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### Cover Photo:

The figures on the left shows incremental sheet forming operated by a robot together with experimentally measured strain contour and stress-based forming limit analysis. At the right the figures show four benchmarks study conducted in NUMISHEET2014 Conference: BM-1 Nonlinear Strain Path Forming Limit of a Reverse draw; BM-2: Springback of draw-redraw pan; BM-3 Incremental sheet forming; and BM-4: Wrinkling during redraw.

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## Contents

### Editorial: NUMISHEET2014 Special Issue

Jeong Whan Yoon, Peter Hodgson and John H. Beynon

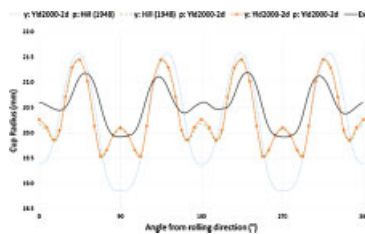
851

### Full Paper

M. Paulino and J. W. Yoon\*

### Study on Yield Function and Plastic Potential Under Non-Associated Flow for Accurate Earing Prediction in Cup Drawing

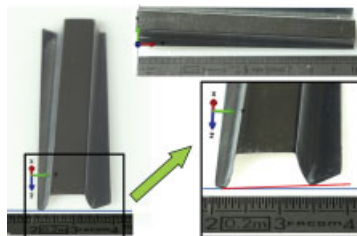
852



Prediction of more than four ears in a cup drawing process can be successfully achieved by considering flexible combinations of two different yield criteria under the framework of Non-Associated Flow Rule. The use of Hill (1948) model for the yield function and Yld2000-2d for plastic potential is shown to lead to accurate prediction of up to eight ears at a low computational cost.

### C. Pham, S. Thuillier,\* and P.-Y. Manach 2D Springback and Twisting of Ultra-Thin Stainless Steel U-Shaped Parts

861

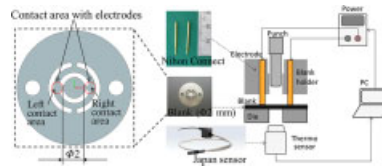


The aim of this work is to investigate numerically the springback and twisting of U-shaped elongated parts made of ultra-thin stainless steel after deep drawing, and to compare with an experimental database. In order to enhance twisting, the blank is set in a misaligned position with respect to the tools. Finite element simulations for different mesh sizes are carried out.

# Contents

Q. Zheng,\* T. Shimizu, and M. Yang  
**Numerical Analysis of Temperature Distribution and Its Optimization for Thin Foils in Micro Deep Drawing Assisted by Resistance Heating**

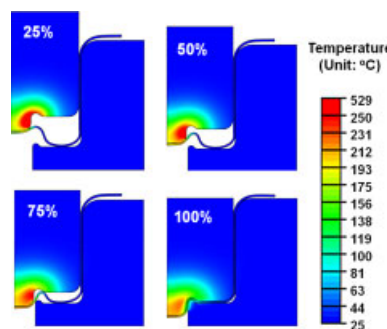
869



Finite element models for the numerical analysis of micro deep drawing process assisted by resistance heating are developed. Coupled thermal-electrical procedure and coupled thermal-displacement dynamic explicit procedure are conducted for the analysis of temperature distribution and material deformation, respectively. The process parameters are optimized to obtain uniform temperature distribution. The influence of temperature distribution on material deformation is discussed.

J. Park, J. Kim, and K. Park\*  
**Fully coupled numerical analysis of high frequency induction heating and warm sheet metal forming**

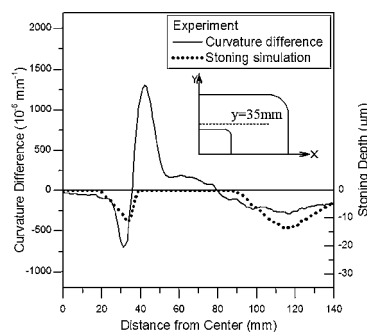
877



This study concerns warm forming of aluminum alloy sheets with the aid of high frequency induction heating. To validate the rapid and localized heating capability of induction heating, an electromagnetic-thermal coupled simulation is performed. A thermomechanical coupled analysis is then conducted to investigate the effect of the localized induction heating on the formability improvement of aluminum alloys.

W. J. Chung,\* Y. C. Chung, and W. S. Kim  
**A Robust Prediction Method of Surface Deflection Using Stoning Simulation and Curvature Analysis**

886



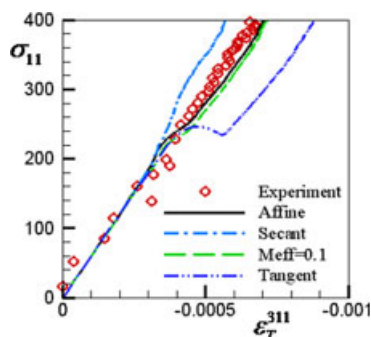
This work proposes a new robust prediction method that uses stoning simulation and curvature analysis sequentially. First, for reliable detection of surface deflection, stoning simulation was utilized. Next, for the accurate quantification, curvature analysis with adaptive span was applied. In a shallow rectangular drawing with inner rectangular embossing, the reliable detection and the accurate quantification of surface deflection is demonstrated.

# Contents

X. Q. Guo, P. D. Wu,\* H. Wang, and X. B. Mao

**Study of Lattice Strain Evolution in Stainless Steel Under Tension: The Role of Self-Consistent Plasticity Model**

894

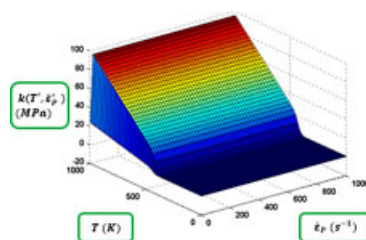


The recently developed large strain elastic visco-plastic self-consistent (EVPSC) model, with various popular self-consistent schemes, is used to study the lattice strain evolution in a stainless steel under uniaxial tension. It is found that, among the self-consistent schemes examined, the Affine and Meff self-consistent schemes give the best results.

D. Leem, H.-J. Bong, F. Barlat, M.-G. Lee\*, J.-H. Song, and D. Kim

**Enhancement in the Modeling of Temperature and Strain Rate-Dependent Plastic Hardening Behavior of a Sheet Metal**

902



In this study, viscoplastic hardening behavior of aluminum alloy 3003 sheet is measured and modeled. Three different hardening models are utilized to fit experimental stress-strain data. Evaluation on each model for flow stress prediction convinces that the modified Hollomon/Voce law with additional  $k(T, \epsilon_p^*)$  function improves prediction accuracy.

R. E. Dick and J. W. Yoon\*

**Wrinkling during Cup Drawing with NUMISHEET2014 Benchmark Test**

915

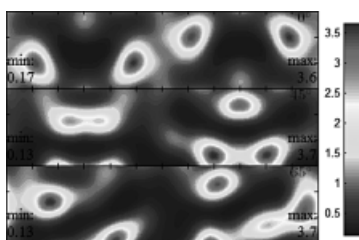


The figure shows the simulated wrinkling profiles for AA5042 with NUMISHEET2014 Benchmark Test. A total of 13 wrinkles are generated consistently for both experiment and simulation. Finite element model contains 57 721 nodes and 57 540 four-node BWC shell elements based on an explicit time integration method. Barlat's Yld2000-2d material model is employed with isotropic hardening.

J. J. de Almeida Grácio, G. Vincze,\* J. W. Yoon,\* R. P. R. Cardoso, E. F. Rauch, and F. G. Barlat

**Modeling the Effect of Asymmetric Rolling on Mechanical Properties of Al-Mg Alloys**

922

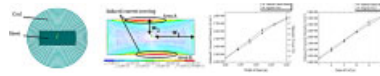


The mechanical behaviour of AA5182 produced by conventional rolling (CR), asymmetric rolling-continuous (ASRC) and asymmetric rolling-reversed (ASRR) is investigated and modeled with a rate dependent crystal plasticity finite element method and VPSC model. The strain-based and stress-based formability is predicted by M-K theory combined with Yld2000 model. The new ASRR process preserves the formability and improves strength relatively to CR.

# Contents

X. Chen, W. Wang,\* M. Wan, and A. Long

## The Study of Magnetic Force in Electromagnetic Forming of Small Size Sheet

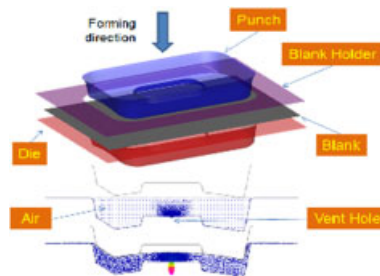


Magnetic force is calculated in electromagnetic forming of small size sheet by ANSYS/EMAG; small size sheet means that sheet length or sheet width, or both, is/are shorter than plane dimensions of coil. Induced current crowding effect is studied, and the influence of charging voltage, capacitance, separation distance, and relative position between coil and sheet on magnetic force are analyzed.

932

K. Y. Choi\* and H. Y. Kim

## A Sheet Metal Forming Simulation of a Fuel Filler Door Considering the Behavior of Air in a Die Cavity

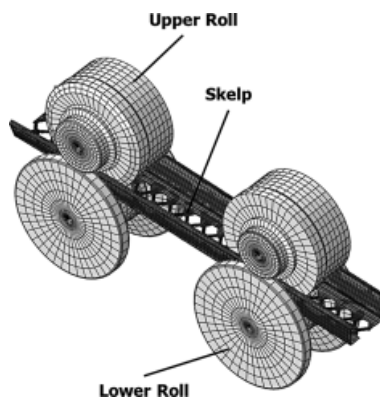


During sheet metal forming process, air trapped between blank sheet and die tool can become highly compressed. To prevent this problem, vent holes are drilled in die tool. CAE can be used to analyze the behavior of air in die cavity during forming process, incorporating both the elasto-plastic behavior of blank sheet and the fluid dynamics of air.

939

J. K. Sim, T. H. Lee, and Y. T. Keum\*

## Roll-Forming Design of Eco-Friendly Stud using Finite Element Analysis

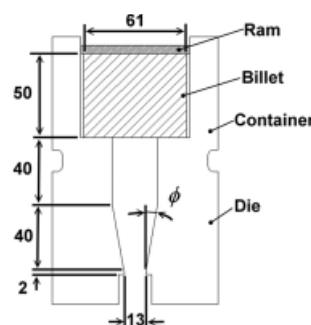


This paper employs the finite element analysis and Taguchi method to design the shearing pattern for the eco-friendly stud. The eco-friendly stud reduces the material cost. Moreover, the side rolls shortens the length of the roll-forming process and minimizes the die cost.

949

Y.-M. Hwang,\* T.-H. Huang, and S. Alexandrov

## Manufacture of Gradient Microstructures of Magnesium Alloys Using Two-Stage Extrusion Dies



A two-stage extrusion die with a straight channel part and a conical part as shown in the figure is designed to manufacture gradient microstructures of magnesium alloys. Hot extrusion experiments with a die of an inclination angle of  $15^\circ$  are conducted to obtain a product with grain sizes of  $17\mu\text{m}$  at the center and  $4\mu\text{m}$  at the edge of the product.

956