

Table of Contents

Committees

Preface

Keynotes

| | |
|---|----|
| | 0 |
| Latest Developments in Sheet Metal Forming Technologies and Materials for Automotive Application: the Use of Ultra High Strength Steels at Fiat to Reach Weight Reduction at Sustainable Costs | |
| M. Lai and R. Brun | 1 |
| Sheet Metal Forming - A New Kind of Forge for the Future | |
| M. Geiger and M. Merklein | 9 |
| Finite Element Simulation of Forming, Joining and Strength of Sheet Components | |
| J.L. Chenot, P.O. Bouchard, Y. Chastel and E. Massoni | 21 |

Materials and Testing

| | |
|--|-----|
| | 29 |
| Formability and Microstructure of AZ31 Magnesium Alloy Sheets | |
| A. Forcellese, M. El Mehtedi, M. Simoncini and S. Spigarelli | 31 |
| Experimental Procedure Definition for Evaluating the Formability at Warm Temperatures of AZ31 Magnesium Alloy | |
| G. Palumbo, D. Sorgente and L. Tricarico | 39 |
| On The Stability of Superplastic Deformation Using Nonlinear Wavelength Analysis | |
| M. Nazzal and M.K. Khraisheh | 47 |
| On the Formability of Magnesium Alloy Sheets in Warm Conditions | |
| G. Ambrogio, C. Bruni, L. Filice and F. Gabrielli | 55 |
| Evaluation of the Annealing Temperature Effect on the Mechanical Properties of a IF Steel by Means of Physical Simulation | |
| D. Cantemir and R. Valentini | 63 |
| Microstructural Characterization of Thermo-Mechanical Treated TRIP Steels | |
| A. Barcellona, L. Cannizzaro and D. Palmeri | 71 |
| Mechanical Properties and Plastic Anisotropy of the Quenchenable High Strength Steel 22MnB5 at Elevated Temperatures | |
| M. Merklein, J. Lecher, V. Gödel, S. Bruschi, A. Ghiotti and A. Turetta | 79 |
| Improvement of Fatigue Behaviour of High Strength Aluminium Alloys by Fluidized Bed Peening (FBP) | |
| M. Barletta, F. Lambiase and V. Tagliaferri | 87 |
| Determination of Yield Locus of Sheet Metal at Elevated Temperatures: A Novel Concept for Experimental Set-Up | |
| A. Ghiotti, S. Bruschi and P.F. Bariani | 97 |
| Detection of the Real Plastification in a Biaxial Tension Test | |
| W. Hussnätter | 105 |
| Influence of Pre-Forming on the Forming Limit Diagram of Aluminum and Steel Sheets | |
| M. Tolazzi and M. Merklein | 113 |
| Material Superplastic Parameters Evaluation by a Jump Pressure Blow Forming Test | |
| D. Sorgente, G. Palumbo and L. Tricarico | 119 |
| Mechanical Characterization of Metal Sheets by Means of Double Indentation | |
| F. Quadrini, L. Santo and E.A. Squeo | 127 |
| Plane Strain Test for Metal Sheet Characterization | |
| P. Flores, F. Bonnet and A.M. Habraken | 135 |
| Investigations on the Mechanical Properties and Formability of Friction Stir Welded Tailored Blanks | |
| G. Buffa, L. Fratini, M. Merklein and D. Staud | 143 |

| | |
|---|-----|
| Crash Behaviour of Various Modern Steels Exposed to High Deformation Rates T. Laumann, M. Pfestorf, A. Beil, M. Geiger and M. Merklein | 151 |
| Cutting | 159 |
| Acoustic and Optical Monitoring of High-Power CO₂ Laser Cutting J. De Keuster, J.R. Dufloy and J.P. Kruth | 161 |
| Investigation into Thermal Characteristics in Cutting of a Low Carbon Sheet Using a High-Power CW Nd:YAG Laser for Net Shape Manufacturing D.G. Ahn and H.J. Park | 169 |
| Effect of Water Jet Orifice Geometry on Jet Behaviour and Cutting Capability M. Annoni and M. Monno | 177 |
| The Influence of Cutting Methods on the Cut-Surface Quality of Titanium Sheets J. Adamus | 185 |
| Deburring of Sheet Metal by Barrel Finishing A. Boschetto, A. Ruggiero and F. Veniali | 193 |
| Numerical Modelling and Analysis of Ductile Crack Propagation in Blanking Process Using Modified Nodal Release Method B.A. Behrens and K.B. Sidhu | 201 |
| Punching Force Reduction with Wave-Formed Tools J.A. Karjalainen, K. Mäntyjärvi and M. Juuso | 209 |
| Improving the Cut Edge by Counter-Shaving H. Hoffmann and F. Hörmann | 217 |
| Development of Cooled Tools for Press Hardening of Boron Steel Sheets R. Kolleck, S. Pfanner and E.P. Warnke | 225 |
| Bending | 233 |
| Laser-Assisted Bending K. Mäntyjärvi, M. Keskitalo, J.A. Karjalainen, A. Leiviskä, J. Heikkala and J. Mäkikangas | 235 |
| Effect of Heat Treatment and Transformation on Bending Angle in Laser Forming of Titanium Foils M. Otsu, Y. Ito, A. Ishii, H. Miura and K. Takashima | 243 |
| New Forming Processes for Sheet Metal with Large Plastic Deformation P. Groche, J. Ringler and D. Vucic | 251 |
| A Comparative Method of Analysis for Evaluating Sheet Metal Machine Tool Flexibility M. Marobin | 259 |
| FEM in Plate Bending B. Grizelj, B. Barisic and M.D. Math | 269 |
| The Effect of Sheet and Material Properties on Springback in Air Bending G. D'Urso, G. Pellegrini and G. Maccarini | 277 |
| Dimensional Deviation of Roll Formed Components Made of High Strength Steel P. Groche and M. Henkelmann | 285 |
| Off-Set Roller Bending of Aluminium Space-Frame J. Endou and S. Katoh | 293 |
| Stamping | 299 |
| Geometry-Flexible Production – a Production Engineering Challenge R. Neugebauer, E. Kunke, H. Bräunlich and A. Göschel | 301 |
| Hot Stamping and Press Quenching of Ultrahigh Strength Steel Sheet Using Resistance Heating S. Maki, A. Hamamoto, S. Saito and K. Mori | 309 |
| Forming Al and Mg Alloy Sheet and Tube at Elevated Temperatures T. Altan, S. Kaya and Y. Aue-u-Ian | 317 |

| | |
|---|-----|
| An Application of Neural Network Solutions to Modeling of Diode Laser Assisted Forming Process of AA6082 Thin Sheets | |
| S. Guarino, N. Ucciardello and V. Tagliaferri | 325 |
| Application of Blank Optimization Method in Deep Drawing of Rectangular Magnesium Alloy Cups under Non-Isothermal Condition | |
| W.T. Zheng, D. Sorgente, G. Palumbo, L. Tricarico, L.M. Ren, L.X. Zhou and S.H. Zhang | 333 |
| Computer Aided Modeling of Deep-Drawing | |
| M.A. Pişkin and B. Kaftanoğlu | 341 |
| Optimisation of the Stamping Parameters of a Drawn-Part Made of Stainless Steel | |
| P. Lacki | 349 |
| Sheet Hemming with Rolling Tools: Analysis and Optimization of the Part Quality | |
| E. Ceretti, A. Aldo, A. Fiorentino and C. Giardini | 357 |
| Straight Hemming of Aluminum Sheet Panels Using the Electromagnetic Forming Technology: First Approach | |
| P. Jimbert, I. Perez, I. Eguia and G.S. Daehn | 365 |
| Mechanics of Tailor Welded Blanks: An Overview | |
| A.A. Zadpoor, J. Sinke and R. Benedictus | 373 |
| Application of Tailored Heat Treated Blanks under Quasi Series Conditions | |
| M. Merklein and U. Vogt | 383 |
| Double Curvature Springback in Stretch Formed 2024-T3 Aluminium | |
| R. McMurray, A.G. Leacock and D. Brown | 391 |
| Non Deterministic Approach in Metal Forming Springback Simulation | |
| A. Del Prete, T. Primo and A.A. De Vitis | 399 |
| Die Forming of Medical Forceps | |
| I. Aoki, S. Masahiro and T. Fuchiwaki | 411 |
| Analytic, Numerical, and Stochastic Comparison of Forming Force Modeling at Deep Drawing and Backward Extrusion on the Same Al 99.5 F7 Parts | |
| B. Barisic, M.D. Math and B. Grizelj | 419 |
| Stamping of One-Piece Automobile Steel Wheels from Tube | |
| Y. Abe, J. Watanabe and K. Mori | 427 |
| Integration of Electromagnetic Calibration into the Deep Drawing Process of an Industrial Demonstrator Part | |
| V. Psyk, C. Beerwald, A. Henselek, W. Homberg, A. Brosius and M. Kleiner | 435 |
| Case Studies and Applications of Flowforming to Aircraft Engine Component Manufacturing | |
| J. Savoie and M. Bissinger | 443 |
| Hydroforming | |
| | 451 |
| Multi Shape Sheet Hydroforming Tooling Design | |
| A. Del Prete, G. Papadia and B. Manisi | 453 |
| Improvement of Filling of Die Corners in Box-Shaped Tube Hydroforming by Control of Wrinkling | |
| M. Loh-Mousavi, K. Mori, K. Hayashi and M. Bakhshi | 461 |
| Modeling Flexforming (Fluid Cell Forming) Process with Finite Element Method | |
| H.A. Hatipoğlu, N. Polat, A. Koksall and A.E. Tekkaya | 469 |
| Integrated Tube and Double Sheet Hydroforming Technology - Optimised Process for the Production of a Complex Part | |
| M. Geiger, M. Merklein and M. Cojutti | 477 |
| Hydromechanical Deep Drawing of Funerary Vases: A Suitable Alternative to the Traditional Forming Processes | |
| P. Bortot, E. Ceretti, A. Fiorentino and C. Giardini | 485 |
| Incremental Forming | |
| | 493 |

| | |
|---|-----|
| Validation of a New Finite Element for Incremental Forming Simulation Using a Dynamic Explicit Approach | |
| C. Henrard, C. Bouffieux, L. Duchêne, J.R. Duflou and A.M. Habraken | 495 |
| Determination of Strain in Incremental Sheet Forming Process | |
| S. He, J. Gu, H. Sol, A. Van Bael, P. van Houtte, Y. Tunckol and J.R. Duflou | 503 |
| Experimental and Numerical Analysis of Forming Limits in CNC Incremental Sheet Forming | |
| M. Bambach, M. Todorova and G. Hirt | 511 |
| Strain in Shear, and Material Behaviour in Incremental Forming | |
| W.C. Emmens and T. van den Boogaard | 519 |
| Feature Based Approach for Increasing the Accuracy of the SPIF Process | |
| J. Verbert, J.R. Duflou and B. Lauwers | 527 |
| Experimental Evidences Concerning Geometrical Accuracy after Unclamping and Trimming Incrementally Formed Components | |
| G. Ambrogio, L. De Napoli, L. Filice and M. Muzzupappa | 535 |
| Force Analysis for Single Point Incremental Forming | |
| J.R. Duflou, Y. Tunckol and R. Aereus | 543 |
| Force Measurement in Pyramid Shaped Parts with a Spindle Mounted Force Sensor | |
| A. Szekeres, M. Ham and J. Jeswiet | 551 |
| Incremental Forming Process for the Accomplishment of Automotive Details | |
| A. Governale, A. Lo Franco, A. Panzeca, L. Fratini and F. Micari | 559 |
| Detailed Incremental Forming of Steel Beverage Cans by a High-Pressure Water Jet | |
| W.C. Emmens | 567 |
| Incremental Bulging of Sheet Metal Using Water Jet and Shots | |
| H. Iseki and T. Nara | 575 |
| Creating Helical Tool Paths for Single Point Incremental Forming | |
| M. Skjoedt, M.H. Hancock and N. Bay | 583 |
| Incremental Forming of Sandwich Panels | |
| K.P. Jackson, J.M. Allwood and M. Landert | 591 |
| Two Point Incremental Forming with Two Moving Forming Tools | |
| H. Meier, V. Smukala, O. Dewald and J. Zhang | 599 |
| A New Incremental Sheet Forming Process Based on a Flexible Supporting Die System | |
| E. Maidagan, J. Zettler, M. Bambach, P.P. Rodríguez and G. Hirt | 607 |
| Stable Incremental Deformation of a Strip to High Strain | |
| A. Hadoush, T. van den Boogaard and J. Huétink | 615 |
| The Increased Forming Limits of Incremental Sheet Forming Processes | |
| J.M. Allwood, D.R. Shouler and A.E. Tekkaya | 621 |
| Single Point Incremental Forming Limits Using a Boxbehnken Design of Experiment | |
| M. Ham and J. Jeswiet | 629 |
| Process Characterization of Sheet Metal Spinning by Means of Finite Elements | |
| G. Sebastiani, A. Brosius, W. Homberg and M. Kleiner | 637 |
| | |
| Joining | 645 |
| | |
| Three Dimensional Finite Element Analysis of Transverse Free Vibration of Self-Pierce Riveting Beam | |
| X.C. He, I. Pearson and K.W. Young | 647 |
| FEM Modeling of Self-Piercing Riveted Joint | |
| E. Atzeni, R. Ippolito and L. Settineri | 655 |
| Finite Element Analysis of Self-Pierce Riveted Joints | |
| X.C. He, I. Pearson and K.W. Young | 663 |
| Effect of Chemical Etching on Adhesively Bonded Aluminum AA6082 | |
| C. Borsellino, G. Di Bella and V.F. Ruisi | 669 |
| METAKLETT – A Metal Cocklebur | |
| H. Hoffmann, C. Hein, S.M. Hong and H.W. So | 677 |
| Study of New Joining Technique: Flat Clinching | |
| C. Borsellino, G. Di Bella and V.F. Ruisi | 685 |

| | |
|---|-----|
| Dieless Clinching and Dieless Rivet-Clinching of Magnesium R. Neugebauer, S. Dietrich and C. Kraus | 693 |
| Numerical Prediction of the Shape of the Molten Pool in a Stationary TIG Welding Process R. Bini and M. Monno | 699 |
| Aesthetic Diode Laser Welding of Stainless Steel F. Quadrini, L. Santo and F. Trovalusci | 707 |
| Investigation on the Residual Stress of AISI 4047 Low Alloy Steel Laser Welded G. Casalino, A.G. Olabi, N. Cipriani and A. Rotondo | 715 |
| Laser Beam Welding of New High Strength Steels for Auto Body Construction H. Haferkamp, O. Meier and K. Harley | 723 |
| The Occurrence of Humping in Welding with Highest Beam Qualities C. Thomy, T. Seefeld and F. Vollertsen | 731 |
| Experimental Analysis of AA5083 Butt Joints Welded by CO₂ Laser L. Tricarico, R. Spina, D. Sorgente, A. Ancona, T. Sibillano and G. Basile | 745 |
| Experimental Characterization of FSW T-Joints of Light Alloys L. Fratini, F. Micari, A. Squillace and G. Giorleo | 751 |
| Enhanced Numerical Results on Friction Stir Welded Aluminium Butt Joints D. Staud, A. Giera, M. Merklein and M. Geiger | 759 |
| Tool Path Design in Friction Stir Spot Welding of AA6082-T6 Aluminum Alloys G. Buffa, L. Fratini and M. Piacentini | 767 |
| | |
| Microforming | 775 |
| | |
| Experimental Study on Specimen and Grain Size Effects in Uniaxial Tension Test of Aluminum Foil J. Zhou, D.B. Shan, B. Guo and D.L. Ma | 777 |
| Nd-YAG Laser Sculpture of WC Punches for Micro-Sheet Forming C. Leone, F. Quadrini, L. Santo, V. Tagliaferri and F. Trovalusci | 783 |
| Analysis of Size-Effects in the Miniaturized Deep Drawing Process H. Justinger and G. Hirt | 791 |
| Mechanical and Laser Micro Deep Drawing H. Schulze Niehoff, Z.Y. Hu and F. Vollertsen | 799 |
| Computer Assisted Design of Actuator Systems for Laser Micro Adjustment R. Plettke, H. Hagenah and M. Geiger | 807 |
| | |
| Modelling | 815 |
| | |
| Classification of Problems Under Uncertainty, in FEM-Based Analysis and Design of Sheet Metal Forming Operations M. Strano and A. Burdi | 817 |
| Prediction on Localized Necking in Sheet Metal Forming: Finite Element Simulation and Plastic Instability in Complex Industrial Strain Paths A. Barata da Rocha, A. dos Santos and P. Teixeira | 825 |
| Numerical Simulation of Sheet Metal Forming Processes Using a New Yield Criterion D.S. Comsa and D. Banabic | 833 |
| An Intelligent Tool to Predict Fracture in Sheet Metal Forming Operations R. Di Lorenzo, G. Ingarao and F. Micari | 841 |
| Triangulation Based Digitizing of Tooling and Sheet Metal Part Surfaces - Measuring Technique, Analysis of Deviation to CAD and Remarks on Use of 3D-Coordinate Fields for the Finite Element Analysis J. Hecht, K. Lamprecht, M. Merklein, K. Galanulis and J. Steinbeck | 847 |
| A Methodology for Real Time Surface Strain Measurement for Stamping Through Non-Contact Optical Strain Measurement System S. Kalyanasundaram, P. Compston and J. Gresham | 855 |

Manufacturing Systems

863

Achieving Operational Excellence Through Systematic Complexity Reduction in Manufacturing System Design

D.T. Matt

865

An Intelligent System for Modeling and Material Selection for Progressive Die Components

S. Kumar and R. Singh

873

Automatic Process Control in Press Shops

H. Hoffmann, M.F. Zaeh, I. Faass, R. Mork, M. Golle, B. Griesbach and M. Kerschner

881

Management of Complexity in Automotive Companies in the West Midlands UK

M. Villegas and B. Shirvani

889

Assessment of Best Scheduling Practice in Continuous Casting and Hot Rolling of Stainless Steel Strip by System Dynamics Simulation

J. Storck and B. Lindberg

897

Laser Forming Oriented CAD/CAM for Developable Surfaces

B. Callebaut, J.R. Duflo and J.P. Kruth

905

Modeling Sheet Metal Integrated Production Planning for Laser Cutting and Air Bending

B. Verlinden, D. Cattrysse, J.R. Duflo and D. Van Oudheusden

913

A More Efficient Method for Clustering Sheet Metal Shapes

E. Lo Valvo and R. Licari

921

ICEM Session

929

Economical and Ecological Aspects of Single Point Incremental Forming Versus Deep Drawing Technology

A. Petek, G. Gantar, T. Pepelnjak and K. Kuzman

931

Economical and Ecological Benefits of Process-Integrated Surface Structuring

M. Thome and G. Hirt

939

Boss Forming, An Environment-Friendly Rotary Forming

K. Kawai, H. Koyama, T. Kamei and W. Kim

947

Towards the Mastering of the Free Surface Position in Roll Coating

E. Szczurek, M. Dubar, R. Deltombe, A. Dubois and L. Dubar

955