

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

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	775
Nd-YAG Laser Sculpture of WC Punches for Micro-Sheet Forming C. Leone, F. Quadrini, L. Santo, V. Tagliaferri and F. Trovalusci	777
Analysis of Size-Effects in the Miniaturized Deep Drawing Process H. Justinger and G. Hirt	783
Mechanical and Laser Micro Deep Drawing H. Schulze Niehoff, Z.Y. Hu and F. Vollertsen	791
Computer Assisted Design of Actuator Systems for Laser Micro Adjustment R. Plettke, H. Hagenah and M. Geiger	799
	807

Modelling

Classification of Problems Under Uncertainty, in FEM-Based Analysis and Design of Sheet Metal Forming Operations M. Strano and A. Burdi	815
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	817
Numerical Simulation of Sheet Metal Forming Processes Using a New Yield Criterion D.S. Comsa and D. Banabic	825
An Intelligent Tool to Predict Fracture in Sheet Metal Forming Operations R. Di Lorenzo, G. Ingarao and F. Micari	833
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	841
A Methodology for Real Time Surface Strain Measurement for Stamping Through Non-Contact Optical Strain Measurement System S. Kalyanasundaram, P. Compston and J. Gresham	847
	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. Storek and B. Lindberg

897

Laser Forming Oriented CAD/CAM for Developable Surfaces

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

905

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

B. Verlinden, D. Cattrysse, J.R. Duflou 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