VIRTUAL 2021
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STUTTGART - GERMANY

International Deep-Drawing Research Group Conference 2021

„Digital Technologies in Sheet Metal Forming “

21st June – 2nd July 2021
Virtual

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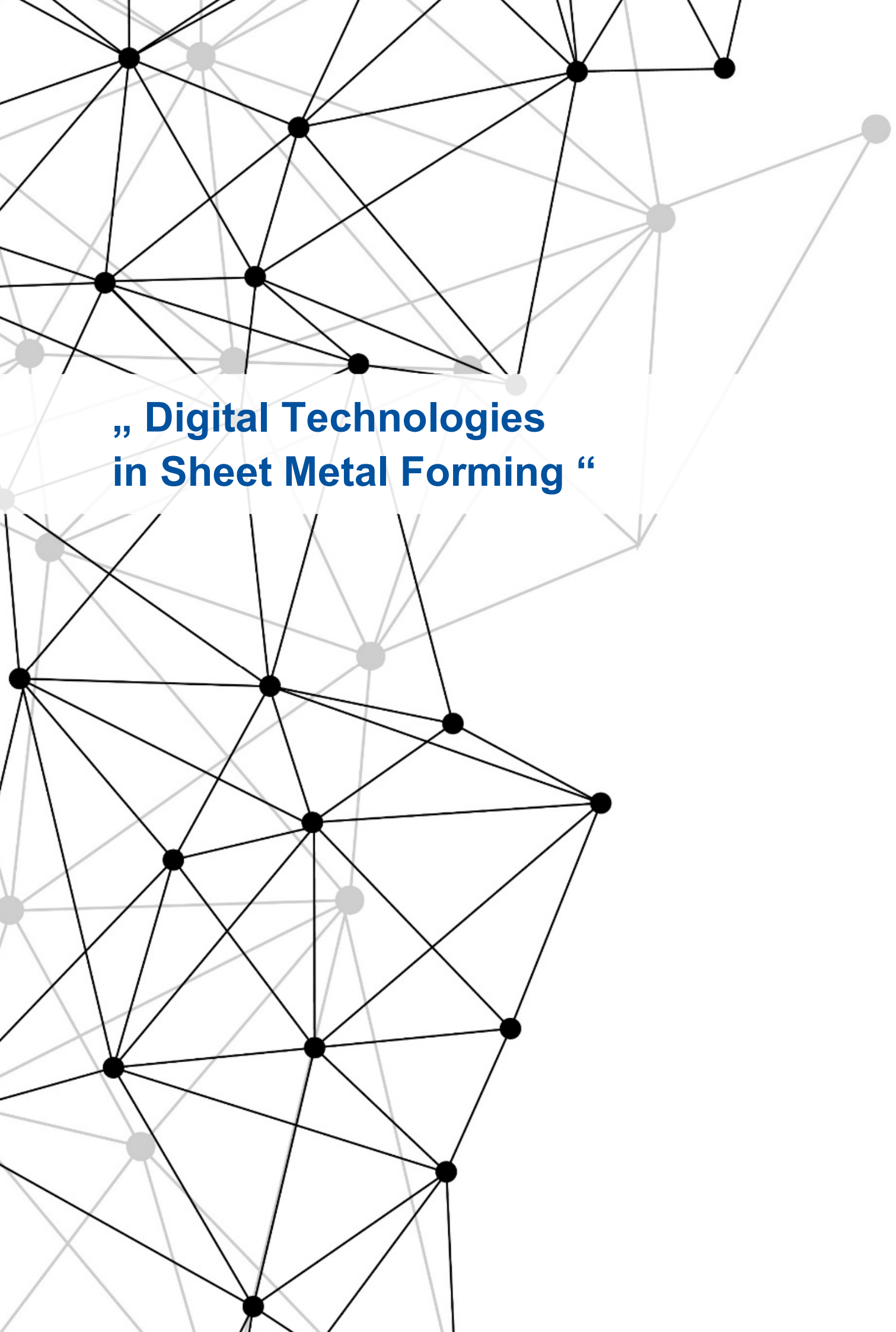

„ Digital Technologies in Sheet Metal Forming “

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Welcome Message

Univ.-Prof. Dr.-Ing. Dr. h. c. Mathias Liewald MBA

Head of Institute
Institute for Metal Forming Technology
University of Stuttgart

Chair of the IDDRG 2021 – Virtual

Dear Colleagues, Dear Friends in Sheet Metal Forming and Modelling, Dear Researchers in Deep-Drawing Technology from all over the world!

Approximately seven months ago the Executive Committee of the International Deep-Drawing Research Group (IDDRG) accepted my proposal to take over the 40th International Deep-Drawing Research Group Conference from June 21st – July 2nd 2021 in Stuttgart, Germany. I feel deeply honored for having the pleasure to invite you today to join the 40th IDDRG Conference, which is going to be held as a fully virtual event.

As we are committed to preserving the long history and the high standards of the IDDRG Conference indeed we are grateful for having the opportunity to learn from the experience gained by our Korean colleagues having organized the 39th IDDRG Conference as a virtual venue. Such new conference styles may appear a little bit different to what we are normally are used to, but we are quite optimistic to cope successfully with rising challenges in terms of keeping the tradition of direct communication, questioning and answering on contributions of participants and guests, of inspiring keynotes, breakout sessions with friends and colleagues as well as of enjoying the flair of booths prepared by suppliers, developers and other members of the community.

Please study these web pages of conference to make you familiar with the overwhelming content of conference on the one hand. On the other hand, please find also plenty of options to meet old friends, to get in touch with them and, of course, to ask your questions concerning the pre-recorded presentations being stored available on the conference platform. You too do have the opportunity to stroll along the virtual booths of exhibitors or to click on the ads of our sponsors. Special thanks to our sponsors, though your donation allows us to realize this conference to this extent.

Please enjoy the conference IDDRG 2021 – Virtual, the huge variety of contributions and make best use of the technical options provided. Seeing you, hearing from you on June 28th on our first live session!

Sincerely

Mathias Liewald

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About the Conference

The annually organized IDDRG conference belongs to the most important venues being attended by the world's leading research and production specialists in the field of sheet metal processing. Members of this community from all over the world regularly meet for fruitful discussions combined with short presentations about new and challenging technical topics in sheet metal forming technology. The 40th International Deep-Drawing Research Group Conference 2021 will be held from June 21st to July 2nd 2021 as a virtual event due to the COVID-19 pandemic and is organized by the Institute for Metal Forming Technology at the University of Stuttgart in Germany.

The IDDRG 2021 - Virtual focuses on the general conference topic entitled "Digital Technologies in Sheet Metal Forming". Main aim of the 2nd conference week respectively is to bring together industry and academia in a well-managed online event though current pandemic conditions don´t allow physical meetings of individuals. During the course of conference, being subdivided into 10 mini symposia, an enlarged scope of technical aspects from the field of sheet metal forming is covered: behavior of sheet materials in manufacturing, formability of sheet metals, forming tools, tribology, advanced joining technologies, robustness of manufacturing processes and new simulation methods and experiments. The Conference also provides 10 keynotes to its participants being linked with mentioned 10 mini symposia, which are led by internationally renowned experts.

Committee of the IDDRG 2021

Organizing Committee

Univ.-Prof. Dr.-Ing. Dr. h. c. Mathias Liewald MBA, Chair
University of Stuttgart

Dr. sc. techn. Celalettin Karadogan, Co-Chair
University of Stuttgart

Maxim Beck, M. Sc., Organizing Office
University of Stuttgart

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Tisza, M. (Hungary)
Uthaisangsuk, V. (Thailand)
van den Boogaard, A.H. (Netherlands)
van Tyne, C. (USA)
Volk, W. (Germany)
Wagner, L. (Austria)
Worswick, M. (Canada)
Yoon, JW (Korea/Australia)
Yoshida, F. (Japan)
Yoshida, Y. (Japan)
Zhang, S.H. (China)

Program Schedule

June 21st – July 2nd, 2021

1st Conference Week
June 21st – June 27th, 2021
Mini-Symposia with pre-recorded on-demand presentations available **24/7** 132 presentations in 10 Mini-Symposia

2nd Conference Week
June 28th – July 2nd, 2021
Mini-Symposia with pre-recorded on-demand presentations available **24/7** 132 presentations in 10 Mini-Symposia
Live-Sessions Keynote presentations & Subsequent discussions linked with the keynotes and mini-symposia Live-Sessions will be shown as a live-stream on the conference platform during given time slots below. *Please note: All times are indicated in CEST (Central European Summer Time)*

Monday, **June 28th**	11:00 - 11:20	Opening of the Conference
	11:20 - 12:05	"Challenges of mechanical joining technologies in versatile process chains" By Prof. Dr.-Ing. Gerson Meschut MS 01: Flexible Processes in mechanical joining
	12:05 - 12:40	Panel discussion MS 01
	12:40 - 12:50	Short Break
	12:50 - 13:25	"Hot forming of high-strength steel components - From scientific fundamentals to industrial applications" By Prof. Dr.-Ing. Marion Merklein MS 02: Press hardening, manufacturing issues
	13:25 - 14:00	Panel discussion MS 02
	14:00 - 14:10	Conclusion & outlook

Tuesday **June 29th**	11:00 - 11:10	Opening of the Live-Session
	11:10 - 11:55	"The liaison of constitutive models with structural shell models: A fruitful but limited symbiosis" By Prof. Dr.-Ing. André Haufe MS 03: Enhanced simulation using thick shells and elastic tools
	11:55 - 12:30	Panel discussion MS 03
	12:30 - 12:40	Short Break
	12:40 - 13:15	"Fundamental strategies of compensation for deviations in sheet metal forming" By Prof. Dr.-Ing. Wolfram Volk MS 04: Springback simulation and compensation
	13:15 - 13:50	Panel discussion MS 04
	13:50 - 14:00	Conclusion & outlook

Wednesday, June 30th	11:00 - 11:10	Opening of the Live-Session
	11:10 – 11:45	Panel discussion MS 05: Damage, forming limits and sheared edge formability Please make sure you have seen the lecture given by Professor Dorel Banabic on "An overview on forming limit curves determination" **ID 100**
	11:45 – 12:20	"Advanced Sheet Forming and Yield Surface Simulations under Consideration of Microstructure, Texture and Damage using DAMASK" By Prof. Dr.-Ing. habil. Dierk Raabe MS 06: Digital techniques in material characterization / Material models, full and small scale testing
	12:20 – 12:55	Panel discussion MS 06
	12:55 – 13:05	Short Break
	13:05 – 13:35	"Experimental and numerical challenges towards machine-learning plasticity models" By Prof. Dr. Dirk Mohr MS 06: Digital techniques in material characterization / Material models, full and small scale testing
	13:35 – 14:10	Panel discussion MS 06
	14:10 – 14:20	Conclusion & outlook

Thursday July 1st	11:00 - 11:10	Opening of the Live-Session
	11:10 - 11:40	"Benefits of smart sensors and actuators in sheet metal forming" By Prof. Dr.-Ing. Dipl.-Wirtsch.-Ing. Peter Groche MS 07: Digitalization in tooling and intelligent tools
	11:40 - 12:15	Panel discussion MS 07
	12:15 - 12:25	Short Break
	12:25 - 13:10	"The use of big data and advanced analytics in sheet metal production and forming" By Ir. Nico Langerak MS 08: Smart production technologies and machine learning
	13:10 - 13:45	Panel discussion MS 08
	13:45 – 13:55	Conclusion & outlook

Friday **July 2nd**	11:00 - 11:10	Opening of the Live-Session
	11:10 - 11:50	"Challenges and application fields in the digital process control of sheet metal forming processes" Prof. Dr. Pavel Hora MS 09: Robust process design and adaptive control
	11:50 - 12:25	Panel discussion MS 09
	12:25 - 12:35	Short Break
	12:35 - 13:00	"Seamless Digitalization of BIW and Stamping Processes" Dr. Bart Carleer MS 10: Prediction and control of product and assembly properties
	13:00 - 13:35	Panel discussion MS 10
	13:35 - 14:00	Conclusion & closing of the conference

Keynotes

“Challenges of mechanical joining technologies in versatile process chains”

Prof. Dr.-Ing. Gerson Meschut
Head Institute - Institute for Lightweight Design with Hybrid Systems
Paderborn University, Germany

“Hot forming of high-strength steel components - From scientific fundamentals to industrial applications”

Prof. Dr.-Ing. habil. Marion Merklein
Chair of Manufacturing Technology
Friedrich-Alexander Universität Erlangen-Nürnberg, Germany

“The liaison of constitutive models with structural shell models: A fruitful but limited symbiosis”

Prof. Dr.-Ing. André Haufe
Head of Process Simulation
DYNAmore GmbH, Germany

“Fundamental strategies of compensation for deviations in sheet metal forming”

Prof. Dr.-Ing. Wolfram Volk
Chair of Metal Forming and Casting
TU Munich, Germany

Lecture: “An overview on forming limit curves”

Prof. Dr.-Ing. Dorel Banabic
Director of the Graduate School on Engineering and Management
Director of the Research Center in Sheet Metal Forming
Technical University from Cluj-Napoca, Romania

“Advanced Sheet Forming and Yield Surface Simulations under Consideration of Microstructure, Texture and Damage using DAMASK”

Prof. Dr.-Ing. habil. Dierk Raabe
Director of the Department Microstructure Physics and Alloy Design
Max-Planck-Institut für Eisenforschung GmbH, Germany

“Experimental and numerical challenges towards machine-learning plasticity models”

Prof. Dr. Dirk Mohr
Chair of Computational Modeling of Materials in Manufacturing
ETH Zurich, Switzerland

“Benefits of smart sensors and actuators in sheet metal forming”

Prof. Dr.-Ing. Dipl.-Wirtsch.-Ing. Peter Groche
Director of the Institute for Production Engineering and Forming Machines
TU Darmstadt, Germany

“The use of big data and advanced analytics in sheet metal production and forming”

Ir. Nico Langerak
Department Manager Applications & Engineering
Tata Steel Europe, The Netherlands

"Challenges and application fields in the digital process control of sheet metal forming processes"

Prof. Dr. Pavel Hora
Institute of Virtual Manufacturing
ETH Zürich, Switzerland

“Seamless Digitalization of BIW and Stamping Processes”

Dr. Bart Carleer
Corporate Technical Director
AutoForm Engineering, Germany

Mini-Symposia

01 Flexible processes in mechanical joining
Organized by Prof. Dr.-Ing. Marion Merklein
Organized by Prof. Dr.-Ing. Alexander Brosius
Organized by Prof. Dr.-Ing. Gerson Meschut

02 Press hardening, manufacturing issues
Organized by Prof. Dr.-Ing. habil. Verena Kräusel

03 Enhanced simulation using thick shells and elastic tools
Organized by Prof. Dr.-Ing. André Haufe

04 Springback simulation and compensation
Organized by Prof. Dr.-Ing. Wolfram Volk

05 Damage, forming limits and sheared edge formability
Organized by Dr.-Ing. Rickmer Meya

06 Digital techniques in material characterization / Material models, full and small scale testing
Organized by the Institute for Metal Forming Technology, University of Stuttgart

07 Digitalization in tooling and intelligent tools
Organized by Prof. Dr.-Ing. Dipl.-Wirtsch.-Ing. Peter Groche

08 Smart production technologies and machine learning
Organized by the Institute for Metal Forming Technology, University of Stuttgart

09 Robust process design and adaptive control
Organized by Prof. Dr. Pavel Hora
Organized by Dr. Eisso Atzema

10 Prediction and control of product and assembly properties
Organized by the Institute for Metal Forming Technology, University of Stuttgart

MS 01 Flexible processes in mechanical joining

Organized by Prof. Dr.-Ing. Marion Merklein
Organized by Prof. Dr.-Ing. Alexander Brosius
Organized by Prof. Dr.-Ing. Gerson Meschut

ID 110 **Towards an adaptable quality monitoring process for self-piercing riveting**

V. Noller[1], U. Walther[1], G. Meschut[2] and T. Bäck[3]

[1]*Mercedes-Benz AG, Germany*
[2]*University of Paderborn, Germany*
[3]*Leiden University, Singapore*

ID 115 **Experimental analysis of the influence of the embossing and upsetting process on joint strength in resistance element welding with upset auxiliary joining elements**

M. Meinhardt[1], M. Lechner[2] and M. Merklein[2]

[1]*BMW AG, München, Germany*
[2]*Lehrstuhl für Fertigungstechnologie, Friedrich-Alexander- Universität Erlangen-Nürnberg, Erlangen, Germany*

ID 118* **Mechanical joining technologies – An insight into further development of established joining technologies**

D. Henke[1]

[1]*Böllhoff Verbindungstechnik GmbH, Germany*

ID 137 **Numerical and experimental investigation of the transmission moment of clinching points**

C. Steinfelder[1], J. Kalich[2], A. Brosius[1] and U. Füssel[2]

[1]*Chair of Forming and Machining Processes, Technische Universität Dresden, Germany*
[2]*Chair of Joining Technology and Assembly, Technische Universität Dresden, Germany*

ID 151 **Inverse parameter identification of an anisotropic plasticity model for sheet metal**

J. Friedlein[1], S. Wituschek[2], M. Lechner[2], J. Mergheim[1] and P. Steinmann[1]

[1]*Institute of Applied Mechanics, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany*
[2]*Institute of Manufacturing Technology, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany*

ID 161 **Joining suitability of cast aluminium for self-piercing riveting**

M. Neuser[1], F. Kappe[2], M. Busch[3], O. Grydin[1], M. Bobbert[2], M. Schaper[1], G. Meschut[2] and T. Hausotte[3]

[1]*Department of Material Science, Paderborn University, Germany*
[2]*Laboratory for material and joining technology, Paderborn University, Germany*
[3]*Institute of Manufacturing Metrology, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany*

ID 168* **On the uncertainty in mechanical joining**

I. Lepenies[1] and A. Saharnean[1]

[1]*SCALE GmbH, Dresden, Germany*

ID 169 **Safe mechanical joining processes by digital manufacturing supervision in steel coil productions**

H.C. Schmale[1] and T. Geddert[2]

[1]*Salzgitter Mannesmann Forschung GmbH, Salzgitter, Germany*
[2]*Salzgitter Flachstahl GmbH, Salzgitter, Germany*

ID 184 **Joining with Friction Spun Joint Connectors – Manufacturing and Analysis**

C. Wischer[1], C. Steinfelder[2], W. Homberg[1] and A. Brosius[2]

[1]*Chair of Forming and Machining Technology, Paderborn University, Germany*
[2]*Chair of Forming and Machining Processes, Technische Universität Dresden, Germany*

ID 239* **Numerical simulation of aluminum ski hemming process**

O. Filali[1], P.-Y. Manach[1] and S. Thuillier[1]

[1]*Université Bretagne Sud, France*

ID 258* **Feasibility study on electro-hydraulic clinching of carbon fiber composites and aluminum alloy sheets**

H. Ghorbanimenghari[1] and J.H. Kim[1]

[1]*Pusan National University, Republic of Korea*

*Presentation Only Contributions

MS 02 Press hardening, manufacturing issues

Organized by Prof. Dr.-Ing. habil. Verena Kräusel

ID 108 **The influence of coating porosity on friction and wear during hot stamping of AlSi coated ultra-high strength steel**

J. Venema[1] and P. Beentjes[1]

[1]*Tata Steel R&D, The Netherlands*

ID 114 **Investigation of the impact of heat treatment on the layer formation of AlSi-coated boron-manganese steel**

F. He[1] and M. Merklein[1]

[1]*Institute of Manufacturing Technology, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany*

ID 117 **A Thermography-based Online Control Method for Press Hardening**

E. Garcia-Llamas[1], J. Pujante[1], P. Torres[2] and F. Bonada[2]

[1]*Eurecat, Centre Tecnològic de Catalunya, Unit of Metallic and Ceramic Materials, Spain*
[2]*Eurecat, Centre Tecnològic de Catalunya, Smart Management Systems, Spain*

ID 121 **Bending behavior of a hot stamped complex phase steel with tailored properties by local carburization**

A. Horn[1] and M. Merklein[1]

[1]*Institute of Manufacturing Technology, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany*

ID 123* **Presshardening of Aluminium – the innovative HDF-Technology**

J. Hirsch[1,2] and P. Amborn[1]

[1]*Hodforming GmbH, Königswinter, Germany*
[2]*Aluminium Consulting Königswinter, Germany*

ID 126 **Constitutive characterization of an 1800 MPa press hardening steel under hot stamping conditions**

S. Lu[1], S. DiCecco[1], M. Worswick[1], C. Chiriac[2], G. Luckey[2], J. Tjong[3], J. Boettger[4] and C. Shi[5]

[1]*University of Waterloo, Waterloo, Ontario Canada*
[2]*Ford Motor Company, Dearborn, Michigan, USA*
[3]*Ford Motor Company, Windsor, Ontario, Canada*
[4]*Magna International, Troy, Michigan USA*
[5]*Promatek Research Centre, Brampton, Ontario, Canada*

ID 141 **Parameter study on press hardened components with tailored properties**

M. Nestler[1], J. Schönherr[1], R. Haase[1], A. Albert[1], A. Stoll[1] and V. Kräusel[1]

[1]*Fraunhofer Institute for Machine Tools and Forming Technology, Chemnitz, Germany*

ID 142 **Effect of heat treatment conditions on the fatigue resistance of press hardened 22MnB5 steel evaluated through rapid testing technique**

S. Parareda[1], D. Casellas[1,2], D. Frómeta[1], E. Garcia-Llamas[1], A. Lara[1], J. Pujante[1] and A. Mateo[3]

[1]*Eurecat, Centre Tecnològic de Catalunya, Unit of Metallic and Cearmic Materials Spain*
[2]*Luleå University of Technology, Division of Mechanics of Solid Materials Sweden*
[3]*Universitat Politècnica de Catalunya, Spain*

ID 155 **MBW 1200 – Hot Stamping Steel with Increased Ductility**

D. Rosenstock[1], J. Banik[1], R.P. Röttger[2], S. Graff[1] and T. Gerber[1]

[1]*thyssenkrupp Steel Europe AG, Dortmund, Germany*
[2]*thyssenkrupp Steel Europe AG, Duisburg, Germany*

ID 156* **Thermographic Process Monitoring in press hardening and the digitalization into an INDUSTRY 4.0 data management system**

S. Sturm[1]

[1]*InfraTec GmbH, Germany*

ID 157 **Investigation of Material Softening and Increase of Deep Drawing Capacity of 22MnB5 during Press Hardening using CRP Technology**

P. Birnbaum[1], Y. Xu[2], X. Zhuang[2], Z. Zhao[2] and V. Kraeusel[1]

[1]*Chemnitz University of Technology, Chemnitz, Germany*
[2]*Shanghai Jiao Tong University, Shanghai, China*

ID 1158 **Friction Characterization of Al-Si Coated Ultra-High Strength Steel under Hot Stamping Conditions**

R. He[1], S. DiCecco[1], R. George[1], M. Worswick[1], C. Chiriac[2], G. Luckey[2], J. Tjong[3], C. Shi[4] and J. Boettger[5]

[1] *University of Waterloo, Canada,*
[2] *Ford Motor Company, USA,*
[3] *Ford Canada, Canada;*
[4] *Magna International, USA*
[5] *Promatek Research Centre, Canada*

ID 1160 **Effect of heating temperatures on AlSi coating microstructure and fracture during hot-tensile tests**

S. B. Zaman[1], J. Hazrati[1], M. Rooij[2] and T. Boogaard[1]

[1]*Nonlinear Solid Mechanics, Faculty of Engineering Technology, University of Twente, Enschede, The Netherlands*
[2]*Surface Technology & Tribology, Faculty of Engineering Technology, University of Twente, Enschede, The Netherlands*

ID 189 **Advanced Data Acquisition for Hot Stamping and its Application**

C. Rouet[1] and G. Trattnig[1]

[1]*voestalpine Stahl GmbH, Linz, Austria*

ID 190 **Application of an Advanced Friction Model in Hot Stamping Simulations: A Numerical and Experimental Investigation of an A-Pillar Reinforcement Panel from Volvo Cars**

A. Güner[1], J. Hol[2], J. Venema[3], M. Sigvant[4], F. Dobrowolski[5], A. Komodromos[5] and A. E. Tekkaya[5]

[1]*AutoForm Engineering Deutschland, Dortmund, Germany*
[2]*TriboForm Engineering B.V., Enschede, The Netherlands*
[3]*Tata Steel, Research & Development, Ijmuiden, The Netherlands*
[4] *Volvo Cars, Olofstrom, Sweden*
[5] *Institute for Forming Technology and Lightweight Components, TU Dortmund University, Germany*

ID 195 **Increasing the energy absorption of monolithic manganese boron steels in oxygen-free environment**

B.-A. Behrens[1], S. Hübner[1], U. Holländer[2], A. Langohr[2], C. Pfeffer[1] and L. Albracht[1]

[1]*Institute of Forming Technology and Machines, Garbsen, Germany*
[2]*Institute of Materials Science, Garbsen, Germany*

ID 203 **Effect of strain rate on formability of 22MnB5 steel during hot stamping process**

A.K. Singh[1] and K. Narasimhan[1]

[1]*IIT Bombay, India*

ID 224 **Numerical investigation of introduction of HFQ® process manufacturing of A-pillar part**

Z. Lukacs[1]

[1]*University of Miskolc, Miskolc, Hungary*

ID 238 **Die material properties needed for Hot Stamping of High Strength Sheet Materials**

S. Sivertsen, R. Oliver

Uddeholms AB, Hagfors, Sweden

ID 256* **Effect of multi-step heat treatment on Al-Si coating of hot-formed steel**

A. Bondar[1], H. Daoud[1], U. Glatzel[1,2]

[1]*Neue Materialien Bayreuth GmbH, Bayreuth, Germany*
[2]*University of Bayreuth, Bayreuth, Bayreuth, Germany*

ID 259* **A Study on Heat Control Technology of Transfer Stage in Hot Stamping Process for Improving Formability of Hot-Stamped Parts**

J.M. Park[1], J.Y. Kong[1], S.C. Yoon[1], K.J. Park[1], J.S. Hyun[1]

[1]*Hyundai Steel, South Korea*

*Presentation Only Contributions

MS 03 Enhanced simulation using thick shells and elastic tools

Organized by Prof. Dr.-Ing. André Haufe

ID 102 **Implementation of Real Contact Areas into Deep Drawing Simulations using Digital Spotting Images**

P. Essig[1], M. Liewald[2] and J. Hol[3]

[1]*Mercedes-Benz AG, Sindelfingen, Germany*
[2]*Institute for Metal Forming Technology, University of Stuttgart, Germany*
[3]*TriboForm Engineering, Enschede, The Netherlands*

ID 129 **A new machine learning based method for sampling virtual experiments and its effect on the parameter identification for anisotropic yield models**

A. Wessel[1,2], L. Morand[1], A. Butz[1], D. Helm[1] and W. Volk[2]

[1]*Fraunhofer Institute for Mechanics of Materials, Freiburg, Germany*
[2]*Chair of Metal Forming and Casting, Technical University of Munich, Germany*

ID 171 **On appropriate Finite Element discretization in simulation of gas-based hot sheet metal forming processes**

N.K. Baru[1], T. Teeuwen[1], M. Teller[1], S. Hojda[1], A. Braun[1] and G. Hirt[1]

[1]*Institute of Metal Forming, RWTH Aachen University, Germany*

ID 191* **Roll forming simulation using higher order NURBS-based Finite Elements in LS-DYNA**

S. Hartmann[1] and P. Glay[2]

[1]*DYNAmore GmbH, Stuttgart, Germany*
[2]*DYNAmore France SAS, France*

ID 211 **Virtual die spotting: Advanced setup for coupling of forming and structure simulation**

F. Zgoll[1], T. Götze[1] and W. Volk[2]

[1]*Production Technology Development, Volkswagen AG, Wolfsburg, Germany*
[2]*Chair of Metal Forming and Casting, Technical University of Munich, Germany*

ID 227* **Advanced 3D-Shell Elements for Sheet Metal Forming Simulation**

T. Willmann[1] and M. Bischoff[1]

[1]*Institute for Structural Mechanics, University of Stuttgart, Germany*

ID 229* **A novel substitutive press model for tool cambering prediction using sheet metal forming simulation**

F. Abbasi[1], E. Saenz de Argandoña[1], A. Sarasua[2] and L. Galdos[1]

[1]*Mondragon Unibertsitatea, Spain*
[2]*Matrici SCoop, Spain*

ID 241* **Simulation process for Tool Design of Heat Exchanger Parts**

A. Gehring[1] and A. Dolderer[1]

[1]*MAHLE International GmbH, Stuttgart, Germany*

ID 242 **Towards forming simulations by means of reduced integration-based solid-shell elements considering gradient-extended damage**

O. Barfusz[1], T. van der Velden[1], T. Brepols[1] and S. Reese[1]

[1]*Institute of Applied Mechanics, RWTH Aachen University, Germany*

*Presentation Only Contributions

MS 04 Springback simulation and compensation

Organized by Prof. Dr.-Ing. Wolfram Volk

ID 103 **New sheet metal forming process for springback reduction by continuous stress superposition**

D. Briesenick[1], M. Liewald[1] and K. R. Riedmüller[1]

[1]*Institute for Metal Forming Technology, University of Stuttgart, Germany*

ID 105 **Reduction of Young's modulus for a wide range of steel sheet materials and its effect during springback simulation**

L. Wagner[1], M. Wallner[2], P. Larour[1], K. Steineder[1] and R. Schneider[2]

[1]*voestalpine Stahl GmbH, R&D Forming Technologies, Linz, Austria*
[2]*University of Applied Sciences Upper Austria - Campus Wels, Austria*

ID 120 **Development of a springback prediction for a hybrid laminate with sensor functionality**

A. Graf[1], V. Kräusel[1], A.V. Rodio[2] and A. Lanzotti[2]

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[2]*University of Naples Federico II, Department of Industrial Engineering, Italy*

ID 130 **Enhancement of springback prediction of AHSS parts by advanced friction modelling**

U. Durmaz[1], S. Heibel[1], T. Schweiker[1], M. Merklein[2], S. Berahmani[3], J. Hol[3] and P. Nägele[4]

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[4]*AutoForm Engineering Deutschland GmbH, Esslingen am Neckar, Germany*

ID 135 **Springback Behaviour due to Die Deflection during Bending**

H. Tsutamori[1], Y. Nakamoto[1] and T. Nishiwaki[1]

[1]*Department of Mechanical Engineering, Daido University, Japan*

ID 138 **Parameterized data handling for forming tool tryout: reverse engineering, data consolidation and springback compensation**

L. Maier[1], C. Hartmann[1] and W. Volk[1]

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ID 146 **Effect of blank-holder force on springback of ultra-thin copper sheets**

N. Ayachi[1,2], N. Guermazi[2] and P.-Y. Manach[1]

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[2]*LGME, ENI Sfax, Tunisia*

ID 153 **Compensating the springback of ultra-high-strength steel parts by specific stress superposition during sheet metal forming**

R. Radonjic[1] and M. Liewald[1]

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ID 197 **Adapted part design methods for springback minimization of stamped sheet metal car body components**

A. Birkert[1], F. Dreiseitel[1], B. Hartmann[2], T. Held[1], O. Hetterle[1], M. Markin[1] and M. Scholle[1]

[1]*Heilbronn University of Applied Sciences, Germany*
[2]*Inigence GmbH, Bretzfeld, Germany*

ID 200 **Dimensionally accurate parts made of high-strength steels - compressive stress superimposition instead of tool compensation**

M. Linnepe[1], P. Sieczkarek[1], M. Kibben[1] and F. Botz[1]

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ID 217 **Structural springback analysis of car body closure assemblies using finite element process chain simulations**

F. Schuler[1] and M. Liewald[1]

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ID 225 **A Numerical Study on Chain-Die Forming of the aluminium profiles with variable cross-section**

K. Lu[1], Z. Liang[1], Y. Liu[1], T. Zou, D. Li[1] and S. Ding[2]

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[2]*School of Mechanical and Mining Engineering, The University of Queensland, St Lucia, Brisbane, Australia*

ID 232 **Experimental and numerical study of springback effect of advanced high strength steel in a V-shape bending**

W. Julsri[1], A. Sanrutsadakorn[1] and V. Uthaisangsuk[2]

[1]*Department of Industrial Engineering, Faculty of Industry and Technology, Rajamangala University of Technology Isan, Thailand*
[2]*Centre for Lightweight Materials, Design and Manufacturing, King Mongkut's University of Technology Thonburi, Thailand*

ID 247 **Study on the influence of the strain rate sensitivity on the springback of the AA5086 alloy under warm forming conditions**

D.M. Neto[1], M.C. Oliveira[1], J.L. Alves[2] and L.F. Menezes[1]

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ID 266* **Finite element simulation of springback using homogeneous anisotropic hardening model with coupled quadratic-nonquadratic yield function**

H. Choi[1], S.W. Nam[2], E.H. Lee[3] and J.W. Yoon[1,4]

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ID 268* Effect of Description of Elastic-Plastic Transition on Springback Prediction

F. Yoshida[1]

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*Presentation Only Contributions

MS 05 Damage, forming limits and sheared edge formability

Organized by Dr.-Ing. Rickmer Meya

ID 100 **Lecture: “An overview on forming limit curves“**

D. Banabic[1]

[1]*Technical University of Cluj Napoca, Romania*

ID 106 **A critical assessment of notched tensile tests for formability mapping of AHSS sheets**

L. Wagner[1], P. Larour[1], F. Sonnleitner[1,2], A. Felbinger[1,2] and J. Angeli[1,2]

[1]*voestalpine Stahl GmbH, Linz, Austria*
[2]*University of Applied Sciences Upper Austria - Campus Wels, Austria*

ID 109 **Alternative characterization method for the failure behaviour of sheet metals derived from Nakajima test**

D. Kohl[1] and M. Merklein[1]

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ID 111 **The Effects of Piercing Methods on Burring Formability under Practical Hole Diameter**

R. Urushibata[1] and Y. Ito[1]

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ID 116 **Comparison of different forming methods on deep drawing and springback behavior of high-strength aluminum alloys**

N. Rigas[1], H. Schmid[1] and M. Merklein

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ID 119 **Study on the impact of temperature on the warm bending of aluminium alloy sheet**

A. Mauduit [1] and A. Maillard [2]

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[2]*CETIM Senlis, France*

ID 122 **Influence of pass reduction in cold rolling on damage evolution in deep drawing of rotationally symmetric cups**

M. Nick[1], C. Liebsch[2], M. Müller[1], I.F. Weiser[1], G. Hirt[2] and T. Bergs[1,3]

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[3]*Fraunhofer Institute for Production Technology IPT, Aachen, Germany*

ID 128 **Effect of various shearing shape conditions for the scrap-used coining method on tensile residual stress on sheared edge**

Y. Honda[1], T. Yasutomi[1] and M. Yamagata[1]

[1]*Nippon Steel Corporation, Japan*

ID 139 **A new Device for Determination of Forming-Limit-Curves under Hot-Forming Conditions**

M. Triebus[1], J. Gierse[1], T. Marten[1] and T. Tröster[1]

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ID 144 **Cryogenic deep drawing of aluminum alloy AA6014 using macro-structured tools**

M. Tulke[1], A. Wolf[1], and A. Brosius[1]

[1]*Chair of Forming and Machining Processes, Technische Universität Dresden, Germany*

ID 170 **Local formability assessment of AHSS steels with shear cut tensile tests**

P. Larour[1], J. Freudenthaler[1], H. Pauli[1], M. Kerschbaum[1], L. Wagner[1], A. Felbinger[1,2], F. Sonnleitner[1,2] and J. Angeli[1,2]

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ID 176 **On the mechanics of edge cracking and the reliable determination of edge formability limits**

N. Manopulo[1], A. R. Chezan[2], E. Atzema[2], I. Picas Anfruns[2], B. Carleer[3], J. Pilthammar[4,5] and M. Sigvant[4,5]

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[3]*AutoForm Engineering Deutschland GmbH, Dortmund, Germany*
[4]*Volvo Cars, Olofström, Sweden*
[5]*Blekinge Institute of Technology, Sweden*

ID 183 **Influence of synthetically generated inclusions on the stress accumulation and concentration in X65 pipeline steel**

N. Fehlemann[1], Y. Sparrer[1], F. Pütz[1], M. Könemann[1] and S. Münstermann[1]

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ID 185* **Experimental study on the deep-drawability of thermoplastic fibre metal laminates made of steel and glass fibre reinforced polyamide**

W. Hua[1], M. Harhash[1], H. Palkowski[1]

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ID 205 **Equivalence between Localization Criterion and Fracture Criterion as Forming Limit in Failure Evaluation for 7xxx Series Aluminum Alloy Sheets**

J. H. Hong[1] and D. Kim[1]

[1]*Materials Deformation Department, Korea Institute of Materials Science, South Korea*

ID 207 **Simplified measurement of the strain to fracture for plane strain tension; On the use of 2D DIC for dual hole plane strain tension mini Nakajima specimens with dihedral punch**

M. Adlafi[1,2], B. Galpin[1,2], L. Mahéo[1,2], C. Roth[3], D. Mohr[3] and V. Grolleau[1,3]

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[2]*Ecoles Saint-Cyr Coetquidan, Guer, France*
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ID 208* **Investigation of GISSMO failure model with different specimens by numerical modelling and fracture analysis**

E. Tamer[1], G. Ozgultekin[1] and B. Gürsoy[2]

[1]*Borcelik Celik Sanayi, Bursa, Turkey*
[2]*Bias Mühendislik, Turkey*

ID 209 **Comparison of different testing approaches to describe the fracture behaviour of AHSS sheets using experimental and numerical investigations**

B.-A. Behrens[1], D. Rosenbusch[1], H. Wester[1] and M. Dykiert[1]

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ID 214* **Effects of Pre-Existing Hydrogen to Stress Triaxiality and Damage Evolution on Ultra High Strength Steel**

H.-J. Kim[1,2], M.-G, Lee[2], K.-J. Kim[1], S.-C. Yoon[1], J.-S. Hyun[1]

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ID 220 **A new specimen for investigating shear fracture strain**

V. Gál[1] and Z. Lukács[1]

[1]*Institute of Materials Science and Technology, University of Miskolc, Hungary*

ID 236 **Experimental research of formability limits in different thicknesses of polycarbonate sheets**

A. Rosa-Sainz[1], JP Magrinho[2], M.B. Silva[3], G. Centeno[1], A.J. Martínez-Donaire[1] and C. Vallellano[1]

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ID 257* **Characterization into the edge pre-damage within shear effect zone of punched sheet**

L. Qian[1], M. Li[1], C. Sun[1] and T. Ma[1]

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ID 261* **Effect of damage evolution on edge crack sensitivity in dual-phase steels**

N. Habibi[1], T. Beier[2], H. Richter[2] and S. Münstermann[1]

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[2]*Thyssenkrupp Steel Europe AG, Duisburg, Germany*

ID 264* **Mechanical and microstructure analysis of solution heat treated Al-Zn-Mg-Cu (7075) alloy sheet**

C. Moon[1], S. Thuillier[2], J. Lee[3], M.-G. Lee[1]

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ID 265* **Quantification and correlation of the microstructural heterogeneity and stretch-flangeability of high-strength dual-phase and complex-phase steels**

Y. Chang[1], M. Lin[1], J. Lian[2], U. Hangen[3] and W. Bleck[1]

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ID 270* **Scatter of material properties and its influence on stretch-flangeability of AHSS**

D.J. Cruz[1], S.S. Miranda[1], R.L. Amaral[1], A.D. Santos[1,2], J.V. Fernandes[3], L.T. Malheiro[4]

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*Presentation Only Contributions

MS 06 Digital techniques in material characterization / Material models, full and small scale testing

Organized by the Institute for Metal Forming Technology, University of Stuttgart

ID 107 **Influence of the strain dependent material behaviour under plane strain on the yield locus modelling**

M. Lenzen[1] and M. Merklein[1]

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ID 124 **Performance Evaluation of Planar Anisotropy Yield Criteria for Aluminum Sheet Forming Analysis**

B. Ghoo[1], N. Ichijo[2], M. Selig[3], N. Manopulo[3], B. Carleer[4], W. Suzuki[1] and H. Takizawa[1]

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[2]*Toyota Motor Corporation, Japan*
[3]*AutoForm Development GmbH, Zurich, Switzerland*
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ID 132* **Adiabatic heating in high-strength steel sheets under crash loads – Experiments and efficient modelling**

S. Klitschke[1] and M. Liewald[2]

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ID 150 **Potential use of machine learning to determine yield locus parameters**

C. Karadogan[1], P. Cyron[1] and M. Liewald[1]

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ID 159 **Effects of initial microstructure before cold rolling on microstructure evolution and mechanical behaviour of CGL-compatible Q&P steel**

Y. Wang[1], Y. Xu[1] and T. Zhang[1]

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ID 177 **Evaluation of Simple Shear Test Geometries for Constitutive Characterization using Virtual Experiments**

A. Narayanan[1], A. Abedini[1], A. Weinschenk[2], M. J. Worswick[1] and C. Butcher[1]

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ID 179 **Potentials for material card validation using an innovative tool**

M. Eder[1], M. Gruber[1], N. Manopulo[2] and W. Volk[1]

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ID 187 **Modelling continuous dynamic recrystallization of lightweight alloys by coupling polycrystal plasticity approach**

S.-F. Chen[1], S.-H. Zhang[1], H.-W. Song[1] and M.-G. Lee[2]

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[2]*Department of Materials Science and Engineering & Research Institute of Advanced Materials, Seoul National University, South Korea*

ID 202 **Virtual design of formability for Zircaloy-4 sheet through texture control**

H. Liu[1,2], S. Deng[1], S. Chen[1], H. Song[1] and S. Zhang[1]

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ID 204 **A novel approach to characterising the cause of disc formation by the shear cutting process in punching machines**

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ID 212* **The study of surface deflection at uniaxial Tension mode using Crystal Plasticity Finite Element Method**

K.J. Kim[1], S. C. Yoon[1], Y.J. Jung[1], G.H. Yim[1] and J.S. Hyun[1]

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ID 221 **Constitutive modelling of Usibor 1500 sheets after intercritical quenching**

M. S. Dastgiri[1], R. Thakkar[1], J. Shi[1], I. Sari Sarraf[1] and D. E. Green[1]

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ID 243* **Aggressive DIC testing in service of accurate material characterization: a detailed exploration of the Numisheet 2020 material dataset**

K. Kannan[1], T. Toughton[2] and A. Devine[1]

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ID 246 **Influence of the orthotropic behaviour on defects prediction in cup drawing, reverse redrawing and expansion**

M.C. Oliveira[1], D.M. Neto[1], J.L. Alves[2] and L.F. Menezes[1],

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ID 267* **Evaluation of transfer layers on friction and wear mechanisms in commercially coated sheet metal forming tool steels**

A.F. Tavares[1], A.P. Lopes[2], D.T. de Almeida[2], E.A. Mesquita[1], J.H. Corrêa de Souza[1] and H.L. Costa[1]

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ID 269* **Multi-scale friction model for sheet metal forming**

J. Hazrati[1], M. Shisode[1] and A.H. van den Boogaard[1]

[1]*Nonlinear Solid Mechanics, University of Twente, Enschede, The Netherlands*

ID 271* **Different plastic flow formulations and its influence in earing prediction of cylindrical cup drawing**

S.S. Miranda[1], R.L. Amaral[1], D.J. Cruz[1], A.D. Santos[1,2], J.C. Sá[1,2] and M. Parente[1,2]

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*Presentation Only Contributions

MS 07 Digitalization in tooling and intelligent tools

Organized by Prof. Dr.-Ing. Dipl.-Wirtsch.-Ing. Peter Groche

ID 104 **Validation of Part Holder Models of Car Body Upper Line Dies for Return Stroke Loads**

M. Burkart[1], M. Liewald[2], J. Wied[1] and C. Kaminsky[1]

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[2]*Institute for Metal Forming Technology, University of Stuttgart, Germany*

ID 149 **Zero-error-production through inline-quality control of press-hardened automotive parts by multi-camera systems**

A. Pierer[1], T. Wiener[1], L. Gjakova[1] and J. Koziorek[2]

[1]*Fraunhofer-Institute for Machine Tool and Forming Technology, Chemnitz, Germany*
[2]*Technical University of Ostrava, Faculty of Electrical Engineering and Computer Science, Czech Republic*

ID 199 **Development of an automatic crack detection method for cupping tests on sheets and foils with a wall thickness below 0.1 mm**

J-L. Schneider[1], D. Staupendahl[1] and L. Wahlers[1]

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ID 215 **New press deflection measuring methods for the creation of substitutive models for efficient die cambering**

J. Pilthammar[1,2], T. Skåre[3], L. Galdos[4], K. Fröjdh[5], P. Ottosson[3], D. Wiklund[3], J. Carlholmer[3], M. Sigvant[1,2], M. Ohlsson[3], E. Sáens de Argandoña[4], F. Abbasi[4], O. Sarasua[6], A. Garro[7] and W. Rutgersson[8]

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ID 230* **Acoustic emission sensors to monitor for material necking during forming**

M. Baral[1], A. Breunig[2], J. Ha[1], P. Groche[2], Y. Korkolis[3] and B. Kinsey[1]

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ID 244* **Complete transparency in the press shop through seamless part tracking**

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*Presentation Only Contributions

MS 08 Smart production technologies and machine learning

Organized by the Institute for Metal Forming Technology, University of Stuttgart

ID 154 **Data-driven analysis of cold-formed pin structure characteristics within versatile joining processes**

D. Römisch [1], C. Zirngibl[2], B. Schleich[2], S. Wartzack[2] and M. Merklein[1]

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ID 162 **Process data-based estimation of tool wear on punching machines using TCN-Autoencoder from waveform time-series information**

S. Asahi[1], C. Karadogan[2], S. Tamura[1], S. Hayamizu[1] and M. Liewald[2]

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ID 163 **Deformation and thinning field prediction for HFQ® formed panel components using convolutional neural networks**

H.R. Attar[1], H. Zhou[1] and N. Li[1]

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ID 173 **Prediction of forming limit diagrams from tensile tests of automotive grade steels by a machine learning approach**

F.P. Finamor[1], M.A. Wolff[1] and V. S. Lage[1]

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ID 178 **Parametric Shape Optimization of Stretch Webs in a Progressive Die Process using a Neural Network Surrogate Model**

S. Athreya[1], A. Weinschenk[1], F. Steinlehner[2], D. Budnick[3], M. Worswick[3], W. Volk[2] and S. Huhn[1]

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ID 180 **Autoencoder based Wear Assessment in Sheet Metal Forming**

P. Niemietz[1], M. Unterberg[1], D. Trauth[1] and T. Bergs[1,2]

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ID 192* **Melting digital technologies around sheet metal forming**

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ID 222 **Lightweight design of an automotive lower control arm using topology optimization for forming process**

K. Sookchanchai[1] S. Olarnrithinun[2] and V. Uthaisangsuk[1]

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ID 226 **On the use of fixed point translations as input variable for digital twins in deep drawing compared to current methods**

M. Ryser[1], P. Hora[1] and M. Bambach[1]

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ID 262* **Schuler Connect - remote support along the machine life cycle and for process optimization**

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MS 09 Robust process design and adaptive control

Organized by Prof. Dr. Pavel Hora
Organized by Dr. Eisso Atzema

ID 134 **Simulation of Dynamic Effects in Progressive Die Operation and Control**

D. Budnick[1], F. Steinlehner[2], A. Weinschenk[3], W. Volk[2], W. Melek[1], M. Worswick[1] and S. Huhn[3]

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ID 147 **Temperature-controlled tools for multi-stage sheet metal forming of high-strength aluminium alloys**

J. Günzel[1,2], J. Haußß[2] and P. Groche[1]

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ID 172 **On thermal compensation of Hot-Form-Quench stamping die**

D. Szegda[1], M. Mohamed[1] and M. Ziane[2]

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ID 186* **Large-scale manufacturing of metallic bipolar plates for fuel cells**

H. Uchtmann[1] and R. Cisar[1]

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ID 194 **Robustness Analysis with LS-OPT and LS-DYNA for sheet metal forming simulations**

M. Merten[1], K. Liebold[2] and A. Haufe[3]

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ID 196 **Variance based sensitivity analysis of deep drawing processes based on neural networks using Sobol indices**

M. Kott[1], M. Kraft[1], A. Emrich[1] and P.Groche[2]

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ID 198 **Process Linearization for Closed-Loop Control of Incremental Sheet Forming**

J. Havinga[1], D. Sikkelbein[1] and T. van den Boogaard[1]

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ID 245 **Approaches to analysing scatter in forming simulations: from fundamental to pragmatic**

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ID 249* **Applications of part-based Process Control in Deep Drawing**

J. Heingärtner[1], D. Hortig[2], M. Veldhuis[3], M. Kott[4] and P. Hora[5]

[1]*inspire AG, Switzerland*
[2]*Daimler AG, Germany*
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ID 260* **Adaptive Rounding System**

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*Presentation Only Contributions

MS 10 Prediction and control of product and assembly properties

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ID 145 **Predicting springback variation and process-reliable tolerance limits of outer car-body panels by stochastic sheet metal forming simulation**

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ID 188 **Load-specific variant generation of bead cross sections in sheet metal components by unidirectional carbon fiber reinforcement**

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ID 210 **A new cracking resistance index based on fracture mechanics for high strength sheet metal ranking**

D. Frómeta[1], S. Parareda[1], A. Lara[1], L. Grifé[1], I. Tarhouni[1] and D. Casellas[2]

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ID 223 **Simulation based approach for light weighting of Connecting rod by tube hydro forming process**

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ID 240 **Prediction and assessment of skid line formation during deep drawing of sheet metal components by using FEM simulation**

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ID 253 **Study on new hot stamping tool with low cost and high cooling efficiency**

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40th International Deep-Drawing Research Group Conference 2021

IDDRG 2021 - Virtual

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