

EWI Forming Center: Current Research and Technical Capabilities Expansion

Sixth Annual Workshop

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The mission of the EWI Forming Center is to develop innovative forming processes, tooling, and equipment to increase the competitiveness of U.S. manufacturers. The Center is also focused on providing a technology, knowledge, and training base for industry with a long-term goal to become the most innovative, industry-based, forming technology center in North America. Since its launch in 2012, the technical capabilities of the Center have continuously grown. Currently, four engineers work as part of the EWI Forming Center team conducting research on novel forming processes, material testing, simulation, and process/tooling designs.

Current Research

EWI's forming experts utilize the Center's 160-ton hydraulic press and 50-ton material testing press to conduct stamping tests and perform material evaluations. Advanced 3D digital measurement methods such as digital image correlation (DIC) and GOM's ARGUS optical forming analysis system are being used to measure part quality and geometry. The team has also developed new formability testing capabilities to obtain high-temperature (up to 400°C) forming-limit diagrams

(FLDs), high strain-rate (up to 5 /s) stress-strain curves, edge-cracking data, and lubricant performance data.

The Center partnered with Honda R&D Americas, KTH Parts Industries, and Shiloh Industries, to complete a joint industry project focused on advanced material formability testing. A second joint industry project is underway to develop practical manufacturing solutions for servo-drive press cold forming and warm forming of aluminum alloys with 12 industry members, including two European sponsors.

Expanding the Center's Capabilities

EWI was recently awarded a \$1.5M capital funding grant from the State of Ohio to invest in advanced metal-forming technologies with the end goal of increasing the competitiveness of US-based manufacturers. This funding will significantly increase the Center's technical capabilities. Among the equipment being considered for investment are a 300-ton servo-drive press, an eddy current nondestructive testing (NDT) device, a 3D visual monitoring system, a coil feeder, and a robot for material handling (Figure 1). This new equipment will be used to provide more complete



manufacturing solutions to EWI's customers. It will also be used to train Ohio State University students and industry professionals to help develop the U.S. manufacturing industry's future workforce.

Development of Intelligent Servo-controlled Forming

In response to rapid advances in servo-drive presses, information technology, real-time measurement sensors, and visual monitoring systems, the EWI Forming Center approached its industry partners with a proposal to develop an innovative forming process combining servo-control techniques with intelligent control algorithms. The end goal of this effort is to integrate the approach into an industry-scale manufacturing system in the near future.

This new process integrates nondestructive testing measurement of incoming material properties, real-time data acquisition, in-process visual monitoring of product quality and geometry, and accurate predictions of the final product's properties using computer-aided analysis. Based on these real-time data, a control algorithm can be created to optimize the servo-drive press RAM speed and motion as well as the cushion force. The outputs of this algorithm can then be directly linked via software to the forming press control panel.

The 6th Annual Workshop on Advanced Sheet Metal Forming Technology

The EWI Forming Center, in coordination with The Ohio State University's Center for Precision Forming (OSU-CPF) hosted its sixth annual workshop entitled "Advanced Sheet Metal Forming Technology – Issues and Applications" at EWI's headquarters in Columbus, OH. This workshop brought together experts from industry and academia to discuss important issues related to current practice as well as the advancement of sheet metal forming technologies. Technical presentations and discussions featured:

- Recent advances in cold, warm, and hot stamping technologies

- Methods of characterizing material properties of aluminum alloys and advanced high-strength steels (AHSS)
- Evaluation methods for friction and wear of aluminum alloys and AHSS
- Process simulation using finite element analysis (FEA) to reduce die/process development time
- Applications of servo-drive presses in forming of aluminum alloys and AHSS

The event was attended by 94 representatives from 45 companies including automotive OEMs, tier 1 automotive suppliers, stampers, steel and aluminum companies, forming equipment manufacturers, and lubricant suppliers, as well as three universities (Figure 2).



Figure 2: Advanced sheet metal forming technology workshop, hosted at the EWI Forming Center on October 13, 2016

Presenters discussed technical challenges associated with advanced forming technologies and proposed solutions. Topics included:

- "New Developments in Sheet Metal Forming" -- Taylan Altan, OSU-CPF
- "Advances in Formability Evaluation Methods and Forming of AHSS & Aluminum Alloys" -- Hyunok Kim, EWI Forming Center

- “New Applications of Servo Drive Presses” -- Shrinivas Patil, AIDA-America
- “Effect of Forming Speed and Temperature in Lubricant Evaluation” -- Cliff Hoschouer, Shiloh Industries and Frank Kenny, IRMCO, Inc.
- “Tailored Hot Stamping: Coupling Forming and In-service Crash Behavior” -- Mike Worswick, University of Waterloo
- “First Production Line and Full Scale Pilot for High Strength AI Hot and Warm Forming Processes” -- Knut-Erik Snilsberg, Automation Press & Tooling (AP&T)
- “Ultrasonic Forming of Sheet Metals” -- Karl Graff, EWI
- “Half Dome Test to Evaluate AHSS Edge Cracking” -- Jim Dykeman, Honda R&D and Mike Shih, the United States Steel Corporation
- “Challenges in Forming and Joining of the Gen. 3 AHSS” -- Hokook Lee, POSCO
- “Training and Education in Stamping Technology - An Example Program Developed in Collaboration with Fiat Chrysler Automobile (FCA) Company” -- Sergey Golovashchenko, Oakland University

In addition to technical presentations, an open forum was held to discuss industry challenges. The workshop participants shared their unique perspectives on a variety of topics, including the need for standard and non-standard formability testing, edge cracking evaluation/predictions,

FLD, hot piercing/trimming, springback, ultrasonic assisted drawing, and evaluation of lubricants.

This annual workshop gives subject matter experts from academia and industry the opportunity to collaborate as the forming industry faces the significant technical challenges posed by lightweighting initiatives.

2017-2018 Forming Consortium Topics

The EWI Forming Center plans to launch a Forming Consortium in early 2017 focusing on the pre-competitive technology topics listed below:

- Intelligent servo-controlled forming
- Hot stamping of laser-welded blanks
- Evaluation of lubricants for improved quality when stamping and joining AHSS and aluminum alloys
- Real-time forming process monitoring
- Warm forming and joining of magnesium alloys for lightweight vehicle structures
- Hot forming of aerospace alloys including titanium, nickel, and aluminum

For more information on this new consortium, or to learn more about the EWI Forming Center, contact Technical Director, Dr. Hyunok Kim at hkim@ewi.org or 614.688.5239, or visit ewi.org/ewi-forming-center/.

Hyunok Kim brings a diverse background of academic, industry, engineering, research, and teaching experience to his role as Technical Director of the EWI Forming Center. He possesses a comprehensive knowledge of forming technology. His areas of expertise include cold/warm/hot sheet and bulk forming technologies, forming equipment, tribology, simulations, and formability testing/analysis. He has led numerous government- and industry-sponsored research programs of hot and warm forming of automotive and aerospace structures, manufacturing fuel cell components, and shear fracture/edge cracking in stamping advanced high strength steel(AHSS), springback control, and crash modeling of AHSS automotive structure parts.