



Research and Development at the Center for Precision Forming (CPF)

(Formerly Engineering Research Center for Net Shape Manufacturing, ERC/NSM)

www.cpforming.org

www.ercnsm.org

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Research for Industry and Government

Stamping

Hydroforming

Forging

Machining

- 1) Material characterization <flow stress & formability>
- 2) Tribology < friction, lubrication & wear >
- 3) Process Modeling/Tool and Process Design
- 4) Metal Forming Presses (Mechanical, Hydraulic, Servo)
- 5) Short Courses/Training for Industry and Students

Forging

- Simultaneous determination of flow stress and interface friction by FE based inverse analysis.
- Determination of flow stress by cylinder upsetting (for cold, warm, hot forging)

Stamping

- Bulge test for determining formability, flow stress and quality of sheet metal.
- Determination of flow stress and friction using the modified stretch forming test (room & elevated temperature)

Tube Hydroforming

- Hydraulic bulge test to determine flow stress of tubular materials and quality of tubes.
- Flow stress determination for Mg and Al tubes at elevated temperature using hydraulic bulge test.

Machining

- Determination of material flow stress data under practical machining conditions using cutting tests.
- Database on material properties for FEM simulation of machining

General

- Development of tribotests that emulate real production conditions
- Performance evaluation of lubricants/coatings used in various metal forming processes (Forging, Stamping and Hydroforming)
- Estimate the friction coefficient and reliable friction models for use in process simulation

Forging

- Development of replacements for phosphate coating used in forging, extrusion, and metal forming processes
- Investigation on effects of surface finish and die temperature on friction & lubrication

Sheet Metal Forming

- Investigation of tribological conditions in forming uncoated and galvanized AHSS/UHSS
- Performance evaluation of dry-film lubricants using the deep drawing test
- Performance evaluation of stamping lubricants at various temperatures using the ironing test with heated dies

Tube Hydroforming

- Improvement of tribological conditions in tube hydroforming by using environmentally friendly lubricant systems and textured tubes
- Evaluation of Twist Compression Test (TCT) for screening tube hydroforming lubricants



Process Modeling and Development

ERC
NSM

- Stamping, Sheet Hydroforming and Tube Hydroforming -

Stamping and Sheet Hydroforming

- Determination of optimum constant / variable blank holder force profiles for stamping using FEM
- Determination of blank shapes, die design and process sequence for progressive die stamping
- Design of mechanical joining process (clinching / crimping) using FEM
- Development of warm sheet forming processes for producing complex parts from Mg and Al alloys
- Design of dies and processes for sheet hydroforming

Tube Hydroforming

- Determination of optimum loading path (Axial feed Vs Time, Pressure Vs Time) profiles for tube hydroforming using FEM
- Design of warm tube hydroforming process for processing Mg and Al alloy tubes
- Design of engineered tubes to improve formability in tube hydroforming process using FEM
- Die design (prediction of die stresses, corner and fillet radii) and process feasibility

Tool and Process Design in Cold, Warm and Hot Forging (with or without flash)

- 3D Simulation of Aircraft Structural Components.
- Forging of Internal Combustion Engine Pistons from Aluminum Alloys.
- Multiple Action Cold Forging of Complex Shaped Parts (gears, transmissions)
- Prediction and Reduction of Die Wear and Failure in Precision Hot and Cold Forging
- Simulation to Compare Surface Quality in Billet Shearing
- Prevention of Ductile Fracture in Cold Forging (Chevron Cracks)
- Three Dimensional Finite Element Simulation of Orbital Forming of (Spindle/Bearing Assembly, Orbital forging of parts)
- Microforming of Medical Devices
- Increasing of Material Yield in Hot Forging Operations

Design and Modeling of Machining Operations:

- Determination of material flow stress data under machining conditions
- Prediction and reduction of tool wear in cutting using FEM
- FEM modeling of multi-layer coated carbide tool and prediction of cutting temperatures
- 2-D simulation of serrated chip formation in HSC
- Effect of tool edge preparation on cutting performance (tool wear, tool fracture, machined surface quality)
- 3-D FEM modeling of cutting processes with nose- radiused tools
- FEM Modeling of ball burnishing processes and selection of process parameters
- Experimental analysis of tool wear for a coated tool with multiple coatings (KC9025)
- Prediction of residual stresses and white layer formation due to turning of hardened bearing steel using FEM