing errors, unacceptable values of functional requirements can occur under critical conditions on operating parameters. To avoid this, a designer should be able to readily evaluate the operating window allowed to the assembly by a given set of tolerance specifications. A method is proposed to help this task on the assumption that requirements are verified through worst-case linear chains of dimensional tolerances.*

Strano, M., Villa, A., Mussi, V.DESIGN AND MANUFACTURING OF ANTI-INTRUSION BARS MADE OF ALUMINIUM FOAM FILLED TUBES

*International Journal of Material Forming, Volume 6, Issue 1, 2013, Pages 153-164*Aluminium foam; Car door; Car manufacturers; Cellular material; Closed sections; Experimental and numerical analysis; Foam filled; Foam filled tube; Internal work; Manufacturing conditions; Metal foams; Performance parameters; Production cost; Production of; Quasi-static; Side structure; Three point bending; Tube hydroforming; Tube materials; Weight reduction Engineering controlled terms: Accidents; Aluminum; Automobile manufacture; Bending (forming); Blowing agents; Composite structures; Foams; Kinetics; Metals; Numerical analysis; Production Engineering main heading: Tubes (components) *The role of an anti-intrusion bar for automotive use is to absorb the kinetic energy of the colliding vehicles that is partially converted into internal work of the members involved in the crash. The aim of this paper is to investigate the performances of anti-intrusion bars, made by tubes filled with aluminium foams. The reason for using a cellular material as a filler deals with its capacity to absorb energy during plastic deformation, while being lightweight. The study is mainly conducted by evaluating some key technical issues of the manufacturing problem and by running experimental and numerical analyses. The evaluation of materials and shapes of the closed sections to be filled is made in the*

perspective of a car manufacturer (production costs, weight reduction, space availability in a car door, etc.). Experimentally, foams are produced starting from an industrial aluminium precursor with a TiH 2 blowing agent. Empty and foam filled tubes are tested in three point bending, in order to evaluate their performances in terms of several performance parameters. Different manufacturing conditions, geometries and tube materials are investigated. The option of using hydroformed tubes, with non constant cross section, for the production of foam filled side structures id also discussed.

Valsecchi, B., Previtali, B.DESIGN AND REALISATION OF A TRIPLE GAS CLADDING HEAD FOR HIGH-POWER ACTIVE FIBRE LASERS

*Procedia CIRP, Volume 12, 2013, Pages 187-192*Automotive component; Hot stamping process; IPG Photonics; Laser characteristics; Laser sources; Maximum power; Powder feeder; Process efficiency Engineering controlled terms: Experiments; Fibers; Industrial engineering; Laser cladding Engineering main heading: Gases *This paper addresses the study, design and realisation of a gas cladding head specifically designed for high-power active fibre lasers. The new cladding head has a coaxial architecture and is able to manage three different gases with three different roles in the coaxial cones. From the central cone to the external cone, the roles of the three gases are as follows: - The first gas (inner gas) is used to protect the focusing lens and control the atmosphere of the molten pool in the cladding to protect and change the final cladding proprieties, - The second gas (central gas) is the powder feeder, and - The last gas (outer gas) is used to shield the work area and increase the process efficiency (to avoid wasting the powder). The new laser cladding head is specifically designed to emphasise the active fibre laser characteristics, such as the small divergence of the fibre beam. The new triple gas head was tested in a long experiment in which the cladding of worn dies used in a hot stamping process for automotive components was repaired. The laser source used in the experiment was an IPG Photonics active fibre laser (1000-W maximum power, 400-micron delivery fibre). The die was made of H13 steel and had considerable dimensions (approximately 450x300x150 mm3). The worn features of the dies were previously milled, and the cavities were filled via laser cladding with Stellite 21.*

Tolio, T., Urgo, M.DESIGN OF FLEXIBLE TRANSFER LINES: A CASE-BASED RECONFIGURATION COST ASSESSMENT

*Journal of Manufacturing Systems, Volume 32, Issue 2, April 2013, Pages 325-334*Automotive sector; Equipment costs; Product feature; Product life cycles; Production system; Reconfiguration; Reconfiguration costs; Transfer lines Engineering controlled terms: Automotive industry; Life cycle; Manufacture Engineering main heading: Systems analysis *Shortening product life cycles leads competing companies to continually release new products or modifying the existing ones; this is one of the major issues in production systems design. According to the changes in product features, production systems need to be properly configured*

or reconfigured to efficiently tackle new production requirements. A configuration approach for multi-product flexible transfer lines is presented which aims at minimizing the equipment cost. The approach is applied to a manufacturing case in the automotive sector. The robustness of the solution is tested against changes that affect the products to highlight reconfiguration costs and the penalty associated to the lack of a pro-active configuration approach.

Demir, A.G., Previtali, B., Lecis, N.DEVELOPMENT OF LASER DIMPLING STRATEGIES ON TIN COATINGS FOR TRIBOLOGICAL APPLICATIONS WITH A HIGHLY ENERGETIC Q-SWITCHED FIBRE LASER

*Optics and Laser Technology, Volume 54, 2013, Pages 53-61*Ceramic; Chemical compositions; Laser micro-machining; Processing condition; Processing strategies; Substrate contamination; Surface-texturing; Tribological applications Engineering controlled terms: Ceramic materials; Q switching; Tin; Titanium nitride; Tribology Engineering main heading: Coatings *Laser micromachining and structuring of thin ceramic surface coatings is an appealing process, especially for tribological applications. Studies show increased wear resistance and friction properties of dimpled surface coatings. The nature of the material and the delicacy of the coating integrity raise the problem of tight processing conditions, especially in terms of the ablated depth. However, for the industrial scale of the application, processing strategies with industrial grade laser systems are required. For this purpose, the present work reports the use of a highly energetic Q-switched fibre laser for the laser dimpling of TiN coatings applied in very limited micrometric thickness. The processing strategy that involves ramped pulse trains and controlled defocusing of the laser beam was demonstrated to be effective for controlling the dimple radius and depth without excessive machining to cause substrate contamination. The dimples were characterised for the amount of damage done by contaminating the coating material with the substrate. Results confirm that in non-contaminated conditions chemical composition of the TiN coating was also maintained.*

Pacella, M., Colosimo, B.M.DIFFERENT FORMULATIONS OF PRINCIPAL COMPONENT ANALYSIS FOR 3D PROFILES AND SURFACES MODELING

*Procedia CIRP, Volume 12, 2013, Pages 474-479*Curves and surfaces; Dependent variables; Geometric modelling; Geometric tolerance; Independent variables; Profile monitoring; Quality of product; Viable solutions Engineering controlled terms: Fits and tolerances; Industrial engineering; Measurements; Principal component analysis; Quality assurance; Quality control; Turning Engineering main heading: Three dimensional *During the past few years, an increasing number of approaches and applications of profile monitoring have been proposed in the literature as the quality of product and process is very often characterized by functional data. In the context of geometric tolerances, where curves and surfaces describe the shape of*

manufactured item, the quality outcome (dependent variable) is a function of one or more spatial location variables (independent variables). Up to now, profile monitoring has been mainly constrained to situations in which the dependent variable is a scalar, which is modeled as a function of a single location variable via linear models or datareduction approaches as Principal Component Analysis (PCA). When the quality of products is related to geometric tolerances (e.g., roundness or circularity, straightness, cylindricity, flatness or planarity) the geometry of the item lies in a 3-dimensional (3D) space and cannot be modeled as a scalar function of one location variable. This paper presents solutions to problems arising when 3D features (either curves or surfaces) are considered and data-reduction techniques are implemented as modeling tool. Two PCAbased approaches are presented, namely (i) the complex PCA (i.e., PCA performed on matrices of complex numbers) and the (ii) multilinear PCA (i.e., PCA performed on tensor data). These two approaches are explored as viable solutions to modeling 3D profiles and surfaces respectively, in the context of geometric tolerance monitoring.

Ferraris, E., Castiglioni, V., Ceyssens, F., Annoni, M., Lauwers, B., Reynaerts, D.EDM DRILLING OF ULTRA-HIGH ASPECT RATIO MICRO HOLES WITH INSULATED TOOLS

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 1, 2013, Pages 191-194*Coated tools; Customized tools; Deep hole drilling; Electrical discharge machining; Electrical discharges; Innovative method; Process capabilities; Process stability Engineering controlled terms: Coatings; Electric discharge machining; Electric discharges Engineering main heading: Aspect ratio *This work presents an innovative method for the Electrical Discharge Drilling of ultra-high aspect ratio (AR > 30) micro holes. It makes use of tools insulated on the sidewall by means of a coating. The concept is to promote the process stability of micro EDM deep drilling by preventing secondary sparks. The performance of standard and customized tools is compared and reviewed against the main criteria of shape quality, tool wear and machining time. Process capabilities are also defined for a given coating. Micro holes within 0.2 mm in diameter and aspect ratio (AR) up to about 120 could be obtained within 1 h. A micro punching die is also realized by combining this strategy with micro wire EDM.*

Liberopoulos, G., MacGregor Smith, J., Papadopoulos, C.T., Tolio, T.EDITORIAL: STOCHASTIC MODELS OF MANUFACTURING AND SERVICE SYSTEM OPERATIONS

Annals of Operations Research, Volume 209, Issue 1, October 2013, Pages 1-3[No abstract available]

Strano, M., Albertelli, P., Chiappini, E., Tirelli, S.EXPERIMENTAL EVALUATION OF INNOVATIVE TOOLS FOR TI-6AL-4V TURNING

*Key Engineering Materials, Volume 554-557, 2013, Pages 1941-1952*Deep cryogenic treatment; Experimental evaluation; Friction coefficients; High performance coatings; Innovative technology; Insert; Ti-6al-4v; Tool wear Engineering controlled terms: Coatings; Cryogenics; Cutting; Magnetron sputtering; Physical vapor deposition; Titanium; Titanium alloys; Turning; Wear resistance Engineering main heading: Tools *Titanium alloys, mainly because of their poor thermal conductivity, need to be cut at relatively low cutting speeds, with obvious negative consequences on the profitability of machining. An important amount of research activities has been done in order to increase productivity in titanium machining operations: high performance coatings and innovative technologies to improve inserts resistance to wear represent promising solutions. In this work, the cutting performance of an innovative TiAlN coating obtained by Physical Vapor Deposition (PVD) magnetron sputtering and the effects of a Deep Cryogenic Treatment (DCT) have been experimentally investigated and a statistical analysis of results has been performed. Typical commercially available inserts (TiAlN-AlCrO coated) have been used as a benchmark. The experiments have been designed in order to estimate the tool life and other variables of interest with different process parameters. The results show that even if friction coefficients are lower for standard tools, innovative inserts exhibit a higher resistance to wear. Taylor's law parameters of PVD coated tools, with and without DCT, have been determined and they clearly show that cryogenically treated tools present higher resistance at higher cutting speeds, mainly due to their superior hardness. This result indicates that cryogenic inserts could have important applications for high rate machining of titanium. Copyright*

Demir, A.G., Lecis, N., Previtali, B., Ugues, D.FIBER LASER SURFACE TEXTURING OF TIN COATINGS AND THEIR RESISTANCE TO SCRATCH TEST

*Proceedings of the 37th International MATADOR 2012 Conference, 2013, Pages 425-428*Friction coefficients; Laser process parameters; Laser surface texturing; Lubricated contacts; Scratch test; Thin hard coatings; Tribological behaviour; Tribological performance Engineering controlled terms: Adhesion; Cracks; Fiber lasers; Hard coatings; Tin; Tribology Engineering main heading: Titanium nitride *Laser surface texturing (LST) is an established technology that involves generation of micro features, usually in the form of dimples (or craters), on a relatively large surface, most commonly to increase the tribological performance. Recently LST has been applied on thin hard coatings to further improve the wear resistance. In the realized patterns on thin coatings, one important aspect is that the texturing should not damage or alter the coating layer. Under certain conditions, the LST pattern can cause local detachments of the coating or induce cracks. These aspects should also be considered when the LST pattern to be applied has to be chosen. Fortunately they can be evaluated in relatively harsher conditions such as non lubricated contact. The present work reports the study of LST of TiN coatings. The tribological performance of the patterns is evaluated by scratch tests under non lubricated conditions in*

order to measure the coating adhesion and toughness. LST is performed on TiN coating of about 3 μm thickness making use of a pulsed active fiber laser working in ns pulse regime. Laser process parameters are varied to obtain several patterns with different dimple diameter, depth and pitch, which are essential to control the tribological behaviour. Scratch tests are applied to the obtained patterns to evaluate the friction coefficient, critical load for crack generation and adhesion. Finally the most suitable LST pattern is identified and proposed to be used also in application under lubricated conditions.

Demir, A.G., Previtali, B., Biffi, C.A.FIBRE LASER CUTTING AND CHEMICAL ETCHING OF AZ31 FOR MANUFACTURING BIODEGRADABLE STENTS

*Advances in Materials Science and Engineering, Volume 2013, 2013, Article number 692635*AZ31 magnesium alloy; Biodegradable stents; Effect of chemicals; Innovative solutions; Laser micro-cutting; Manufacturing process; Material compositions; Material thickness Engineering controlled terms: Biocompatibility; Chemical cleaning; Etching; Magnesium alloys; Manufacture; Oxygen cutting; Stents Engineering main heading: Laser chemistry *The use of magnesium-alloy stents shows promise as a less intrusive solution for the treatment of cardiovascular pathologies as a result of the high biocompatibility of the material and its intrinsic dissolution in body fluids. However, in addition to requiring innovative solutions in material choice and design, these stents also require a greater understanding of the manufacturing process to achieve the desired quality with improved productivity. The present study demonstrates the manufacturing steps for the realisation of biodegradable stents in AZ31 magnesium alloy. These steps include laser microcutting with a Q-switched fibre laser for the generation of the stent mesh and subsequent chemical etching for the cleaning of kerf and surface finish. Specifically, for the laser microcutting step, inert and reactive gas cutting conditions were compared. The effect of chemical etching on the reduction in material thickness, as well as on spatter removal, was also evaluated. Prototype stents were produced, and the material composition and surface quality were characterised. The potentialities of combining nanosecond laser microcutting and chemical etching are shown and discussed.*

Demir, A.G., Maressa, P., Previtali, B.FIBRE LASER TEXTURING FOR SURFACE FUNCTIONALIZATION

Physics Procedia, Volume 41, 2013, Pages 759-768Textured surfaces exhibit improved properties in terms of tribological, biological, optical, or wetting performance once the texture is opportunely tailored for purpose. Fibre lasers provide a flexible solution for texturing different materials with different surface structures. In this work, the use of a Q-switched fiber laser for surface texturing for tribological, adhesion and biomedical applications is demonstrated. The required surface pattern of the application is investigated along with the processing conditions to realize the pattern. Results show the adaptability of the ns pulsed fibre laser to achieve various patterns with high productivity and industrial robustness.

Biffi, C.A., Bonacina, L., Nespoli, A., Previtali, B., Tuissi, A.FUNCTIONAL CHARACTERIZATION OF NITI SHAPE MEMORY ELEMENTS FOR SMART MICRO-ACTUATION

ASME 2013 Conference on Smart Materials, Adaptive Structures and Intelligent Systems, SMASIS 2013, Volume 1, 2013, Article number SMASIS2013-3253 Engineering controlled terms: Functional materials; Intelligent materials; Intelligent systems; Mechanical testing; Shape memory effect Calorimetric analysis; Functional characterization; Functional performance; Mechanical response; Mechanical systems; Operating temperature; Thermal hysteresis; Thermo-mechanical testing Engineering main heading: Computer simulation *Shape Memory Alloys (SMAs) are smart and functional materials, which are considered good candidates for the activation of devices for the automotive, aerospace, biomedical and mechanical systems, thanks to the shape memory effect. In this work, a study on the mechanical response of NiTi SMA snake like elements has been proposed. The production route of these elements from thin sheets, was given by laser machining followed by chemical etching. The micro-elements were characterized by means of calorimetric analysis for the definition of the theoretical operating temperatures and by means of thermo-mechanical testing for the evaluation of their functional performances. Mechanical tests has been carried out to assess the tensile behavior of martensite and austenite separately, and to evaluate the thermal hysteresis under different constant loads. Moreover, Finite Element Modeling (FEM) has been also accomplished to study the numerical evaluation of the stress field that origins by the application of the different loads in both the martensitic and austenitic phases. Copyright*

Colledani, M., Yemane, A.IMPACT OF MACHINE RELIABILITY DATA UNCERTAINTY ON THE DESIGN AND OPERATION OF MANUFACTURING SYSTEMS

*Procedia CIRP, Volume 7, 2013, Pages 557-562*Continuous improvements; Design and operations; Digital manufacturing; Mean time to repairs; Multi-stage manufacturing systems; Robust designs; Uncertainty; Virtual representations Engineering controlled terms: Design; Digital devices; Manufacture; Reliability; Repair; Tools; Uncertainty analysis Engineering main heading: Industrial applications *Decision making in the design and operation of advanced multi-stage manufacturing systems is more and more supported by digital manufacturing tools. In order to be effective in their scope, such tools have to be based on high-fidelity virtual representations of the real system. To achieve this goal, they are continuously fed with process and system data directly collected from the field. Once validated, these digital tools can be used to evaluate and generate alternative system improvement actions and optimized re-designs of the system, based on scenario analysis. Traditionally, manufacturing systems engineering methods suitable to this scope include analytical methods and simulation. While evaluating the performance of the system under a given configuration, they typically assume that machine reliability parameters (Mean Time to Failure and Mean Time to Repair) are precisely known. However, in practical situations, these parameters are either estimated from real life data or*

based on experts' knowledge. In both cases, they are subject to estimate uncertainty. This paper investigates the risks and the potential performance losses due to design and operation decisions derived by neglecting machine reliability uncertainty in the digital manufacturing tools. The proposed method paves the way to the on-line adoption of digital models for manufacturing system continuous improvements.

Moroni, G., Petrò, S.INSPECTION STRATEGIES AND MULTIPLE GEOMETRIC TOLERANCES

*Procedia CIRP, Volume 10, 2013, Pages 54-60*Coordinate measurements; Geometric tolerance; Manufacturing process; Manufacturing signatures; Measurement uncertainty; Optimization algorithms; Sampling strategies; Uncertainty Engineering controlled terms: Algorithms; Coordinate measuring machines; Costs; Fits and tolerances; Manufacture; Optimization; Uncertainty analysis Engineering main heading: Inspection *Recent years have seen an increase in the adoption of geometric tolerances. It is often possible to find several geometric tolerances defined on a single part. However, this poses inspection issues: the values of the geometric error may be interrelated; therefore, the presence of multiple tolerances should be considered in inspection design. In this work, a methodology is proposed for planning CMM sampling strategies for multiple tolerances based on the minimization of inspection costs. A model for inspection costs is proposed, which takes into account the influence of the inspection strategy on measurement and inspection errors costs, both directly and through its impact on measurement uncertainty. The cost is then minimized by means of a suitable optimization algorithm, thus defining an optimal sampling strategy. The approach can be adopted both to optimize generic, uniform, sampling strategies, and to generate manufacturing specific strategies, which consider the manufacturing signature, i.e., the part shape deviation from design nominal inherent to a specific manufacturing process. The latter kind of strategies is shown to be the most effective to minimize costs. A case study which illustrates the methodology is presented.*

Colledani, M., Tolio, T.INTEGRATED PROCESS AND SYSTEM MODELLING FOR THE DESIGN OF MATERIAL RECYCLING SYSTEMS

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 1, 2013, Pages 447-452*Economic performance; Engineering perspective; Industrial settings; Material recycling; Mechanical recycling; Performance evaluation; Process parameters; Recycling systems Engineering controlled terms: Metal recovery Engineering main heading: Recycling *Recycling systems are becoming more complex as increasing material recovery is required from products with complicated material mixtures, including key-metals and rare earths, such as electronic and automotive waste. However, the design of multi-stage mechanical recycling systems has never been tackled from a system engineering perspective. This paper proposes a multi-level recycling system model that integrates process physics and system dynamics. It allows jointly configuring the system layout and setting the characteristic process parameters, to achieve desired grade and recovery levels. Results show that improved recycling rates and economic performance can be achieved by applying this approach to industrial settings.*

Colledani, M., Pedrielli, G., Terkaj, W., Urgo, M.INTEGRATED VIRTUAL PLATFORM FOR MANUFACTURING SYSTEMS DESIGN

*Procedia CIRP, Volume 7, 2013, Pages 425-430*Commercial applications; Effective systems; Heterogeneous software; Industrial companies; Integrated approach; Software platforms; Software vendors; Virtual factory environments Engineering controlled terms: Computer software; Design; Embedded systems; Industrial plants; Integration; Interoperability; Manufacture Engineering main heading: Systems analysis *The design of manufacturing systems is a critical task to be addressed throughout the factory life-cycle phases, including the early design, detailed design, ramp-up, reconfiguration, and monitoring. An efficient and effective system design platform may have a relevant impact on the profitability of industrial companies facing these challenges. Although several commercial applications are available for supporting different activities within the manufacturing system design and operation these stand-alone tools are usually supplied by different software vendors and cannot be easily integrated, thus entailing a massive and time-consuming integration effort. This paper proposes the integration of heterogeneous software tools supporting factory design activities over a common platform. A virtual factory environment, based on a shared data model providing to all the applications a common language to exchange data, is developed. A test case is presented that shows the integration of five methods and the related software tools to support different activities for the design of a manufacturing production line, hence the benefits derived by the application of this integrated approach in industry.*

Basha, A.T., Annoni, M., Monno, M., Inzoli, F.INVESTIGATION OF THE HYDRODYNAMIC CHARACTERISTICS OF ABRASIVE WATER JET CUTTING HEAD

*International Journal of Machining and Machinability of Materials, Volume 14, Issue 1, 1 January 2013, Pages 105-122*Abrasive water jet; AWJ cutting; Cutting heads; Geometrical modelling; Jet flow Engineering controlled terms: Abrasives; Computational fluid dynamics; Computer simulation; Flow patterns; Hydrodynamics; Jets; Numerical models Engineering main heading: Abrasive cutting *Cutting heads are core components of abrasive water jet cutting plants which dramatically affect the achievable cutting performance. Therefore, investigating their characteristics to achieve an efficient design is fundamental to improve the AWJ technology. In this study, computational fluid dynamics models for ultrahigh velocity waterjets and abrasive waterjets are established using ANSYS FLUENT® software. Jet flow dynamic characteristics inside a cutting head are simulated under unsteady state, turbulent, two-phase and three-phase flow conditions. Water and particles velocities are obtained under different operating conditions to provide an insight into the jet characteristics and study the effect of cutting head geometry. The comparison with experimental data shows the accuracy of the numerical simulations in predicting cutting head performance, as well as revealing the effect of operating conditions. Moreover, the fact that results obtained with two different geometrical*

models (2D-axisymmetric and 3D) are similar reveals that the flow pattern does not depend much on the position of the abrasive and air suction zone. This investigation aids the understanding of the flow inside the AWJ cutting head and provides information for designing this component to suit optimum performances. Copyright

Frigerio, N., Matta, A.MACHINE CONTROL POLICIES FOR ENERGY SAVING IN MANUFACTURING

*IEEE International Conference on Automation Science and Engineering, 2013, Article number 6653992, Pages 651-656*Automotive sector; Control policy; Inter-arrival time; Machine controls; Manufacturing IS; Numerical comparison; Production plant; Single- machines Engineering controlled terms: Automotive industry; Environmental impact; Manufacture; Scheduling algorithms Engineering main heading: Energy conservation *Energy saving in production plants is becoming more and more relevant due to the pressure from governments to contain the environmental impact of manufacturing, and from companies to reduce costs. This work deals with the problem of saving energy in single machines visited by singlepart type with stochastic interarrival times. Specifically, several control policies are proposed for switching the machine off when production is not critical, and on when the part flow has to be resumed. The policy parameter that minimizes the machine energy request is provided analytically for exponentially distributed arrival times, and numerically for general distributions. A numerical comparison with the most common practices in manufacturing is also reported, together with a real case analysis from the automotive sector.*

Alfieri, A., Matta, A.MATHEMATICAL PROGRAMMING TIME-BASED DECOMPOSITION ALGORITHM FOR DISCRETE EVENT SIMULATION

*European Journal of Operational Research, Volume 231, Issue 3, 16 December 2013, Pages 557-566*Computational time; Decomposition algorithm; Linear functions; Mathematical program; Mathematical programming models; Optimisation problems; Running simulations; Simulation Engineering controlled terms: Algorithms; Decomposition; Discrete event simulation Engineering main heading: Mathematical programming *Mathematical programming has been proposed in the literature as an alternative technique to simulating a special class of Discrete Event Systems. There are several benefits to using mathematical programs for simulation, such as the possibility of performing sensitivity analysis and the ease of better integrating the simulation and optimisation. However, applications are limited by the usually long computational times. This paper proposes a time-based decomposition algorithm that splits the mathematical programming model into a number of submodels that can be solved sequentially to make the mathematical programming approach viable for long running simulations. The number of required submodels is the solution of an optimisation problem that minimises the expected time for solving all of the submodels. In this way, the solution time becomes a linear function of the number of simulated entities.*

Colosimo, B.M., Pagani, L., Strano, M.METAMODELING BASED ON THE FUSION OF FEM SIMULATIONS RESULTS AND EXPERIMENTAL DATA

*Key Engineering Materials, Volume 554-557, 2013, Pages 2487-2498*Computer experiment; Deterministic simulation; Hierarchical fusions; Meta-modeling technique; Metal foams; Metamodeling; Process Variability; Stochastic optimizations Engineering controlled terms: Bending (forming); Digital storage; Experiments; Foams; Metals; Optimization; Stochastic models Engineering main heading: Computer simulation *In this paper an innovative multistage metamodeling technique is proposed for linking data coming from two different sources: simulations and experiments. The model is hierarchical, in the sense that one set of data (the experiments) is considered to be more reliable and it is labeled as "high- resolution" and the other set (the simulations) is labeled as "low-resolution". The results of experiments is obviously fully accurate, except for the only approximation due to the measurement system and given the intrinsically aleatory nature of all real experiments. In the proposed approach, Gaussian models are used to describe results of computer experiments because they are flexible and they can easily interpolate data coming from deterministic simulations. A second stage model is used, in order to link the prediction of the first model to the real experimental data. For the linkage model, as in the first stage, a Gaussian process is used. In this second stage a random parameter can be added to the model, known as nugget, in order to take into account the process variability. This kind of metamodeling can have different purposes: adjusting or tuning the simulations, having a better tool to drive the design process, making an optimization of a parameter of interest. In the paper, its use for optimization of a single response y with two design variables x 1 and x 2 is demonstrated. The approach is applied for modeling the crash behavior in three point bending of metal foam filled tubes. Copyright*

Annoni, M., Biella, G., Rebaioli, L., Semeraro, Q.MICROCUTTING FORCE PREDICTION BY MEANS OF A SLIP-LINE FIELD FORCE MODEL

*Procedia CIRP, Volume 8, 2013, Pages 558-563*Built up edge; Chip formations; Cutting edge radius; Cutting forces; Effective rake angle; Mechanical micro-machining; Minimum chip thickness; Uncut chip thickness Engineering controlled terms: Composite micromechanics; Cutting; Cutting tools; Forecasting; Machining centers Engineering main heading: Micromachining *Mechanical micromachining is a very flexible and widely exploited process, but its knowledge should still be improved since several typical phenomena play a role on the microscale chip removal (e.g. "minimum chip thickness effect", microstructure influence on cutting forces, stable built-up edge, etc.). Several models have been developed to describe the machining process, but only some of them take into account a rounded-edge tool, which is a typical condition in micromachining. Among these models, the slip-line field model developed by Waldorf for the macroscale allows to separately evaluate shearing and ploughing force components in orthogonal cutting conditions, therefore it is suitable to predict the cutting forces when a large ploughing action occurs, as in micromachining. The present work aims at*

objectively verifying the cutting and feed force prediction performance of the Waldorf model within typical microscale cutting conditions (uncut chip thickness lower than 50 μm and comparable in size to cutting edge radius) in its original version and in a modified version considering the partial effective rake angle. A suitable set-up, especially designed for microturning conditions, has been used in this research to measure forces and chip thickness. Tests have been carried out on C38500 brass (CuZn39Pb3) with different cutting speeds and different ratios between uncut chip thickness and cutting edge radius. Copyright

Moroni, G., Petrò, S., Syam, W.P.ON PERFORMANCE VERIFICATION OF 3D MICRO MEASURING INSTRUMENT

Proceedings of the 28th Annual Meeting of the American Society for Precision Engineering, ASPE 2013, 2013, Pages 459-464[No abstract available]

Strano, M., Monno, M., Rossi, A.OPTIMIZED DESIGN OF PRESS FRAMES WITH RESPECT TO ENERGY EFFICIENCY

*Journal of Cleaner Production, Volume 41, 2013, Pages 140-149*Eco-design principles; Ecodesign; Global optimization algorithm; Lightweight design; Objective functions; Optimization models; Prestressed structures; Scientific literature Engineering controlled terms: Algorithms; Analytical models; Deformation; Design; Energy efficiency; Energy utilization; Global optimization; Machine tools; Models; Optimization Engineering main heading: Presses (machine tools) *Large forming presses require great amounts of construction metal materials. Nevertheless, eco-design principles in the field of forming presses have seldom been confronted in the scientific literature. In this paper, an optimization model is proposed, suitable for designing press frames which are optimal in terms of energy efficiency. First, a framework is proposed for modular and functional description of a machine tool is described, in order to identify the largest energy consuming modules and functions. Then, a simple analytical model of loads, stresses and deformations is proposed for pre-stressed structures. Then, the equations of the analytical models are used as the constraints of a numerical global optimization algorithm, aimed at minimizing the amount of energy stored into the press frame and the extra-energy due to deformation of the columns in the usage lifetime of the press. The results clearly show that, only if the press frame structure is monolithic, it is possible to obtain a solution which is truly optimal. This conclusion is robust with respect to potential noise or uncertainty issues, which in this case are mainly related to the coefficient of the objective functions.*

Pellegrinelli, S., Tolio, T.PALLET OPERATION SEQUENCING BASED ON NETWORK PART PROGRAM LOGIC

*Robotics and Computer-Integrated Manufacturing, Volume 29, Issue 5, 2013, Pages 322-345*Automatically generated; Four-axis machines; Integrating process; Mechanical components; Nonlinear process; Operation sequencing; Optimal operation; Part programs Engineering controlled terms: Computer aided process planning; Floors; Mathematical models; Planning; Production control; Profitability Engineering main heading: Pallets *CAPP systems play a relevant role in aiding planners during setup planning, operation sequencing and pallet configuration activities. The support and automation granted by these techniques, together with the use of non-linear process planning logic, lead to a reduction in the planning time and costs, thus making manufacturers more competitive. This paper presents an approach that integrating process and production planning leads to the definition at the shop-floor level of the optimal operation sequence to machine all of the workpieces on a pallet using a four-axis machine tool. Part programs of non-production movements for each possible sequence of two operations are automatically generated at the shop-floor level and are simulated to obtain the non-production time. The complete sequence of operations is then defined on the basis of the minimisation of the estimated non-production time. This minimisation is performed using a mathematical model that defines a good sequence of operations. Four algorithms are adopted to analyse the proposed solution and to reduce the gap from optimality. The approach is tested on some cases taken from literature and on a real case. The real case was provided by a company that produces mechanical components. The obtained results underline a reduction on production and planning time, and consequently an increment in the company profit.*

Bassani, P., Biffi, C.A., Carnevale, M., Lecis, N., Previtali, B., Lo Conte, A.PASSIVE DAMPING OF SLENDER AND LIGHT STRUCTURES

*Materials and Design, Volume 45, March 2013, Pages 88-95*Design optimization; Dynamic characterization; Flexural vibrations; Hybrid composite materials; Hybrid composites; Laser micro-cutting; Numerical calculation; Passive damping; Pattern geometry; Structural damping; Thermo-mechanical characterization; Weight/stiffness ratio Engineering controlled terms: Composite materials; Optimization; Reinforcement; Shape memory effect Engineering main heading: Damping PaperChem Variable: Alloy; Assembly; Composites; Cutting; Damping; Optimization; Patterns; Reinforcement; Stiffness; Weight *This paper describes the design optimization and fabrication of a hybrid composite material for the passive suppression of flexural vibrations in slender and light structures. The material is made from glass fiber/epoxy resin laminated, reinforced with two thin, fiber-laser patterned sheets of NiTiCu shape memory alloy (SMA). The thickness of the SMA layers and their pattern geometry have been optimized by the numerical calculation of the first natural frequency and of the structural damping of the hybrid composite. In addition to describing the thermo-mechanical characterization of the SMA alloy, selected as a reinforcement, the paper also describes the final dynamic characterization of four, beam-shaped prototypes using the material in question.*

Yemane, A., Colledani, M.PERFORMANCE ANALYSIS OF UNRELIABLE MANUFACTURING SYSTEMS WITH UNCERTAIN PARAMETER ESTIMATES

*Procedia CIRP, Volume 12, 2013, Pages 360-365*Bayesian estimations; Design and operations; Digital factories; Machine reliability; Mean time to failure; Mean time to repairs; Performance analysis; Uncertain parameters Engineering controlled terms: Bayesian networks; Industrial engineering; Manufacture; Planning; Probability density function; Repair; Uncertainty analysis Engineering main heading: Parameter estimation *Traditional systems engineering methods for the performance evaluation of manufacturing systems assume that machine reliability parameters (Mean Time to Failure and Mean Time to Repair) are precisely known. However, in practical situations, these parameters are either estimated from real life data or based on experts' knowledge. In both cases, they are subject to uncertainty. This paper proposes for the first time an approach for the performance evaluation of unreliable manufacturing systems that considers uncertain machine parameter estimates. The proposed method is based on the combined use of Bayesian estimation, probability density function discretization and existing decomposition-based techniques for analyzing manufacturing lines composed of unreliable machines and capacitated buffers. Numerical results show that neglecting uncertainty in the input parameter estimates generates consistent errors in the output performance measure estimates, thus making the consequent system design and operation decisions sub-performing. An industrial case is proposed to show the benefits of this method in real production settings.*

Colledani, M.PERFORMANCE EVALUATION OF TWO-STAGE BUFFERED PRODUCTION SYSTEMS WITH DISCRETE GENERAL MARKOVIAN MACHINES

*IFAC Proceedings Volumes (IFAC-PapersOnline), 2013, Pages 1638-1643*Analytical method; Finite buffer; Flexible machines; Markov reward model; Markovian; Performance evaluation; System decomposition; Two-stage production system Engineering controlled terms: Difference equations; Production engineering; Repair Engineering main heading: Manufacture *This paper presents an exact analytical method for the performance evaluation of buffered two-stage production systems where machines are modeled as generally complex discrete time Markov reward models. The method is based on the exact solution of the difference equation describing the dynamics of the system in the internal states. Then, a unique solution is obtained by imposing boundary conditions at the limiting buffer levels. The method results to be computationally stable and efficient even for large number of machine states. The generality of the model allows evaluating a wide set of previously uninvestigated systems. For example, systems with machines having generally distributed failure and repair times, systems with quality deteriorating machines or with flexible machines processing multiple part-types can be modeled. Furthermore, the developed model can be used as a building block to extend the analysis to generally long production lines via system decomposition.*

Senin, N., Colosimo, B.M., Pacella, M.POINT SET AUGMENTATION THROUGH FITTING FOR ENHANCED ICP REGISTRATION OF POINT CLOUDS IN MULTISENSOR COORDINATE METROLOGY

*Robotics and Computer-Integrated Manufacturing, Volume 29, Issue 1, February 2013, Pages 39-52*Coordinate metrology; Iterative closest point; Model fitting; Multisensor data fusion; Registration Engineering controlled terms: Algorithms; Geometry; Measurement errors; Measurements; Scanning; Signal processing; Units of measurement Engineering main heading: Coordinate measuring machines *In multisensor coordinate metrology scenarios involving the fusion of homogenous data, specifically 3D point clouds like those originated by CMMs and structured light scanners, the problem of registration, i.e. The proper localization of the clouds in the same coordinate system, is of central importance. For fine registration, known variants of the Iterative Closest Point (ICP) algorithm are commonly adopted; however, no attempt seems to be done to tweak such algorithms to better suit the distinctive multisensor nature of the data. This work investigates an original approach that targets issues which are specific to multisensor coordinate metrology scenarios, such as coexistence of point sets with different densities, different spatial arrangements (e.g. sparse CMM points vs. gridded sets from light scanners), and different noise levels associated to the point sets depending on the metrological performances of the sensors involved. The proposed approach is based on combining known ICP variants with novel point set augmentation techniques, where new points are added to existing sets with the purpose of improving registration performance and robustness to measurement error. In particular, augmentation techniques based on advanced fitting solutions promote a paradigm shift for registration, which is not seen as a geometric problem consisting in moving point sets as close as possible to each other, but as a problem where it is not the original points, but the underlying geometries that must be brought together. In this work, promising combinations of ICP and point augmentation techniques are investigated through the application to virtual scenarios involving synthetic geometries and simulated measurements. Guidelines for approaching registration problems in industrial scenarios involving multisensor data fusion are also provided.*

Coupek, D., Verl, A., Aichele, J., Colledani, M.PROACTIVE QUALITY CONTROL SYSTEM FOR DEFECT REDUCTION IN THE PRODUCTION OF ELECTRIC DRIVES

2013 3rd International Electric Drives Production Conference, EDPC 2013 - Proceedings, 2013, Article number 6689762 Engineering controlled terms: Chains; Defects; Electric drives; Energy resources; Inspection; Laminating; Magnetic fields; Optimization; Production engineering; Repair End-of-line; Manufacturing chain; Multi-stage production systems; Off-line inspections; Optimization problems; Process parameters; Selective assembly; Sequential assembly Engineering main heading: Assembly *State of the art in multi-stage production systems*

is End-Of-Line (EOL) quality control. The main drawback of EOL inspection is the off-line inspection at the final stage of the manufacturing chain, where already all possible defects of the production chain have been accumulated. Thus, a defective workpiece is machined wasting time, money and energy resources for creating a final product, which is out of tolerances and has to be recycled or scrapped. To overcome this drawback it is necessary to create solutions to reduce either defect generation or defect propagation. This paper focusses on the second approach, which aims at repairing defective workpieces by adapting consecutive process parameters in a multi-stage production system (downstream repair). By applying this concept to the production of electrical drives for power train applications, the effort needed for EOL testing can be reduced by shifting testing steps into the previous process chain. The currently used total flux measurement of laminated steel stacks is replaced by a space-resolved measurement. This permits the identification and local allocation of deviations in the magnetic field due to defective or weak magnets. The downstream repair strategy solves an optimization problem in order to compensate deviations in the magnetic field of single laminated steel stacks by adapting the assembly stage. Two repair strategies are discussed within this paper, namely sequential and selective assembly. In the proper assembling sequence, the laminated steel stacks are then assembled on the rotor according to the optimal assembling policy. Thus deviations of the laminated steel stacks are compensated.

Annoni, M., Petrò, S., Rebaioli, L., Semeraro, Q., Solito, R.PROCESS PARAMETERS EFFECT ON CUTTING FORCES AND GEOMETRICAL QUALITY IN THIN WALL MICROMILLING

*Transactions of the North American Manufacturing Research Institution of SME, Volume 41, 2013, Pages 489-498*ANCOVA; Cutting forces; Flatness deviation; Micro milling; Thin walls; Wall thickness Engineering controlled terms: Aspect ratio; Carbon steel; Cutting; Industrial research; Micromachining; Quality control; Regression analysis; Thin walled structures Engineering main heading: Milling (machining) *Micromilling is one of the most geometrically versatile tooling processes, in fact three-dimensional features can be effectively manufactured on molds and dies achieving a good accuracy performance. Typical and challenging features for these microcomponents are high aspect ratio thin walls. The present study evaluates the effect of wall thickness, milling strategy and tool path on cutting forces in 0.4% carbon steel (C40) thin wall micromilling. An experimental campaign has been designed in order to statistically analyse the cutting force responses and a proper technique (ANalysis of COVAriance) has been applied to remove the tool wear effect. Considerations drawn in the present paper on micromilling cutting forces have been coupled with previous knowledge of the same authors, regarding the process parameters direct link with the thin wall geometrical quality, in order to study the feasibility of a general approach able to meet tolerances by controlling forces.*

Colombo, D., Previtali, B., Masotti, G.REMOTE FIBER LASER PROCESSING OF ZINC COATED STEELS FOR AUTOMOTIVE APPLICATIONS

*ASME 2013 International Manufacturing Science and Engineering Conference Collocated with the 41st North American Manufacturing Research Conference, MSEC 2013, Volume 1, 2013, Article number MSEC2013-1256*Active fibers; Automotive applications; High power; High quality fibers; Laser process; Process parameters; Remote laser welding; Zinc-coated steel Engineering controlled terms: Fiber lasers; Laser beam welding; Manufacture Engineering main heading: Industrial research *The flexibility in terms of beam shapability and amplitude in the process parameters range offered by the emerging high power and quality active fiber lasers can be advantageously used in overcoming the well known problems in remote laser welding of zinc coated steel components in the car mass production. The paper explores the potentiality offered by an ad hoc scanner head realized for remote laser welding, making use of high power and high quality fiber laser beams. In particular the substitution of the traditional mechanical dimpling with the laser dimpling is investigated, state of art remote laser welding joints are obtained, and the laser wobbling technique is explored in order to increase the bead quality. Copyright*

Borgia, S., Matta, A., Tolio, T.STEP-NC COMPLIANT APPROACH FOR SETUP PLANNING PROBLEM ON MULTIPLE FIXTURE PALLETS

*Journal of Manufacturing Systems, Volume 32, Issue 4, October 2013, Pages 781-791*Real case; Setup planning; Solution accuracy; STEP-NC; Technological data; Workpiece Engineering controlled terms: Computer aided process planning; Data structures; Manufacture; Mathematical programming; Pallets Engineering main heading: Fixtures (tooling) *Manufacturing system configuration is a broad problem that involves various topics concerning workpiece, cutters, fixture and machine. This paper presents an approach to solve the setup planning problem on machining centres based on a STEP-NC compliant data structure. The aim of this approach is to shorten the time required for the process planning activity by automating some time-consuming steps without compromising the solution accuracy. In the proposed approach, a CAM software tool is employed to associate the geometric and technological data regarding the product. Using the proposed data structure, a method is proposed for solving the setup planning problem based on mathematical programming. The developed approach has been tested on a real case.*

Putnik, G., Sluga, A., Elmaraghy, H., Teti, R., Koren, Y., Tolio, T., Hon, B.SCALABILITY IN MANUFACTURING SYSTEMS DESIGN AND OPERATION: STATE-OF-THE-ART AND FUTURE DEVELOPMENTS ROADMAP

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 2, 2013, Pages 751-774*Flexibility; Operational aspects; Research and development; Roadmap; State of the art; Theory and practice Engineering controlled terms: Design; Education computing; Scalability Engineering main heading: Manufacture *The paper covers the main design, management and operational aspects of scalability in manufacturing systems (MS). It promotes scalability as an area of research of MS theory and practice in order to enhance techniques and methodologies in existing MS paradigms using advanced and emerging design and management approaches and ICT, and*

meet challenges of emerging MS paradigms and support their promotion and effective and efficient deployment in practice. The paper presents an introduction to scalability, state-of-the art in manufacturing and computer science, and related applications including manufacturing and education and a roadmap for future research and developments.

Demir, A.G., Lecis, N., Previtali, B., Ugues, D.SCRATCH RESISTANCE OF FIBRE LASER SURFACE TEXTURED TIN COATINGS

*Surface Engineering, Volume 29, Issue 9, October 2013, Pages 654-659*Friction coefficients; Laser process parameters; Laser surface texturing; Nanosecond pulse; Scratch; Scratch resistance; Substrate contamination; Tribological behaviour Engineering controlled terms: Adhesion; Coatings; Cracks; Lasers; Texturing; Tin; Titanium nitride; Wear of materials Engineering main heading: Pulsed lasers *In this work, the scratch resistance of laser surface textured TiN coatings is studied to discriminate laser conditions in terms of coating adhesion and integrity in view of future wear tests. Laser surface texturing (LST) is performed on TiN coating ,3 mm thick using a pulsed active fibre laser working in nanosecond pulse regime. Laser process parameters are varied to obtain several patterns with different dimple diameter, depth and pitch, all of which are essential for controlling tribological behaviour. Scratch tests are applied to the obtained patterns to evaluate the friction coefficient, the critical loads for crack generation and adhesion. The most suitable LST pattern is identified as having shallow dimples without substrate contamination, showing no cracks even under harsh scratch conditions.*

Biffi, C.A., Previtali, B.SPATTER REDUCTION IN NANOSECOND FIBRE LASER DRILLING USING AN INNOVATIVE NOZZLE

*International Journal of Advanced Manufacturing Technology, Volume 66, Issue 9-12, June 2013, Pages 1231-1245*High beam quality; Laser percussion drilling; Long pulse durations; Maximum productivity; Nanosecond regime; Nozzle configuration; Positive features; Spatter production Engineering controlled terms: Fiber lasers; Fibers; Industrial applications; Laser applications; Nozzle design; Nozzles; Productivity; Titanium Engineering main heading: Pulsed lasers *Pulsed wave fibre lasers are becoming a popular industrial tool in microprocessing due to their many positive features, such as high beam quality, high reliability and high productivity, which are fundamental to machining small, precise features of industrial applications. However, the lasers' use in the machining of ultraprecise features, such as small holes, is hindered by the fact that commercial pulsed wave fibre lasers commonly operate with pulse durations in the nanosecond regime. Such long pulse durations mean that the material is thermally removed, which results in the production of a melted layer and thermal damage in the bulk material. Consequently, the typical thermal defects of the melting regime, such as spattering of recast material around the hole, taper, heat-affected zone and poor hole circularity, are found in materials machined with these lasers. This paper proposes a design for an innovative nozzle that combines the high productivity of nanosecond fibre lasers with an improvement in the quality of*

the machined holes by reducing the spatter production in titanium laser percussion drilling. The innovative nozzle is based on the suction effect created by the Venturi principle that prevents the deposition of melted and vaporised material on the workpiece surface. The influence of the nozzle configuration and shielding gas on hole quality is investigated after the laser percussion drilling of 0.5-mm-thick titanium sheets, in which the process conditions that allow maximum productivity are used. The innovative nozzle produces a remarkable decrease in spatter on the entrance hole surface without affecting the other quality features, such as hole diameter, circularity and taper, while preserving the high productivity obtainable with a standard nozzle.

Strano, M., Pourhassan, R., Mussi, V.THE EFFECT OF COLD ROLLING ON THE FOAMING EFFICIENCY OF ALUMINIUM PRECURSORS

*Journal of Manufacturing Processes, Volume 15, Issue 2, April 2013, Pages 227-235*Elevated temperature; Foamability; Foaming efficiency; Metal foams; Orthogonal directions; Rolling direction; Rolling parameters; Secondary processing Engineering controlled terms: Aluminum; Aluminum alloys; Cold rolling; Extrusion; Foams; Hardness; Metals Engineering main heading: Efficiency *The objective of the present study is to investigate the role of cold rolling on the foaming ability (or foamability) of aluminium precursors, made by continuous rotary extrusion, a process performed at elevated temperature, starting by powder. For this purpose, the effect of different parameters including initial shape of precursors, rolling direction, amount of deformation in each rolling pass and final thickness of rolled specimens are experimentally investigated. Furthermore, the foaming efficiency of both rolled precursors and as-received extruded ones is compared. To clarify the role of secondary processing operations on the foaming efficiency, precursor samples are prepared following different forming and machining process chains, before the final foaming operation. Finally, hardness tests are performed on as-received precursors and rolled samples to notice the correlation between rolling parameters, state of strain, foaming efficiency and hardness. The results of the study show that: (a) cold rolling considerably improves foamability, (b) rectangular precursor bars have higher foaming efficiency than round ones, both before and after cold rolling. Besides, the improvement in foamability due to cold rolling is greater if precursors are rolled in the extrusion direction, rather than the orthogonal direction.*

Armillotta, A., Moroni, G., Polini, W.TO ANALYTICALLY ESTIMATE THE 3D POSITION DEVIATION OF A HOLES PATTERN DUE TO FIXTURING

*Procedia CIRP, Volume 10, 2013, Pages 186-193*3D positions; Application examples; Fixturing; Gaussian probability density functions; Optimal positioning; Six-point locating principle; Statistical positioning; Tolerance control Engineering controlled terms: Probability density function; Three dimensional Engineering main heading: Location *This work considers how deviation on fixturing elements propagate on location tolerance of a holes' pattern. The 3-2-1 locating principle has been adopted. The position of each locator is represented by a Gaussian*

probability density function and, consequently, the probability the holes pattern falls inside the location tolerance, centred around each hole nominal position, is estimated as the product of the probabilities due to each hole. The optimal positioning of the locators is designed by minimising the deviation in holes pattern positioning during drilling due to locators inaccuracy. 3D parts have been considered as application examples.

Colosimo, B.M., Meneses, M., Semeraro, Q.VERTICAL DENSITY PROFILE MONITORING USING MIXED-EFFECTS MODEL

*Procedia CIRP, Volume 12, 2013, Pages 498-503*Functional datas; Non-parametric; Profile monitoring; Statistical process controls (SPC); Vertical density profiles Engineering controlled terms: Image quality; Industrial engineering; Statistical process control Engineering main heading: Research *Profile monitoring is a recent field of research in Statistical Process Control (SPC) literature, which is attracting the interests of many researchers. This approach is used where process data follow a profile and the stability of this functional relationship is checked over time. We consider nonparametric mixed effect models for functional data to model the profile. Then, multivariate control charting is applied to identify mean shifts or shape changes in the profile. A real case study dealing with density measurements along the particleboard thickness (usually referred to as Vertical Density Profile -VDP) is taken as reference throughout the paper. Performance of the nonparametric approach is computed for a set of outof- control scenarios. Our main conclusion is that nonparametric methods represent a flexible and effective solution to complex profile monitoring.*

Moroni, G., Petrò, S.VIRTUAL CMM-BASED SAMPLING STRATEGY OPTIMIZATION

Product Lifecycle Management: Geometric Variations, 21 January 2013, Pages 385-403[No abstract available]

Tolio, T., Sacco, M., Terkaj, W., Urgo, M.VIRTUAL FACTORY: AN INTEGRATED FRAMEWORK FOR MANUFACTURING SYSTEMS DESIGN AND ANALYSIS

*Procedia CIRP, Volume 7, 2013, Pages 25-30*Business Process; Co-evolution; Competitive manufacturing; Digital factories; Digital tools; Integrated frameworks; Production system; Virtual factory Engineering controlled terms: Data structures; Digital devices Engineering main heading: Manufacture *Competitive manufacturing companies have to effectively deal with the concurrent evolution of products, processes and production systems. This problem, known as Co-evolution, can be addressed only through the integrated use of different methodologies, provided that the digital tools implementing these methodologies can interoperate properly and effectively. This paper presents the concept of an integrated framework to support the*

interoperability between digital factory tools and shows how it can benefit the business processes along the whole factory life-cycle.

Galetto, M., Mastrogiacomo, L., Moroni, G., Petrò, S.VOLUMETRIC ERROR COMPENSATION FOR THE MSCMS-II

*Procedia CIRP, Volume 10, 2013, Pages 98-104*Automated vehicles; Error model; Large scale dimensional metrologies; Measurement accuracy; Measurement volume; Self calibration; Self-calibration procedures; Volumetric calibration Engineering controlled terms: Error compensation; Measurements; Triangulation Engineering main heading: Calibration *Large scale measuring systems, i.e. measuring systems characterized by a measurement volume from some meters up to some hundreds of meters, are gaining importance in industry to check large parts or track the position of automated vehicles. In contrast with classical monolithic measuring systems, modern large scale measuring systems are constituted by constellations of sensors able to track the position of objects by triangulation or trilateration. This new design allows a greater system flexibility, scalability, and portability, together with a general reduction of costs. The MScMS-II is a large scale measuring system based on infrared triangulation. It has been designed to guarantee the maximum flexibility and reconfigurability, so every set-up procedure has been reduced as much as possible, so that its deployment and calibration requires a short time. However, its accuracy could benefit of a more complete volumetric calibration through the definition of a model of the volumetric error to be compensated. In this paper a self-calibration procedure based on a simple one-dimensional uncalibrated artifact is proposed to define a volumetric error model of the MScMS-II. Self-calibration can be performed in short time and can improve system performance by reducing systematic errors. Experimental results complete the work.*

Politecnico di torino

Priarone, P.C., Ruffa, S., Bedolla, J.S., Settineri, L.A DOE APPROACH TO HOLE QUALITY EVALUATION IN DRILLING OF AN ELECTRON BEAM MELTED TITANIUM ALUMINIDE

*Procedia CIRP, Volume 8, 2013, Pages 481-486*DoE; Gamma titanium aluminides; Gamma-titanium aluminide; Geometrical accuracy; High temperature strength; Hole quality; Nickel-based superalloys; Titanium aluminides Engineering controlled terms: Carbides; Design of experiments; Drilling; High strength alloys; Machining centers; Superalloys; Titanium alloys; Titanium compounds Engineering main heading: Titanium *Gamma titanium aluminides are heat-resistant intermetallic structural alloys with many attractive properties such as low weight, high stiffness, high refractoriness and high temperature strength. These alloys are excellent candidates to be used as alternative to Nickel-based superalloys for thermally and mechanically*

stressed components in aerospace and automotive engines. The material properties, however, lead to γ-TiAl difficult machinability, resulting in poor surface quality. In this paper, the geometrical accuracy of holes drilled on a Ti-48Al-2Cr-2Nb γ-TiAl component, produced via Electron Beam Melting (EBM), is analyzed. Particularly, the Design of Experiments (DoE) technique was selected because of its usefulness in determining simultaneously the individual and interactive effects of many variables, that could affect the output results. Experiments were conducted with uncoated carbide drills, varying the cutting parameters. Machined holes were measured by means of a coordinate measuring machine. Hole quality was assessed focusing on the dimensional and geometrical errors, in terms of both cylindricity and roundness, and taking into account the tool wear and the hole depth. Copyright

Franceschini, F., Maisano, D., Mastrogiacomo, L.A NOVEL APPROACH FOR ESTIMATING THE OMITTED-CITATION RATE OF BIBLIOMETRIC DATABASES WITH AN APPLICATION TO THE FIELD OF BIBLIOMETRICS

*Journal of the American Society for Information Science and Technology, Volume 64, Issue 10, October 2013, Pages 2149-2156*Accuracy level; Bibliometric; Bibliometrics; Citation analysis; Confidence interval; Electronic links; Statistical modeling Engineering controlled terms: Estimation; Information science Engineering main heading: Database systems *One of the most significant inaccuracies of bibliometric databases is that of omitted citations, namely, missing electronic links between a paper of interest and some citing papers, which are (or should be) covered by the database. This paper proposes a novel approach for estimating a database's omitted-citation rate, based on the combined use of 2 or more bibliometric databases. A statistical model is also presented for (a) estimating the "true" number of citations received by individual papers or sets of papers, and (b) defining an appropriate confidence interval. The proposed approach could represent a first step towards the definition of a standard for evaluating the accuracy level of databases.*

Fasolo, L., Galetto, M., Turina, E.IMPACT OF PERFORMANCE INDICATORS ON ORGANISATIONS: A PROPOSAL FOR AN EVALUATION MODEL

Quality and Quantity, Volume 47, Issue 2, 2013, Pages 633-657The serious economic crisis broken out in 2008 highly stressed the limitations of GDP used as a well-being indicator and as a predictive tool for economy. This induced the need to identify new indicators able to link the economic prosperity of a country to aspects of sustainable development and externalities, both positive and negative, in the long run. The aim of this paper is to introduce a structured approach which supports the choice or the construction of alternative indicators to GDP. The starting point is the definition of what a well-being indicator actually should represent according to the Recommendations of the Stiglitz-Sen-Fitoussi Report on the measurement of economic

performance and social progress. Then the paper introduces a systematic procedure for the analysis of well-being indicators. The different phases of this procedure entail the checking of indicators technical properties and their effect on the representational efficacy. Finally, some of the most representative well-being indicators drawn from the literature are compared and a detailed application example is proposed.

Franceschini, F., Galetto, M., Turina, E.A PRAGMATIC APPROACH TO EVALUATE ALTERNATIVE INDICATORS TO GDP

*Production Planning & Control, Volume 25, Issue 9, Pages 783-799*Quality of life indicator; Well-being indicator; Sustainability indicator; GDP; Indicator properties*This work aims at giving some guidelines to assess the impact of performance indicators on organisations. Performance measurement systems are usually introduced into organisations in order to monitor goal achievement, to allocate resources and to implement a strategy. However, the implementation of performance indicators may generate an alteration in the rational behaviour of the monitored structure. The risk of this impact is always present, and must be considered very carefully in order to preserve the organisation from a counter-productive effect. In the present analytical work, a reference model is proposed as a first step. This model considers all the organisational dimensions on which an indicator may exert its influence. The method makes use of the four Kaplan and Norton's balanced scorecard perspectives in order to identify the dimensions on which an indicator may exert its impact. Previous works reported in scientific literature do not provide operational models for impact analysis, whereas, the proposed model is linked to an operative procedure in order to support management to make this analysis. The aim is to make the impact analysis less complex by structuring it in a sequence of predefined steps. The proposal is supported by some practical examples.*

Franceschini, F., Galetto, M., Maisano, D., Mastrogiacomo, L.AN INFORMETRIC MODEL FOR THE SUCCESS-INDEX

*Journal of Informetrics, Volume 7, Issue 1, January 2013, Pages 109-116*H indices; Information production; Lotka's laws; Scientific context; Scientometrics; Success-Index Engineering controlled terms: Production engineering Engineering main heading: Publishing *Based on an idea by Kosmulski, Franceschini et al. (2012, Scientometrics 92(3), 621-641) propose to classify a publication as " successful" when it receives more citations than a specific comparison term (CT). In the intention of the authors CT should be a suitable estimate of the number of citations that a publication - in a certain scientific context and period of time - should potentially achieve. According to this definition, the success-index is defined as the number of successful papers, among a group of publications examined, such as those associated to a scientist or a journal. In the first part of the paper, the success-index is recalled, discussing its properties and limitations. Next, relying on the theory of Information Production Processes (IPPs), an informetric model of*

the index is formulated, for a better comprehension of the index and its properties. Particular emphasis is given to a theoretical sensitivity analysis of the index.

Antonelli, D., Baralis, E., Bruno, G., Cerquitelli, T., Chiusano, S., Mahoto, N.ANALYSIS OF DIABETIC PATIENTS THROUGH THEIR EXAMINATION HISTORY

*Expert Systems with Applications, Volume 40, Issue 11, 1 September 2013, Pages 4672-4678*Analysis frameworks; Clustering techniques; Experimental validations; Health-care system; Healthcare organizations; Patient examination; Variable distribution; Vector space models Engineering controlled terms: Cluster analysis; Data mining; Health care; Medical problems Engineering main heading: Knowledge management *The analysis of medical data is a challenging task for health care systems since a huge amount of interesting knowledge can be automatically mined to effectively support both physicians and health care organizations. This paper proposes a data analysis framework based on a multiple-level clustering technique to identify the examination pathways commonly followed by patients with a given disease. This knowledge can support health care organizations in evaluating the medical treatments usually adopted, and thus the incurred costs. The proposed multiple-level strategy allows clustering patient examination datasets with a variable distribution. To measure the relevance of specific examinations for a given disease complication, patient examination data has been represented in the Vector Space Model using the TF-IDF method. As a case study, the proposed approach has been applied to the diabetic care scenario. The experimental validation, performed on a real collection of diabetic patients, demonstrates the effectiveness of the approach in identifying groups of patients with a similar examination history and increasing severity in diabetes complications.*

Gatto, A., Bassoli, E., Denti, L., Iuliano, L.BRIDGES OF DEBRIS IN THE EDD PROCESS: GOING BEYOND THE THERMO-ELECTRICAL MODEL

*Journal of Materials Processing Technology, Volume 213, Issue 3, March 2013, Pages 349-360*Bridge effects; Cluster; Dielectric strengths; Domain-specific application; Electro discharge machining; Electrodischarges; Empirical model; Experimental evidence; Ignition model; Optimization method; Physical model; Transient phenomenon Engineering controlled terms: Chains; Titanium carbide Engineering main heading: Debris *Electro-discharge (ED) processes depend on the contemporaneous effect of many factors, which complicates process control/predictability and induced many authors in the last 60 years to work on explicative models. Studies split into two main approaches: theoretical and empirical. Theoretical works are based on the thermo-electrical theory and try to describe process phenomena by a physical model, with unavoidable assumptions and simplifications that cause a move away from veracity. On the contrary, experimentalists establish empirical models based on statistical analysis of results and optimization methods, but the findings are limited to domain-specific applications. In*

addition, numerous papers focus on single-spark analysis, failing in considering the interaction between successive discharges, or of transient phenomena as the presence of bubbles and debris in the gap. At present the scientific debate involves the ignition model, with two different points of view regarding the discharge-driving phenomenon: the debris bridge effect (pollutants in the dielectric drive the performances), and the dielectric strength effect (properties of the dielectric drive the performances). The paper addresses this dispute by investigating the debris formed during small-hole ED drilling of a 72 wt% Al 2 O 3 -28 wt% TiC composite. Particles are found to hollow out and pack within the gap, joining by necks. The first experimental evidence is given of the presence of chains and clusters of debris, towards a new model for electro-discharge processes that goes beyond the thermoelectric theory.

Salvador, E., Montagna, F., Marcolin, F.CLUSTERING RECENT TRENDS IN THE OPEN INNOVATION LITERATURE FOR SME STRATEGY IMPROVEMENTS

*International Journal of Technology, Policy and Management, Volume 13, Issue 4, 2013, Pages 354-376*Key feature; Methods for SMEs; Open innovation; Path dependence; Recent trends Engineering controlled terms: Industry; Innovation Engineering main heading: Cluster analysis *The literature on Open Innovation is booming. In recent years, more and more contributions have been published in several scientific reviews. This increasing trend calls for an approach that could lead to a classification of the specificities of these contribution contents. This is what this paper aims to do. More specifically, our goal is to provide not a simple catalogue of the hundreds of articles published in this field, but rather it tries by cluster analysis a classification of the most important key features of the typical articles published in the field of Open Innovation, with a specific focus on implemented methods in SMEs. Notwithstanding the limitations of our attempt, the cluster analysis results provide a reference paradigm to compare existing as well as future contributions and add new insights. This paper highlights how a path dependence approach in the literature has influenced the companies Open Innovation implementation, but some recent attempts at overcoming this process are arising. This recent trend focuses on SMEs as the real key challenge. Copyright*

Antonelli, D., Bruno, G., Taurino, T., Villa, A.CONDITIONS FOR EFFECTIVE COLLABORATION IN SME NETWORKS BASED ON GRAPH MODEL

*IFIP Advances in Information and Communication Technology, Volume 408, 2013, Pages 129-136*Collaboration; Development strategies; Graph model; Graph-based modeling; Hub and spoke networks; Production process; Small and medium enterprise; Supply chain network Engineering controlled terms: Supply chains; Virtual corporation Engineering main heading: Graph theory *Collaboration represents an increasing tendency among Small and Medium Enterprises (SMEs), since the possibility of being a cooperative partner of a network allows the achievement of development strategies, either to improve production processes or to increase competitiveness. The objective of the paper is to propose and apply a new methodology to model manufacturing*

SME networks in terms of graph matrices, in order to identify some conditions that can foster an effective collaboration among partners of a SME network. A classification of SME networks in four typologies named "Marshallian Network", "Supply chain network", "Hub and Spoke network" and "Scientific Park" will be introduced. For each typology a graph-based model will be used to find out limits and critical points that can hinder the SME collaboration, or focal points for the interaction reinforcing.

Galetto, M., Mastrogiacomo, L.CORRECTIVE ALGORITHMS FOR MEASUREMENT IMPROVEMENT IN MSCMS-II (MOBILE SPATIAL COORDINATE MEASUREMENT SYSTEM)

*Precision Engineering, Volume 37, Issue 1, January 2013, Pages 228-234*Contact probes; Correction models; Dimensional Metrology; Industrial metrology; ITS architecture; Lens distortion; MScMS; Probe tips; Prototype system; Spatial coordinates Engineering controlled terms: Algorithms; Kalman filters; Probes Engineering main heading: Units of measurement *This paper presents a set of algorithms for the correction of measurement errors of a prototype system designed for large scale dimensional metrology (LSDM) applications. The system, developed in the Quality and Industrial Metrology Laboratory of Politecnico di Torino, is based on the principles of photogrammetry and consists of a set of cameras wirelessly connected to a central unit able to track the position of a portable contact probe. Due to its architecture the system is affected by several systematic error sources. This paper addresses some of them: the distortion of the lenses, the dimension of the probe tip and the kinematic of the probe. By means of the implementation of appropriate mathematical correction models, the overall system performance is significantly improved as shown by the conducted tests.*

Atzeni, E., Minetola, P., Salmi, A.DIMENSIONAL ANALYSIS OF A PROTOTYPE MOULD-MAKING PROCESS FOR THERMOPLASTIC RESIN TRANSFER MOULDING

*International Journal of Advanced Manufacturing Technology, Volume 65, Issue 1-4, March 2013, Pages 309-317*Contact less; Dimensional analysis; Dimensional deviation; Dimensional inspection; Large components; Mould manufacturing; Nickel shells; Point wise; Production of; Tooling costs; Whole process Engineering controlled terms: Milling (machining); Molds; Resin transfer molding; Resins Engineering main heading: Quality control *The resin transfer moulding (RTM) process is a low-cost process for the production of parts of composite material. However, the economic convenience is lost when large components should be produced, because of the high tooling cost. The step milling of a resin master and the subsequent deposition of a nickel shell could be a valid alternative for the fabrication of an RTM mould. So far, information about the quality of this method of fabricating RTM moulds is lacking, thus more efforts are needed to quantify the error induced by the manufacturing sequence. In order to control the whole process*

and to assess the quality of the manufactured part, the dimensional deviation due to single manufacturing steps is evaluated for a reference part. Both traditional pointwise measurements and contactless scanning are used for dimensional inspection.

Manfredi, D., Calignano, F., Ambrosio, E.P., Krishnan, M., Canali, R., Biamino, S., Pavese, M., Atzeni, E., Luliano, L., Fino, P., Badini, C.DIRECT METAL LASER SINTERING: AN ADDITIVE MANUFACTURING TECHNOLOGY READY TO PRODUCE LIGHTWEIGHT STRUCTURAL PARTS FOR ROBOTIC APPLICATIONS

*Metallurgia Italiana, Volume 105, Issue 10, October 2013, Pages 15-24*Additive Manufacturing; Additive manufacturing technology; Design and manufactures; Direct metal laser sintering; Fine microstructure; Lightweight components; Robotic applications; Three-dimensional object Engineering controlled terms: Aluminum alloys; Biological materials; Computer aided design; Electron microscopy; Laser heating; Machine components; Mechanical properties; Metallic matrix composites; Robotics Engineering main heading: Fabrication *Direct metal laser sintering (DMLS) is an additive manufacturing (AM) technology for the fabrication of near netshaped parts directly from computer-aided design (CAD) data by melting together different layers with the help of a laser source. Its application for manufacturing three-dimensional objects represents one of the promising directions to solve challenging industrial problems. This approach permits to extend significantly the freedom of design and manufacture by allowing, for example, to create an object with desired shape and internal structure in a single fabrication step. The design of the part can be tailored to meet specific functions and properties (e.g. physical, mechanical, chemical, biological, etc.) using different materials. In this paper a DMLS machine was used for robotic lightweight components fabrication in an aluminium alloy. It was observed that DMLS technology not only achieved very interesting mechanical properties thanks to the very fine microstructure, but also can easily promote the development and study of lightweight lattice structures. In addition, it is envisaged to develop new custom materials, such as light metal matrix composites, suitable for the DMLS process, broadening the range of applications in different fields like space, aviation, automotive and other industries.*

Loglisci, G., Priarone, P.C., Settineri, L.CUTTING TOOL MANUFACTURING: A SUSTAINABILITY PERSPECTIVE

*Proceedings of the 11th Global Conference on Sustainable Manufacturing (GCSM), pp. 275-280, Ed. G. Seliger, Berlin (Germany), 23rd-25th September 2013*machining; process consumption; sustainable manufacturing; tap production*Over the last few years, sustainability has become a major challenge for manufacturing systems, due to the rising awareness of energy consumption and to the associated environmental impact of processes. In order to measure the sustainability of a specific process, metrics for sustainable manufacturing were developed and*

proposed in the scientific literature. The research activities presented in this paper aim to apply a structured sustainable approach to a tool manufacturing process. More in detail, the production of a tap, starting from the raw material up to the finished product, is investigated. The process, divided into the various stages of the manufacturing route, is evaluated from a technological and sustainable point of view. Results provides a basis for decision-making, and are expected to be incorporated into the business strategy development processes.

Priarone, P.C., Rizzuti, S., Ruffa, S., Settineri, L.DRILLING EXPERIMENTS ON A GAMMA TITANIUM ALUMINIDE OBTAINED VIA ELECTRON BEAM MELTING

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 1-4, 2013, Pages 483-490*Additive Manufacturing; Aero-engine components; Gamma titanium aluminides; Gamma-titanium aluminide; High specific strength; Hole quality; Mechanical and thermal properties; Tool wear Engineering controlled terms: Automotive industry; Carbides; Drilling; Electron beam melting; High temperature applications; Powder metals; Surface roughness; Titanium; Wear of materials Engineering main heading: Titanium alloys *Gamma titanium aluminides are intermetallic structural alloys with many advantages like high temperature and oxidation resistance, low density, high specific strength, rigidity, etc. This makes them promising candidates for critical applications where both mechanical and thermal properties are required. Unfortunately, their machinability is demanding, generating low cutting life and poor surface conditions. A deeper knowledge on the machining parameters is essential for a wider application of these heat-resistant light-weight alloys in aircraft and automotive industry. In this paper, the performance of uncoated carbide drills in drilling a gamma titanium aluminide was analysed. The workpiece material was obtained via electron beam melting (EBM) process, a versatile technology for additive manufacturing of complex metal parts from metal powders. EBM is highly appealing in the field of aeroengine components, and it is particularly interesting in processing gamma titanium aluminides. Cutting performances were measured in terms of tool wear, surface roughness, dimensional and geometric errors. The experimental results show strong dependence of tool wear and part quality on cutting parameters, with poor tool life compared with other work materials.*

Franceschini, F., Maisano, D., Mastrogiacomo, L.EVALUATING RESEARCH INSTITUTIONS: THE POTENTIAL OF THE SUCCESS-INDEX

*Scientometrics, Volume 96, Issue 1, July 2013, Pages 85-101*Success-index; Hirsch index; Field normalization; Citation propensity; Groups of researchers; Research institutions*Similarly to the h-index and other indicators, the success-index is a recent indicator that makes it possible to identify, among a general group of papers, those of greater citation impact. This indicator implements a field-normalization at the level of single paper and can therefore be applied to multidisciplinary groups of articles. Also, it is very practical for normalizations aimed at*

achieving the so-called size-independency. Thanks to these (and other) properties, this indicator is particularly versatile when evaluating the publication output of entire research institutions. This paper exemplifies the potential of the success-index by means of several practical applications, respectively: (i) comparison of groups of researchers within the same scientific field, but affiliated with different universities, (ii) comparison of different departments of the same university, and (iii) comparison of entire research institutions. A sensitivity analysis will highlight the success-index's robustness. Empirical results suggest that the success-index may be conveniently extended to large-scale assessments, i.e., involving a large number of researchers and research institutions.

Rotella, G., Dillon Jr., O.W., Umbrello, D., Settineri, L., Jawahir, I.S.FINITE ELEMENT MODELING OF MICROSTRUCTURAL CHANGES IN TURNING OF AA7075-T651 ALLOY

*Journal of Manufacturing Processes, Volume 15, Issue 1, January 2013, Pages 141-150*AA7075-T651; Bulk materials; Cutting speed; Dry cutting; FE model; Finite element method FEM; Finite element modeling; Functional performance; Grain size; Hall-Petch equation; Machined surface; Microstructural changes; Nose radius; Surface characteristics; Surface hardness; Surface integrity; User subroutine Engineering controlled terms: Cerium alloys; Dynamic recrystallization; Grain size and shape; Iron alloys; Machining; Materials handling equipment; Surfaces; Turning Engineering main heading: Finite element method *The surface characteristics of a machined product strongly influence its functional performance. During machining, the grain size of the surface is frequently modified, thus the properties of the machined surface are different to that of the original bulk material. These changes must be taken into account when modeling the surface integrity effects resulting from machining. In the present work, grain size changes induced during turning of AA7075-T651 (160 HV) alloy are modeled using the Finite Element (FE) method and a user subroutine is implemented in the FE code to describe the microstructural change and to simulate the dynamic recrystallization, with the consequent formation of new grains. In particular, a procedure utilizing the Zener-Hollomon and Hall-Petch equations is implemented in the user subroutine to predict the evolution of the material grain size and the surface hardness when varying the cutting speeds (180-720 m/min) and tool nose radii (0.4-1.2 mm). All simulations were performed for dry cutting conditions using uncoated carbide tools. The effectiveness of the proposed FE model was demonstrated through its capability to predict grain size evolution and hardness modification from the bulk material to machined surface. The model is validated by comparing the predicted results with those experimentally observed.*

Sauza Bedolla, J., Ricci, F., Martinez Gomez, J., Chiabert, P.FOSTERING PLM IMPLEMENTATION IN SMES: MODELLING AND MANAGING VERIFICATION PROCESSES

*IFAC Proceedings Volumes (IFAC-PapersOnline), 2013, Pages 1762-1767*Business strategy; Geometrical product specification; Multinational level; Precision manufacturing; Verification process; Visualization modeling Engineering controlled terms: Design; Flow visualization; Manufacture; Measurements; Product development; Units of measurement; Visualization Engineering main heading: Industry *PLM is largely recognized as the most effective business strategy by all those companies committed to deliver complex and continuously-evolving products, particularly if these operate at a multinational level. However, only a small number of these companies, the larger ones, has reached the level of maturity necessary to implement it in an effective manner. SMEs are not usually amongst these. This paper proposes a user-friendly Visualization Model (VM), that can guide the implementation of PLM philosophy in whatever scale company, provided its processes have been standardized. The model has been tested with major and smaller companies operating in the field of precision manufacturing showing encouraging results. However, as SMEs would get the greatest benefits, it is presented, in this paper, by means of a case study involving a small metrology company. A further content of novelty here, is represented by the fact that the case study's company is using this method to start operating according to the new ISO Geometrical Product Specification and Verification (GPS) standards.*

Villa, A., Taurino, T.FROM JIT TO SERU, FOR A PRODUCTION AS LEAN AS POSSIBLE

*Procedia Engineering, Volume 63, 2013, Pages 956-965*Lean production; Just In Time; Seru-Seisan; production systems evolution.*Lean Manufacturing is not especially new. It derives from the Toyota Production System or Just In Time Production (JIT), but even before from Henry Ford and other predecessors. Based on analysis of mass production systems in USA, Toyota engineers began to incorporate Ford production and other techniques into the JIT approach: they recognized the central role of inventory. JIT is fit for a stable, but not "volatile", business environment such as that which the electronics industry belongs. That means short product life cycles and fluctuating production. Seru Seisan, a new production organization, was developed to cope with this environment. Outside Japan, however, few people in the academic and practical area are aware of such production management mode. This work gives an interpretation of the evolution from JIT towards Seru Seisan such as to attract the interest in this labor organization that appears to be promising.*

Manfredi, D., Calignano, F., Krishnan, M., Canali, R., Ambrosio, E.P., Atzeni, E.FROM POWDERS TO DENSE METAL PARTS: CHARACTERIZATION OF A COMMERCIAL ALSIMG ALLOY PROCESSED THROUGH DIRECT METAL LASER SINTERING

*Materials, Volume 6, Issue 3, 2013, Pages 856-869*Additive Manufacturing; Additive process; Chemical compositions; Direct metal laser sintering; Fine microstructure; Mechanical characterizations; Micro-structural properties; Powder deposition Engineering controlled terms:

Aluminum alloys; Characterization; Electron microscopy; Laser heating; Metals; Optical microscopy Engineering main heading: Powder metals *In this paper, a characterization of an AlSiMg alloy processed by direct metal laser sintering (DMLS) is presented, from the analysis of the starting powders, in terms of size, morphology and chemical composition, through to the evaluation of mechanical and microstructural properties of specimens built along different orientations parallel and perpendicular to the powder deposition plane. With respect to a similar aluminum alloy as-fabricated, a higher yield strength of about 40% due to the very fine microstructure, closely related to the mechanisms involved in this additive process is observed.*

Antonelli, D., Bruno, G., Schwichtenberg, A., Villa, A.FULL EXPLOITATION OF PRODUCT LIFECYCLE MANAGEMENT BY INTEGRATING STATIC AND DYNAMIC VIEWPOINTS

*IFIP Advances in Information and Communication Technology, Volume 398, Issue PART 2, 2013, Pages 176-183*File manager; IDEF0; Information integration; PLM systems; Product life cycle management; Static structures; UML Engineering controlled terms: Industrial management; Life cycle; Ontology Engineering main heading: Information management *Even if PLM offers a wide range of functionalities, they are currently not fully exploited by most of the companies, which use it mainly as a file manager. In this paper we aim at helping the full exploitation of PLM systems. To this aim, we propose a model of the product lifecycle management in the form of an ontology integrating both the static structure of product's data and the dynamic description of the related processes.*

Klocke, F., Settineri, L., Lung, D., Priarone, P.C., Arft, M.HIGH PERFORMANCE CUTTING OF GAMMA TITANIUM ALUMINIDES: INFLUENCE OF LUBRICOOLANT STRATEGY ON TOOL WEAR AND SURFACE INTEGRITY

*Wear, Volume 302, Issue 1-2, April 2013, Pages 1136-1144*Brittle-to-ductile transition; Cryogenic cooling; Gamma titanium aluminides; Gamma-titanium aluminide; Lubrication condition; Minimum quantity lubrication; Strength to weight ratio; Tool wear Engineering controlled terms: Abrasion; Aircraft engines; Cooling; Cryogenics; Cutting; Cutting tools; High pressure effects; Liquid nitrogen; Lubrication; Strength of materials; Surface roughness; Surfaces; Titanium; Wear of materials Engineering main heading: Titanium alloys *Heat resistant gamma titanium aluminides are intermetallic alloys planned to be widely used in high-performance aircraft engines within the next few years. This application field is ascribed to the exceptional material properties, especially the low density and a unique strength-to-weight ratio for titanium-based alloys, good oxidation behaviour and thermal stability, limited ductility and fracture toughness below brittle-to-ductile transition, and good creep resistance.The demanding machinability of gamma titanium aluminides can be traced back to these desirable material*

properties. Consequently, cutting process adaptation is essential to obtain components suitable to satisfy strong regulations regarding surface integrity, without neglecting an economical production. Previous research activities confirmed that thermal material softening during cutting due to the high speed machining is a key to reach high quality surfaces, but tool wear was identified as the limiting factor.The relatively high cutting speed results in high temperatures in the shear zone and the low thermal conductivity of the γ-TiAl workpiece material leads to an extreme thermal tool load. Furthermore, in combination with the formation of saw-tooth chips and the discontinuous flow of the chip along the rake face, adhesive wear is caused.The influence of conventional flood cooling and high pressure lubricoolant supply (wet conditions), cryogenic cooling with liquid nitrogen, and minimum quantity lubrication (MQL) were investigated in longitudinal external turning operations. Tool wear, cutting forces, chip morphology and surface roughness were evaluated. Surface integrity was analysed in terms of machined surface defects and sub-surface alterations.The investigations indicate that cryogenic cooling is the most promising lubrication strategy, meaning that the thermodynamical impact of the expanding liquid nitrogen applied directly close to the cutting zone successfully counteract the huge thermal load on the tool cutting edges, providing potentially enormous benefits in terms of tool wear reduction and consequent surface quality improvement.

Calignano, F., Manfredi, D., Ambrosio, E.P., Iuliano, L., Fino, P.INFLUENCE OF PROCESS PARAMETERS ON SURFACE ROUGHNESS OF ALUMINUM PARTS PRODUCED BY DMLS

*International Journal of Advanced Manufacturing Technology, Volume 67, Issue 9-12, 2013, Pages 2743-2751*Additive Manufacturing; Different layers; Direct metal laser sintering; Experimental planning; Field emission scanning electron microscopes; Influence of process parameters; Input parameter; Orthogonal array Engineering controlled terms: Aluminum; Computer aided design; Laser heating; Shot peening; Taguchi methods Engineering main heading: Surface roughness *Direct metal laser sintering (DMLS) is an additive manufacturing technique for the fabrication of near net-shaped parts directly from computer-aided design data by melting together different layers with the help of a laser source. This paper presents an investigation of the surface roughness of aluminum samples produced by DMLS. A model based on an L 18 orthogonal array of Taguchi design was created to perform experimental planning. Some input parameters, namely laser power, scan speed, and hatching distance were selected for the investigation. The upper surfaces of the samples were analyzed before and after shot peening. The morphology was analyzed by means of field emission scanning electron microscope. Scan speed was found to have the greatest influence on the surface roughness. Further, shot peening can effectively reduce the surface roughness.*

Antonelli, D., Chiabert, P., Romagnoli, V.INFORMATION SYSTEM AND SYSTEMS THINKING: A COMPULSORY MARRIAGE?

*IFAC Proceedings Volumes (IFAC-PapersOnline), 2013, Pages 1780-1785*Amount of information; Core competence; Engineering words; Enterprise management; Product development process; Product life cycle management; System thinkings; Systems thinking Engineering controlled terms: Industry; Information systems; Knowledge management; Life cycle; Manufacture Engineering main heading: Enterprise resource planning *Information systems play a fundamental role in enterprise management and development. Moving from MRP to ERP and from CAD to PLM, the amount of information stored in the enterprises' computers increased exponentially. Nowadays enterprises face a double-faced risk: on one side they have increasing difficulties in the management of large amount of information and sometimes they lose the access to important data; on the other side the availability of large amount of information allows for unconstrained modification of product development process and sometimes it promotes solutions which do not preserve the enterprises' core competences. Both problems could be solved by experts trained to manage complex data in complex systems. The evolution of information systems from MRP to ERP and from CAD to PLM may require a new approach based on a holistic view or, in engineering words, on system thinking. The paper deals with such hypothesis: the adoption of system thinking approach in product development process and the skills required to people involved in the process.*

Mahmood, A., Montagna, F.MAKING LEAN SMART BY USING SYSTEM-OF-SYSTEMS' APPROACH

*IEEE Systems Journal, Volume 7, Issue 4, 2013, Article number 6468064, Pages 537-548*Industrial sector; Lean manufacturing; Lean production; Management frameworks; Production system; Production system designs; smart lean; System of systems Engineering controlled terms: Agile manufacturing systems; Production engineering Engineering main heading: Systems engineering *System of systems (SoS) is quite a new approach in the practical field that is on the verge of transcending the boundaries of the defense system and ready to be applied in the industrial sector. This paper attempts to answer the important question of whether a production system falls under the scope of SoS by using a general framework proposed by the system theory. This also unearths the need to radicalize lean manufacturing with state-of-the-art tools. In order to achieve this objective, we design and elaborate a new management framework for an SoS lean or smart lean system by applying the SoS approach to lean manufacturing.*

Alfieri, A., Matta, A.MATHEMATICAL PROGRAMMING TIME-BASED DECOMPOSITION ALGORITHM FOR DISCRETE EVENT SIMULATION

*European Journal of Operational Research, Volume 231, Issue 3, 16 December 2013, Pages 557-566*Computational time; Decomposition algorithm; Linear functions; Mathematical program; Mathematical programming models; Optimisation problems; Running simulations; Simulation Engineering controlled terms: Algorithms; Decomposition; Discrete event simulation Engineering main heading: Mathematical programming *Mathematical programming has been proposed in the literature as an alternative technique to simulating a special class of Discrete Event Systems. There are several benefits to using mathematical programs for simulation, such*

as the possibility of performing sensitivity analysis and the ease of better integrating the simulation and optimisation. However, applications are limited by the usually long computational times. This paper proposes a time-based decomposition algorithm that splits the mathematical programming model into a number of submodels that can be solved sequentially to make the mathematical programming approach viable for long running simulations. The number of required submodels is the solution of an optimisation problem that minimises the expected time for solving all of the submodels. In this way, the solution time becomes a linear function of the number of simulated entities.

Rocca, S., Zomeren, A.V., Costa, G., Dijkstra, J.J., Comans, R.N.J., Lombardi, F.MECHANISMS CONTRIBUTING TO THE THERMAL ANALYSIS OF WASTE INCINERATION BOTTOM ASH AND QUANTIFICATION OF DIFFERENT CARBON SPECIES

*Waste Management, Volume 33, Issue 2, February 2013, Pages 373-381*Bottom ash; Carbon species; Elemental carbon; Hospital waste incinerations; Hydrocalumite; Incineration technology; Leaching behavior; Loss on ignition; Moisture evaporation; Reaction mechanism; TG-MS; Thermal decomposition products; Weight change Engineering controlled terms: Ash handling; Ashes; Barium compounds; Calcium carbonate; Carbon; Carbonation; Decomposition; Incineration; Leaching; Mass spectrometry; Refuse derived fuels; Thermoanalysis; Thermogravimetric analysis Engineering main heading: Waste incineration EMTREE drug terms: calcium hydroxide; chemical compound; hydrocalumite; organic carbon; unclassified drug GEOBASE Subject Index: bottom ash; dehydration; evaporation; fly ash; incineration; leaching; mass spectrometry; optimization; organic carbon; speciation (chemistry); water treatment EMTREE medical terms: analytic method; article; artifact; ash; bottom ash; chemical composition; chemical reaction; controlled study; decomposition; dry weight; evaporation; high temperature; hospital waste incineration; incineration; loss on ignition; low temperature; mass spectrometry; priority journal; reaction analysis; refuse derived fuel incineration; thermogravimetry MeSH: Carbon; Carbonates; Coal Ash; Gases; Incineration; Mass Spectrometry; Medical Waste; Refuse Disposal; Solid Waste; Thermogravimetry Medline is the source for the MeSH terms of this document. *The focus of this study was to identify the main compounds affecting the weight changes of bottom ash (BA) in conventional loss on ignition (LOI) tests and to obtain a better understanding of the individual processes in heterogeneous (waste) materials such as BA. Evaluations were performed on BA samples from a refuse derived fuel incineration (RDF-I) plant and a hospital waste incineration (HW-I) plant using thermogravimetric analysis and subsequent mass spectrometry (TG-MS) analysis of the gaseous thermal decomposition products. Results of TG-MS analysis on RDF-I BA indicated that the LOI measured at 550°C was due to moisture evaporation and dehydration of Ca(OH) 2 and hydrocalumite. Results for the HW-I BA showed that LOI at 550°C was predominantly related to the elemental carbon (EC) content of the sample. Decomposition of CaCO 3 around 700°C was identified in both materials. In addition, we have identified reaction mechanisms that underestimate the EC and overestimate the CaCO 3 contents of the HW-I BA during TG-MS analyses. These types of artefacts are expected to occur also when conventional LOI methods are*

adopted, in particular for materials that contain CaO/Ca(OH) 2 in combination with EC and/or organic carbon, such as e.g. municipal solid waste incineration (MSWI) bottom and fly ashes. We suggest that the same mechanisms that we have found (i.e. in situ carbonation) can also occur during combustion of the waste in the incinerator (between 450 and 650°C) demonstrating that the presence of carbonate in bottom ash is not necessarily indicative for weathering. These results may also give direction to further optimization of waste incineration technologies with regard to stimulating in situ carbonation during incineration and subsequent potential improvement of the leaching behavior of bottom ash.

Cantamessa, M., Montagna, F., Messina, M.MULTISTAKEHOLDER ANALYSIS OF REQUIREMENTS TO DESIGN REAL INNOVATIONS

*Proceedings of the International Conference on Engineering Design, ICED, Volume 1 DS75-01, 2013, Pages 309-318*Biomedical sectors; Innovation process; Multi-stakeholder analysis; Product diffusion; Requirement management; Requirements to designs; Start-up companies; Traditional approaches Engineering controlled terms: Engineering; Industrial engineering Engineering main heading: Product design *People are generally influenced in their purchasing choices by diverse stake-holders and these influences are often not related to "use situations". Learning processes, product diffusion dynamics and externalities in fact frequently complicate innovation processes. "Design for Innovation" means considering that design cannot focus only on buyer's preferences and on "product use" because this could limit diffusion of products, besides bounding in general innovation opportunities. The "Design for Innovation" approach drives to study "beyond use situations" and the influences among the actors involved in the innovation processes. This paper describes the application of the "Design for Innovation" approach to MEDALLCARE, an Italian start-up company of the biomedical sector. What resulted is a more original list of needs that would have not emerged with more traditional approaches for the requirement management.*

Klocke, F., Lung, D., Arft, M., Priarone, P.C., Settineri, L.ON HIGH-SPEED TURNING OF A THIRD-GENERATION GAMMA TITANIUM ALUMINIDE

*International Journal of Advanced Manufacturing Technology, Volume 65, Issue 1-4, March 2013, Pages 155-163*Automotive parts; Chip formations; Chip morphologies; Crack-free surfaces; Cutting forces; Cutting speed; Defect-free surfaces; Experimental campaign; Experimental evidence; Gamma titanium aluminides; Gamma-titanium aluminide; Heat resistant; High quality; High temperature; High-speed turning; Innovative approaches; Intermetallic alloys; Lubrication condition; Lubrication system; Lubricoolant strategy; Mechanical stress; Process adaptations; Process condition; Process parameters; Shear zone; Surface integrity; Third generation; Tool geometry; Tool wear Engineering controlled terms: Crystallography; Cutting; Lubrication; Stresses; Turning; Wear of materials Engineering main heading: Titanium *Gamma titanium aluminides are heat-resistant intermetallic alloys predestined to be employed in*

components suffering from high mechanical stresses and thermal loads. These materials are regarded as difficult to cut, so this makes process adaptation essential in order to obtain high-quality and defect-free surfaces suitable for aerospace and automotive parts. In this paper, an innovative approach for longitudinal external high-speed turning of a third-generation Ti-45Al-8Nb-0.2C-0.2B gamma titanium aluminide is presented. The experimental campaign has been executed with different process parameters, tool geometries and lubrication conditions. The results are discussed in terms of surface roughness/integrity, chip morphology, cutting forces and tool wear. Experimental evidence showed that, due to the high cutting speed, the high temperatures reached in the shear zone improve chip formation, so a crack-free surface can be obtained. Furthermore, the use of a cryogenic lubrication system has been identified in order to reduce the huge tool wear, which represents the main drawback when machining gamma titanium aluminides under the chosen process conditions.

Villa, A., Bruno, G.PROMOTING SME COOPERATIVE AGGREGATIONS: MAIN CRITERIA AND CONTRACTUAL MODELS

*International Journal of Production Research, Volume 51, Issue 23-24, 1 November 2013, Pages 7439-7447*Business activities; Business strategy; Co-operation strategy; Effective solution; European institutions; Feasibility studies; Small and medium enterprise; UML Engineering controlled terms: Ontology; Planning Engineering main heading: Contracts *Collaboration is considered an effective solution to improve business strategies. However, small and medium enterprises (SMEs) often lack common principles and common forms of contractual coordination. Several policies implemented by the EU have addressed the set-up of a comprehensive SME policy framework, but European institutions seem to have focused more on organisational devices to conduct business activities rather than on contractual forms of coordination. In April 2009, Italy adopted a law in network contract to promote the development of inter-firm cooperation strategies to foster enterprises innovation and growth. Even if this law represents a novelty in Europe and may offer new challenges and hints, it still presents some lacks in its formulation. The current research aims at presenting the Italian law for network contract and a comparison with other models of SME aggregations adopted in EU countries. A formal model to support the design of an SME network was proposed, by providing both an ontology-based model to help the definition of the contract in a structured way, and a basic workflow to identify the important phases of the network design, i.e. The feasibility study and the negotiation.*

Franceschini, F., Turina, E.QUALITY IMPROVEMENT AND REDESIGN OF PERFORMANCE MEASUREMENT SYSTEMS: AN APPLICATION TO THE ACADEMIC FIELD

*Quality and Quantity, Volume 47, Issue 1, 2013, Pages 465-483*Performance measurement system redesign; Quality improvement; Performance measurement; Indicators; Balanced

scorecard; Higher education*The increasing competition both in the public and private sectors gave rise to a growing interest in quality improvement and in designing and implementing Performance Measurement Systems (PMS). Academic organizations also recognized the need for implementing performance measurement systems. Some recent works on PMS in the higher education make use of the Kaplan and Norton's Balanced Scorecard (BSC) to translate the characteristic strategic goals (e. g. research and teaching excellence) into performance measures. However, a PMS needs to be updated when external or internal changes influence the organization modus operandi. In this way a continuous quality improvement of organization performance is required. This paper describes a methodology based on the BSC model to redesign a current PMS. In detail, a reference BSC-check matrix is proposed. A "mapping analysis" of the current PMS is developed to understand if all the operational aspects involved in goals achievement are considered and if proper indicators have been defined. As an example, the methodology is applied to a Department of the authors' own University. The paper shows also how the proposed approach can be extended to other contexts.*

Franceschini, F., Maisano, D., Mastrogiacomo, L.RESEARCH QUALITY EVALUATION: COMPARING CITATION COUNTS CONSIDERING BIBLIOMETRIC DATABASE ERRORS

*Quality and Quantity, 2013, Pages 1-11*Database quality; Database error; Citation count; Omitted citations; Pair-wise comparison*When evaluating the research output of scientists, institutions or journals, different portfolios of publications are usually compared with each other. e.g., a typical problem is to select, between two scientists of interest, the one with the most cited portfolio. The total number of received citations is a very popular indicator, generally obtained by bibliometric databases. However, databases are not free from errors, which may affect the result of evaluations and comparisons; among these errors, one of the most significant is that of omitted citations. This paper presents a methodology for the pair-wise comparison of publication portfolios, which takes into account the database quality regarding omitted citations. In particular, it is defined a test for establishing if a citation count is (or not) significantly higher than one other. A statistical model for estimating the type-I error related to this test is also developed.*

Spena, P.R., De Maddis, M., Lombardi, F., D'Aiuto, F.RESISTANCE SPOT WELDING OF ADVANCED HIGH STRENGTH TWIP STEELS

*Applied Mechanics and Materials, Volume 423-426, 2013, Pages 876-880*High manganese austenitic steel; Orthogonal array; Resistance spot welding; Taguchi's methods; Tensile shear test; Tensile-shear strengths; TWIP steel; Welding parameters Engineering controlled terms: Clamping devices; High strength steel; Manufacture; Plasticity; Resistance welding; Stainless steel; Welded steel structures; Welding; Welds Engineering main heading: Tensile strength *In this study, advanced high manganese austenitic steel sheets were welded by resistance spot*

welding at different welding parameters. The effects of welding current, clamping force, number of the current impulse, and duration of each current impulse were examined. Based on Taguchi's method, an L-27(3 13) orthogonal array was employed for carrying out resistance spot welding tests. The welded sheets were subjected to tensile-shear tests in order to determine the strength of the welded joints. Basically, the results showed that tensile-shear strength increase with clamping force at the medium and high effective welding time (>400 ms). However, the occurrence of micro cracks within the welded joints may justify the scattering of tensile-shear strength values.

Cascini, G., Fantoni, G., Montagna, F.SITUATING NEEDS AND REQUIREMENTS IN THE FBS FRAMEWORK

*Design Studies, Volume 34, Issue 5, September 2013, Pages 636-662*Cognitive process; Design models; FBS models; Formal approach; Industrial projects; New product development; Transformation process; Water and energies Engineering controlled terms: Energy utilization; Product design; Specifications Engineering main heading: Product development *The paper proposes an extension of Gero's Function-Behaviour-Structure (FBS) framework aimed at representing Needs and Requirements and their relationships with the Function, the Behaviour and the Structure of an artefact. Needs and Requirements are modelled as further types of variables to describe, with the same formal approach of the situated FBS model, the transformation processes, which occur in the earlier stages of design. The proposed model is clarified through an application to the information gathered within an industrial project to reduce water and energy consumption of a washing machine. By situating Needs and Requirements into the FBS framework, it is possible to properly represent all the tasks and the related cognitive processes characterising the earliest stages of the new product development.*

Calignano, F., Denti, L., Bassoli, E., Gatto, A., Iuliano, L.STUDIES ON ELECTRODISCHARGE DRILLING OF AN AL

*International Journal of Advanced Manufacturing Technology, Volume 66, Issue 9-12, June 2013, Pages 1757-1768*Electrical discharges; Electrical resistivity; Electro discharge machining; Electrodischarges; Independent variables; Material removal mechanisms; Performance indicators; Structural applications Engineering controlled terms: Alumina; Aspect ratio; Benchmarking; Ceramic materials; Ceramic matrix composites; Electric conductivity; Electric discharges; Phase transitions; Surface roughness Engineering main heading: Titanium carbide *Ceramic matrix composites (CMCs) can be attractive for structural applications, but their machining by conventional methods is expensive and often critical. Complex geometries on advanced ceramics require contactless processes, such as electrodischarge machining or drilling (EDD). These proved to be viable for CMCs with electrical resistivity below a critical value in the range of 1-3 Ω m. The condition is complied with by many CMCs: an example is alumina with titanium carbide. Material removal of ceramics by electrical discharges is a complex process involving different mechanisms, depending on the process setup. The paper describes an experimental study on EDD of 0.4-mm diameter holes with an aspect ratio of 20 in*

Al 2 O 3 -TiC, using copper electrodes. Peak current (I p), pulse-on time (t on), and pulse-off time (t off) are varied as independent variables. Four performance indicators are measured: material removal rate, electrode wear rate, overcut, and surface roughness (R a , S a). Empirical models are proposed to describe the effect of process parameters on the output indicators. The analysis is supported by the observation of the surface and subsurface morphology, with the aim of investigating the material removal mechanisms and attaining a full comprehension of macroscopic results. It is found that removal mostly occurs by melting and evaporation and that surface morphology is determined by two phenomena ruled by pulse power. A process description is proposed, built around power as the ruling factor.

Franceschini, F., Galetto, M., Turina, E.TECHNIQUES FOR IMPACT EVALUATION OF PERFORMANCE MEASUREMENT SYSTEMS

*International Journal of Quality and Reliability Management, Volume 30, Issue 2, January 2013, Pages 197-220*Quality performance indicators, Performance measurement system, PMS, Impact assessment, Balanced scorecard, BSC, Quality management, Performance management*Purpose: Organizations often introduce performance measurement systems (PMSs) in order to evaluate the level of their performance, make comparison with competitors, and plan their future activities. Since indicators may affect the behaviour of the monitored system, the design and implementation of a PMS should always include the analysis of the impact it may exert on the organization itself. The aim of this paper is to suggest a methodology to evaluate this impact. Design/methodology/approach: The proposed approach is based on an impact reference model derived from the balanced scorecard (BSC) framework. The different perspectives of the BSC are interpreted as areas of impact within an organization. Structured steps for impact evaluation are described and specific techniques of analysis are introduced. Findings: A series of case studies, together with an analysis of advantages and disadvantages of the proposed method, are presented. Results show that, although many sets of indicators are usually able to meet the role of a PMS, they may exert a different impact on the context they are applied. The proposed methodology results to be a useful instrument for choosing the right set of indicators from the impact point of view. Finally, possible research paths to be undertaken for further developments of the proposed methodology are traced. Research limitations/implications: The application of the method is based on the assumption that managers charged with the analysis have a profound understanding of the specific contextual factors which may determine a reaction of the organization to a performance indicator or a PMS. Furthermore, at the moment, the methodology does not consider the possibility of interaction among different indicators in producing the impact. Practical implications: This paper may be used to guide the selection of the most appropriate PMS from the impact point of view. The proposed methodology can be very helpful instrument for an organization involved in the design of new PMSs. It guides the decision maker through the various phases: indicators definition, analysis of their properties, impact analysis, and choice of the set with the preferable impact profile. Originality/value: The issue of impact has been long debated in literature. Many articles try to analyse the operative and strategic consequences of the introduction of a PMS in an organization. This paper proposes a methodology for a more structured and objective evaluation of the impact of new PMS before introducing it in a firm. This can result in a significant help for manager who have to find the*

best set of indicators for the performance evaluation of their organization or have to choose between two or more sets of indicator satisfying, in principle, the same representation objective.

Franceschini, F., Maisano, D., Mastrogiacomo, L.THE CITER-SUCCESS-INDEX: AN INDICATOR TO SELECT A SUBSET OF ELITE PAPERS, BASED ON CITERS

*Proceedings of ISSI 2013 - 14th International Society of Scientometrics and Informetrics Conference, Volume 1, 2013, Pages 300-315*Multi-disciplinary groups; Scientific fields; Scientometrics *The goal of this paper is introducing the citer-success-index (cs-index), i.e., an indicator that uses the number of different citers as a proxy for the impact of a generic set of papers. For each of the articles of interest, it is defined a comparison term - which represents the number of citers that, on average, an article published in a certain period and scientific field is expected to "infect" - to be compared with the actual number of citers of the article. Similarly to the recently proposed success-index (Franceschini et al., Scientometrics 92(3):621-6415, 2011), the cs-index allows to select a subset of "elite" papers. The cs-index is analyzed from a conceptual and empirical perspective. Special attention is devoted to the study of the link between the number of citers and cited authors relating to articles from different fields, and the possible correlation between the cs- and the success-index. Some advantages of the cs-index are that (i) it can be applied to multidisciplinary groups of papers, thanks to the field-normalization that it achieves at the level of individual paper and (ii) it is not significantly affected by self citers and recurrent citers. The main drawback is its computational complexity.*

Franceschini, F., Maisano, D., Mastrogiacomo, L.THE EFFECT OF DATABASE DIRTY DATA ON H-INDEX CALCULATION

*Scientometrics, Volume 95, Issue 3, June 2013, Pages 1179-1188*Citations; h-index; h-index robustness; Uncertain data; Dirty database*As all databases, the bibliometric ones (e. g. Scopus, Web of Knowledge and Google Scholar) are not exempt from errors, such as missing or wrong records, which may obviously affect publication/citation statistics and-more in general-the resulting bibliometric indicators. This paper tries to answer to the question "What is the effect of database uncertainty on the evaluation of the h-index?", breaking the paradigm of deterministic database analysis and treating responses to database queries as random variables. Precisely an informetric model of the h-index is used to quantify the variability of this indicator with respect to the variability stemming from errors in database records. Some preliminary results are presented and discussed.*

Bruno, G., Villa, A.THE EXPLOITATION OF AN ONTOLOGY-BASED MODEL OF PLM FROM A SME POINT OF VIEW

*IFAC Proceedings Volumes (IFAC-PapersOnline), 2013, Pages 1447-1452*Assembly process; Data and information; IDEF0; Ontology-based; PLM; Product-life-cycle; Small and medium enterprise; UML Engineering controlled terms: Knowledge management; Manufacture; Ontology Engineering main heading: Industry *The wide range of functionalities offered by PLM systems are often not fully exploited by companies, especially small and medium enterprises, in which the management of data and information about product lifecycle is done without computer software systems. Consequently, a lot of time is spent in managing information "by hand". In this paper we aim at providing an example of a methodology to exploit the potentiality of PLM systems from the point of view of a SME, by using an ontology-based model of PLM. The presented case study regards an assembly process of a small Romanian enterprise.*

Antonelli, D., Astanin, S., Galetto, M., Mastrogiacomo, L.TRAINING BY DEMONSTRATION FOR WELDING ROBOTS BY OPTICAL TRAJECTORY TRACKING

*Procedia CIRP, Volume 12, 2013, Pages 145-150*Automated welding; Man machines; Optical measuring systems; Trajectory tracking; Trajectory tracking problems; Welding robots; Welding station; Welding tasks Engineering controlled terms: Accident prevention; Industrial engineering; Industrial robots; Optical systems; Robot applications; Welding Engineering main heading: Industrial applications *The paper shows the application of an optical measuring system to a trajectory tracking problem with the aim of training a welding robot in a collaborative man-machine welding station. The optical system allows a fast and reliable training of the welding tasks imparted by the human co-worker. An algorithm developed for this application filters inaccurate and noisy data, re-orders points and computes a trajectory suitable for a welding robot. This can shorten time required for programming. The industrial relevance of this application is twofold: on one side it increases the safety of human workers by leaving the robot to perform the risky tasks, namely the welding, on the other side it guarantees higher repeatability than manual execution.*

Alfieri, A., Cantamessa, M., Montagna, F., Raguseo, E.USAGE OF SOS METHODOLOGIES IN PRODUCTION SYSTEM DESIGN

*Computers and Industrial Engineering, Volume 64, Issue 2, 2013, Pages 562-572*Alternative systems; Corporate strategies; Integrated production systems; Manufacturing operations; Modeling tool; Production designs; Production system; Production system designs; Sub-problems; Sub-systems; System of systems; Systemic approach Engineering controlled terms: Production engineering; Systems engineering Engineering main heading: Systems analysis *Production systems design is a multifaceted task, due to a variety of aspects such as the mutual interdependency between the sub-systems, the variety of configurations and alternative system control strategies, the multiple managerial and "soft" aspects that cast an influence on the behavior of the system. A reasonable number of modeling tools can be applied to production system design, but they tend to divide the problem into unconnected sub-problems whose*

individual solutions may result in a poor global one. This is despite the fact that production design encompasses all aspects of manufacturing operations, and needs a systemic approach, as clearly shown in practitioner-oriented literature. This paper proposes to apply the "System of Systems" approach to production system design in order to represent their main aspects and support the rational definition of the path leading from corporate strategy to system (re)design.

De Maddis, M., Gandini, M.VARIABILITY OF THE MANUFACTURING PROCESS IN THE GPS FRAMEWORK: A CASE STUDY

Product Lifecycle Management: Geometric Variations, 21 January 2013, Pages 371-384During the product lifecycle several types of uncertainty contribute to making it increasingly difficult to control product quality. The geometrical product specifications and verification approach (GPS) provides a mythology to match the ideal product with the manufactured work piece by considering three sources of variability and their related uncertainties: correlation, specification and measurement uncertainty. In this chapter we analyze the uncertainties adopted in GPS, and use independent component analysis (ICA) and time series analysis to discriminate the various sources of process variability. This will be done with particular focus on roughness measurements

Galetto, M., Mastrogiacomo, L., Moroni, G., Petrò, S.VOLUMETRIC ERROR COMPENSATION FOR THE MSCMS-II

*Procedia CIRP, Volume 10, 2013, Pages 98-104*Automated vehicles; Error model; Large scale dimensional metrologies; Measurement accuracy; Measurement volume; Self calibration; Self-calibration procedures; Volumetric calibration Engineering controlled terms: Error compensation; Measurements; Triangulation Engineering main heading: Calibration *Large scale measuring systems, i.e. measuring systems characterized by a measurement volume from some meters up to some hundreds of meters, are gaining importance in industry to check large parts or track the position of automated vehicles. In contrast with classical monolithic measuring systems, modern large scale measuring systems are constituted by constellations of sensors able to track the position of objects by triangulation or trilateration. This new design allows a greater system flexibility, scalability, and portability, together with a general reduction of costs. The MScMS-II is a large scale measuring system based on infrared triangulation. It has been designed to guarantee the maximum flexibility and reconfigurability, so every set-up procedure has been reduced as much as possible, so that its deployment and calibration requires a short time. However, its accuracy could benefit of a more complete volumetric calibration through the definition of a model of the volumetric error to be compensated. In this paper a self-calibration procedure based on a simple one-dimensional uncalibrated artifact is proposed to define a volumetric error model of the MScMS-II. Self-calibration can be performed in short time and can improve system performance by reducing systematic errors. Experimental results complete the work.*

Lombardi, F., Lategano, E., Cordiner, S., Torretta, V.WASTE INCINERATION IN ROTARY KILNS: A NEW SIMULATION COMBUSTION TOOL TO SUPPORT DESIGN AND TECHNICAL CHANGE

*Waste Management and Research, Volume 31, Issue 7, July 2013, Pages 739-750*Combustion pro-cess; Different operating conditions; External temperature; Mass balance; Primary combustions; Rotary kiln incinerator; Simulation model; Waste combustion Engineering controlled terms: Combustion chambers; Computer simulation; Incineration; Refractory materials; Rotary kilns Engineering main heading: Waste incineration EMTREE drug terms: carbon; hydrogen; nitrogen; oxygen; sulfur GEOBASE Subject Index: combustion; corrosion; incineration; mass balance; water treatment EMTREE medical terms: air; article; combustion; corrosion; distillation; flow rate; hospital waste; incineration; Italy; oxygen concentration; priority journal; sensitivity analysis; simulation; temperature; volatilization Medline keywords: refractory; rotary kiln; simulation model; thermal and mass balances; Waste combustion Medline is the source for the MeSH terms of this document. MeSH: Incineration; Waste Management Medline is the source for the MeSH terms of this document. Regional Index: Italy; Lazio; Roma [Lazio]; Rome *This article presents a tool based on a simplified model developed for the combustion processes in a rotary kiln incinerator (slightly inclined rotating primary combustion chamber). The model was developed with the aim of supporting the design phase of the incinerator combustion chamber and, at the same time, of investigating possible technical changes in existing plants in order to optimise the combustion process and the dimension of the rotary kiln (length, diameter) as a function of the characteristics of the fed waste. The tool has been applied and the obtained results compared with a real incineration plant operating on healthcare waste located in Rome (Italy). The mass and thermal balances were taken into account, together with kinetic parameters for the combustion of the specific waste stream. The mass balance considered only the major mass components (carbon, hydrogen, oxygen, nitrogen and sulphur). The measured external temperatures appear to be in good agreement with the simulated results. A sensitivity analysis of the plant under different operating conditions was carried out using different input flow rates and excess air ratios, and an assessment was made of the refractory and insulator properties of the kiln's behaviour. Some of the simulated results were used during the periodical maintenance to improve the refractory characteristics in order to reduce the fret and corrosion process.*

Roma la sapienza

Boschetto, A., Giordano, V., Veniali, F.3D ROUGHNESS PROFILE MODEL IN FUSED DEPOSITION MODELLING

*Rapid Prototyping Journal, Volume 19, Issue 4, 2013, Article number 17088799, Pages 240-252*Design/methodology/approach; Fused deposition modelling; Microscopic analysis;

Roughness parameters; Surface characterization; Surface-roughness measurements; Technological aspects; Theoretical modeling Engineering controlled terms: Deposition; Electrodeposition; Models; Product development; Profilometry; Surface roughness Engineering main heading: Three dimensional *Purpose - The paper aims to predict the surface roughness of fused deposition modelling prototypes. Since average roughness is not comprehensive, this study aims to extend the characterization to all the roughness parameters obtainable by a profilometric analysis. Design/methodology/approach - A theoretical model of the 3D profile is supplied as a function of process parameters and part shape. A suitable geometry was designed and prototyped for validation. Data were measured by a profilometer and complemented by microscopic analysis. A methodology based on the proposed model was applied to optimise prototype fabrication in two practical cases. Findings - The proposed profile is effective in describing the micro-geometrical surface of fused deposition modelling prototypes. The third dimension enables the calculation of amplitude, spatial and hybrid roughness parameters. Research limitations/implications - Because of mathematical assumptions and technological aspects, the validity of the model presents limitations related to the deposition angle. Practical implications - The method is an effective tool in the process planning stage: it enables knowing in advance how to assure part specifications delivering a set of technical choices. Two practical applications point out the usability in the product development and process parameters optimisation. Originality/value - This work fulfils an identified need to predict a complete surface characterization of fused deposition modelling technology.*

Barletta, M., Guarino, S., Vesco, S., Gisario, A., Tagliaferri, V.ABRASIVE FLUIDIZED BED (AFB) FINISHING OF THERMALLY SPRAYED COBALT-CHROMIUM COATINGS

Manufacturing Letters, Volume 1, Issue 1, October 2013, Pages 1-4Abrasive Fluidized Bed (AFB) finishing of cobalt-chromium coatings is investigated. Cylindrical metal components coated by High Velocity Oxygen Fuel (HVOF) with Stellite 6 were machined, while rotating at high speed in a bed of suspended Al 2 O 3 abrasives. The interaction between abrasives and coatings was analyzed varying the machining time, abrasive size and rotational speed. The morphology and dimensional stability of the machined parts was monitored by microscopy, profilometry and dimensional analysis. AFB is able to smoothen the morphology of the Stellite 6 coatings, preserving their dimensional accuracy. This makes AFB a promising technique in the reprocessing of hard coatings.

Barletta, M., Puopolo, M., Gisario, A., Vesco, S.APPLICATION AND DRYING AT AMBIENT TEMPERATURE OF THICK ORGANIC-INORGANIC HYBRID COATINGS ON GLASS

*Surface and Coatings Technology, Volume 236, 15 December 2013, Pages 212-223*Damage mechanism; Maximum thickness; Organic materials; Organic-inorganic hybrid coatings; Scratch resistance; Silicone-epoxy; Stringent requirement; Tribological tests Engineering controlled terms: Adhesion; Coatings; Epoxy resins; Glass; Manufacture; Silicone coatings; Silicones; Sol-gel process; Thick films Engineering main heading: Inorganic coatings *Organic-inorganic hybrid coatings have achieved success in scientific environments because they can be designed using the sol-gel route to combine the high hardness and chemical stability typical of glass-like or ceramic materials (i.e., the inorganic side) with the toughness and ductility typical of organic materials (i.e., the organic side). Nevertheless, organic-inorganic hybrid coatings are often very brittle, and they can collapse if applied as thick film on rigid substrates because of the shrinkage during the drying/curing process. However, the manufacturing of a thick coating is compulsory, when stringent requirements for scratch performance and wear endurance must be met. In this respect, the present investigation proposes the design of self-drying silicone-epoxy resins and the manufacturing of the corresponding thick coatings (approximately ~. 120. μm thick) on as-received and micro-corrugated glass using an automatic drawdown applicator. The scratch performance of the coatings was tested using progressive- and constant-mode scratch tests, and the wear resistance was examined using dry sliding linear reciprocating tribological tests. The experimental findings demonstrate how the role of the interface is crucial and how micro-corrugation is extremely beneficial in increasing the threshold of the maximum thickness beyond that at which coating bulging and delamination occur.*

D'Andrea, A., Tozzo, C., Boschetto, A., Bottini, L.INTERFACE ROUGHNESS PARAMETERS AND SHEAR STRENGTH

Modern Applied Science, Volume 7, Issue 10, 2013, Pages 1-10The interlayer bond strength between binder and wearing course and several possible treatments of enhancing the contact surface roughness and the interlocking are investigated. For this purpose, conventional methods, such as shear tests, but also laser image acquisition of the binder upper surface have been used. The mechanical outcomes of a shear test device and the binder surface roughness parameters, have been compared looking for a relation between the shear performance and the surface characteristics. The comparison between the roughness average and the root mean square of the profile heights with the maximum shear stress shows the achievement of the same strength level for treatments with similar roughness parameters, as proved by the statistical analysis. Furthermore, the comparison between the roughness parameter kurtosis and the maximum height of the profile with the slope of the response curve before the peak and residual shear stress, demonstrates a better locking for more high peaks.

Boschetto, A., Bottini, L., Campana, F., Consorti, L., Pilone, D.INVESTIGATION VIA MORPHOLOGICAL ANALYSIS OF ALUMINIUM FOAMS PRODUCED BY REPLICATION CASTING

*Frattura ed Integrita Strutturale, Volume 26, 2013, Pages 1-11*Aluminium foam; Critical process parameters; Digital image processing technique; Distribution of particles; Foam morphology; Physical and mechanical properties; Statistical distribution; Watershed methods Engineering controlled terms: Aluminum; Image analysis; Liquid metals; Molds; Pore size; Porous materials Engineering main heading: Fillers *Foams and porous materials with cellular structure have many interesting combinations of physical and mechanical properties coupled with low specific weight. By means of replication casting it is possible to manufacture foams from molten metal without direct foaming. A soluble salt is used as space holder, which is removed by leaching in water. This can be done successfully if the content of space holding fillers is so high that all the granules are interconnected. One of the main advantages of using the replication casting is a close control of pore sizes which is given by the distribution of particle sizes of the filler material. This contrasts with the pore size distribution of the materials foamed by other processes where a wider statistical distribution of pores is found. On the other hand, the maximum porosities that can be achieved using space holders are limited to values below 60%, whereas the other methods allow for porosities up to 98%. Temperature of the mould and infiltration pressure are critical process parameters: a typical problem encountered is the premature solidification of the melt, especially due to the high heat capacity of the salt. In this work foam properties such as cell shape, distribution and anisotropy and defect presence are investigated by using digital image processing technique. For this purpose replicated AlSi7Mg0.3 alloy foams are produced by infiltrating preforms of NaCl particles, varying the metal infiltration pressure and the mould preheating temperature. An original procedure based on image analysis has been set up to determine size, morphology and distribution of cells. The paper demonstrates that this methodology, coupled with microstructural analysis, is a useful tool for investigating the effects of process parameters on foam properties.*

Boschetto, A., Bellusci, M., La Barbera, A., Padella, F., Veniali, F.KINEMATIC OBSERVATIONS AND ENERGY MODELING OF A ZOZ SIMOLOYER HIGH-ENERGY BALL MILLING DEVICE

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 9-12, December 2013, Pages 2423-2435*Ball trajectories; Conventional methods; Digital image acquisition; High-energy ball milling; Mechanical characteristics; Mechanosynthesis; Particle tracking; Speed distributions Engineering controlled terms: Amorphous materials; Kinematics; Mechanical alloying; Milling (machining); Nanocrystalline materials Engineering main heading: Ball milling *High-energy ball milling is a material-processing method promoting near-room temperature transformations of powder mixtures. Obtained products possess peculiar properties, otherwise difficult or impossible to obtain by using conventional methods. Powder transformation is promoted by energy releases from milling media to trapped powder and the mechanism strongly depends by mechanical characteristics of the milling device. Planetary and horizontal ball mills, attritors, 1D and 3D vibrating apparatus are well-known and utilized in this powder-processing technology. This paper is focused on a ZOZ Simoloyer CM01 horizontal ball milling apparatus; a kinematic model characterizing balls motion and energy released have been found. For the purpose, an experimental setup, based on digital image acquisition, has*

been constructed and ball trajectories have been caught by using a properly developed software. Using image analysis results, tangential and radial components of balls speed distribution have been assessed and kinetic energies of the impacting balls inside the milling vial have been evaluated. The obtained results permits to evaluate the energy released to the powder during the milling action and to infer some expected consequences on mechanically activated reactions.

Boschetto, A., Bottini, L., Veniali, F.MICROREMOVAL MODELING OF SURFACE ROUGHNESS IN BARREL FINISHING

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 9-12, December 2013, Pages 2343-2354*Barrel finishing; In-process; Material removal; Modeling of surface roughness; Statistical approach; Working time Engineering controlled terms: Reliability analysis Engineering main heading: Surface roughness *This paper presents a model to describe the evolution of the roughness profile machined by barrel finishing (BF) operation. It is based on the measure of the material removal (MR) and on the assumptions that no plastic deformation and cutting of peak take place. In order to obtain these information, a morphological procedure has been developed based on the finding of a representative peak of the profile. By this way, it is possible to overcome the common problem of repositioning the instrument on a specific point of the surface, especially if an action takes place. The measurements taken on specimens machined in different conditions satisfied the assumptions and confirmed the capability of the model to predict roughness attainable. An interesting result has been the constant MR per working time. The analysis has been carried out by means of statistical approach demonstrating the reliability of the model. This permits to obtain a desired level of surface roughness just stopping the operation at a specific working time. Especially for BF, it is very useful considering that the inspection in-process is not possible.*

Barletta, M., Trovalusci, F., Gisario, A., Venettacci, S.NEW WAYS TO THE MANUFACTURING OF PIGMENTED MULTI-LAYER PROTECTIVE COATINGS

*Surface and Coatings Technology, Volume 232, 15 October 2013, Pages 860-867*Aluminium powder; Erosion-corrosion; Manufacturing process; Metallic powder; Multi-layered coatings; Protection; Tribological tests; Visual appearance Engineering controlled terms: Aluminum coatings; Composite coatings; Corrosion resistance; Fluidized beds; Industrial engineering; Powders; Production engineering; Protective coatings; Resins; Scanning electron microscopy; Silicone coatings; Silicones Engineering main heading: Manufacture *The manufacturing of pigmented multi-layer protective coatings is the matter of the present investigation. Finely sieved Al-Mg (4.5 wt.%) powders were used in combination with a phenyl-methyl silicone resin to form single or multi-layered coatings with good erosion-corrosion properties. The coatings were formed on low carbon steel by alternating a layer of resin deposited by dipping or spraying to a layer of dry metallic powders deposited by fluidized bed. Baking in convection oven at 250. °C for 45. min allowed the full consolidation of the composite coatings. The visual appearance of*

the coatings and the uniformity in them of the powder distribution were assessed by scanning electron microscopy. The favorable erosion-corrosion endurance of the developed coating systems were investigated by progressive load scratch tests, dry sliding linear reciprocating tribological tests and dipping in acid and salty solutions. In conclusion, the good protection grade the coatings are able to provide together with the viability of the manufacturing process ensure a high potential of the proposed technology in several industrial domains.

Piller, M., Boschetto, A., Stalio, E., Schena, G., Errico, O.PORE-SCALE SIMULATION OF LAMINAR FLOW THROUGH A SAMPLE OF ALUMINUM FOAM

*Journal of Porous Media, Volume 16, Issue 9, 2013, Pages 777-793*Compact heat exchanger; Darcy-Forchheimer equation; Enhanced heat transfer; Ergun coefficient; Hydraulic permeability; Open-cell metal foams; Pore-scale simulation; X-ray tomography Engineering controlled terms: Computer simulation; Imaging systems; Laminar flow; Metals Engineering main heading: Foams *Open-cell metal foams are used in a growing number of applications like lightweight porous structures, enhanced heat transfer devices and compact heat exchangers, catalytic reactors, and even rotors of centrifugal compressors. In many cases, pressure drops and flow rates through the metal foams are predicted using the macroscopic Darcy-Forchheimer equation. Values obtained can be accurate enough for applications, provided the hydraulic properties of the foam are known. The present work is aimed to describe a numerical approach for calculating the hydraulic permeability and the Ergun coefficient of a real sample of metal foam starting from an x-ray tomography of the sample. Fluid dynamic simulations are conducted in the digital sample at the scale of the pores and data obtained are postprocessed to obtain the main hydraulic properties of the porous material.*

Barletta, M., Tagliaferri, V., Gisario, A., Venettacci, S.PROGRESSIVE AND CONSTANT LOAD SCRATCH TESTING OF SINGLE- AND MULTI-LAYERED COMPOSITE COATINGS

*Tribology International, Volume 64, 2013, Pages 39-52*Aggressive environment; Aluminum-magnesium; Contact conditions; Industrial sector; Multi-layered composites; Performance and reliabilities; Scratch resistance; Testing conditions Engineering controlled terms: Cathodic protection; Composite coatings; Instrument testing; Mapping; Models; Silicones; Testing Engineering main heading: Load testing *The development of effective coating systems that offer high protection against erosion-corrosion is of utmost importance in several industrial sectors. Such a coating class is typically designed to provide an effective barrier against aggressive environments combined with cathodic protection. The adherence to the substrate ensures full performance and reliability of the coatings during service. In the present investigation, the scratch response of single- and multi-layered composite coatings made from superimposed layers of a modified phenyl-methyl silicone resin and of aluminum-magnesium (Al-Mg 4.5 wt%) metallic powders was investigated. The applied loads, the contact conditions between the*

indenter and coating surface and the sliding speeds were analyzed, and empirical models were developed accordingly. The scratch response of the composite coatings was mapped according to the testing conditions, thus providing a useful instrument for designers and practitioners.

Boschetto, A., Giordano, V., Veniali, F.SURFACE ROUGHNESS PREDICTION IN FUSED DEPOSITION MODELLING BY NEURAL NETWORKS

*International Journal of Advanced Manufacturing Technology, Volume 67, Issue 9-12, 2013, Pages 2727-2742*Design specification; Evaluation function; Functional Prototypes; Fused deposition modelling; Manufacturing strategy; Product development stages; Roughness parameters; Roughness predictions Engineering controlled terms: Forecasting; Function evaluation; Neural networks; Product development; Surface properties; Surface roughness Engineering main heading: Deposition *Fused deposition modelling is a proven technology for the fabrication of both aesthetic and functional prototypes. The obtainable roughness is the most limiting aspect for its application. The prediction of surface quality is an essential tool for the diffusion of this technology, in fact at product development stage, it allows to comply with design specifications and in process planning it is useful to determine manufacturing strategies. The existing models are not robust enough in predicting roughness parameters for all deposition angles, in particular for near horizontal walls. The aim of this work is to determine roughness parameters models reliable over the entire part surface. This purpose is pursued using a feed-forward neural network to fit experimental data. By the utilisation of an evaluation function, the best solution has been found. This has been obtained using a feed-forward neural network for fitting the experimental data. The best solution has been founded by using an evaluation function that we constructed. The validation proved the robustness of the model found to process parameters' variation and its applicability to different FDM machines and materials.*

Barletta, M., Tagliaferri, V., Trovalusci, F., Veniali, F., Gisario, A.THE MECHANISMS OF MATERIAL REMOVAL IN THE FLUIDIZED BED MACHINING OF POLYVINYL CHLORIDE SUBSTRATES

*Journal of Manufacturing Science and Engineering, Transactions of the ASME, Volume 135, Issue 1, 2013, Article number 011003*Abrasive media; Contact conditions; Cylindrical components; FEG-SEM; Impact speed; Machining time; Main process; Material removal; Mesh size; Polymeric substrate; Process parameters; Rotational speed Engineering controlled terms: Abrasives; Fluidization; Machining; Morphology; Polyvinyl chlorides; Scanning electron microscopy; Substrates Engineering main heading: Fluidized beds *In this paper, the mechanisms of material removal during the fluidized bed machining (FBM) of polymeric substrates are analyzed. Cylindrical components composed of polyvinyl chloride (PVC) were exposed to the impact of abrasives while rotating at high speed within a fluidization column. The interaction between the Al 2 O 3 abrasive media and the PVC surfaces was studied to identify the effect of the main process parameters, such as the machining time, the abrasive mesh size, and the*

rotational speed. The change in the surface morphology as a function of the process parameters was evaluated using field emission gun-scanning electron microscopy (FEG-SEM) and contact gauge profilometry. An improvement in the finishing of the processed surfaces was achieved, and the related mechanisms were identified. The roles of the impact speed and the contact conditions between the abrading particles and the substrate were also investigated.

Barletta, M., Gisario, A., Trovalusci, F., Vesco, S.VISUAL APPEARANCE AND SCRATCH RESISTANCE OF HIGH PERFORMANCE THERMOSET AND THERMOPLASTIC POWDER COATINGS

*Progress in Organic Coatings, Volume 76, Issue 1, January 2013, Pages 244-256*Coated part; Coating thickness; Comparative evaluations; Continuous films; Electrostatic spray; Electrostatic spray deposition; Fast deposition; High temperature; High-performance thermosets; Hot dipping; Micro-mechanical; Scratch; Scratch resistance; Scratch test; Selective coatings; Thermoplastic coatings; Thermoplastic powder coating; Visual appearance; Wear resistant Engineering controlled terms: Deposits; Electrostatics; Fluidized beds; Polyolefins; Powder coatings; Reinforced plastics; Thermosets; Thickness measurement; Visualization Engineering main heading: Electrostatic coatings *A comparative evaluation of electrostatic spray and 'hot dipping' fluidized bed to deposit two different organic paints belonging to the class of thermoplastic (PPA571, an alloy of acid modified polyolefins) and thermoset (TGIC-free transparent pigmented bronze polyester) powders was performed. Visual appearance of the investigated coatings was evaluated by colour, gloss and coating thickness measurements as well as by the determination of the surface morphologies. Micro-mechanical performance of the coatings was assessed by progressive load scratch tests. 'Hot dipping' fluidized bed is found a fast deposition technique as, after substrate pre-heating, it takes just few seconds to have the part completely powder coated. On the other hand, electrostatic spray deposition is a potentially selective coating technique, but it lasts longer (generally, 6-15 s) and, moreover, the coated parts must be post-cured for long time (at least, 15 min) and at high temperature (150-200 °C) to give rise to the formation of continuous films. Indeed, whilst 'hot dipping' fluidized bed is found particularly suitable for the deposition of thick and smooth thermoplastic coatings, electrostatic spray deposition is found the most viable technique to deposit thinner and highly scratch and wear resistant thermoset coatings.*

Roma tor vergata

Barletta, M., Guarino, S., Vesco, S., Gisario, A., Tagliaferri, V.ABRASIVE FLUIDIZED BED (AFB) FINISHING OF THERMALLY SPRAYED COBALT-CHROMIUM COATINGS

Manufacturing Letters, Volume 1, Issue 1, October 2013, Pages 1-4Abrasive Fluidized Bed (AFB) finishing of cobalt-chromium coatings is investigated. Cylindrical metal components coated by High Velocity Oxygen Fuel (HVOF) with Stellite 6 were machined, while rotating at high speed in a bed of suspended Al 2 O 3 abrasives. The interaction between abrasives and coatings was analyzed varying the machining time, abrasive size and rotational speed. The morphology and dimensional stability of the machined parts was monitored by microscopy, profilometry and dimensional analysis. AFB is able to smoothen the morphology of the Stellite 6 coatings, preserving their dimensional accuracy. This makes AFB a promising technique in the reprocessing of hard coatings.

Barletta, M., Puopolo, M., Gisario, A., Vesco, S.APPLICATION AND DRYING AT AMBIENT TEMPERATURE OF THICK ORGANIC-INORGANIC HYBRID COATINGS ON GLASS

*Surface and Coatings Technology, Volume 236, 15 December 2013, Pages 212-223*Damage mechanism; Maximum thickness; Organic materials; Organic-inorganic hybrid coatings; Scratch resistance; Silicone-epoxy; Stringent requirement; Tribological tests Engineering controlled terms: Adhesion; Coatings; Epoxy resins; Glass; Manufacture; Silicone coatings; Silicones; Sol-gel process; Thick films Engineering main heading: Inorganic coatings *Organic-inorganic hybrid coatings have achieved success in scientific environments because they can be designed using the sol-gel route to combine the high hardness and chemical stability typical of glass-like or ceramic materials (i.e., the inorganic side) with the toughness and ductility typical of organic materials (i.e., the organic side). Nevertheless, organic-inorganic hybrid coatings are often very brittle, and they can collapse if applied as thick film on rigid substrates because of the shrinkage during the drying/curing process. However, the manufacturing of a thick coating is compulsory, when stringent requirements for scratch performance and wear endurance must be met. In this respect, the present investigation proposes the design of self-drying silicone-epoxy resins and the manufacturing of the corresponding thick coatings (approximately ~. 120. μm thick) on as-received and micro-corrugated glass using an automatic drawdown applicator. The scratch performance of the coatings was tested using progressive- and constant-mode scratch tests, and the wear resistance was examined using dry sliding linear reciprocating tribological tests. The experimental findings demonstrate how the role of the interface is crucial and how micro-corrugation is extremely beneficial in increasing the threshold of the maximum thickness beyond that at which coating bulging and delamination occur.*

Quadrini, F., Bellisario, D., Santo, L., Hren, I.DIRECT MOULDING OF RUBBER GRANULES AND POWDERS FROM TYRE RECYCLING

*Applied Mechanics and Materials, Volume 371, 2013, Pages 315-319*European Commission; Manufacturing technologies; Moulding pressure; Moulding process; Particle properties; Tensile specimens; Tyre recycling; Ultimate tensile strength Engineering controlled terms: Buffing;

Compression molding; Granulation; Grinding (machining); Industrial engineering; Mechanical properties; Particles (particulate matter); Powders; Recycling; Rubber; Tensile strength; Tensile testing; Tires Engineering main heading: Rubber applications *SMART project (Sustainable Moulding of Articles from Recycled Tyres) is a research project financed by the European Commission with the aim of developing a new moulding process of granules and powders from tyre recycling without any addition of virgin rubber or linking agent. The so called "direct moulding" is a compression moulding process which is directly applied to rubber particles from tyre grinding. After one year of activities, the new moulding process has been deeply investigated and some results are reported in the current work for the first time. Rubber granules and powders were produced by GumiImpex (partner of the European project) thanks to different technologies: particles from tyre grinding and buffings from tyre machining. Different size distributions of rubber particles and buffings were used to produce rubber sheets with the size of 200x200x5 mm 3 at the temperature of 160°C and the pressure of 3 MPa by using aluminium moulds. Tensile specimens were extracted from the sheets and tensile tests were performed and related to sample density and particle properties. Rubber densities over 1 g/cm 3 have been reached for all the samples with ultimate tensile strength and maximum elongation up to 1 MPa and 80%, respectively. These mechanical data are very promising in comparison with properties of polyurethane bound rubber composites. Increasing moulding pressure and temperature would lead to higher mechanical properties, if necessary.*

Santo, L., Quadrini, F., De Chiffre, L.FORMING OF SHAPE MEMORY COMPOSITE STRUCTURES

*Key Engineering Materials, Volume 554-557, 2013, Pages 1930-1937*Composite stiffness; Shape memory composites; Shape memory polymers; Shape-memory properties; Structural composites; Thermoplastic composite; Thickness reduction; Three point bending Engineering controlled terms: Composite materials; Composite structures; Coremaking; Filled polymers; Forming; Glass; Polypropylenes; Structure (composition) Engineering main heading: Shape memory effect *A new forming procedure was developed to produce shape memory composite structures having structural composite skins over a shape memory polymer core. Core material was obtained by solid state foaming of an epoxy polyester resin with remarkably shape memory properties. The composite skin consisted of a two-layer unidirectional thermoplastic composite (glass filled polypropylene). Skins were joined to the foamed core by hot compression without any adhesive: a very good adhesion was obtained as experimental tests confirmed. The structure of the foam core was investigated by means of computer axial tomography. Final shape memory composite panels were mechanically tested by three point bending before and after a shape memory step. This step consisted of a compression to reduce the panel thickness up to 60%. At the end of the bending test the panel shape was recovered by heating and a new memory step was performed with a higher thickness reduction. Memory steps were performed at room temperature and 120 °C so as to test the foam core in the glassy and rubbery state, respectively. Shape memory tests revealed the ability of the shape memory composite structures to recover the initial shape also after severe damaging (i.e. after room temperature compression). Compressing the panel at a temperature higher than the foam resin glass transition temperature minimally affects composite stiffness. Copyright*

Barletta, M., Pezzola, S., Trovalusci, F., Vesco, S.HARD POLYURETHANE COATINGS ON COMPLIANT POLYCARBONATE: AN APPLICATION OF THE 3D DEFORMATION RESPONSE MODEL TO SCRATCH VISIBILITY

*Progress in Organic Coatings, Volume 76, Issue 10, October 2013, Pages 1494-1504*Coating designs; Material processing; Morphological features; Scanning Electron Microscope; Scratch resistance; Tribological response; Wear endurance; Wear resistant materials Engineering controlled terms: Analytical models; Hard coatings; Organic coatings; Plating; Polycarbonates; Protective coatings; Scanning electron microscopy; Substrates; Tribology; Wear resistance Engineering main heading: Deformation *The present investigation deals with the design of a transparent protective coating and its application on flat substrates in polycarbonate. The experimental analyses looked into the formulation of the coating material, the best strategy to deposit it as well as the characterization of the coated substrates. Visual appearance and morphological features of the coatings were studied by combined scanning electron microscope and contact gauge surface profiler. Their scratch and wear endurance were assessed by progressive and constant load scratching procedure and dry sliding linear reciprocating tribological tests. Imaging analyses were also used to evaluate the deformation response of the coating material to scratch and wear. Analytical modeling was developed accordingly, thus allowing to establish a strict relation between the design criteria of the coatings, the overall (coating + substrate) material performance and the loading conditions. The experimental findings showed the organic coatings were able to significantly improve the micro-mechanical and tribological response of the bare polycarbonate, thus making it available for a large share of applications where high performant, scratch and wear resistant materials are an ineluctable pre-requisite.*

Quadrini, F., Bellisario, D., Squeo, E.A., Santo, L.LASER FORMING OF METAL FOAMS

Lasers in Manufacturing, 7 March 2013, Pages 109-138[No abstract available]

Santo, L., Quadrini, F., Mascetti, G., Dolce, F., Zolesi, V.MISSION STS-134: RESULTS OF SHAPE MEMORY FOAM EXPERIMENT

*Acta Astronautica, Volume 91, 2013, Pages 333-340*Data acquisition system; Epoxy foams; International Space stations; Microgravity conditions; Shape memory composites; Shape memory epoxy foams; Shape memory polymers; Shape recovery Engineering controlled terms: Foam control; Heating equipment; Intelligent materials; Microgravity; Recovery; Shape memory effect; Shape optimization; Torsional stress Engineering main heading: Experiments *Shape*

memory epoxy foams were used for an experiment aboard the International Space Station (ISS) to evaluate the feasibility of their use for building light actuators and expandable/deployable structures. The experiment named I-FOAM was performed by an autonomous device contained in the BIOKON container (by Kayser Italia) which was in turn composed of control and heating system, battery pack and data acquisition system. To simulate the actuation of simple devices in micro-gravity conditions, three different configurations (compression, bending and torsion) were chosen during the memory step of the foams so as to produce their recovery on ISS. Micro-gravity does not affect the ability of the foams to recover their shape but it poses limits for the heating system design because of the difference in heat transfer on Earth and in orbit. A recovery about 70% was measured at a temperature of 110 °C for the bending and torsion configuration whereas poor recovery was observed for the compression case. Thanks to these results, a new experiment has been developed for a future mission by the same device: for the first time a shape memory composite will be recovered, and the actuation load during time will be measured during the recovery of an epoxy foam sample.

Quadrini, F., Guglielmotti, A., Lucignano, C., Tagliaferri, V.MOLDING OF SPENT RUBBER FROM TIRE RECYCLING

Sustainable Manufacturing, 7 March 2013, Pages 211-240Tire recycling is a growing problem that must be faced by the scientific community. However, economically feasible solutions must be found to ensure a sustainable development of the rubber market. Many interesting ideas are provided by the scientific literature even if many concerns are often present. The best idea deals with direct molding of rubber powders. The vulcanization process is not reversible because of the rubber molecule cross-linking. By increasing the crosslinking density, stiffer materials are obtained with higher wear resistance. Molding rubber pellets or powders does not allow us to obtain the cross-linking density of the initial tire. As a consequence, the final mechanical and wear performances of the molded parts are expected to be lower. Even if the proposed recycling technology is not able to remanufacture new tires, many other industrial applications are possible if sufficient performances are achieved.

Bellisario, D., Quadrini, F., Santo, L.NANO-CLAY FILLED POLYESTER COATINGS

*Progress in Organic Coatings, Volume 76, Issue 12, December 2013, Pages 1863-1868*Coating thickness; Mixing conditions; Montmorillonite (MMT); Polyester coatings; Polyester composites; Rheological analysis; Rheological property; Tribological behaviors Engineering controlled terms: Clay minerals; Composite coatings; Mixing; Mixtures; Resins; Thickness measurement; Tribology; Viscosity Engineering main heading: Polyester resins *Polyester composite coatings were produced by mixing un-saturated polyester (HP) resin and functionalized montmorillonite (MMT) powder. The effect of the mixing conditions on the final performances of the composite coatings was accurately evaluated: samples were produced with different MMT contents (up to 5 wt%) and stirring time (up to 1200 min). Rheological analyses of the un-catalyzed resin matrix were performed as well as tribological and scratch tests of*

coatings. Results show the strong effect of the mixing time on the performance of the MMT filled coatings. This effect is never negligible and can overcome the effect of the MMT content. After 20 h mixing, a 1 wt% filled mixture reaches a viscosity similar to a 5 wt% mixture after 30 min. By increasing the resin viscosity, the resulting coating thickness increases as well and this effect seems to dominate the tribological behavior of coatings rather than it's filling. Best results were obtained with low mixing times and filler contents. .

Barletta, M., Trovalusci, F., Gisario, A., Venettacci, S.NEW WAYS TO THE MANUFACTURING OF PIGMENTED MULTI-LAYER PROTECTIVE COATINGS

*Surface and Coatings Technology, Volume 232, 15 October 2013, Pages 860-867*Aluminium powder; Erosion-corrosion; Manufacturing process; Metallic powder; Multi-layered coatings; Protection; Tribological tests; Visual appearance Engineering controlled terms: Aluminum coatings; Composite coatings; Corrosion resistance; Fluidized beds; Industrial engineering; Powders; Production engineering; Protective coatings; Resins; Scanning electron microscopy; Silicone coatings; Silicones Engineering main heading: Manufacture *The manufacturing of pigmented multi-layer protective coatings is the matter of the present investigation. Finely sieved Al-Mg (4.5 wt.%) powders were used in combination with a phenyl-methyl silicone resin to form single or multi-layered coatings with good erosion-corrosion properties. The coatings were formed on low carbon steel by alternating a layer of resin deposited by dipping or spraying to a layer of dry metallic powders deposited by fluidized bed. Baking in convection oven at 250. °C for 45. min allowed the full consolidation of the composite coatings. The visual appearance of the coatings and the uniformity in them of the powder distribution were assessed by scanning electron microscopy. The favorable erosion-corrosion endurance of the developed coating systems were investigated by progressive load scratch tests, dry sliding linear reciprocating tribological tests and dipping in acid and salty solutions. In conclusion, the good protection grade the coatings are able to provide together with the viability of the manufacturing process ensure a high potential of the proposed technology in several industrial domains.*

Quadrini, F., Bellisario, D., Ferrari, D., Santo, L., Santarsiero, A.NUMERICAL SIMULATION OF LASER BENDING OF ALUMINUM FOAMS

*Key Engineering Materials, Volume 554-557, 2013, Pages 1864-1871*3D finite element model; Closed-cell aluminum foam; Laser-forming; Metal foams; Open cell aluminum foams; Process simulations; Process Variables; Thermomechanical model Engineering controlled terms: Finite element method; Foams; Forming; Metals; Numerical models Engineering main heading: Computer simulation *Laser forming of open-cell aluminum foams has been modeled by means of a 3D finite element model which is able to take into account the real foam geometry as well as the main process variables. A parametric procedure has been defined for the geometry construction and meshing, and the simulation run. In order to calibrate and validate numerical modeling, compression and flexure tests were performed on a closed-cell aluminum foam. The*

simulation of mechanical tests allowed a correct modeling of the aluminum alloy behavior under plastic deformation. The same material behavior was implemented in a complex thermo-mechanical model for laser bending simulation. The final model is able to predict the shape evolution during forming and the correlation between process variables and final bent angles. Copyright

Barletta, M., Tagliaferri, V., Gisario, A., Venettacci, S.PROGRESSIVE AND CONSTANT LOAD SCRATCH TESTING OF SINGLE- AND MULTI-LAYERED COMPOSITE COATINGS

*Tribology International, Volume 64, 2013, Pages 39-52*Aggressive environment; Aluminum-magnesium; Contact conditions; Industrial sector; Multi-layered composites; Performance and reliabilities; Scratch resistance; Testing conditions Engineering controlled terms: Cathodic protection; Composite coatings; Instrument testing; Mapping; Models; Silicones; Testing Engineering main heading: Load testing *The development of effective coating systems that offer high protection against erosion-corrosion is of utmost importance in several industrial sectors. Such a coating class is typically designed to provide an effective barrier against aggressive environments combined with cathodic protection. The adherence to the substrate ensures full performance and reliability of the coatings during service. In the present investigation, the scratch response of single- and multi-layered composite coatings made from superimposed layers of a modified phenyl-methyl silicone resin and of aluminum-magnesium (Al-Mg 4.5 wt%) metallic powders was investigated. The applied loads, the contact conditions between the indenter and coating surface and the sliding speeds were analyzed, and empirical models were developed accordingly. The scratch response of the composite coatings was mapped according to the testing conditions, thus providing a useful instrument for designers and practitioners.*

Quadrini, F., Bellisario, D., Santo, L.RECYCLING OF THERMOSET POLYURETHANE FOAMS

*Polymer Engineering and Science, Volume 53, Issue 7, July 2013, Pages 1357-1363*Compacting factor; Different thickness; Mechanical performance; Molding pressure; Molding temperature; Polyurethane Foam; Polyurethane foams; Virgin materials Engineering controlled terms: Molds; Presses (machine tools); Recycling; Scrap metal reprocessing; Tensile testing; Thermosets Engineering main heading: Compression molding *A new way for recycling polyurethane (PU) foams is shown by scrap pulverization and subsequent compression molding of resulting particles. The compression molding stage is also called "direct molding" to highlight the absence of any linking agent or virgin material. Large disks, 190 mm in diameter, were molded by recycling foam scraps from motorcycle seats. Aluminum alloy molds and a hot parallel press plate press were used: the molding temperature was fixed to 180°C, the molding pressure to 4.2 MPa, and the molding time to 15 min, whereas the weight of the particles to mold was changed so as to obtain disks with different thickness. The final density of molded product was close to 1 g/cm 3 , resulting in a compacting factor of 14 in comparison with the initial PU foam.*

Indentation tests and tensile tests showed that final products exhibit good mechanical performances. Copyright

Quadrini, F., Bellisario, D., Santo, L., Del Gaudio, C., Bianco, A.SHAPE MEMORY FOAMS OF MICROBIAL POLYESTER FOR BIOMEDICAL APPLICATIONS

*Polymer - Plastics Technology and Engineering, Volume 52, Issue 6, May 2013, Pages 599-602*Biomedical applications; Compression mode; Distilled water; Microbial polyesters; Particulate leaching; SEM observation; Shape memory polymers; Shape recovery Engineering controlled terms: Biodegradable polymers; Foams; Medical applications; Metabolism; Polycaprolactone; Preforming; Shape optimization; Urea Engineering main heading: Functional polymers *Foams of polycaprolactone (PCL) and microbial polyester (poly-hydroxybutyrate-hydroxyvalerate, PHBV with 10% mol PHV) were produced by particulate leaching in an urea preform and subsequent preform dissolution in distilled water. Films were also cast to compare mechanical and shape memory performances. SEM observations of foam sections showed that a homogenous microstructure was obtained with good replication of urea particles. Cylindrical PHBV samples (porosity about 90%) were used for shape memory tests in compression mode and a good behavior was observed. After training, 100% shape recovery can be achieved if a maximum 30% compression is applied.*

Quadrini, F., Bellisario, D., Lucignano, C., Santo, L.THE ROLE OF MIXING TIME IN THE PRODUCTION OF NANOCOMPOSITE THERMOSETTING COATINGS

*Polymer - Plastics Technology and Engineering, Volume 52, Issue 12, September 2013, Pages 1200-1212*Dynamic mechanical test; Montmorillonite (MMT); Nano-composite coating; Polyester coatings; Rheological analysis; Rheological property; Tribological tests; Unsaturated polyester resin Engineering controlled terms: Clay minerals; Mixing; Nanocomposites; Wear resistance Engineering main heading: Composite coatings *In this study, nanocomposite coatings have been produced by mixing unsaturated polyester resin with 1 and 5 wt% of montmorillonite (MMT). Nanocomposites were studied as bulk and as coatings to accurately evaluate the combined effect of mixing time and MMT content on final performances of the mixtures. Rheological analyses, mechanical and dynamic mechanical tests, tribological tests and scratch tests were performed on samples. Results show the strong effect of the mixing time on the performance of MMT-filled coatings: this effect is never negligible and can overcome the effect of the MMT content.*

Barletta, M., Tagliaferri, V., Trovalusci, F., Veniali, F., Gisario, A.THE MECHANISMS OF MATERIAL

REMOVAL IN THE FLUIDIZED BED MACHINING OF POLYVINYL CHLORIDE SUBSTRATES

*Journal of Manufacturing Science and Engineering, Transactions of the ASME, Volume 135, Issue 1, 2013, Article number 011003*Abrasive media; Contact conditions; Cylindrical components; FEG-SEM; Impact speed; Machining time; Main process; Material removal; Mesh size; Polymeric substrate; Process parameters; Rotational speed Engineering controlled terms: Abrasives; Fluidization; Machining; Morphology; Polyvinyl chlorides; Scanning electron microscopy; Substrates Engineering main heading: Fluidized beds *In this paper, the mechanisms of material removal during the fluidized bed machining (FBM) of polymeric substrates are analyzed. Cylindrical components composed of polyvinyl chloride (PVC) were exposed to the impact of abrasives while rotating at high speed within a fluidization column. The interaction between the Al 2 O 3 abrasive media and the PVC surfaces was studied to identify the effect of the main process parameters, such as the machining time, the abrasive mesh size, and the rotational speed. The change in the surface morphology as a function of the process parameters was evaluated using field emission gun-scanning electron microscopy (FEG-SEM) and contact gauge profilometry. An improvement in the finishing of the processed surfaces was achieved, and the related mechanisms were identified. The roles of the impact speed and the contact conditions between the abrading particles and the substrate were also investigated.*

Barletta, M., Gisario, A., Trovalusci, F., Vesco, S.VISUAL APPEARANCE AND SCRATCH RESISTANCE OF HIGH PERFORMANCE THERMOSET AND THERMOPLASTIC POWDER COATINGS

*Progress in Organic Coatings, Volume 76, Issue 1, January 2013, Pages 244-256*Coated part; Coating thickness; Comparative evaluations; Continuous films; Electrostatic spray; Electrostatic spray deposition; Fast deposition; High temperature; High-performance thermosets; Hot dipping; Micro-mechanical; Scratch; Scratch resistance; Scratch test; Selective coatings; Thermoplastic coatings; Thermoplastic powder coating; Visual appearance; Wear resistant Engineering controlled terms: Deposits; Electrostatics; Fluidized beds; Polyolefins; Powder coatings; Reinforced plastics; Thermosets; Thickness measurement; Visualization Engineering main heading: Electrostatic coatings *A comparative evaluation of electrostatic spray and 'hot dipping' fluidized bed to deposit two different organic paints belonging to the class of thermoplastic (PPA571, an alloy of acid modified polyolefins) and thermoset (TGIC-free transparent pigmented bronze polyester) powders was performed. Visual appearance of the investigated coatings was evaluated by colour, gloss and coating thickness measurements as well as by the determination of the surface morphologies. Micro-mechanical performance of the coatings was assessed by progressive load scratch tests. 'Hot dipping' fluidized bed is found a fast deposition technique as, after substrate pre-heating, it takes just few seconds to have the part completely powder coated. On the other hand, electrostatic spray deposition is a potentially selective coating technique, but it lasts longer (generally, 6-15 s) and, moreover, the coated parts must be post-cured for long time (at least, 15 min) and at high temperature (150-200 °C) to give rise to*

the formation of continuous films. Indeed, whilst 'hot dipping' fluidized bed is found particularly suitable for the deposition of thick and smooth thermoplastic coatings, electrostatic spray deposition is found the most viable technique to deposit thinner and highly scratch and wear resistant thermoset coatings.

Barletta, M., Pezzola, S., Tagliaferri, V., Trovalusci, F., Vesco, S.WEAR RESPONSE AND MECHANICAL BEHAVIOUR OF SILICONE-BASED PHOTOLUMINESCENT COATINGS

*Colloids and Surfaces A: Physicochemical and Engineering Aspects, Volume 429, July 2013, Pages 1-11*Field emission guns; Mechanical and tribological properties; Mechanical behaviour; Medium density fiberboards; Photoluminescent pigments; Polyurethane binders; Process; Sliding wear tests Engineering controlled terms: Adhesion; Coatings; Industrial applications; Photoluminescence; Scanning electron microscopy; Silicones; Wear of materials Engineering main heading: Silicone coatings EMTREE drug terms: chemical compound; photoluminescent coating; silicone; unclassified drug EMTREE medical terms: article; photoluminescence; priority journal; scanning electron microscopy *Photoluminescent coatings were manufactured by dispersing different sized hydrophobic silane surface-modified SrAl 2 O 4 :Eu 2+ , Dy 3+ photoluminescent pigments in a waterborne, silicone-modified 1-pack polyurethane binder. The resulting emulsions were deposited by spraying and automatic drawdown applicator on medium density fiberboard (MDF) panels covered with decorative paper. After automatic drawdown applications, half of the photoluminescent coatings were recoated with a transparent acrylic topcoat for protection purpose. The visual appearance of the coatings was analyzed by combined contact gauge profilometry and field emission gun scanning electron microscopy. Mechanical and tribological properties of the coatings were then analyzed by progressive and continuous load scratch as well as by linear reciprocating ball-on-flat sliding wear tests. High resistant, flexible and partially transparent photoluminescent coatings are achieved with a very simple, reproducible and eco-sustainable procedure, which can be easily extended to industrial applications for a wide range of substrates.*

Salento

Biolato, M., Miele, L., Di Stasi, C., Grieco, A.A GIANT CALCIFIED HEPATIC MASS

Annals of Hepatology, Volume 12, Issue 5, September 2013, Pages 822-823 EMTREE drug terms: alpha fetoprotein; carvedilol; finasteride; furosemide; iodinated poppyseed oil; lamivudine; rabeprazole; spironolactone; warfarin EMTREE medical terms: abdominal radiography; aged; alpha fetoprotein blood level; calcification; cardiomegaly; case report; chemoembolization; computer assisted tomography; coughing; differential diagnosis; disease association; follow up; heart atrium fibrillation; hepatitis B; human; intrahepatic calcification;

laboratory test; liver cell carcinoma; liver cirrhosis; liver disease; male; mitral valve regurgitation; paroxysmal dyspnea; physical examination; prostate hypertrophy; review; thorax radiography; treatment response; tumor volume MeSH: Aged; Antineoplastic Agents; Artifacts; Calcinosis; Carcinoma, Hepatocellular; Chemoembolization, Therapeutic; Diagnostic Errors; Ethiodized Oil; Humans; Liver Neoplasms; Male; Predictive Value of Tests; Tomography, X-Ray Computed Medline is the source for the MeSH terms of this document. *[No abstract available]*

Barone, C., Basso, M., Biolato, M., Pompili, M., Rufini, V., Miele, L., Basso, M., De Gaetano, A.M., Castaldi, P., Iaculli, A., Leccisotti, L., Riccardi, L., Grieco, A.A PHASE II STUDY OF SUNITINIB IN ADVANCED HEPATOCELLULAR CARCINOMA

Digestive and Liver Disease, Volume 45, Issue 8, August 2013, Pages 692-698 EMTREE drug terms: alcohol; sunitinib EMTREE medical terms: adult; advanced cancer; aged; article; brain disease; cancer chemotherapy; cancer patient; chemoembolization; clinical article; clinical assessment; controlled study; disease severity; drug dose reduction; drug efficacy; drug fatality; drug safety; drug withdrawal; fatigue; female; human; injection; liver cell carcinoma; liver cirrhosis; liver failure; liver function; liver resection; male; multiple cycle treatment; nausea; overall survival; percutaneous ethanol injection; phase 2 clinical trial; portal vein thrombosis; priority journal; progression free survival; radiofrequency ablation; treatment duration; treatment response; tumor growth; upper gastrointestinal bleeding Medline keywords: Alpha-fetoprotein; Aminopyrine; Methacetin; PET Medline is the source for the MeSH terms of this document. MeSH: Administration, Oral; Aged; Aged, 80 and over; Antineoplastic Agents; Carcinoma, Hepatocellular; Disease Progression; Female; Humans; Indoles; Liver Neoplasms; Male; Middle Aged; Neoplasm Invasiveness; Neoplasm Staging; Pyrroles; Risk Assessment; Risk Factors; Survival Analysis; Treatment Outcome Medline is the source for the MeSH terms of this document. *Background: In 2007, sorafenib was the first drug able to improve overall survival in patients with advanced hepatocellular carcinoma. Aim: In 2005 we designed a phase II study to assess safety and efficacy of sunitinib. Methods: This is a single arm, open-label, single-centre phase II trial. Eligibility criteria were advanced hepatocellular carcinoma; no prior chemotherapy, performance status 0-1; and Child. ≤. B8. The treatment schedule was 50. mg each day orally, 4 weeks on, 2 weeks off. Results: Between 10/2007 and 10/2010, 34 patients were enrolled. A significant worsening of liver functional reserve after sunitinib was observed. Grade 3/4 adverse effects occurred in 80% of patients and included fatigue (47%), nausea (15%), liver failure (15%), encephalopathy (12%) and upper gastrointestinal bleeding (12%). Six patients (18%) died within 60 days of enrolment. A partial response was observed in 4 patients (12%). Median time to tumour progression was 2.8 months and median overall survival was 5.8 months. Conclusion: A dose of 50. mg/d induces a high rate of severe adverse events. Toxicity remains a key concern also at the dose of 37.5. mg/d. However, sunitinib is able to induce a prolonged response in some patients. Positron Emission Tomography/Computed Tomography scans may select good responders.*

Del Prete, A., Papadia, G., Primo, T., Schipa, S.BLANK SHAPE OPTIMIZATION IN SHEET HYDROFORMING PROCESS

*Key Engineering Materials, Volume 549, 2013, Pages 197-204*Blank shapes; Deformation behavior; Experimental correlation; Hydroformed components; Hydroforming; Hydroforming process; Initial blank shapes; Strain distributions Engineering controlled terms: Computer aided engineering; Metal forming; Metal stamping; Optimization Engineering main heading: Sheet metal *Blank shape is one of the most important parameters of sheet metal stamping. In fact it can directly affect the forming quality of parts and it has to be taken in account in sheet hydroforming design. Reasonable blank shape not only can reduce materials and production cost but, also, it can improve the strain distribution of the material and product quality in the hydroforming process. However, it is not easy to find an optimal blank shape because of complexity of deformation behavior and presence of many process parameters like die radius, punch radius, punch speed, blank holder force and friction. In fact, they affect the result of the process i.e. tearing, wrinkling, springback and surface conditions such as earing. Even a slight variation in one of these parameters can result in defects. This paper reports numerical and experimental correlation for axis symmetrical hydroformed component using initial blank with different shape and size. Experimental tests have been carried out through the hydroforming cell tooling, designed by the authors thanks to a research project, characterized by a variable upper blankholder load of eight different hydraulic actuators. Two different initial blank shapes, square and circular, of same material and thickness have been used.*

Cammà, C., Cabibbo, G., Petta, S., Enea, M., Iavarone, M., Grieco, A., Gasbarrini, A., Villa, E., Zavaglia, C., Bruno, R., Colombo, M., Craxì, A.COST-EFFECTIVENESS OF SORAFENIB TREATMENT IN FIELD PRACTICE FOR PATIENTS WITH HEPATOCELLULAR CARCINOMA

Hepatology, Volume 57, Issue 3, March 2013, Pages 1046-1054 EMTREE drug terms: sorafenib EMTREE medical terms: aged; article; cancer patient; cancer survival; Caucasian; cost effectiveness analysis; drug cost; drug dose reduction; human; liver cell carcinoma; liver cirrhosis; major clinical study; male; priority journal; quality adjusted life year; recommended drug dose; sensitivity analysis; survival rate; treatment outcome; treatment response MeSH: Aged; Antineoplastic Agents; Carcinoma, Hepatocellular; Cost-Benefit Analysis; Drug Costs; Humans; Kaplan-Meier Estimate; Liver Neoplasms; Male; Markov Chains; Multivariate Analysis; Niacinamide; Phenylurea Compounds; Prospective Studies; Quality-Adjusted Life Years Medline is the source for the MeSH terms of this document. *The purpose was to assess the cost-effectiveness of sorafenib in the treatment of hepatocellular carcinoma (HCC) patients incorporating current prices and the results of the recent published field practice SOraFenib Italian Assessment (SOFIA) study. We created a Markov Decision Model to evaluate, in a hypothetical cohort of Caucasian male patients, aged 67 years with Barcelona Clinic Liver*

Cancer (BCLC) C HCC, or BCLC B HCC who were unfit or failed to respond to locoregional therapies, well compensated cirrhosis, and with performance status 0-1 according to Eastern Cooperative Oncology Group (ECOG), the cost-effectiveness of the following strategies: (1) full or dose-adjusted sorafenib for BCLC B and C patients together; (2) full or dose-adjusted sorafenib for BCLC B patients; (3) full or dose-adjusted sorafenib for BCLC C patients. Outcomes include quality-adjusted life years (QALYs), costs, and incremental cost-effectiveness ratio (ICER). In the base-case analysis dose-adjusted sorafenib was the most effective of the evaluated strategies. For dose-adjusted sorafenib, QALY was 0.44 for BCLC B and C patients together, 0.44 for BCLC C patients, and 0.38 for BCLC B patients. The ICER of dose-adjusted sorafenib compared with BSC was €34,534 per QALY gained for BCLC B and C patients together, €27,916 per QALY gained for BCLC C patients, and €54,881 per QALY gained for BCLC B patients. Results were sensitive to BSC survival rate, and sorafenib treatment duration. Conclusion: In daily practice dose-adjusted, but not full-dose, sorafenib is a cost-effective treatment compared to BSC in intermediate and advanced HCC.

Del Prete, A., Papadia, G., Primo, T., Mariano, E.DEVELOPMENT OF ACCURATE NUMERICAL MODELS FOR BENDING OF ALUMINUM TAILORED BLANKS

*Key Engineering Materials, Volume 549, 2013, Pages 205-212*Automotive sector; Bending testing; Different materials; Experimental studies; Experimental test; Passenger safety; Tailored blank; Thin aluminum sheets Engineering controlled terms: Aluminum; Automotive industry; Bending (forming); Computer aided engineering; Filler metals; Laser beam welding; Numerical models; Sheet metal Engineering main heading: Aluminum alloys *Nowadays the main target in the automotive field is the realization of lightweight and safe components. In this way it is possible to reduce costs and improve fuel consumption and, at the same time, enhance passenger safety. The use of tailored blanks has increased considerably in the automotive industry. Tailored blanks are a combination of different thicknesses or different materials, obtained by welding together two or more blanks, used in particular in car body panels. A new requirement in the automotive sector is the application of aluminum tailored blanks. The main target of this paper is the development of accurate numerical models for bending tailored blanks made from thin aluminum sheets, joined by laser welding, without filler metal. The FE bending simulations have been carried out using an explicit solver. The accuracy of the numerical models has been estimated and improved through a comparison with the results from an experimental study. The experimental tests have been performed using bending testing equipment, designed and developed by the authors. Three different bending radii have been tested. Tailored blanks, used as specimens, have been made by laser welding of thin Al6061 sheets. The considered outputs, used for the numerical-experimental comparison, are the punch force and the bending angle. The experimental results have been compared with the numerical ones in order to verify the accuracy of the FE model related to thickness and radius variations.*

Pacella, M., Colosimo, B.M.DIFFERENT FORMULATIONS OF PRINCIPAL COMPONENT ANALYSIS FOR 3D PROFILES AND SURFACES MODELING

*Procedia CIRP, Volume 12, 2013, Pages 474-479*Curves and surfaces; Dependent variables; Geometric modelling; Geometric tolerance; Independent variables; Profile monitoring; Quality of product; Viable solutions Engineering controlled terms: Fits and tolerances; Industrial engineering; Measurements; Principal component analysis; Quality assurance; Quality control; Turning Engineering main heading: Three dimensional *During the past few years, an increasing number of approaches and applications of profile monitoring have been proposed in the literature as the quality of product and process is very often characterized by functional data. In the context of geometric tolerances, where curves and surfaces describe the shape of manufactured item, the quality outcome (dependent variable) is a function of one or more spatial location variables (independent variables). Up to now, profile monitoring has been mainly constrained to situations in which the dependent variable is a scalar, which is modeled as a function of a single location variable via linear models or datareduction approaches as Principal Component Analysis (PCA). When the quality of products is related to geometric tolerances (e.g., roundness or circularity, straightness, cylindricity, flatness or planarity) the geometry of the item lies in a 3-dimensional (3D) space and cannot be modeled as a scalar function of one location variable. This paper presents solutions to problems arising when 3D features (either curves or surfaces) are considered and data-reduction techniques are implemented as modeling tool. Two PCAbased approaches are presented, namely (i) the complex PCA (i.e., PCA performed on matrices of complex numbers) and the (ii) multilinear PCA (i.e., PCA performed on tensor data). These two approaches are explored as viable solutions to modeling 3D profiles and surfaces respectively, in the context of geometric tolerance monitoring.*

Miele, L., Marrone, G., Lauritano, C., Cefalo, C., Gasbarrini, A., Day, C., Grieco, A.GUT-LIVER AXIS AND MICROBIOTA IN NAFLD: INSIGHT PATHOPHYSIOLOGY FOR NOVEL THERAPEUTIC TARGET

Current Pharmaceutical Design, Volume 19, Issue 29, 2013, Pages 5314-5324 EMTREE medical terms: article; correlation analysis; disease association; drug targeting; energy metabolism; human; inflammation; insulin resistance; intestine flora; intestine mucosa permeability; nonalcoholic fatty liver; nonhuman; nutrient uptake; obesity; pathophysiology; priority journal MeSH: Fatty Liver; Humans; Intestines; Liver; Permeability Medline is the source for the MeSH terms of this document. *There is increasing evidence for a correlation between intestinal microbiota, bacterial translocation and hepatic steatosis. Intestinal microbiota affects nutrient absorption and energy homeostasis. Altered intestinal permeability may favor the passage of bacteriaderived compounds into systemic circulation, causing a*

systemic inflammatory state, characteristic of the metabolic syndrome. The interaction between intestinal permeability and luminal bacteria is involved in the pathogenesis and evolution of non-alcoholic liver disease. Microbiota pharmacological modulation could be a promising tool for a new therapeutical approach to non-alcoholic fatty liver disease.

Addolorato, G., Mirijello, A., Leggio, L., Ferrulli, A., D'Angelo, C., Vassallo, G., Cossari, A., Gasbarrini, G., Landolfi, R., Agnes, S., Gasbarrini, A., Abbate, V., Abenavoli, L., Antonelli, M., Annicchiarico, E., Avolio, A.W., Biolato, M., Campanale, C., Capristo, E., Caputo, F., Cesario, V., Castagneto, M., deMatthaeis, N., Favale, C., Ferrarese, D., Garcovich, M., Frongillo, F., Grieco, A., Malandrino, N., Miele, L., Milani, A., Nesci, A., Nure, E., Pelecca, G., Pepe, G., Pietrogiacomi, P., Pizzolante, F., Pompili, M., Romana Ponziani, F., Rapaccini, G., Riccardi, L., Rinninella, E., Santoro, M.C., Sganga, G., Siciliano, M., Vero, V., Vonghia, L.LIVER TRANSPLANTATION IN ALCOHOLIC PATIENTS: IMPACT OF AN ALCOHOL ADDICTION UNIT WITHIN A LIVER TRANSPLANT CENTER

Alcoholism: Clinical and Experimental Research, Volume 37, Issue 9, September 2013, Pages 1601-1608 EMTREE drug terms: baclofen EMTREE medical terms: abstinence; adult; alcohol consumption; alcoholism; article; clinical evaluation; controlled study; female; human; liver cirrhosis; liver transplantation; major clinical study; male; mixed infection; prevalence; priority journal; recidivism Medline keywords: Alcohol Addiction Unit; Alcohol Dependence; Alcohol Recidivism; Alcoholism; Orthotopic Liver Transplantation Medline is the source for the MeSH terms of this document. MeSH: Adult; Aged; Alcohol Abstinence; Alcoholics; Alcoholism; Baclofen; Female; Follow-Up Studies; Humans; Liver Transplantation; Male; Middle Aged; Retrospective Studies; Substance Abuse Treatment Centers; Treatment Outcome Medline is the source for the MeSH terms of this document. *Background: Many concerns about liver transplantation in alcoholic patients are related to the risk of alcohol recidivism. Starting from 2002, an Alcohol Addiction Unit (AAU) was formed within the liver transplant center for the management of alcoholic patients affected by end-stage liver disease and included in the waiting list for transplantation. We evaluated retrospectively the impact of the AAU on alcohol recidivism after transplantation. The relationship between alcohol recidivism and the duration of alcohol abstinence before transplant was evaluated as well. Methods: Between 1995 and 2010, 92 cirrhotic alcoholic patients underwent liver transplantation. Clinical evaluation and management of alcohol use in these patients was provided by psychiatrists with expertise in*

addiction medicine not affiliated to the liver transplant center before 2002 (n = 37; group A), or by the clinical staff of the AAU within the liver transplant center starting from 2002 (n = 55; group B). Results: Group B, as compared with group A, showed a significantly lower prevalence of alcohol recidivism (16.4 vs. 35.1%; p = 0.038) and a significantly lower mortality (14.5 vs. 37.8%; p = 0.01). Furthermore, an analysis of group B patients with either ≥6 or <6 months of alcohol abstinence before transplantation showed no difference in the rate of alcohol recidivism (21.1 vs. 15.4%; p = ns). Conclusions: The presence of an AAU within a liver transplant center reduces the risk of alcohol recidivism after transplantation. A pretransplant abstinence period <6 months might be considered, at least in selected patients managed by an AAU.

Del Prete, A., Papadia, G., Primo, T., Mariano, E.MODELLING OF DAMAGE IN BLANKING PROCESSES

*Key Engineering Materials, Volume 554-557, 2013, Pages 2432-2439*Blanking; Damage; Deform-2d; Experimental correlation; Material behavior; Metal-forming process; Numerical solution; Plastic instabilities Engineering controlled terms: Computer aided engineering; Computer simulation; Metal forming; Numerical models; Punching Engineering main heading: Materials *Fracturing by ductile damage occurs quite naturally in metal forming process due to the development of microcracks associated with large straining or due to plastic instabilities associated with material behavior and boundary conditions. Metal forming processes generally introduce a certain amount of damage in the material being formed. Predictions of the damage formation and growth in a series of forming steps may assist in optimizing the individual operations and their order. This is particularly true for operations such as cutting and blanking, which rely on the nucleation of damage and cracks in order to separate material. In this work numerical simulation of the blanking process, using Deform 2D, taking in account the damage, has been performed. In order to evaluate the accuracy of the numerical solution, experimental test have been performed. Furthermore a numerical - experimental correlation has been carried out. Copyright*

Paynabar, K., Jin, J.J., Pacella, M.MONITORING AND DIAGNOSIS OF MULTICHANNEL NONLINEAR PROFILE VARIATIONS USING UNCORRELATED MULTILINEAR PRINCIPAL COMPONENT ANALYSIS

*IIE Transactions (Institute of Industrial Engineers), Volume 45, Issue 11, 1 November 2013, Pages 1235-1247*Dimension reduction; Industrial practices; Monitoring and diagnosis; Nonlinear profiles; Process Variation; Production process; Progressive dies; tensor-to-vector projection Engineering controlled terms: Classification (of information); Forging; Online systems; Principal component analysis; Process monitoring; Sensors Engineering main heading: Fault detection *In modern manufacturing systems, online sensing is being increasingly used for process monitoring and fault diagnosis. In many practical situations, the output of the sensing system is represented by time-ordered data known as profiles or waveform signals. Most of the work reported in the*

literature has dealt with cases in which the production process is characterized by single profiles. In some industrial practices, however, the online sensing system is designed so that it records more than one profile at each operation cycle. For example, in multi-operation forging processes with transfer or progressive dies, four sensors are used to measure the tonnage force exerted on dies. To effectively analyze multichannel profiles, it is crucial to develop a method that considers the interrelationships between different profile channels. A method for analyzing multichannel profiles based on uncorrelated multilinear principal component analysis is proposed in this article for the purpose of characterizing process variations, fault detection, and fault diagnosis. The effectiveness of the proposed method is demonstrated by using simulations and a case study on a multi-operation forging process.

Papadia, G., Primo, T., Schipa, S.NUMERICAL MODELING OF DUCTILE PLASTIC DAMAGE IN TENSILE TEST

*Key Engineering Materials, Volume 554-557, 2013, Pages 93-98*Deform-2d; Dissipative process; Experimental materials; Large deformations; Lemaitre; LS-DYNA; Numerical benchmark; Uniaxial tensile test Engineering controlled terms: Coalescence; Computer aided engineering; Metal cutting; Numerical analysis; Plastic deformation; Stress analysis Engineering main heading: Tensile testing *Material behaviour description frequently used in commercial codes may not be adequate to simulate real forming processes. One of the reasons is the fact that they rarely include the modeling of internal damage of material. This is a decisive feature in order to be able to predict defective parts in processes like forging or to describe processes in which fracture is a part of the process itself as in sheet blanking or metal cutting. In large deformation of metals, when plastic deformation reaches a threshold level, which may depend on the loading, the fatigue limit and the ultimate stress, a ductile damage process may occur concomitantly with the plastic deformation due to the nucleation, growth and coalescence of micro-voids. Although damage and plastic deformation are two distinct dissipative processes, they influence each other. In this paper a numerical benchmark of the uniaxial tensile tests, for aluminium alloy, has been performed using LS-Dyna and Deform 2D without damage. Then, a numerical uniaxial tensile tests has been studied using a coupled model of elasto-plasticity and ductile damage implemented in LS-Dyna. Experimental material property present in literature has been used. Copyright*

Del Prete, A., Filice, L., Umbrello, D.NUMERICAL SIMULATION OF MACHINING NICKEL-BASED ALLOYS

*Procedia CIRP, Volume 8, 2013, Pages 540-545*Constitutive behaviors; Finite element simulations; Inconel-718; Machining Inconel 718; Material characterizations; Material flow stress; Phenomenological models; Simulation of machining Engineering controlled terms: Computer simulation; Finite element method; Fracture; Hardness; Iron alloys; Machining; Machining centers; Metallurgy; Numerical models; Plastic flow Engineering main heading:

Materials *The phenomenological models for material flow stress and fracture, typically used in the Finite Element simulations of machining Nickel-based alloys, are often deemed to represent only certain metallurgical material states. In contrast, these models are not suitable to describe the constitutive behavior of the workpiece for different metallurgical states (i.e., annealed, aged, etc.) and, consequently, different hardness values. Since the description of the material behavior requires correct formulation of the constitutive law, new flow stress models which include also the hardness effect should be developed and used, for computer simulation of machining Nickel-based alloys. This paper describes the development of a hardness-based flow stress and fracture models for machining Inconel 718 alloy which can be applied for a wide range of work material hardness. These models have been implemented in a non-isothermal viscoplastic numerical model to simulate the influence of work material hardness on the chip formation process. The predicted results are being validated with experimental results properly carried out for this research. They are found to satisfactory predict the cutting forces, the temperature and the chip morphology from continuous to segmented chip as the hardness values change. Copyright*

Maffezzoli, A., Grieco, A.OPTIMIZATION OF PARTS PLACEMENT IN AUTOCLAVE PROCESSING OF COMPOSITES

*Applied Composite Materials, Volume 20, Issue 3, June 2013, Pages 233-248*Autoclave processing; Composite processing; Critical constraints; Cure optimizations; Maximum temperature; Objective functions; Optimization models; Processing variables Engineering controlled terms: Autoclaves; Curing; Laminated composites; Optimization Engineering main heading: Pressure vessels *The main processing variable in autoclave production, besides pressure and time, is fluid temperature. The different geometry of tools and composite laminates and the fluid dynamic characteristics of each autoclave batch lead to temperature changes in the composites, during heating, soaking and cooling, not easily predicted. The soak time at maximum temperature is considered one of the most critical constraints. This time is computed for the entire autoclave batch when the last composite laminate reaches the specified cure temperature. In this work a completely different approach is presented. Areduction of cure time is achieved identifying a rule for the position of different tools inside the autoclave. An optimization model is derived by defining an objective function in terms of penalty coefficients associated to different tools and different positions into the autoclave. Test cases of the behaviour of autoclave batches have been simulated leading to significant predicted cure time reductions.*

Senin, N., Colosimo, B.M., Pacella, M.POINT SET AUGMENTATION THROUGH FITTING FOR ENHANCED ICP REGISTRATION OF POINT CLOUDS IN MULTISENSOR COORDINATE METROLOGY

*Robotics and Computer-Integrated Manufacturing, Volume 29, Issue 1, February 2013, Pages 39-52*Coordinate metrology; Iterative closest point; Model fitting; Multisensor data fusion;

Registration Engineering controlled terms: Algorithms; Geometry; Measurement errors; Measurements; Scanning; Signal processing; Units of measurement Engineering main heading: Coordinate measuring machines *In multisensor coordinate metrology scenarios involving the fusion of homogenous data, specifically 3D point clouds like those originated by CMMs and structured light scanners, the problem of registration, i.e. The proper localization of the clouds in the same coordinate system, is of central importance. For fine registration, known variants of the Iterative Closest Point (ICP) algorithm are commonly adopted; however, no attempt seems to be done to tweak such algorithms to better suit the distinctive multisensor nature of the data. This work investigates an original approach that targets issues which are specific to multisensor coordinate metrology scenarios, such as coexistence of point sets with different densities, different spatial arrangements (e.g. sparse CMM points vs. gridded sets from light scanners), and different noise levels associated to the point sets depending on the metrological performances of the sensors involved. The proposed approach is based on combining known ICP variants with novel point set augmentation techniques, where new points are added to existing sets with the purpose of improving registration performance and robustness to measurement error. In particular, augmentation techniques based on advanced fitting solutions promote a paradigm shift for registration, which is not seen as a geometric problem consisting in moving point sets as close as possible to each other, but as a problem where it is not the original points, but the underlying geometries that must be brought together. In this work, promising combinations of ICP and point augmentation techniques are investigated through the application to virtual scenarios involving synthetic geometries and simulated measurements. Guidelines for approaching registration problems in industrial scenarios involving multisensor data fusion are also provided.*

Iezzi, R., Cesario, V., Siciliani, L., Campanale, M., De Gaetano, A.M., Siciliano, M., Agnes, S., Giuliante, F., Grieco, A., Pompili, M., Rapaccini, G.L., Gasbarrini, A., Bonomo, L.SINGLE-STEP MULTIMODAL LOCOREGIONAL TREATMENT FOR UNRESECTABLE HEPATOCELLULAR CARCINOMA: BALLOON-OCCLUDED PERCUTANEOUS RADIOFREQUENCY THERMAL ABLATION (BO-RFA) PLUS TRANSCATHETER ARTERIAL CHEMOEMBOLIZATION (TACE)

Radiologia Medica, Volume 118, Issue 4, June 2013, Pages 555-569 EMTREE drug terms: antineoplastic agent; carboplatin; ethiodized oil; gelatin sponge EMTREE medical terms: aged; algorithm; antibiotic prophylaxis; article; balloon occlusion; catheter ablation; chemoembolization; comparative study; female; human; liver cell carcinoma; liver tumor; male; methodology; middle aged; multimodality cancer therapy; patient safety; pilot study; treatment outcome MeSH: Aged; Algorithms; Antibiotic Prophylaxis; Antineoplastic Combined

Chemotherapy Protocols; Balloon Occlusion; Carboplatin; Carcinoma, Hepatocellular; Catheter Ablation; Chemoembolization, Therapeutic; Combined Modality Therapy; Ethiodized Oil; Female; Gelatin Sponge, Absorbable; Humans; Liver Neoplasms; Male; Middle Aged; Patient Safety; Pilot Projects; Treatment Outcome Medline is the source for the MeSH terms of this document. *Purpose: This study was undertaken to evaluate the feasibility, safety and efficacy of a new combined single-step therapy in patients with unresectable multinodular unilobar hepatocellular carcinoma (HCC), with at least one lesion >3 cm, with balloon-occluded radiofrequency ablation (BO-RFA) plus transcatheter arterial chemoembolization (TACE) of the main lesion and TACE of the other lesions. The second purpose of our study was to compare the initial effects in terms of tumour necrosis of this new combined therapy with those obtained in a matched population treated with TACE alone in a singlestep treatment in our centre in the previous year. Methods and materials: This pilot study was approved by the institutional review board, and informed consent was obtained from all patients. Ten consecutive patients with multinodular (two to six nodules) unilobar unresectable HCC and with a main target lesion >3 cm (range, 3.5-6 cm) not suitable for curative therapy were enrolled in our single-centre multidisciplinary pilot study. The schedule consisted of percutaneous RFA (single 3-cm monopolar needle insertion) of the target lesion during occlusion of the hepatic artery supplying the tumour, followed by selective TACE, plus lobar TACE for other lesions (450-mg carboplatin and lipiodol plus temporary embolisation with SPONGOSTAN). Adverse events and intra- and periprocedural complications were clinically assessed. Early local efficacy was evaluated on 1-month follow-up multiphasic computed tomography (CT) on the basis of the Modified Response Evaluation Criteria in Solid Tumors (m-RECIST). A separate evaluation of target lesions in terms of enhancement, necrotic diameter and presence and distribution of lipiodol uptake was also performed. Results: No major complications occurred. Overall technical success, defined as complete devascularisation of all nodules during the arterial phase, was achieved in seven of 10 patients, with three cases of partial response (persistence of small hypervascular nodules). When considering only target lesions, technical success was obtained in all patients, with a nonenhancing area corresponding in shape to the previously identified HCC (necrotic diameter, 3.5-5 cm) and with circumferential peripheral lipiodol uptake (safety margin) of at least 0.5 cm (0.5-1.3cm). Conclusions: TACE and BO-RFA, plus TACE in a singlestep approach seems to be a safe and effective combined therapy for treating advanced, unresectable HCC lesions, allowing a high rate of complete local response to be achieved in large lesions also.*

Del Prete, A., Primo, T., Franchi, R.SUPER-NICKEL ORTHOGONAL TURNING OPERATIONS OPTIMIZATION

*Procedia CIRP, Volume 8, 2013, Pages 164-169*Automated optimization; Conflicting objectives; Machining optimization; Machining parameters; Manufacturing industries; Nickel superalloy; Optimal cutting parameters; Response surface methodology Engineering controlled terms: Industrial applications; Machining centers; Mathematical models; Nickel; Optimization; Superalloys Engineering main heading: Turning *The machining processes simulation are commonly used by manufacturing industries in order to produce high quality and very complex products in a short time. These machining processes simulation include large number of input parameters which may affect the cost and quality of the products. Selection of optimum*

machining parameters in such machining processes is very important to satisfy all the conflicting objectives of the process. There are two options to choose the optimal cutting parameters for a given economic objective. The first one is concerned with the need of a machine expert that manually selects the machining parameters on the basis of its own experience and by means of a proper machining handbook. That way generates many uncertainties and drawbacks in terms of efficiency of solutions and time/cost requirements. As an alternative to the above mentioned approach, many research efforts have been made to state a comprehensive mathematical model of a turning process that, in practice, entails a set of cutting constraints to be handled. Machining optimization problems become tricky whenever a given objective function must be optimized with respect to a large number of constraints. This paperwork is focused about the generation of an automated optimization procedure, for turning processes of nickel superalloys, under certain process conditions. For the automated optimization procedure the response surface methodology (RSM) has been used to detect the influence of the process variables on its performances. Copyright

Pompili, M., Biolato, M., Miele, L., Grieco, A.TUMOR NECROSIS FACTOR-A INHIBITORS AND CHRONIC HEPATITIS C: A COMPREHENSIVE LITERATURE REVIEW

World Journal of Gastroenterology, Volume 19, Issue 44, 28 November 2013, Pages 7867-7873
EMTREE drug terms: adalimumab; alanine aminotransferase; alpha2b interferon plus ribavirin; autoantibody; bilirubin; cardiolipin antibody; cyclosporin; etanercept; etretin; gamma glutamyltransferase; hepatitis B surface antigen; immunosuppressive agent; infliximab; leflunomide; methotrexate; placebo; tumor necrosis factor alpha; tumor necrosis factor alpha inhibitor; virus RNA EMTREE medical terms: adjuvant therapy; article; drug safety; drug withdrawal; hepatitis C; human; liver cirrhosis; liver fibrosis; liver function; liver toxicity; nonhuman; phase 2 clinical trial (topic); psoriasis; randomized controlled trial (topic); rheumatoid arthritis; sarcoidosis; side effect; signal transduction; unspecified side effect Medline keywords: Adalimumab; Etanercept; Hepatitis C virus; Inflammatory bowel disease; Infliximab; Psoriasis; Rheumatoid arthritis Medline is the source for the MeSH terms of this document. MeSH: Animals; Antiviral Agents; Drug Monitoring; Hepacivirus; Hepatitis C, Chronic; Humans; Immunosuppressive Agents; Risk Factors; Treatment Outcome; Tumor Necrosis Factor-alpha Medline is the source for the MeSH terms of this document. *Tumor necrosis factor-α (TNF-α) inhibitors are known to increase reactivation of concurrent chronic hepatitis B, but their impact on the hepatitis C virus (HCV) is controversial. Some conditions of immunosuppression, such as liver transplantation, typically cause an increase in the rate of HCV evolution. Inhibition of TNF-α, a cytokine involved in the apoptotic signaling pathway of hepatocytes infected by HCV, could potentially increase viral replication. Currently available clinical data appear to contradict this hypothesis. A review of medical literature revealed that a total of 216 patients with HCV were exposed to one or more treatments with TNF-α inhibitors, with a median observation time of 1.2 years and 260 cumulative patient-years of exposure. Only three cases of drug withdrawal due to suspected HCV liver disease recrudescence were reported. Treatment with TNF-α inhibitors in patients with HCV infection appears to be safe in the short*

term, but there are insufficient data to assess their long-term safety. Universal screening for HCV before beginning treatment with TNF-α inhibitors is currently controversial. The presence of HCV is not a contraindication to therapy with TNF-α inhibitors, with the exception of cirrhotic patients. In cases of cirrhosis, the benefit/risk ratio should be evaluated at the individual level. Prior to treatment with TNF-α inhibitors, patients with HCV should be referred to a hepatologist to determine the necessity of hepatic disease assessment, using liver biopsy or noninvasive methods, and the potential indication for antiviral therapy. In patients with HCV infection who are treated with TNF-α inhibitors, liver function monitoring every three months is advised.

Biolato, M., Barbaro, B., Siciliani, L., Grieco, A.VANISHING-RECURRENT BENIGN LIVER LESIONS

Liver International, 2013[No abstract available]

Grieco, A., Lombardo, A., Biolato, M.VENTRICULAR THROMBOSIS DURING SORAFENIB THERAPY FOR ADVANCED HEPATOCELLULAR CARCINOMA

European Journal of Gastroenterology and Hepatology, Volume 25, Issue 8, August 2013, Pages 1001-1002 EMTREE drug terms: alpha fetoprotein; amiodarone; atorvastatin; captopril; carvedilol; clopidogrel; enoxaparin; furosemide; nitrate; pantoprazole; sorafenib EMTREE medical terms: advanced cancer; aged; akinesia; alcohol liver cirrhosis; anorexia; asthenia; cancer size; case report; computer assisted tomography; congestive cardiomyopathy; contrast enhancement; diarrhea; diastolic dysfunction; disease severity; drug withdrawal; echocardiography; follow up; heart failure; heart function; heart left ventricle ejection fraction; heart ventricle thrombosis; hepatic encephalopathy; human; hypertension; letter; liver cell carcinoma; liver function; low drug dose; male; mitral valve regurgitation; priority journal; weight reduction MeSH: Aged; Anticoagulants; Antineoplastic Agents; Carcinoma, Hepatocellular; Enoxaparin; Heart Diseases; Humans; Liver Neoplasms; Male; Niacinamide; Phenylurea Compounds; Predictive Value of Tests; Protein Kinase Inhibitors; Risk Factors; Thrombosis; Treatment Outcome; Ventricular Dysfunction Medline is the source for the MeSH terms of this document. *[No abstract available]*

Salerno

Citarella, R.G., Carlone, P., Lepore, M., Palazzo, G.S.A FEM-DBEM INVESTIGATION OF THE INFLUENCE OF PROCESS PARAMETERS ON CRACK GROWTH IN ALUMINUM FRICTION STIR WELDED BUTT JOINTS

*Key Engineering Materials, Volume 554-557, 2013, Pages 2118-2126*Computational approach; Crack propagation rate; Dual boundary element method; FEMDBEM; Influence of process parameters; Numerical investigations; Process parameters; Residual stresses distributions Engineering controlled terms: Boundary element method; Butt welding; Crack propagation; Friction stir welding; Residual stresses; Stress concentration Engineering main heading: Cracks *This paper deals with a numerical investigation on the influence of FSW process parameters, namely the rotating speed and the welding speed, on fatigue crack growth in AA2024- T3 butt joints. The computational approach is based on a sequential usage of Finite Element Method (FEM) and Dual Boundary Element Method (DBEM) procedure. The process induced residual stress distribution has been mapped by means of a recently developed technique named contour method. The computed residual stress field has then been superimposed to the stress field produced by a remote fatigue traction load in a DBEM environment. A two-parameters crack growth law is used for the crack propagation rate assessment. The simulation results corresponding to different combinations of process parameters are presented. The influence of process parameters on the residual stresses distribution has also been highlighted. Copyright*

Carlone, P., Palazzo, G.S.A MICRO-SCALE MODEL FOR FIBER TOW CHARACTERIZATION UNDER NONDETERMINISTIC ASSUMPTION: LONGITUDINAL AND TRANSVERSE PERMEABILITY

*Key Engineering Materials, Volume 554-557, 2013, Pages 2348-2354*Dimensional variations; Experimental observation; Liquid composite molding process; Micro scale models; Permeability tensors; Representative volume element (RVE); Transverse permeability; Trial-and-error procedures Engineering controlled terms: Fibers; Liquids; Mechanical permeability; Molding Engineering main heading: Stochastic models *Liquid Composite Molding processes are characterized by the impregnation of a dry fibrous perform by means of injection or infusion of a catalyzed resin. In recent years computational flow and cure models allowed for a remarkable time and cost compression in process planning with respect to trial and error procedures. In this contest multi-scale simulative approaches are gaining considerable attention and intriguing results have been recently presented. Most of the proposed models, however, rely on deterministic hypothesis, assuming perfect fiber packing and neglecting dimensional variations between fibers, in strong contrast with experimental observations. In this paper the influence of the stochastic variability of the fiber packing on tow permeability has been investigated by means of a CFD micro scale model. The variability of the microstructure defining the Representative Volume Element has been considered introducing random perturbations of the fiber packing. The components of the permeability tensor, in each case, have then been derived applying the Darcy model to flow simulations through the representative cell. Copyright*

Carlone, P., Palazzo, G.S.A MULTI-SCALE NON-DETERMINISTIC APPROACH TO COMPOSITE CURINGPROCESS SIMULATION

*Advanced Materials Research, Volume 750-752, 2013, Pages 11-15*Computational model; Cure process; Curing process; Multi-scale Modeling; Non-deterministic approach; Stochastic perturbations; Thermosetting matrices; Trial-and-error procedures Engineering controlled terms: Composite materials; Mechanical properties; Stochastic models Engineering main heading: Diamond cutting tools PaperChem Variable: Composites; Curing; Cutting Tools; Diamond; Mathematical Models; Mechanical Properties *Thermosetting matrix composite materials are often subject to a curing process to enhance the mechanical properties of the final product.In recent years computational models of the curing process allowed for a remarkable time and cost compression with respect to trial and error procedures. Most of the proposed models, however, rely on deterministic hypothesis. In this papera multi-scale non deterministic approach to cure process simulation has been proposed, evidencing the effect of stochastic perturbations of fibers distribution on simulative results on macro-scale.*

Carlone, P., Palazzo, G.S.A NUMERICAL AND EXPERIMENTAL ANALYSIS OF MICROSTRUCTURAL ASPECTS IN AA2024-T3 FRICTION STIR WELDING

*Key Engineering Materials, Volume 554-557, 2013, Pages 1022-1030*CFD models; Grain size; Influence of process parameters; Microstructural alterations; Numerical and experimental analysis; Recrystallized grain sizes; Three-dimensional CFD model; Zener-Holloman parameters Engineering controlled terms: Computational fluid dynamics; Formability; Friction stir welding; Grain size and shape; Microstructure Engineering main heading: Materials *Heat generation and material stirring in friction stir welding induce significant microstructural alteration in the base material. The influence of microstructural aspects on mechanical properties and formability of FSWed assemblies is well recognized in the recent literature. In this paper the influence of process parameters, namely rotating speed and welding speed, on microstructural aspects in AA2024-T3 friction stir butt welds is numerically and experimentally investigated. A three-dimensional CFD model has been implemented to simulate temperature field, material flow, and microstructural aspects in an Eulerian framework. Recrystallized grain size has been numerically predicted taking into account the Zener-Holloman parameter and experimentally measured by means of conventional metallographic techniques. Satisfactory agreement has been found between simulated and experimental results. Copyright*

Caiazzo, F., Alfieri, V., Cardaropoli, F., Sergi, V.BUTT AUTOGENOUS LASER WELDING OF AA 2024 ALUMINIUM ALLOY THIN SHEETS WITH A YB:YAG DISK LASER

*International Journal of Advanced Manufacturing Technology, Volume 67, Issue 9-12, 2013, Pages 2157-2169*AA 2024; Autogenous laser welding; Central composite designs; Defocusing; Disk lasers; Energy dispersive spectrometry; Modelling and optimisation; Optimisations Engineering controlled terms: Aerospace industry; Aluminum alloys; Optimization; Productivity; Tensile testing; Ytterbium Engineering main heading: Laser beam welding *Higher productivity,*

lower distortion and better penetration are the main advantages provided by laser welding in comparison with conventional processes. A Trumpf Tru-Disk 2002 Yb:YAG disk laser is used in this work to increases productivity and quality. Aluminium alloys lead to many technological issues in laser welding, resulting in shallow penetration and defects. In particular, AA 2024 aluminium alloy in a thin sheet is investigated in this paper, being it is used extensively in the automotive and aerospace industries. Bead-on-plate and butt autogenous laser welding tests with continuous wave emission on 1.25 mm thick AA 2024 aluminium alloy sheets were examined morphologically and micro-structurally. The geometric and mechanical features of the welding bead were evaluated via a three-level experimental plan. In addition to the power and speed which are traditionally referred to, beam defocusing was considered as an additional governing factor in a central composite design scheme because it massively affects keyhole conditions. Softening in the fused zone is discussed via Vickers micro-hardness testing and magnesium loss through energy dispersive spectrometry. After properly performing the modelling and optimisation of the fused zone and the cross-section shape factor as the response variables, the laser welding conditions for thin sheets of AA 2024 aluminium alloy are suggested. X-ray and tensile tests were conducted on the specimens obtained with the recommended processing parameters to characterise the AA 2024 disk laser welded beads.

Caiazzo, F., Alfieri, V., Cardaropoli, F., Corrado, G., Sergi, V.CHARACTERIZATION OF DISK-LASER DISSIMILAR WELDING OF TITANIUM ALLOY TI-6AL-4V TO ALUMINUM ALLOY 2024

*Proceedings of SPIE - The International Society for Optical Engineering, Volume 8603, 2013, Article number 86030I*Aerospace and automotive industries; Corrosive resistances; Disk lasers; Dissimilar welding; High-temperature environment; Mechanical feature; Porosity formation; Specific properties Engineering controlled terms: Aluminum alloys; Automotive industry; Dissimilar metals; Friction stir welding; Heat affected zone; Industrial applications; Joining; Laser beam welding; Laser materials processing Engineering main heading: Titanium alloys
Both technical and economic reasons suggest to join dissimilar metals, benefiting from the specific properties of each material in order to perform flexible design. Adhesive bonding and mechanical joining have been traditionally used although adhesives fail to be effective in high-temperature environments and mechanical joining are not adequate for leak-tight joints. Friction stir welding is a valid alternative, even being difficult to perform for specific joint geometries and thin plates. The attention has therefore been shifted to laser welding. Interest has been shown in welding titanium to aluminum, especially in the aviation industry, in order to benefit from both corrosive resistance and strength properties of the former, and low weight and cost of the latter. Titanium alloy Ti-6Al-4V and aluminum alloy 2024 are considered in this work, being them among the most common ones in aerospace and automotive industries. Laser welding is thought to be particularly useful in reducing the heat affected zones and providing deep penetrative beads. Nevertheless, many challenges arise in welding dissimilar metals and the aim is further complicated considering the specific features of the alloys in exam, being them susceptible to oxidation on the upper surface and porosity formation in the fused zone. As many variables are involved, a systematic approach is used to perform the process and to characterize

the beads referring to their shape and mechanical features, since a mixture of phases and structures is formed in the fused zone after recrystallization.

Carlone, P., Palazzo, G.S.COMPOSITE LAMINATES CURE CYCLE OPTIMISATION BY META-HEURISTIC ALGORITHMS

*International Journal of Materials and Product Technology, Volume 46, Issue 2-3, 2013, Pages 106-123*Composite laminate; Cure process; Downhill simplex method; Meta heuristic algorithm; Meta-heuristic optimisation; Nelder meads; Polymeric matrix composites; Simulated annealing algorithms Engineering controlled terms: Curing; Finite element method; Genetic algorithms; Heuristic algorithms; Mechanical properties; Simulated annealing Engineering main heading: Laminated composites *Thermoset polymeric matrix composites (PMC) are often subjected to thermal cure cycles to improve the mechanical properties of the final product. The cycle design, i.e., the definition of the temperature-time curve, is a crucial issue for a competitive production. This paper deals with the simulation-based meta-heuristic optimisation of the thermal cure cycle of thick composite laminates. Optimisation routines have been coupled with a finite element thermochemical model of the process. Two optimisation procedures have been implemented and tested. The former is a combination of the Downhill simplex method with the simulated annealing algorithm; the latter is a genetic algorithm. In both cases, some variations to the original algorithms have been introduced to improve the efficiency of the optimisation procedure in relation to the problem examined. Copyright*

Carlone, P., Baran, I., Hattel, J.H., Palazzo, G.S.COMPUTATIONAL APPROACHES FOR MODELING THE MULTIPHYSICS IN PULTRUSION PROCESS

Advances in Mechanical Engineering, Volume 2013, 2013, Article number 301875Pultrusion is a continuous manufacturing process used to produce high strength composite profiles with constant cross section. The mutual interactions between heat transfer, resin flow and cure reaction, variation in the material properties, and stress/distortion evolutions strongly affect the process dynamics together with the mechanical properties and the geometrical precision of the final product. In the present work, pultrusion process simulations are performed for a unidirectional (UD) graphite/epoxy composite rod including several processing physics, such as fluid flow, heat transfer, chemical reaction, and solid mechanics. The pressure increase and the resin flow at the tapered inlet of the die are calculated by means of a computational fluid dynamics (CFD) finite volume model. Several models, based on different homogenization levels and solution schemes, are proposed and compared for the evaluation of the temperature and the degree of cure distributions inside the heating die and at the postdie region. The transient stresses, distortions, and pull force are predicted using a sequentially coupled three-dimensional (3D) thermochemical analysis together with a 2D plane strain mechanical analysis using the finite element method and compared with results obtained from a semianalytical approach.

Carlone, P., Palazzo, G.S.COMPUTATIONAL MODELING OF THE PULLING FORCE IN A CONVENTIONAL PULTRUSION PROCESS

*Advanced Materials Research, Volume 772, 2013, Pages 399-406*CFD modeling; Computational model; Degree of cure; Frictional effects; High productivity; Pulling force; Pultruded products; Pultrusion process Engineering controlled terms: Composite materials; Friction; Research; Temperature Engineering main heading: Pultrusion *Pultrusion process is gaining increasing attention in several sectors, due to the high productivity and quality achievable. Recent researches highlighted the influence of the pulling force on the quality of pultruded products. In this paper a pulling force model, accounting for compacting, viscous, and frictional effects in a conventional pultrusion process has been implemented. The model is based on the combination of an impregnation, a thermochemical, and a frictional sub-models. Obtained outcomes evidenced, for the considered case,adominant role of the viscous drag.*

Caiazzo, F., Corrado, G., Alfieri, V., Sergi, V., Cuccaro, L.DISK-LASER WELDING OF HASTELLOY X COVER ON RENÉ 80 TURBINE STATOR BLADE

*Proceedings of SPIE - The International Society for Optical Engineering, Volume 8677, 2013, Article number 86770O*Disk-laser; Geometric feature; Governing parameters; Hastelloy X; High temperature; Nickel base alloys; Processing windows; Resistance properties Engineering controlled terms: Aerospace applications; Laser beam welding; Superalloys; Turbines; Turbomachine blades Engineering main heading: Industrial applications *Nickel-base alloys, such as Hastelloy X and René 80, are among the most common ones for aerospace applications, due to their mechanical strength at high temperatures and oxidation resistance properties, although processing for missile and space vehicle applications requires extensive fusion and resistance welding for fastening. Laser welding using a Yb:YAG disk laser in continuous mode emission is investigated in this paper for overlap joining of Hastelloy X plates on René 80 samples resulting from waste turbine blades. An explorative study is carried out in order to find an appropriate processing window as well as discussing bead features and common issues. Special fixtures for clamping have been specifically developed and tested. A 3-factors study with power, welding speed and focus position as governing parameters has been arranged; 2 levels have been chosen for each factor. Geometric features, defects and indications are discussed referring to the parameters main effects.*

Caiazzo, F., Alfieri, V., Sergi, V., Schipani, A., Cinque, S.DISSIMILAR AUTOGENOUS DISK-LASER WELDING OF HAYNES 188 AND INCONEL 718 SUPERALLOYS FOR AEROSPACE APPLICATIONS

*International Journal of Advanced Manufacturing Technology, Volume 68, Issue 5-8, 2013, Pages 1809-1820*Beam angle; Disk-laser; Experimental plans; Governing parameters; Inconel 718 superalloys; Industrial environments; Non-destructive test; Vickers microhardness Engineering controlled terms: Aerospace applications; Nondestructive examination; Optimization; Superalloys; Tensile strength Engineering main heading: Laser beam welding *New materials and new processing methods are being progressively tested for aerospace applications in order to meet the challenges of innovation and operating cost reduction, but extensive studies are needed before any change may be introduced in industrial environments. Laser beam welding is considered to be a valid alternative to arc and electron beam welding for aerospace applications; in particular, interest is growing toward disk-laser sources due to their increased beam quality. The autogenous disk-laser welding of Haynes 188 and Inconel 718, which are among the most common and representative aerospace superalloys, is discussed in the paper. The aim is to provide a comprehensive description of the quality issues in terms of both structure and shape defects, via non-destructive tests and dimensional checks referring to special needs as required in industrial specifications. A systematic approach is adopted, defining both the main governing parameters and the crucial response variables at a pre-design stage, and a three-factor experimental plan with power, welding speed, and beam angle is arranged to feed the optimization process. The suggested optimal welding conditions are assessed in terms of the resulting Vickers micro-hardness and tensile strength, and convincing results are achieved.*

Alfieri, V., Caiazzo, F., Sergi, V.DISSIMILAR JOINING OF TITANIUM ALLOY TI-6AL-4V TO ALUMINUM ALLOY 2024 VIA LASER WELDING

*ICALEO 2013 - 32nd International Congress on Applications of Lasers and Electro-Optics, 2013, Pages 529-537*Chemical compositions; Coefficient of linear expansions; Dissimilar joining; Dissimilar welding; Intermetallic formation; Processing speed; Shielding systems; Welding parameters Engineering controlled terms: Crystal structure; Filler metals; Intermetallics; Joining; Laser beam welding Engineering main heading: Titanium alloys *Dissimilar joining of titanium to aluminum is required for several purposes in automotive and aerospace. Nevertheless, a number of issues arise due to their different properties, in terms of crystal micro structure, melting point, heat conductivity and coefficient of linear expansion. In addition, brittle intermetallic formation is induced at the interface and affects the strength of the joint. Therefore, irrespective of the welding method, the amount of intermetallics has to be reduced to acceptable limits. Laser welding is a valid solution to be investigated as different advantages are benefited, with reduced heat affected zone as a consequence of a localized heat input; nevertheless, a shielding system must be developed and the proper window for the welding parameters must be found. The capability of dissimilar welding of titanium alloy Ti-6Al-4V to aluminum alloy AA 2024 with no need for filler metal is investigated using a Yb:YAG disk-laser source; 1 mm thick sheets are considered. The influence of the beam offset and the processing speed is discussed with respect to overall geometry, micro structure and chemical composition.*

Caiazzo, F., Cardaropoli, F., Alfieri, V., Sergi, V., Cuccaro, L.EXPERIMENTAL ANALYSIS OF SELECTIVE LASER

MELTING PROCESS FOR TI-6AL-4V TURBINE BLADE MANUFACTURING

*Proceedings of SPIE - The International Society for Optical Engineering, Volume 8677, 2013, Article number 86771H*Dimensional inspection; Experimental analysis; Fluorescent penetrant inspections; Processing parameters; Selective laser melting; Three-dimensional computer aided designs; Ti-6al-4v titanium alloys; Turbine blade Engineering controlled terms: Computer aided design; Investment casting; Laser heating; Manufacture; Rapid prototyping; Three dimensional; Titanium alloys; Turbomachine blades; Wear resistance Engineering main heading: Turbines *The present work focuses on the use of Selective Laser Melting (SLM) technique for manufacturing of near-net-shape aircraft component prototypes with Ti-6Al-4V titanium alloy, which has already successfully employed for the production of turbine blades since it combines mechanical properties with excellent wear resistance. The main characteristic of SLM is layer manufacturing which allows to obtain complex shaped elements using three dimensional computer aided design data, with the addition of particular features like channels or cavities which can not been easily obtained with traditional technologies. The other key aspect in comparison with investment casting is shorter post-processing. The feasibility of manufacturing turbine blades with mentioned process using a laser sintered machine EOSINT M 270 (Titanium version) is analysed. The first experimental phase has dealt with the definition of processing parameters which would guarantee laser sintered part maximum density. Preliminary specimens have been manufactured to define any material-dependent scaling value to control dimensional shrinkage. Afterwards a prototype of a turbine blade has been produced using optimal process parameter set. The element positioning and support definition are discussed as they influence the overall job time and the need of post processing operations. Further analyses have been carried out to check the whole structure of the prototype using X-rays and Fluorescent Penetrant Inspection, aiming to point out possible imperfections; no defects have been detected. Furthermore, laser sintered part dimensional inspection has been successively performed via coordinate measuring machine. Eventually, the microstructure of the prototype has been examined.*

Carlone, P., Palazzo, G.S.INFLUENCE OF PROCESS PARAMETERS ON MICROSTRUCTURE AND MECHANICAL PROPERTIES IN AA2024-T3 FRICTION STIR WELDING

*Metallography, Microstructure, and Analysis, Volume 2, Issue 4, August 2013, Pages 213-222*Experimental investigations; Influence of process parameters; Material deposition; Microstructure and mechanical properties; Parameters setting; Process model; Processing windows; Rate distributions Engineering controlled terms: Aluminum; Mechanical properties; Mechanical testing; Microstructure; Optical microscopy; Welding Engineering main heading: Friction stir welding *Material stirring and heat generation in friction stir welding processes induce significant microstructure and material properties alterations. Previous studies highlighted the relationship among microstructure, grain size, microhardness, and performance*

of the joint. In this context, an opportune definition of process parameters, in particular rotating and welding speed, is crucial to improve joint reliability. In this article, results provided by a numerical and experimental investigation on the influence of rotating and welding speed on microstructure, mechanical properties, and joint quality in AA2024-T3 friction stir welded butt joints are reported. Experimental data are presented and discussed considering numerically computed temperature and strain rate distributions, providing useful information for parameters setting. Processing window, i.e., parameters resulting in a successful material deposition, is also individuated.

Paulo, R.M.F., Carlone, P., Valente, R.A.F., Teixeira-Dias, F., Palazzo, G.S.INTEGRATED DESIGN AND NUMERICAL SIMULATION OF STIFFENED PANELS INCLUDING FRICTION STIR WELDING EFFECTS

*Key Engineering Materials, Volume 554-557, 2013, Pages 2237-2242*Friction stir welding(FSW); Geometrical imperfections; Initial geometrical imperfections; Integrated designs; Longitudinal residual stress; Stiffened panel; Stiffened structures; Structural behaviour Engineering controlled terms: Computer simulation; Friction stir welding; Scaffolds (biology); Sensitivity analysis; Structural design Engineering main heading: Residual stresses *Stiffened panels are lightweight structures with high resistance, composed by a base plate with stiffeners in one or more directions. The structural design, in most cases, focuses mainly on the longitudinal compressive loads that the panels are subjected to and can safely withstand. Welding processes used to build large stiffened structures, such as friction stir welding (FSW), are responsible for introducing geometrical imperfections, changing the material properties and adding residual stresses. These factors can therefore affect the panel's structural behaviour when subjected to compressive loads. In this work, the longitudinal residual stresses that arise from FSW processes were measured by means of the contour method. These residual stresses were then introduced into a numerical simulation model based on the finite element method (FEM), and their effect on the buckling collapse load was assessed. The sensitivity of the models to initial geometrical imperfections was also analysed. It could be inferred that the collapse loads showed no relevant sensitivity to the inclusion of the residual stresses in the tested model, being nevertheless affected by small variations of the initial geometrical imperfection magnitude. Copyright*

Caiazzo, F., Alfieri, V., Corrado, G., Cardaropoli, F., Sergi, V.INVESTIGATION AND OPTIMIZATION OF LASER WELDING OF TI-6AL-4V TITANIUM ALLOY PLATES

*ASME 2013 International Manufacturing Science and Engineering Conference Collocated with the 41st North American Manufacturing Research Conference, MSEC 2013, Volume 1, 2013, Article number MSEC2013-1134*Face-centred cubic; Governing parameters; High specific strength; Regression model; Statistical tools; Ti-6al-4v titanium alloys; Traditional techniques; Welded structures Engineering controlled terms: Corrosion resistance; Industrial research; Laser

beam welding; Manufacture; Optimization; Plates (structural components); Regression analysis; Statistical mechanics; Tensile strength Engineering main heading: Titanium alloys *Titanium alloys are employed for several applications, ranging from aerospace to medicine. In particular, Ti-6Al-4V is the most common, thanks to an excellent combination of low density, high specific strength and corrosion resistance. Laser welding has been increasingly considered as an alternative to traditional techniques to join titanium alloys. An increase in penetration depth and a reduction of possible welding defects is achieved indeed; moreover a smaller grain size in the fused zone is benefited in comparison to either TIG and plasma arc welding, thus providing an increase in the tensile strength of the welded structures. The aim of this work is to develop the regression model for a number of responses which are crucial for the feature of the joint. The study was carried out on 3 mm thick Ti-6Al-4V plates; a square butt welding configuration was considered employing a disk-laser source. A 3-level factorial plan was hence arranged in a face-centred cubic scheme. The responses were analyzed referring to the governing parameters. Then, an optimization was carried out via statistical tools, in order to find the optimal welding set-up for the alloy under examination. Copyright*

Caiazzo, F., Alfieri, V., Corrado, G., Cardaropoli, F., Sergi, V.INVESTIGATION AND OPTIMIZATION OF LASER WELDING OF TI-6AL-4 V TITANIUM ALLOY PLATES

*Journal of Manufacturing Science and Engineering, Transactions of the ASME, Volume 135, Issue 6, December 2013, Article number 061012*Face-centered cubic; High specific strength; Numerical optimizations; Traditional techniques; Tungsten inert gas; Vickers microhardness; Welded structures; X ray inspection Engineering controlled terms: Aluminum; Corrosion resistance; Inert gases; Laser beam welding; Optimization; Plates (structural components); Regression analysis; Tensile strength; Tensile testing Engineering main heading: Titanium alloys *Titanium alloys are employed in a wide range of applications, from aerospace to medicine. In particular, Ti-6Al-4 V is the most common, thanks to an excellent combination of low density, high specific strength, and corrosion resistance. Laser welding has been increasingly considered as an alternative to traditional techniques to join titanium alloys. An increase in penetration depth and a reduction of possible welding defects are indeed achieved; moreover, a smaller grain size in the fused zone (FZ) is benefited in comparison to either tungsten inert gas (TIG) or plasma arc welding, thus improving the tensile strength of the welded structures. This study was carried out on 3 mm thick Ti-6Al-4 V plates in square butt welding configuration. The novelty element of the investigation is the use of a disk-laser source, which allows a number of benefits thanks to better beam quality; furthermore, a proper device was developed for bead protection, as titanium is prone to oxidation when in fused state. A three-level factorial plan was arranged in face-centered cubic scheme. The regression models were found for a number of crucial responses and the corresponding surfaces were discussed; then a numerical optimization was carried out. The suggested condition was evaluated to compare the actual responses to the predicted values; X-ray inspections, Vickers micro hardness tests, and tensile tests were performed for the optimum. Copyright*

Caiazzo, F., Alfieri, V., Sergi, V.INVESTIGATION ON MECHANICAL PROPERTIES OF DISK LASER WELDED AEROSPACE ALLOYS

*Advanced Materials Research, Volume 702, 2013, Pages 128-134*Aerospace alloys; Common metals; Disk lasers; Dissimilar welding; Square butt joints; Ti-6al-4v; Welded structures; Welding thermal cycles Engineering controlled terms: Aluminum alloys; Cerium alloys; Laser beam welding; Mechanical properties; Pumping (laser); Superalloys; Tensile strength; Tensile testing; Titanium alloys Engineering main heading: Welding *The original micro structure of the base metal is significantly affected by a welding thermal cycle, irrespective of the type of the heat source. Hence, new phases and different grain size result in the welding bead. The tensile strength of the overall structure is affected in turn. Tensile tests are normally conducted to eventually test a square butt joint configuration. In conjunction, micro hardness is thought to be a good indicator to predict where the fracture would occur in the welded structure. Referring to common metal alloys for aerospace and considering a diode-pumped disk-laser source, the response of the base metal to the laser beam is investigated in this paper. Autogenous welding of aluminum alloy 2024, autogenous welding of titanium alloy Ti-6Al-4V and dissimilar welding of Haynes 188 with Inconel 718 are discussed, with respect to micro structure changes in the fused zone and in the heat affected zone. The failure mode is examined.*

Carlone, P., Gaetano, S.LONGITUDINAL RESIDUAL STRESS ANALYSIS IN AA2024-T3 FRICTION STIR WELDING

Open Mechanical Engineering Journal, Volume 7, Issue 1, 2013, Pages 18-26 Engineering controlled terms: Materials properties; Residual stresses; Stress analysis; Stress concentration; Welding AA2024-T3; Contour method; Friction stir welding(FSW); Influence of process parameters; Longitudinal residual stress; Micro-structural effects; Solid-state joining; Static and dynamic performance Engineering main heading: Friction stir welding *Friction Stir Welding (FSW) is an innovative solid-state joining process, which is gaining a great deal of attention in several applicative sectors. The opportune definition of process parameters, i.e. minimizing residual stresses, is crucial to improve joint reliability in terms of static and dynamic performance. Longitudinal residual stresses, induced by FSW in AA2024-T3 butt joints, have been inferred by means of a recently developed technique, namely the contour method. Two approaches to stress measurement have been adopted; the former is based on the assumption of uniform material properties, the latter takes into account microstructural effects and material properties variations in the welding zones. The influence of process parameters, namely rotating and welding speeds, on stress distribution is also discussed.*

Carlone, P., Palazzo, G.S.MECHANICAL CHARACTERIZATION OF AA2024-T3 FSWED BUTT JOINTS

*Advanced Materials Research, Volume 753-755, 2013, Pages 431-434*AA2024-T3; Butt joints; Influence of process parameters; Mechanical characterizations; Microstructural alterations; Process parameters; Rotating speed; Transport industry Engineering controlled terms: Butt welding; Friction stir welding; Mechanical properties Engineering main heading: Characterization *In recent years friction stir welding process has received a great deal of attention from the transport industry. During the process, heat generation and material stirring induce significant microstructural alteration in the base material, affecting the properties of the welded assembly. In this paper the influence of process parameters, namely rotating speed and welding speed, on mechanical properties of AA2024-T3 friction stir butt welds is experimentally investigated. An increase of the yield stress has been found decreasing the heat input, while an opposite variation was measured for the elongation.*

Trento

Bosetti, P., Bort, C.M.G.A FRAMEWORK FOR IN-LINE MILLING PROCESS OPTIMISATION

ASME International Mechanical Engineering Congress and Exposition, Proceedings (IMECE), Volume 2 A, 2013This work proposes a possible framework for implementing model-based optimization of process parameters in a milling operation. The latter is the first step in the development of an artificial machine tool operator, i.e. a supervising controller that looks at the process status and continuously estimate an optimal set of controls on the basis of a given process model. After a description of the software architecture, the discussion on the process model adopted for the definition of the target function, and the illustration of the optimization algorithm (the Nelder-Mead Method), the paper presents the results obtained from the application of the optimization system to two different case studies, showing how the same part-program can be run with significant improvements in productivity when the feed rate and spindle speed overrides are continuously varied during the machining according to profiles calculated by the proposed process optimization system. Copyright

Bosetti, P., Maximiliano, C., Bort, G., Bruschi, S.IDENTIFICATION OF JOHNSON-COOK AND TRESCA'S PARAMETERS FOR NUMERICAL MODELING OF AISI-304 MACHINING PROCESSES

*Journal of Manufacturing Science and Engineering, Transactions of the ASME, Volume 135, Issue 5, 2013, Article number 051021*Hybrid procedure; Johnson-Cook model; Machining Process; Nelder-Mead methods; Optimization algorithms; Optimized parameter; Orthogonal cutting; Thermomechanical numerical model Engineering controlled terms: Algorithms; Curve fitting; Cutting; Cutting tools; Identification (control systems); Numerical models; Optimization Engineering main heading: Parameter estimation *This paper presents a procedure for the identification of Johnson Cook model parameters and Tresca's law friction factor for orthogonal*

cutting of AISI 304. The process is described by a thermomechanical numerical model. The parameters are identified by minimizing the error in the prediction of cutting force, chip thickness, and chip curvature. Two optimization algorithms where tested: a pure Nelder-Mead method (NMM), and a hybrid procedure, in which the starting simplex for NMM is calculated by means of a genetic algorithm. The results emphasize the importance of the initial guess chosen in the optimization to obtain a reliable set of parameters. By using the optimized parameters in the numerical model, the cutting force, the chip thickness, and the chip curvature can be evaluated with an acceptable accuracy. The identified rheological and tribological coefficients are validated for different orthogonal cutting conditions.

Bosetti, P., Leonesio, M., Parenti, P.ON DEVELOPMENT OF AN OPTIMAL CONTROL SYSTEM FOR REAL-TIME PROCESS OPTIMIZATION ON MILLING MACHINE TOOLS

*Procedia CIRP, Volume 12, 2013, Pages 31-36*Chatter; Dynamic process modeling; Optimal controls; Optimization algorithms; Real-time optimization; Self-excited vibrations; Toolpaths; Vibration Engineering controlled terms: Algorithms; Control; Controllers; Cutting; Cutting tools; Feedback; Industrial engineering; Milling machines; Multiobjective optimization; Optimal control systems; Wear of materials Engineering main heading: Process control *Developing an intelligent machine tool means to augment its level of automation. This augmentation, in turn, requires a machine controller able to perform actions and to implement attributes that are currently demanded to, and hold by, human operators. The present paper describes how this issue is being faced by a large Italian national research project, funded under the Industria 2015 initiative. Considering the case of milling machines, human operators are currently in charge of supervising the cutting process by acting on spindle speed and feed override controls in order to compensate for undesired process conditions (e.g. excessive vibration or power absorption) caused by a wrong choice of process parameters during the design of the part-program, by tool wear, by unexpected work material properties, or by machine tool dynamics. The first part of the paper proposes the architecture for an augmented-automation machine tool. Rather than revolutionizing the well-established architecture of a conventional machine tool, the concept is based on an additional controller that implements a supervision and optimization loop. This additional controller gets process state information from the CNC and from dedicated measurement systems, and closes a feedback action on the CNC as a human operator would do: by acting on feed and spindle speed overrides. The second part of the paper illustrates how the additional controller works: following the optimal control theory, it is based on a dynamic process model, a set of state variables (i.e. measurements), and a set of controls. Exploiting a simplified process model and efficient optimization algorithms, it performs a real-time optimization of the controls (i.e. the overrides named above) on the basis of a weighted multi-objective target function and a set of measurements taken from the cutting process (power, forces, accelerations). In particular, the target function takes into account the following objectives: cutting time, work-piece surface finish, tool wear rate and vibration mitigation in general. The third part of the paper details the strategies concerned with tool vibrations prediction, monitoring and mitigation, which are integrated into the optimization loop. A*

vibrations prediction module based on a simplified cutting process model allows the estimation of the vibration level and/or chatter occurrence during a pre-processing phase: Thus, through the computation of the Stability Lobes Diagram along the tool path, the more stable spindle speeds can be identified. The pre-processing phase is complemented with an in-process chatter monitoring algorithm based on a recursive dynamic model identification: detecting realtime self-excited vibrations onset, and distinguishing them from forced vibrations, this module allows the controller to properly update the vibration estimation.

Udine

Sortino, M., Totis, G., Prosperi, F.DRY TURNING OF SINTERED MOLYBDENUM

*Journal of Materials Processing Technology, Volume 213, Issue 7, 2013, Pages 1179-1190*Advanced engineerings; Commercial tools; Dry; Experimental datum; High mechanical strength; High temperature; Longitudinal turning; Physical and mechanical properties Engineering controlled terms: Corrosion resistance; Cutting; Molybdenum; Sintering; Surface roughness; Tools Engineering main heading: Turning *Molybdenum is a refractory metal which is recommended for advanced engineering applications requiring high mechanical strength and corrosion resistance at extremely high temperatures. However, Molybdenum-based alloys are generally difficult to machine, due to their superior physical and mechanical properties, usually requiring effective refrigeration. In this work, the feasibility of dry machining of sintered Molybdenum using commercial tools in finish longitudinal turning was investigated. A list of suitable tools was selected and cutting tests were performed in order to evaluate their performance and assess the machinability of sintered Molybdenum. Specifically, chip formation and chip control, surface roughness and cutting forces were considered. It turned out that most of the tools were inadequate for this application, therefore tool life tests were carried out on the remaining tools. Nevertheless, the analysis of experimental data confirmed that good surface quality and satisfactory tool life can be achieved in dry conditions at relatively high cutting speeds by using commercial tools.*

Sortino, M., Totis, G., Prosperi, F.MODELING THE DYNAMIC PROPERTIES OF CONVENTIONAL AND HIGH-DAMPING BORING BARS

*Mechanical Systems and Signal Processing, Volume 34, Issue 1-2, January 2013, Pages 340-352*Boring bars; Cutting parameters; Cutting process; Damping coefficients; Different geometry; Dominant mode; Dynamic property; Empirical model; Experimental observation; Experimental values; High-damping; High-quality standards; Hybrid dynamics; Machining systems; Modal parameters; Modal testings; Precision machining; Tooling systems Engineering controlled terms: Boring; Carbides; Cutting tools; Dynamic models; Modal analysis; Pneumatic tools; Precision engineering; Turning Engineering main heading: Damping *Nowadays, the availability of reliable mathematical models of machining system dynamics is a key issue for achieving high quality*

standards in precision machining. Dynamic models can indeed be applied for tooling system design, preventive evaluation of cutting process stability and optimization of cutting parameters. This is of particular concern in internal turning, where the cutting process is greatly affected by the compliance of the tooling system. In this paper, an innovative hybrid dynamic model of the tooling system in internal turning, based on FE beams and empirical models, is presented. The model was based on physical and geometrical assumptions and it was refined by using experimental observations derived from modal testing of boring bars with different geometries and made of different materials, i.e. alloy steel and high-damping carbide. The predicted modal parameters of the tooling system (tool tip static compliance, natural frequency and damping coefficient of the dominant mode) are in good accordance with experimental values.

Della calabria

Filice, L., Ambrogio, G., Guerriero, F.A MULTI-OBJECTIVE APPROACH FOR WIRE-DRAWING PROCESS

*Procedia CIRP, Volume 12, 2013, Pages 294-299*Elastic resistance; Material thinning; Mechanical points; Multi objective; Optimization problems; Process redesign; Process sustainability; Scientific literature Engineering controlled terms: Industrial engineering; Multiobjective optimization; Optimization Engineering main heading: Wire *Drawing of wires is a well known process and several manuscripts are recognizable looking at the scientific literature. The main reason why the process is used is related to increasing of the elastic resistance of the materials thanks to the induced yielding. Nevertheless many information are available from a mechanical point of view, today new needs related to process sustainability push toward a process redesign taking into account different criteria. In this paper, a multi-objective approach based on the optimization of a set of objectives is presented. Process force, die wear, material thinning and damage are considered building an optimization problem in which the technologist can decide the role of each criterion in the operative scenario.*

Umbrello, D.ANALYSIS OF THE WHITE LAYERS FORMED DURING MACHINING OF HARDENED AISI 52100 STEEL UNDER DRY AND CRYOGENIC COOLING CONDITIONS

*International Journal of Advanced Manufacturing Technology, Volume 64, Issue 5-8, February 2013, Pages 633-642*AISI 52100; Cryogenic cooling; Hard machining; SEM-EDS; White layer; XRD Engineering controlled terms: Chemical analysis; Cooling; Energy dispersive spectroscopy; Hardening; Scanning electron microscopy; X ray diffraction Engineering main heading: Cryogenics *The present work aims at understanding the effects of cryogenic coolant application and machined surface alterations during orthogonal machining of hardened AISI 52100 bearing steel. Experiments were performed under dry and cryogenic cooling conditions*

using cubic boron nitride tool inserts with varying initial hardness and tool shape. Several experimental techniques were used in order to analyze the machined surface. In particular, optical and scanning electron microscopes were used for characterizing the surface topography, whereas the microstructural phase composition analysis and chemical characterization have been performed by means of X-ray diffraction and energy-dispersive spectroscopy techniques. The experimental results prove that the white layer is partially reduced or can be totally eliminated under certain process parameters and cryogenic cooling condition.

Ambrogio, G., Gagliardi, F.DESIGN OF AN OPTIMIZED PROCEDURE TO PREDICT OPPOSITE PERFORMANCES IN PORTHOLE DIE EXTRUSION

*Neural Computing and Applications, Volume 23, Issue 1, July 2013, Pages 195-206*Advanced manufacturing; ANN; Conflicting objectives; DoE; Experimental investigations; Finite-element approach; Porthole; Porthole-die extrusions Engineering controlled terms: Dies; Expert systems; Finite element method; Forecasting; Manufacture; Neural networks; Taguchi methods; Tools Engineering main heading: Extrusion *The main objective of advanced manufacturing control techniques is to provide efficient and accurate tools in order to control the set-up of machines and manufacturing systems. Recent developments and implementations of expert systems and neural networks support this aim. This research explores the combined use of neural networks and Taguchi's method to enhance the performance of porthole die extrusion process; the energy saving and the quality of the welding line are two conflicting objectives of the process taken into account. The complexity of the analysis, due to the number of the involved variables, does not allow the representation of the specified outputs by means of a simple analytical approach. The implementation of a more accurate and sophisticated tool, such as the neural network, results more efficient and easier to be integrated into a simple "ready to use" procedure for predicting the investigated outputs. The main limit to wider implementation of neural networks is the huge computation resources (times and capacities) required to build the data set; a finite element approach was adopted to overcome the time and money wasting typical of experimental investigations. Satisfactory results in terms of prediction capability of the highlighted outputs were found. Finally, a simple and integrated interface was designed to make easier the application of the proposed procedure and to allow the generalization to other manufacturing processes.*

Ingarao, G., Kellens, K., Behera, A.K., Vanhove, H., Ambrogio, G., Duflou, J.R.ELECTRIC ENERGY CONSUMPTION ANALYSIS OF SPIF PROCESSES

*Key Engineering Materials, Volume 549, 2013, Pages 547-554*Conventional machining; Electric energy consumption; Energy consumption analysis; Environmental footprints; Single point incremental forming; SPIF; Sustainable manufacturing; Total energy consumption Engineering controlled terms: Energy efficiency; Environmental impact; Metal analysis; Metal forming; Sheet metal Engineering main heading: Energy utilization *Manufacturing processes, as used for*

discrete part manufacturing, are responsible for a substantial part of the environmental impact of products, but are still poorly documented in terms of environmental footprint. A thorough analysis on the causes affecting the environmental impact in metal forming processes, especially the innovative but very energy intensive sheet metal forming technologies required to form light-weight products, is nowadays necessary. Therefore, this paper presents an energy consumption analysis, including a power and time study, of Single Point Incremental Forming (SPIF) processes. First, the influence of the most relevant process parameters (e.g. feed rate, step down) as well as the material forming itself are analysed regarding the power demand. Moreover, a comparative study and related energy efficiency assay are carried out on two different machine tools. As the forming time proves to be the dominant factor for the total energy consumption, from environmental point of view, the overall results show many similarities with conventional machining processes. Finally, this paper reports on some potential improvement measures to reduce the SPIF energy consumption.

Rotella, G., Rizzuti, S., Umbrello, D.ENHANCING PRODUCT PERFORMANCE IN MACHINING PROCESSES: STATISTICAL ANALYSIS AND DEVELOPMENT OF PREDICTIVE MODELS

*Simulation Series, Volume 45, Issue 11, 2013, Pages 304-311*Cryogenic conditions; Functional performance; Lubrication system; Machined components; Operating condition; Predictive models; Surface characteristics; Sustainability performance Engineering controlled terms: Computer simulation; Hardness; Lubrication; Surface roughness; Tools Engineering main heading: Statistical methods *Process parameters, tool geometry and operating conditions considerably influence the quality and the functional performance, including the service-life, of machined components. Surface characteristics of the machined products such as hardness and roughness can influence the sustainability performance of the machined product and they have to be taken into account while changing the process conditions for improving its sustainability aspects. In this paper, a statistical analysis has been performed on the experimental data derived by external turning operations of aluminum AA 7075-T651, in dry, near dry and cryogenic conditions. The influence of lubrication, cutting speed and tool nose radius on some product and process performance has been analyzed. Predictive models for the surface roughness and hardness of the machined part has been derived at the varying of the lubrication system.*

Pu, Z., Dillon Jr., O.W., Lu, T., Jawahir, I.S., Umbrello, D., Puleo, D.A.FINITE ELEMENT MODELING OF MICROSTRUCTURAL CHANGES IN DRY AND CRYOGENIC MACHINING OF AZ31B MAGNESIUM ALLOY FOR ENHANCED CORROSION RESISTANCE

*Transactions of the North American Manufacturing Research Institution of SME, Volume 41, 2013, Pages 358-367*AZ31B magnesium alloys; Cryogenic machining; Dynamic

recrystallization (DRX); Dynamic recystallization; Machining conditions; Mg alloy; Microstructrual changes; Microstructural changes Engineering controlled terms: Alloys; Cryogenics; Dynamic recrystallization; Finite element method; Grain refinement; Grain size and shape; Industrial research; Magnesium alloys; Manufacture Engineering main heading: Corrosion resistance *Unsatisfactory corrosion resistance is one of the major disadvantages of magnesium alloys that impede their wide application. Microstructural changes, especially grain sizes, of Mg alloys have significant influence on their corrosion resistance. Cryogenic machining was reported to effectively induce grain refinement on Mg alloys and has a potential to improve their corrosion resistance. It is important to model these changes so that proper machining conditions can be found to enhance the corrosion rate of Mg alloys. In this paper, a preliminary study was conducted to model the microstructural changes of AZ31B Mg alloy during dry and cryogenic machining using the finite element (FE) method and a user subroutine based on the dynamic recystallization (DRX) mechanism of Mg alloys. Good agreement in terms of grain size and affected layer thickness was found between experimental and predicted results. A numerical study was conducted using this model to investigate the influence of rake angle on microstructural changes after cryogenic machining.*

Rotella, G., Dillon Jr., O.W., Umbrello, D., Settineri, L., Jawahir, I.S.FINITE ELEMENT MODELING OF MICROSTRUCTURAL CHANGES IN TURNING OF AA7075-T651 ALLOY

*Journal of Manufacturing Processes, Volume 15, Issue 1, January 2013, Pages 141-150*AA7075-T651; Bulk materials; Cutting speed; Dry cutting; FE model; Finite element method FEM; Finite element modeling; Functional performance; Grain size; Hall-Petch equation; Machined surface; Microstructural changes; Nose radius; Surface characteristics; Surface hardness; Surface integrity; User subroutine Engineering controlled terms: Cerium alloys; Dynamic recrystallization; Grain size and shape; Iron alloys; Machining; Materials handling equipment; Surfaces; Turning Engineering main heading: Finite element method *The surface characteristics of a machined product strongly influence its functional performance. During machining, the grain size of the surface is frequently modified, thus the properties of the machined surface are different to that of the original bulk material. These changes must be taken into account when modeling the surface integrity effects resulting from machining. In the present work, grain size changes induced during turning of AA7075-T651 (160 HV) alloy are modeled using the Finite Element (FE) method and a user subroutine is implemented in the FE code to describe the microstructural change and to simulate the dynamic recrystallization, with the consequent formation of new grains. In particular, a procedure utilizing the Zener-Hollomon and Hall-Petch equations is implemented in the user subroutine to predict the evolution of the material grain size and the surface hardness when varying the cutting speeds (180-720 m/min) and tool nose radii (0.4-1.2 mm). All simulations were performed for dry cutting conditions using uncoated carbide tools. The effectiveness of the proposed FE model was demonstrated through its capability to predict grain size evolution and hardness modification from the bulk material to machined surface. The model is validated by comparing the predicted results with those experimentally observed.*

Umbrello, D.INVESTIGATION OF SURFACE INTEGRITY IN DRY MACHINING OF INCONEL 718

*International Journal of Advanced Manufacturing Technology, Volume 69, Issue 9-12, December 2013, Pages 2183-2190*Aerospace materials; Cooling lubricants; Environmentally safe; Inconel-718; Microstructural alterations; Nickel based alloy; Product performance; Surface integrity Engineering controlled terms: Cutting; Cutting fluids; Machining; Surface roughness; Titanium alloys; Tools Engineering main heading: Surfaces *Machining of advanced aerospace materials have grown in the recent years although the diffucult-to-machine characteristics of alloys like titanium or nickel-based alloys cause higher cutting forces, rapid tool wear, and more heat generation. Therefore, machining with the use of cooling lubricants is usually carried out. To reduce the production costs and to make the processes environmentally safe, the goal is to move toward dry cutting by eliminating cutting fluids. This objective can be achieved by using coated tool, by increasing cutting speed, and by improving the product performance in term of surface integrity and product quality. The paper addresses the effects of cutting speed and feed on the surface integrity during dry machining of Inconel 718 alloy using coated tools. In particular, the influence of the cutting conditions on surface roughness, affected layer, microhardness, grain size, and microstructural alteration was investigated. Results show that cutting conditions have a significant effect on the parameters related to the surface integrity of the product affecting its overall performance.*

Gagliardi, F., Alfaro, I., Ambrogio, G., Filice, L., Cueto, E.NEM-FEM COMPARISON ON PORTHOLE DIE EXTRUSION OF AA-6082

*Journal of Mechanical Science and Technology, Volume 27, Issue 4, 2013, Pages 1089-1095*Construction complexity; Different shapes; Natural element method; Numerical results; Porthole die; Porthole-die extrusions; Process parameters; Welding criteria Engineering controlled terms: Crystallography; Dies; Finite element method; NEMS; Optimization; Welding; Welding codes Engineering main heading: Extrusion *Porthole die extrusion is a forming process used to manufacture hollow components with different shapes. This forming process is optimized to improve the welding line quality. Process optimization can be achieved by determining the influences that each process parameter has on the pressure along the welding plane. The construction complexity of the die results in research difficulty from an experimental point of view. Even the finite element method (FEM) presents relevant drawbacks primarily because of numerical codes are not capable of simulating the welding phase. Hence, the natural element method (NEM), which allows the joining phase of free surfaces, presents significant advantages. In this work, experimental results obtained using a flexible porthole die are discussed. A suitable 2D geometry was extracted from the die, and both FEM and NEM were conducted. A good agreement among the numerical results was recorded.*

Maletta, C., Filice, L., Furgiuele, F.NITI BELLEVILLE WASHERS: DESIGN, MANUFACTURING AND TESTING

*Journal of Intelligent Material Systems and Structures, Volume 24, Issue 6, April 2013, Pages 695-703*Finite element software; Force-deflection curves; Nickel titanium alloy; Recovery capabilities; Reversible phase transformations; Stress-strain response; Thermo-mechanical response; Thermomechanical properties Engineering controlled terms: Finite element method; Hysteresis; Nickel; Nickel alloys; Shape memory effect; Thermal cycling; Thermomechanical treatment; Titanium; Titanium alloys; Washers Engineering main heading: Domestic appliances *The thermomechanical properties of nickel-titanium-based Belleville washers have been analyzed in this investigation, together with their unusual mechanical and functional features, which can be attributed to the reversible phase transformation mechanisms of nickel-titanium alloys. In particular, numerical simulations have been carried out for a preliminary design of the Belleville washer, using a commercial finite element software and a special constitutive model for shape memory alloys. Subsequently, Belleville washers have been manufactured from a commercial pseudoelastic nickel-titanium alloy, by disk cutting and a successive shape setting by a thermomechanical treatment. Finally, the thermomechanical response of the washers, in terms of isothermal force-deflection curve and thermal cycles between phase transition temperatures, has been experimentally analyzed. The results highlighted a marked effect of the temperature on the characteristic curve, as well as good recovery capabilities under both mechanical and thermal cycles. In addition, nickel-titanium Belleville washers exhibit a marked hysteretic behavior, as a consequence of the hysteresis in the stress-strain response of the alloy. Thanks to these features, nickel-titanium Belleville washers can be used as smart elastic elements, that is, with tunable stiffness and damping properties, as well as solid-state actuators, due to their recovery capabilities.*

Del Prete, A., Filice, L., Umbrello, D.NUMERICAL SIMULATION OF MACHINING NICKEL-BASED ALLOYS

*Procedia CIRP, Volume 8, 2013, Pages 540-545*Constitutive behaviors; Finite element simulations; Inconel-718; Machining Inconel 718; Material characterizations; Material flow stress; Phenomenological models; Simulation of machining Engineering controlled terms: Computer simulation; Finite element method; Fracture; Hardness; Iron alloys; Machining; Machining centers; Metallurgy; Numerical models; Plastic flow Engineering main heading: Materials *The phenomenological models for material flow stress and fracture, typically used in the Finite Element simulations of machining Nickel-based alloys, are often deemed to represent only certain metallurgical material states. In contrast, these models are not suitable to describe the constitutive behavior of the workpiece for different metallurgical states (i.e., annealed, aged, etc.) and, consequently, different hardness values. Since the description of the material behavior requires correct formulation of the constitutive law, new flow stress models which include also the hardness effect should be developed and used, for computer simulation of machining Nickel-*

based alloys. This paper describes the development of a hardness-based flow stress and fracture models for machining Inconel 718 alloy which can be applied for a wide range of work material hardness. These models have been implemented in a non-isothermal viscoplastic numerical model to simulate the influence of work material hardness on the chip formation process. The predicted results are being validated with experimental results properly carried out for this research. They are found to satisfactory predict the cutting forces, the temperature and the chip morphology from continuous to segmented chip as the hardness values change. Copyright

Zhang, Y., Umbrello, D., Mabrouki, T., Rizzuti, S., Nelias, D., Gong, Y.ON DIFFERENT FE-BASED MODELS TO SIMULATE CUTTING OPERATION OF TITANIUM ALLOY (TI-6AL-4V)

*Mechanika, Volume 19, Issue 3, 2013, Pages 349-357*Cutting simulation; Effectiveness; FE model; Multi-physics couplings; Numerical predictions; Temperature evolution; Ti-6al-4v; Ti-6al-4v titanium alloys Engineering controlled terms: Aluminum; Computer simulation; Titanium alloys Engineering main heading: Finite element method *Finite element based models for cutting operation present outstanding complexities due to their nonlinear and multi-physics coupling. Nevertheless, there is no uniform standard for the comparison between cutting simulation models based on different software. The present work deals with various methodologies to simulate orthogonal cutting operation for Ti-6Al-4V Titanium alloy inside two commercial codes: ABAQUS and DEFORM. The aim is to show how considered optimal FE numerical approaches can imply agreements or disparities in outputs between the two pre-cited codes. In order to carry out a comparative study between the two codes, similar conditions concerning geometrical models and cutting parameters were adopted. A multi-physic comprehension related to chip formation, cutting forces, temperature evolutions, and surface integrity was presented. Moreover, the numerical results were compared with experimental ones for a deeper discussion on numerical predictions, and problems with current simulation were addressed to improve and support process innovations.*

Ambrogio, G., Gagliardi, F., Bruschi, S., Filice, L.ON THE HIGH-SPEED SINGLE POINT INCREMENTAL FORMING OF TITANIUM ALLOYS

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 1, 2013, Pages 243-246*Dimensional accuracy; High speed forming; High speed machine; Incremental sheet forming; Material quality; Single point incremental forming; Suitable solutions; Target component Engineering controlled terms: Metal forming; Microstructure; Titanium; Titanium alloys Engineering main heading: Aluminum sheet *Single Point Incremental Forming processes show some limitations related to both dimensional accuracy and process slowness. The process slowness is here overcome by introducing the high speed forming, which allows a reduction to less than 1 min of execution time of target components made in Titanium alloys. The paper is aimed at analyzing the influence of the feed increasing on the material quality in order to*

investigate if the development of high speed machines could be a suitable solution to implement more extensively the Single Point Incremental Forming technique in practice. All the results are discussed in the paper.

Filice, L., Ambrogio, G., Gaudioso, M.OPTIMISED TOOL-PATH DESIGN TO REDUCE THINNING IN INCREMENTAL SHEET FORMING PROCESS

*International Journal of Material Forming, Volume 6, Issue 1, 2013, Pages 173-178*Design phase; Ecological awareness; Effective measures; Energy efficient; Energy prices; Global efficiency; Homogeneous thickness distribution; Incremental forming; Incremental sheet forming; Manufacturing process; Market requirements; Product performance; Production process; Scientific community; Technological alternatives; Thickness distributions; Thinning; Toolpaths; User friendly Engineering controlled terms: Energy efficiency; Formability; Production engineering; Thickness control Engineering main heading: Manufacture *Rising energy prices and customers' increasing ecological awareness pushed energy efficient manufacturing to the top position in industrial interests. Actually, companies want to identify the most effective measures to increase energy efficiency in manufacturing processes looking at the sustainability of their product as a point of strength and not only as an extra-cost according to an ancient production vision. For the above considerations, the scientific community introduced in the last years newer technological alternatives to improve the global efficiency in production processes. Incremental Sheet Forming belongs to this family and can be classified as a flexible solution for the modern market requirement. Nowadays, if the points of strength of the above process are widely recognized, more efforts are still necessary to enhance the product performance allowing a wider industrial suitability. In particular, a significant problem which penalizes the quality of the manufacture parts, is the not homogeneous thickness distribution. The research here presented can be placed in this frame: a promising analytical model is highlighted and a user friendly procedure is set up to simplify the design phase with the aim to optimise the thickness distribution along the profile. Satisfactory experimental results which validate the proposed technique are also presented.*

Arrazola, P.J., Özel, T., Umbrello, D., Davies, M., Jawahir, I.S.RECENT ADVANCES IN MODELLING OF METAL MACHINING PROCESSES

*CIRP Annals - Manufacturing Technology, Volume 62, Issue 2, 2013, Pages 695-718*Chip formations; Dimensional tolerance; Industry applications; Machining operations; Machining performance; Modelling techniques; Predictive modeling; Predictive performance models Engineering controlled terms: Elasticity; Forecasting; Industrial applications; Machining; Machining centers; Models; Strain rate; Structural design Engineering main heading: Industry *During the last few decades, there has been significant progress in developing industry-driven predictive models for machining operations. This paper presents the state-of-the-art in predictive performance models for machining, and identifies the strengths and weaknesses of current*

models. This includes a critical assessment of the relevant modelling techniques and their applicability and/or limitations for the prediction of the complex machining operations performed in industry. This paper includes contributions from academia and industry, and is expected to serve as a comprehensive report of recent progress, as well as a roadmap for future directions. Process models often target the prediction of fundamental variables such as stresses, strains, strain-rates, temperatures etc. However, to be useful to industry, these variables must be correlated to performance measures: product quality (accuracy, dimensional tolerances, finish, etc.), surface and subsurface integrity, tool-wear, chip-form/breakability, burr formation, machine stability, etc. The adoption of machining models by industry critically depends on the capability of a model to make this link and predict machining performance. Therefore, this paper would identify and discuss several key research topics closely associated with predictive model development for machining operations, primarily targeting industry applications.

Ambrogio, G., Gagliardi, F., Filice, L.ROBUST DESIGN OF INCREMENTAL SHEET FORMING BY TAGUCHI'S METHOD

*Procedia CIRP, Volume 12, 2013, Pages 270-275*Experimental investigations; Homogeneous thickness distribution; Incremental forming; Incremental sheet forming; Literature reviews; Robust procedures; Taguchi's methods; Thickness distributions Engineering controlled terms: Competition; Finite element method; Industrial applications; Industrial engineering; Thickness control; Trajectories Engineering main heading: Tools *Although the competitiveness of Incremental Sheet Forming process can be recognized by the literature review, some intrinsic aspects penalize its industrial application In particular, even if the idea to take advantage from the bigger formability appears of great interest, on the other hand the not homogeneous thickness distribution reduces the industrial suitability. However, a significant improvement in the thickness distribution can be obtained by using an "artificially modified" tool trajectory. In fact, previous experimental investigations carried out by the authors showed that it is possible to influence the thinning phenomenon by applying a proper tool trajectory. The present study was executed with the aim to design a robust procedure able to highlight how to modify the tool trajectory in order to improve the thickness distribution along the profile. More in particular, the study is based on the coupled use of the numerical analysis and the Taguchi's method. All the results are widely discussed in the paper.*

Umbrello, D.THE EFFECTS OF CUTTING CONDITIONS ON SURFACE INTEGRITY IN MACHINING INCONEL 718 ALLOY

*Key Engineering Materials, Volume 554-557, 2013, Pages 2093-2100*Aerospace materials; Cutting conditions; Experimental evaluation; Grain size variation; Inconel-718; Machining Inconel 718; Nickel based alloy; Surface integrity Engineering controlled terms: Alloys; Cerium alloys; Cutting; Machining; Surface roughness; Titanium alloys Engineering main heading: Surfaces *Machining of advanced aerospace materials have grown in the recent years although*

the hard-to-machine characteristics of alloys like titanium or nickel based alloys cause higher cutting forces, rapid tool wear, and more heat generation. This paper presents an experimental evaluation of machining of Inconel 718 alloy under dry conditions at varying of cutting speeds and feed rates. The influence of the cutting conditions on surface integrity was studied in terms of surface roughness, affected layer, grain size variations and phase changes/modification. Also, the machining process performance was evaluated through the power consumption and tool-wear. Copyright