

# Validation and Prediction of Single Point Incremental Forming (SPIF), PSED Cluster 2009-2010

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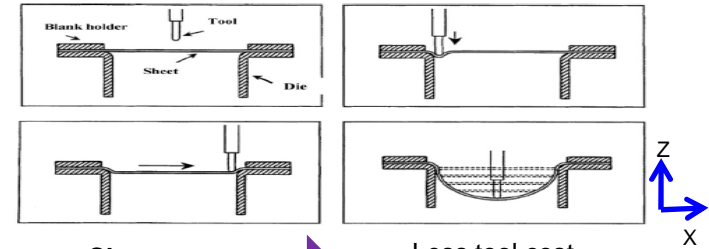
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Academic Disciplines:  
**MECHANICAL ENGINEERING, INDUSTRIAL ENGINEERING**  
**AND MANAGEMENT SCIENCES**  
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## Research Objective

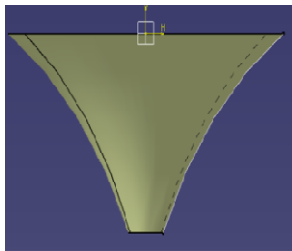
- 1) Calibrate the fracture model to predict formability in SPIF using FEA
- 2) Obtain knowledge about uncertainties in simulations and experiments in SPIF
- 3) Assess the predictive capability of FEA simulations for SPIF

## Single Point Incremental Forming (SPIF)



- Cheaper, generic tooling** → Less tool cost, greater process flexibility
- Reduced tool forces** → Reduced machine size, use in micro-factories
- Higher Formability** → Reduced joining processes, greater component strength

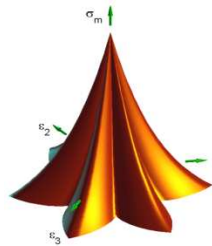
## Experiments



**Incremental depth ( $\Delta z$ ):**  
 Increments by which tool goes down in z direction

- Failure:**
- Controlled by  $\Delta z$
  - Tested by forming funnel shapes at different  $\Delta z$

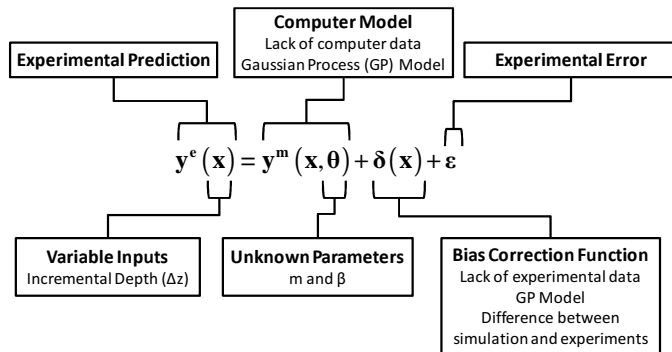
## Fracture Model



Fracture envelope depends on pressure and on shear modes of deformation

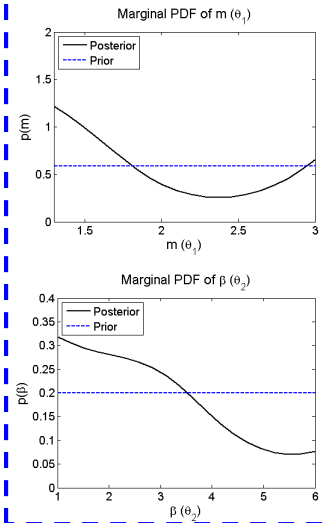
## Uncertainty Quantification and Prediction

Calibration and Bias-Correction Probabilistic Model Formulation (Kennedy and O'Hagan 2001)

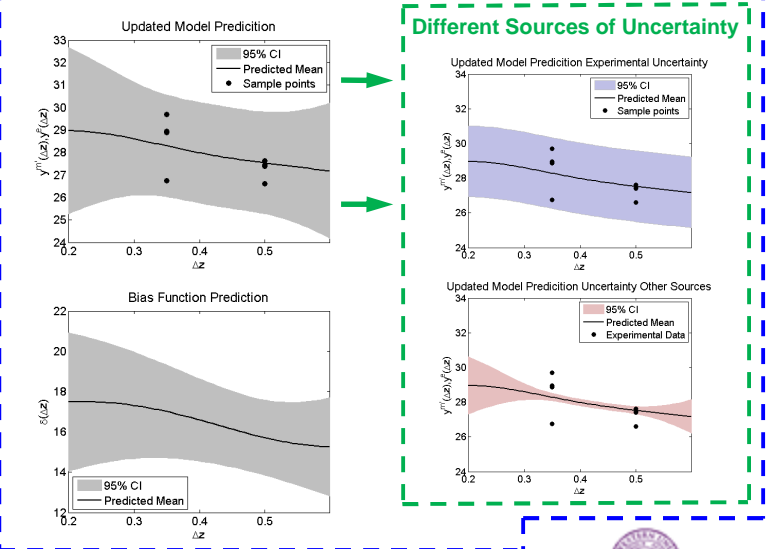


	Simulation Inputs	Description
x	$\Delta z$	Incremental depth (mm)
$\theta_1$	m	Damage evolution parameter
$\theta_2$	$\beta$	Weakening function parameter

### Probability Distribution of Calibration Parameters



### Prediction and Uncertainty of Experimental process



	Simulation Output	Description
$y^m(x, \theta_1, \theta_2)$	$y^m(\Delta z, m, \beta)$	Fracture depth (mm)