EWI Forming Center Workshop: Advanced Sheet Metal Forming Technology

Virtual Workshop | November 9-10, 2021

Speaker Abstracts and Biographies:

1. Hyunok Kim, EWI — *Recent R&D Updates on Sheet Metal Forming Technology*

ABSTRACT

The first-time quality of stampings with reduced scrap rates is a primary goal of the metal stamping industry. To produce the quality stampings, major defects such as necking, wrinkling, and excessive springback should be predicted in advance, and practically monitored and prevented in production. This presentation will update on the latest R&D activities and findings on the following topics:

- *The Machine Learning (ML) and inline monitoring sensors for springback in stamping of the S-rail part with GEN3 steel and aluminum alloys*
- *A novel tensile testing method to characterize the weld metal properties for laser welded blanks (LWB) with AHSS and GEN3 steel*
- *Advanced FEM simulations in forming LWB materials*

BIO

Hyunok Kim is currently the Director of EWI Forming Center. His technical expertise includes sheet metal forming, tribology, formability analysis, and process simulations over 15-year experiences for industrial research and development projects. Hyunok received his M.S. at the University of Michigan and Ph.D. at The Ohio State University in metal forming and manufacturing areas. He is also an Ohio-certified Professional Engineer (PE) of Mechanical Engineering. He is also actively involved in teaching manufacturing/metal forming courses to undergraduate and graduate students as an instructor at The Ohio State University College of Engineering. He has authored and co-authored more than 70 technical papers and articles on topics related to metal forming.

Speaker Abstracts and Biographies:

2. Ryan Hahnlen, Ph.D., Honda Development & Manufacturing of America, LLC — *Additively Manufactured Forming Dies: Material Strategies for Part Quality, Tool Life, and Cost Savings*

ABSTRACT

Additive Manufacturing (AM) has enhanced design freedom, cut lead times, and lead to cost savings in low-volume production across several industries. Also cutting across industries, tooling is a large expense for any product development and often changes as a concept goes from prototype to production. By using AM for early-stage tooling, significant lead time and cost reductions can be realized during pre-production development. While sheet metal forming tools are typically made of machined metal castings, this research investigates the use of polymer AM tool sets for use in low-volume sheet metal part production. The impact of different AM systems, materials, and build strategies on part quality, tool wear, and cost are compared against traditional hard tooling methods.

BIO

Ryan Hahnlen is a Senior Engineer in the Strategic Research Operations division of Honda R&D Americas, LLC. His responsibilities include third party outreach, working with universities, non-government, and government institutions to identify and develop new technologies in lightweighting, high performance structures, additive manufacturing, and multi-material joining. Ryan received his BS, MS, and PhD degrees in Mechanical Engineering at The Ohio State University with his graduate research focusing on modeling and characterizing metal matrix composites made via additive manufacturing. Ryan has co-authored over 17 technical papers and articles and has four patents granted with several more pending in the area of advanced manufacturing.

3. Madhura Athale, OSU — *Performance Prediction of Low-cost Agile Tooling (LCAT) for Sheet Metal Stamping Applications through FE Simulations*

ABSTRACT

3D printed polymer composites offer great flexibility in tool design due to low cost of fabrication and rapid production times. Due to their lower stiffness and strength compared to conventional tooling materials such as steel, LCAT tooling application is limited to low-volume production. Mechanical properties of 3D printed materials are highly anisotropic due to various factors such as presence of reinforcements, voids, irregularities in cooling history of adjacent material beads etc., all of which cause areas of stress concentration inside the material. Accurate characterization and modeling of the materials is crucial to successful design and implementation of stamping tools. This presentation focuses on experimental characterization of various 3D printed polymer composites considered as potential tooling materials, as well as calibration of homogenized constitutive models using the experimental data. Calibrated material models for tools are used in finite element simulations of the stamping process and the results are shown to be in good agreement with experiments with respect to parameters such as tool deformation and stamped part geometry.

BIO

Madhura Athale is a PhD student in the Materials, Mechanics and Manufacturing lab at The Ohio State University.

Speaker Abstracts and Biographies:

4. Paul Bosler, Fuchs — *Metalforming Lubricant Developments Particularly for Steel and Aluminum in Lightweighting Programs*

ABSTRACT

The metal stamping industry is faced with many new challenges such as the use of advanced high-strength steel and aluminum to meet lightweighting goals, increased regulations and safety concerns, and the need to meet OEM process specifications. Lubricant suppliers have developed new technologies to meet some of these challenges. This presentation will inform the audience of these three topics:

- *The effect of new metals on the performance of lubricants and newer technology lubricants to address these effects*
- *The effect of regulations upon lubricants and lubricant trends to address them*
- *General OEM process specifications and related lubricant requirements*

BIO

Paul Bosler has worked in the specialty chemical industry for 40 years and has brought his experience in the metalforming and metal finishing industries to assist stamping companies and their end-customers. From 1996 to 2008, he was president and co-owner of MS Fluid Technologies, Inc. – an Indianapolis-based specialty chemical company. While leading the company, he spearheaded the growth of environmentally-friendly synthetic lubricants into the automotive industry. Their Eco Draw lubricants gained the first full automotive Body In White (BIW) approval for such technology. In late 2008, he sold his company to Fuchs Petrochem and joined the company in their North American Product Management division. He manages the company's metalforming lubricant line and the mill applied corrosion preventative line. He and his team also work closely with automotive OEMs, steel and aluminum mills, and industry consortiums to partner in the development of forming lubricants particularly for lightweighting and body panels.

5. Dongun Kim, POSCO — *Roll Stamping Technology for Automotive Gigasteel*

ABSTRACT

Roll Forming is a very useful forming method using the Gigasteel. But, there is also threshold point that only uniform cross-sectional profile along the longitudinal direction can be producible. So, POSCO had proposed Roll Stamping technology which is combined forming process of Roll Forming and Stamping. Using the forming rolls having each embossing and engraving part shape along the circumferential direction for upper and lower roll, varying cross-sectional profile can be manufactured along the longitudinal direction.

Using this, POSCO developed the Door Impact Beam with Korean Roll Former, which is ASAN. The conventional door impact beam was manufactured using 1.5GPa Post Heat Treated pipe and additional brackets. In this project, the 'W' sectional profile is manufactured by the Roll Forming, and then, the partial flattened region is formed by the Roll Stamping through in-line process. This flattened region is to be the brackets of Door Impact Beam. So, by the elimination of heat treatment and welding procees, by parts integration and by the process simplification, 10% of weight reduction as well as 20% of cost saving were achieved. This Roll Stamping Door Impact Beam was passed the crash and safety test of Korean Motor company, and it was successfully applied to the automotive.

BIO

Dongun Kim works in the Materials Forming Research Group, Steel Solution Research Lab., Technical Research Laboratories

Speaker Abstracts and Biographies:

6. J. Clare Gu, EWI — *Evaluation of Laser Weld Quality and Formability of the TWB Materials with Different Shearing Methods*

ABSTRACT

The edge profile is one of the most important factors to obtain high quality laser welded blanks (LWB). In a previous study on the influence of the shearing speed on the edge quality, high speed shearing using the AIRAM pneumatic press has obtained a distinct straight and smooth edge profile in advance high strength steel (AHSS). In this study, two different AHSSs – DP780 and GEN3-980 was selected to investigate the influence of the edge preparation method on the LWB formability. Three different edge preparation method, high speed shearing, machining and precision shearing was conducted on both materials. The edge cross section profile and edge gap was non-destructively evaluated by laser measurement. The cross-section profile and hardness of the welded area using different edge preparation method was obtained. Lastly, the formability of the LWB was evaluated by biaxial dome test. 3D DIC was used to measure the instantaneous displacement and strain field. Interestingly, although the LWB shows various fracture initiation, the high-speed shearing prepared sample still shows the highest fracture strain among those sample which had fracture initiated from the weld.

BIO

J. Clare Gu is a graduate fellow at the EWI Forming Center. Joined from 4 years ago with B.S. Materials Science and Engineering from OSU, she is back on the journey for a Ph.D. degree at the Department of Integrated Systems and Engineering. Her expertise includes materials modeling and finite element analysis on forming process, mechanical testing, and formability analysis.

7. Amir Asghazadeh, OSU — *System Dynamics Modeling of Mechanical Servo Press for Sheet Metal Forming and High-temp FLD Testing Method*

ABSTRACT

3D printed polymer composites offer great flexibility in tool design due to low cost of fabrication and rapid production times. Due to their lower stiffness and strength compared to conventional tooling materials such as steel, LCAT tooling application is limited to low-volume production. Mechanical properties of 3D printed materials are highly anisotropic due to various factors such as presence of reinforcements, voids, irregularities in cooling history of adjacent material beads etc., all of which cause areas of stress concentration inside the material. Accurate characterization and modeling of the materials is crucial to successful design and implementation of stamping tools. This presentation focuses on experimental characterization of various 3D printed polymer composites considered as potential tooling materials, as well as calibration of homogenized constitutive models using the experimental data. Calibrated material models for tools are used in finite element simulations of the stamping process and the results are shown to be in good agreement with experiments with respect to parameters such as tool deformation and stamped part geometry.

BIO

Amir Asgharzadeh is a 5th year PhD candidate at the Ohio State University. He is performing scientific research both experimentally and numerically in metal forming and manufacturing process modeling. His area of research interests includes multiscale microstructure-based material modeling, modeling of materials using advanced phenomenological yield functions and crystal plasticity, metallurgical and mechanical testing of metals, as well as diverse forming processes such as Tube Hydroforming, Rolling, and sheet metal forming.

Speaker Abstracts and Biographies:

8. Laura Zoller, EWI — *Developing Cyclic-Tension Compression Testing for a More Reliable Springback Prediction Model for Aluminum and Advanced High Strength Steels*

ABSTRACT

Aluminum and advanced high-strength steels (AHSS) have been increasingly applied to automotive structural components allowing improvement in crashworthiness without corresponding weight increases. However, these materials bring along challenges with controlling or compensating springback in design and production phases. Therefore, a reliable prediction of springback is important to reduce compensation efforts and forming the parts with minimal springback. EWI developed a cyclic tension-compression fixture and test method to establish the kinematic hardening material model to be used with the Yoshida-Uemori model. This presentation will cover the cyclic tension-compression testing with 3 aluminum and 2 AHSS materials and explore FE modeling with the developed Yoshida-Uemori model and compare the results with experimental tests completed at EWI.

BIO

Laura Zoller is currently an Applications Engineering at EWI Forming Center. She specializes in processing, measuring and analyzing sheet metal forming. Laura operates EWI's stamping presses and leads quality inspection testing. In addition, she conducts material formability tests and research. Prior to EWI, Laura was a Quality Engineer at Honda of America Mfg., Inc. She has her B.S. in Materials Science and Engineering from The Ohio State University.