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Recent Developments in Model setup for Metal Forming

October 18, 2004

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Overview

LS-PREPOST For Metal Forming Application

- Tool Meshing and mesh repair
- Mesh Data manipulation
- Other geometric data creation
  - Drawbead creation
  - Guide pin and binder wall creation
- Material database
- Process setup
- Post-processing

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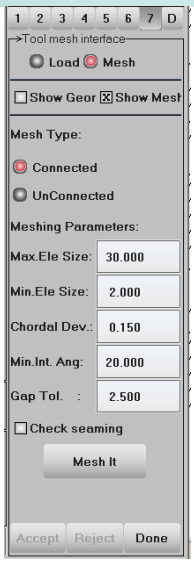
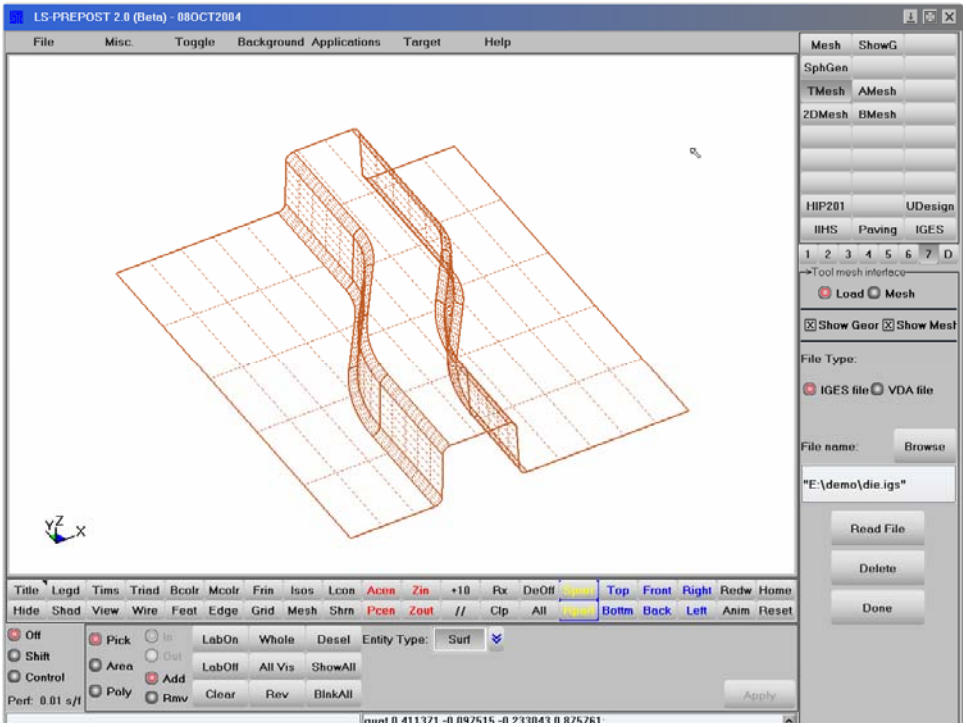
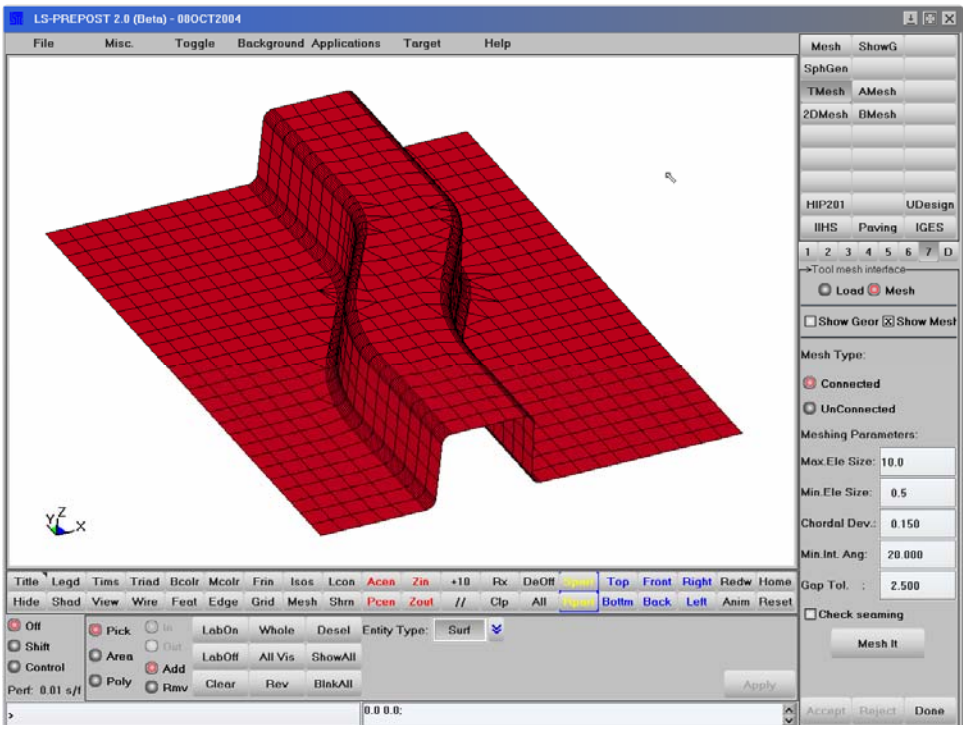
Meshing – TMesh

LSTC purchased ETA tool mesher for metal forming application

- Tmesh – tool meshing for metal stamping
- Read Iges or Vda geometry file
- Select surfaces to be meshed
- Enter meshing parameters
- Mesh it, accept or reject mesh







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Mesh Repair

Mesh repair can be done by Eledit and other interfaces

- Dupgrid – Merge duplicated nodes automatically
- Node replace – merge 2 nodes by picking
- Delete elements
- Create elements
- Align nodes
- Split elements
- Reverse shell normal

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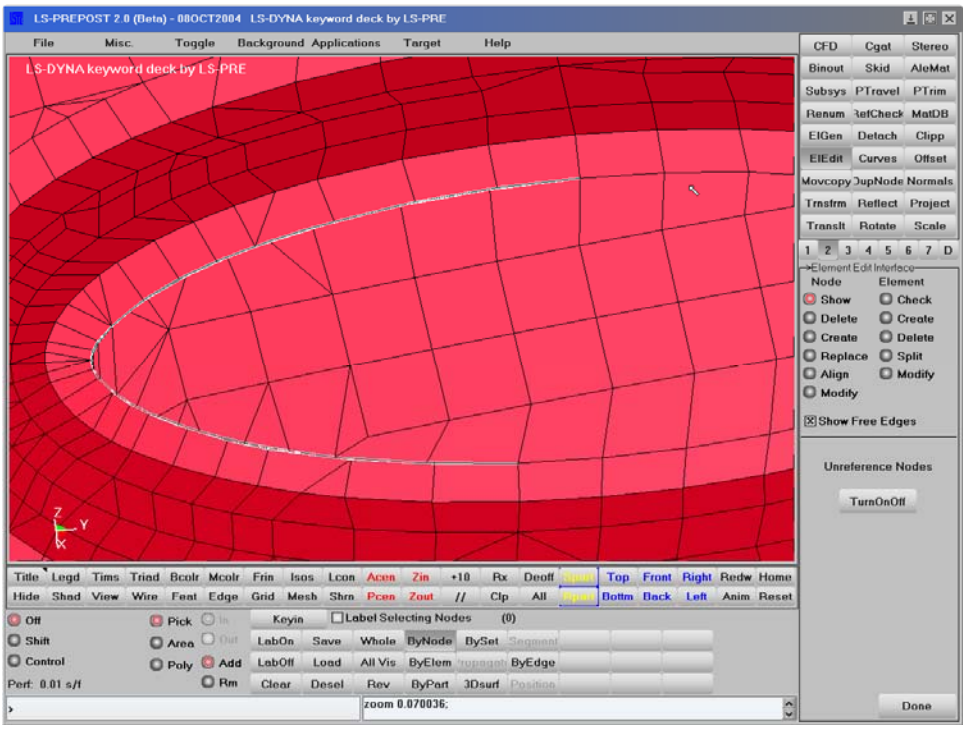

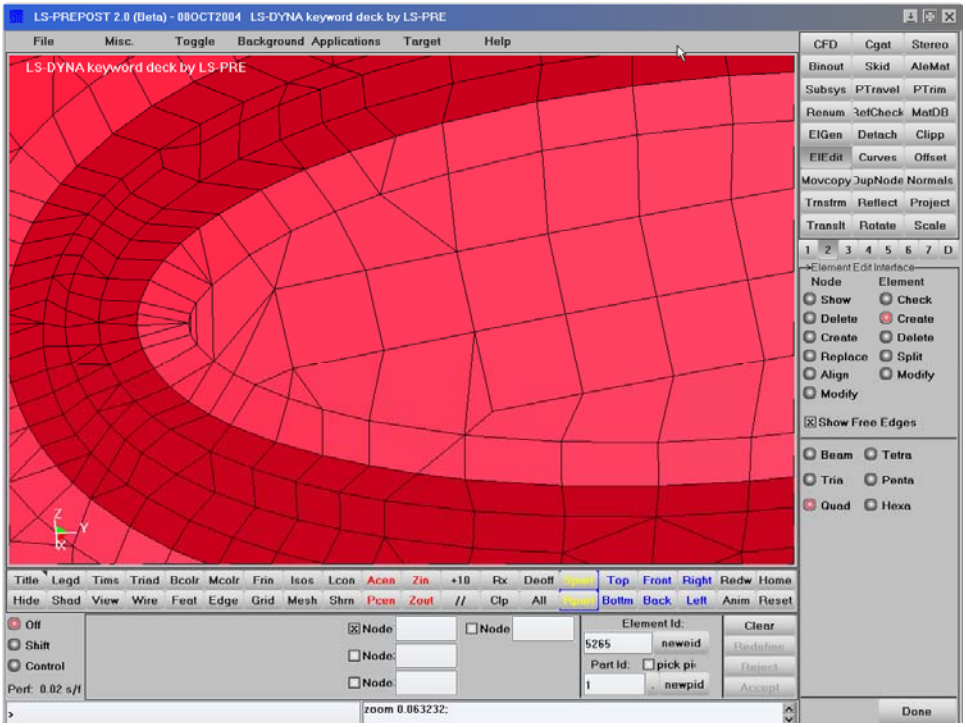

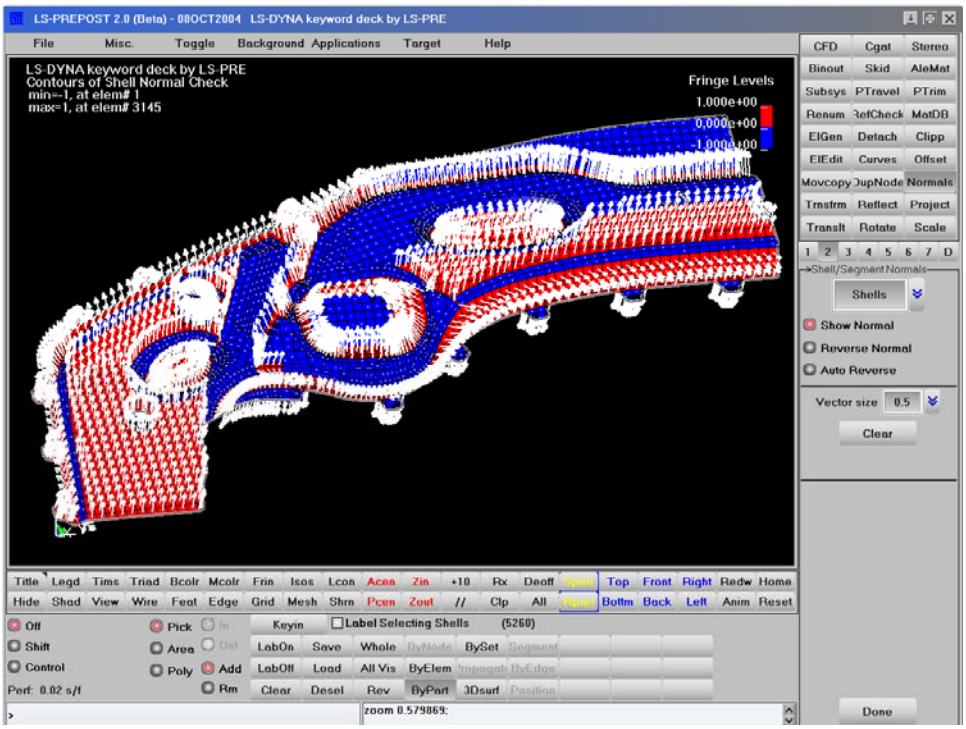

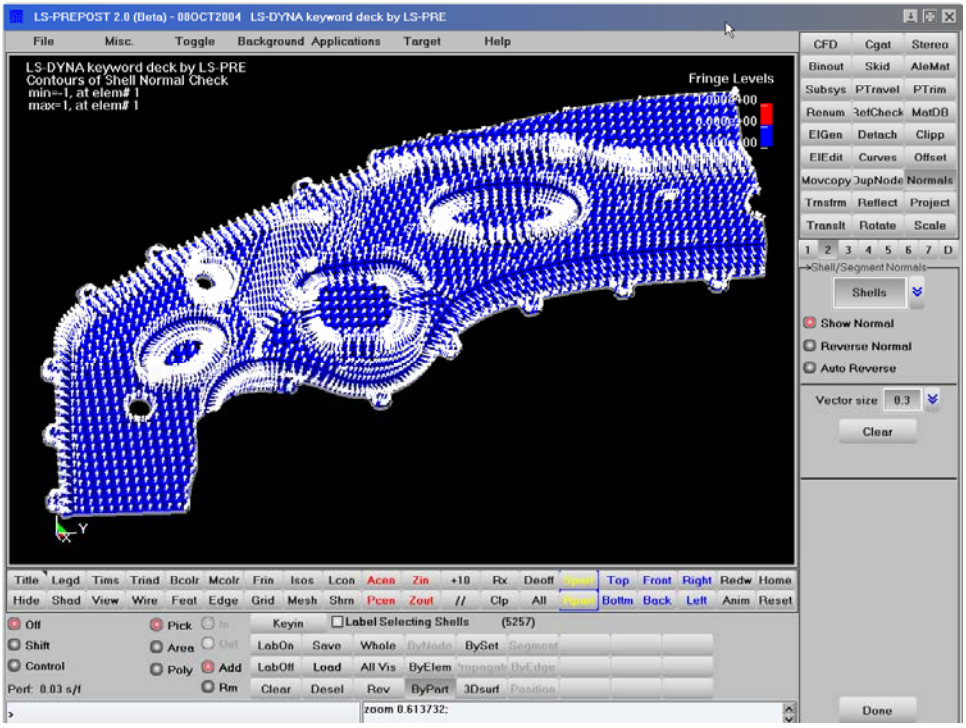

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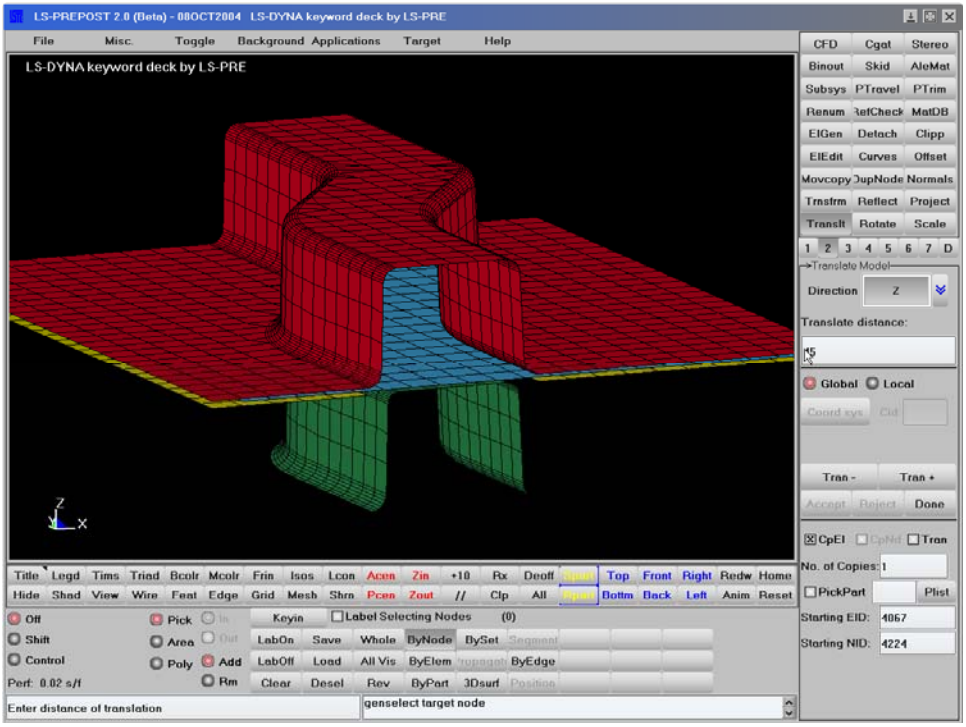
Mesh Data Manipulation

- Blank can be created by simple rectangular mesh with or without outline trimmed
- Punch can be created by offsetting part of the tool and copy the elements
- Blank holder can also be created by translation part of the tool and with elements copied



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Wall Creation for Binder

Purpose: To create binder wall

Selects the edges of the binder to create wall.

Giving: Angle,Length,Element segment and Element normal or Direction

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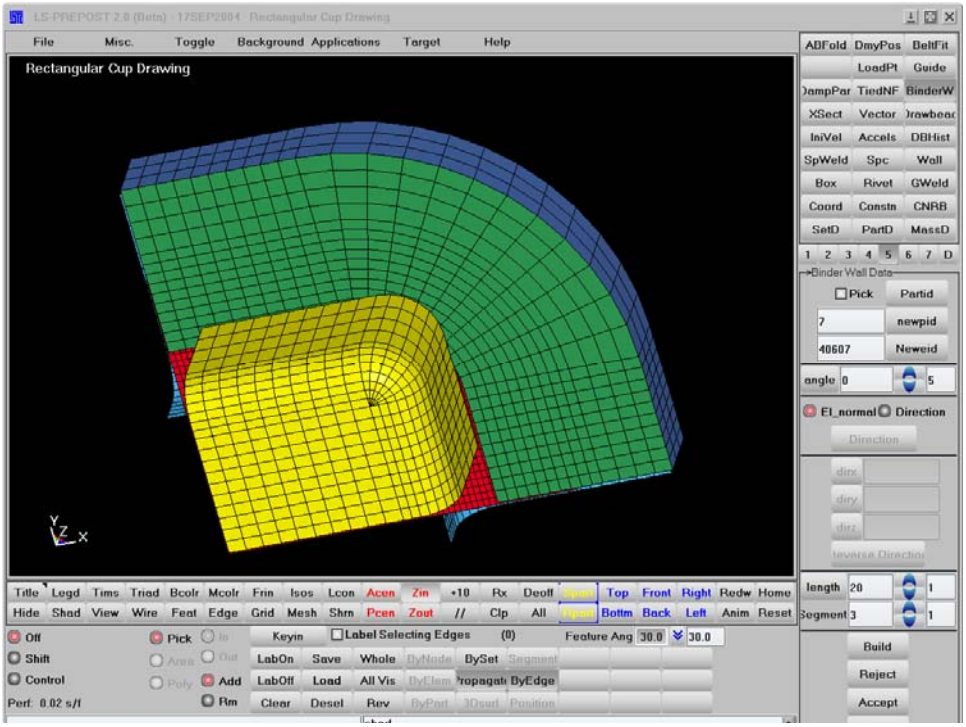

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Guide Building

Purpose: To create guides that will keep the blank in position

Selects a direction and two positions to create Guide.

Giving angle, length and below percent.

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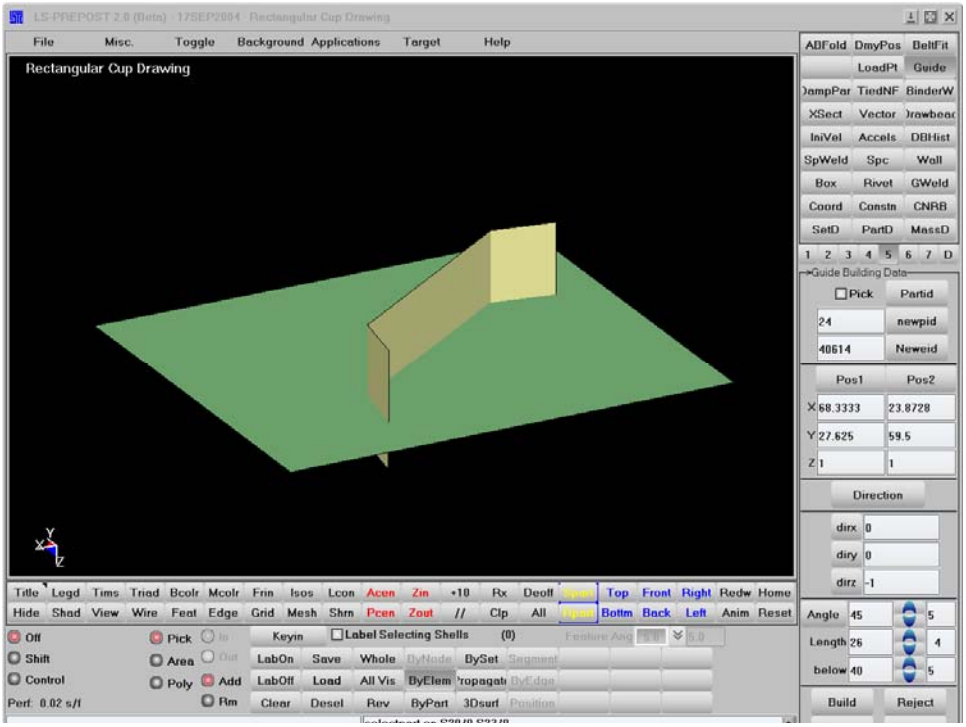

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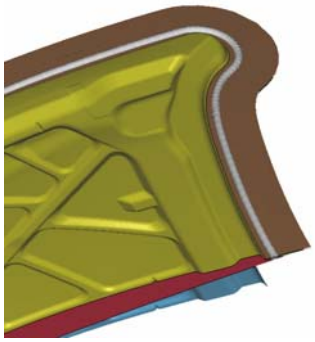
Metal Stamping – Draw Bead

To show/create/modify/delete drawbead data

- Create by beam part, or by node set, or by curves
- Automatically create all necessary keyword data cards
- Drawbead is shown as pipe with actual depth



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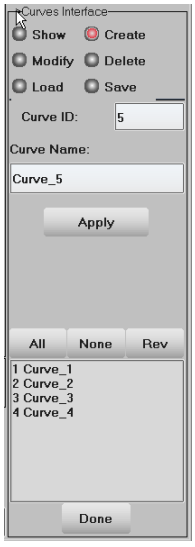
Metal Stamping – Curves

To show/create/modify/delete curves data

- A curve is a series of points connect together
- Points can be created by general selection
- Save – save curves data to file with IGES or VDA or simple format
- Load – read curves data from file
- Modify
  - Break curve
  - Joint curve
  - Translate
  - Insert and delete points



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Metal Stamping - PTRIM

- Part Trimming
  - Trimming a given part with open curves.
    - Trimming algorithms taking care of open curves.
    - Several open curves are allowed to trim at the same time.
    - Seed nodes can be provided to keep/remove the needed region.
  - Trimming algorithm will take care of the adapted elements as well as element thickness and initial stress/strains during the trimming process.

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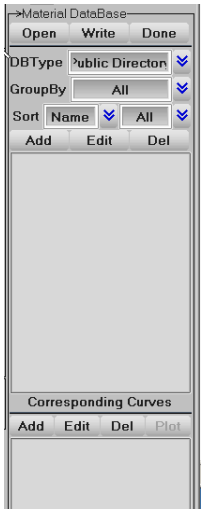
Material Database

- Manage material data as separate entity
- Put material data in files and directories.
- Define material data by public and private ownership.
- Material data including corresponding curves and coordinate systems
- Material data file/directory name can be save in configuration file
- Allow user to write to material database
- Material data can be easily transferred between model and database



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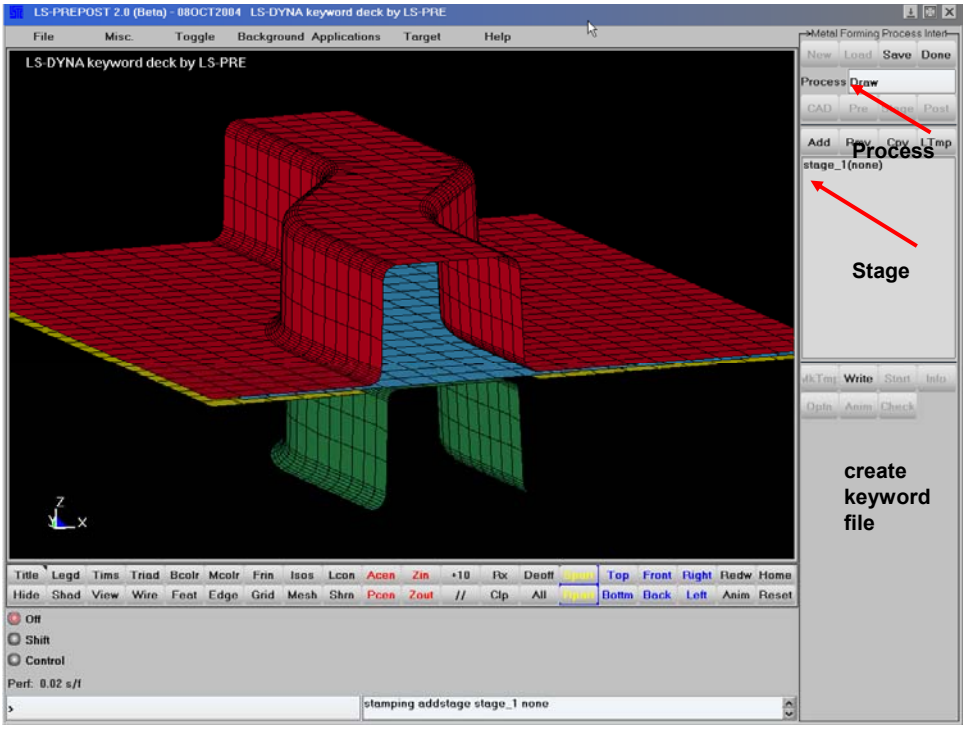
Stamping Process and Stage Manage

Multistage Process Setup

- Define a single stage
- Create keyword deck for a single stage
- Define a multiple stages
- Save/import stage templates
- Save/import process templates
- Establish Communication with Process Simulation Manager



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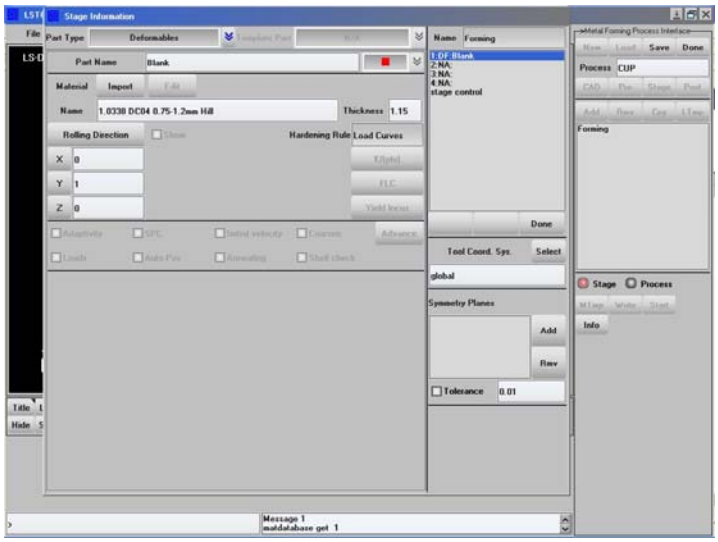
Define Blank (Deformable) Part



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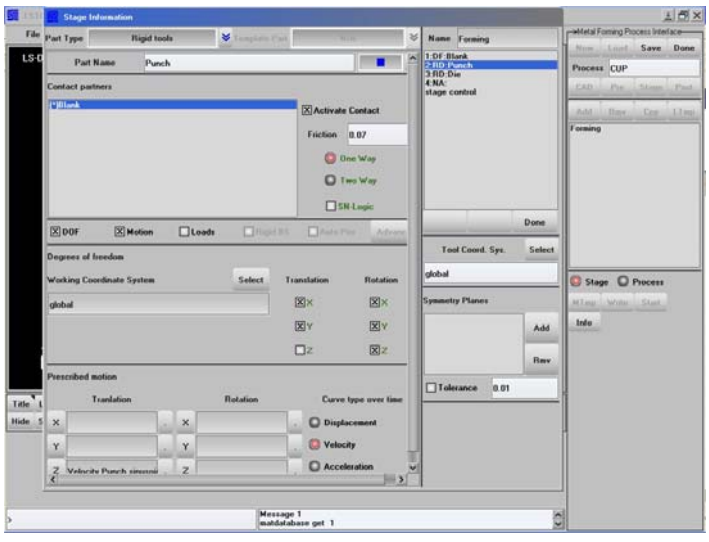
Define Punch (Rigid body) Part



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Define Stage Control data

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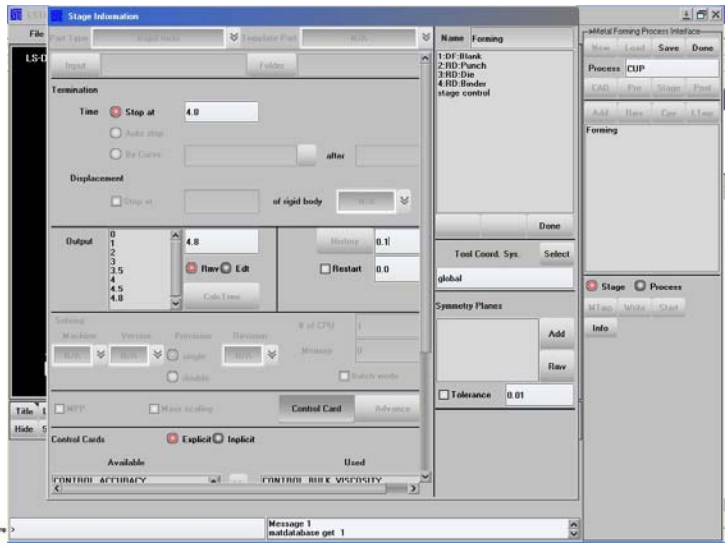
Define Stage Control Data



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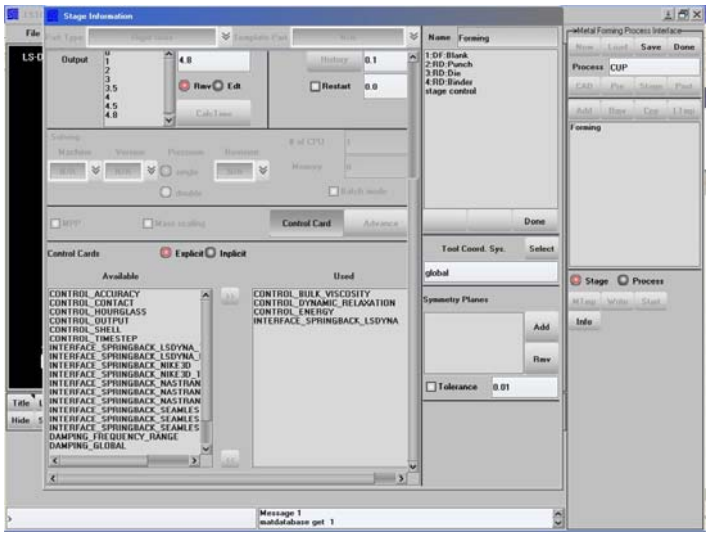
Define Stage Control Data(2-lower part)



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Curve Dialog

•Load Curve Creation/Edition/Selection Dialog

Load curves used in stamping process can be created, edit and/or selected here, then applied to certain fields of the user interface.

•Load Curve creation method includes –

•Sinusoidal: A curve that maps the keyword *DEFINE_CURVE_SMOOTH will be created

•Ramp: a ramp-shaped curve, that will increase linearly to a maximum ordinate value and then keep the curve with a constant value until termination time reached.

•Math: regular mathematical expressions are accepted, user can even select existing curves and associate them together with mathematical operators. (i.e. $crv1+$crv2*t*sqrt(t)) Defined curves will be discredited as requested by users.

•XY-Data: User input (X,Y) data pairs, preview panel shows the current curve defined.

•I/O: Import/Export curves from files with *DEFINE_CURVE keyword to/from the current model.

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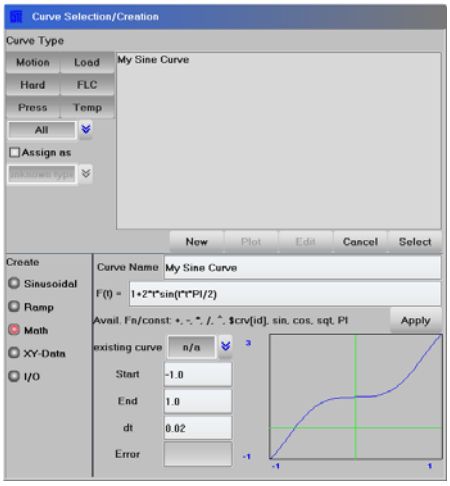
Load Curve Dialog



Load Curve dialog accepts mathematical expressions like the one below. It provides a preview for the curve as well.

$$f(t) = 1 + 2t\sin(\frac{\pi}{2}t^2)$$

$$-1 \le t \le 1$$

$$dt = 0.02$$

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Metal Stamping – FLD
Forming Limit Diagram

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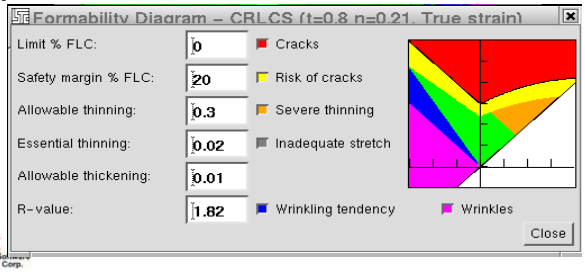
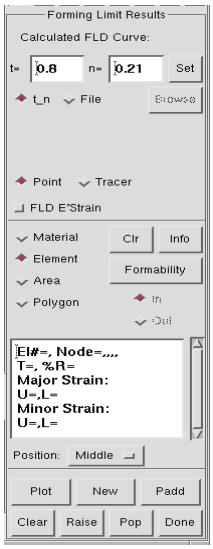
- Metal forming results for state of strain in formed part is analysed by reference to the forming limit curve for the material
- The biaxial strains for each element can be plotted on the FL Diagram to decide if the state of strain is safe, ie material is in a serviceable condition.
- The FLD is split into regions which are collectively known as Formability.





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Metal Stamping – FLD
Forming Limit Diagram

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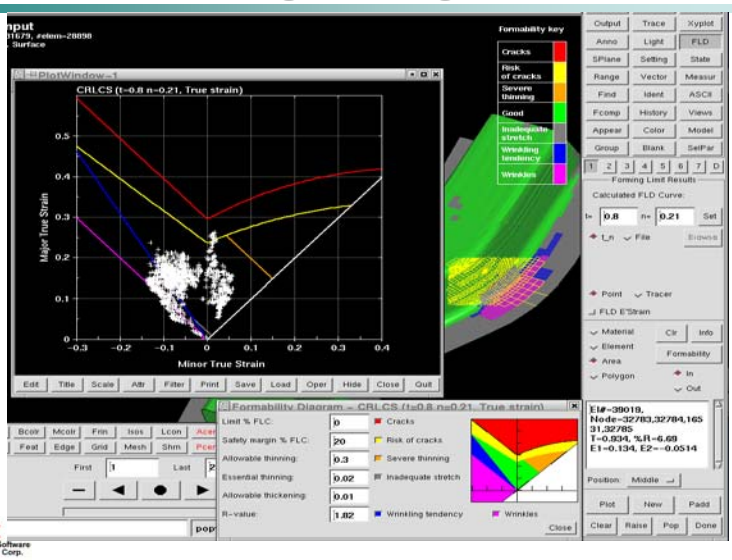

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Metal Forming Skid Mark Traces

- The motion of the blank over critical areas of the die or punch are tracked for the forming process.
- A set of line segments are picked on the die at the critical region. Where this line crosses the edges of the mesh representing the die gives points taken as the tracking positions on the die.
- The die tracking points are projected onto the blank at each plot data state.
- The points found on the blank as it proceeds over the die are connected up to appear as line traces. Each of these points is also tracked over the proceeding time.

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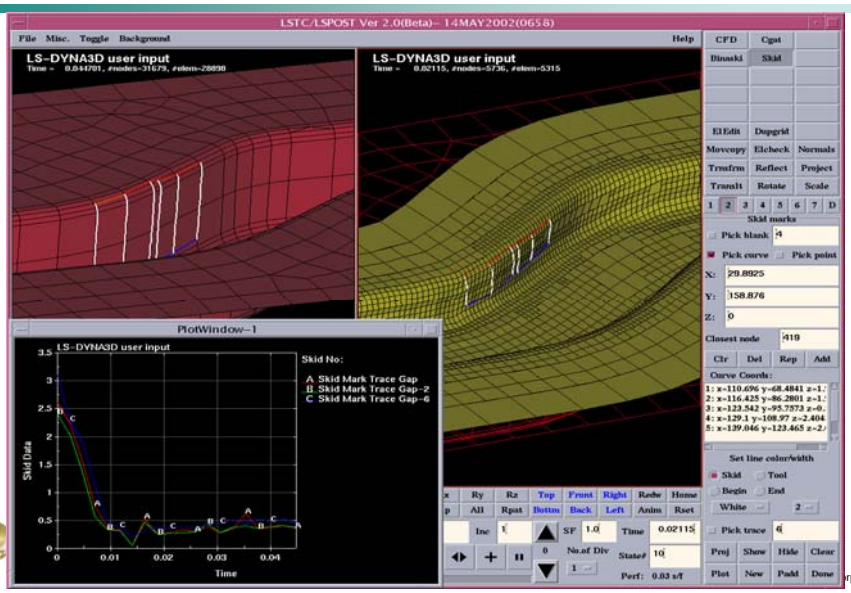
View of Skid Traces



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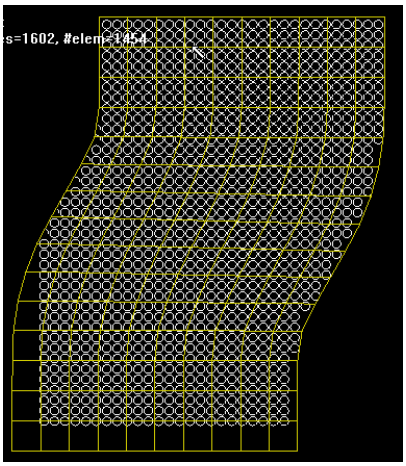
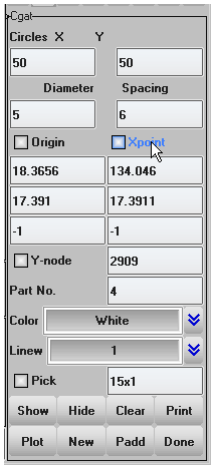
Circular Grid Generation Technique

- A method for measuring the biaxial strain on a formed part.
- The menu allows this procedure to be simulated by tracing parametric points on the mesh through the forming simulation





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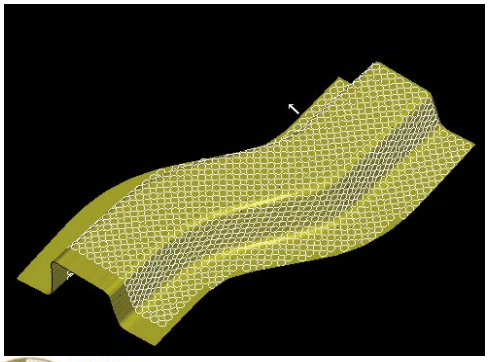
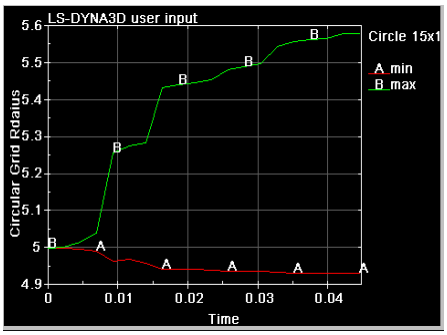
Circular Grid Generation Technique

- Here the part is completely formed with a refined (adapted) mesh to comply with the shape
- The change in the radii of any circle indicates the biaxial strain and can be compared to the real part scribed with the same grid, $\varepsilon_1 = \ln(d_1/d_0)$ $\varepsilon_2 = \ln(d_2/d_0)$





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Current Developments

- LS-Prepost 1.0 is frozen, only bugs fix will be made
- LS-Prepost 2.0 is introduced with new capabilities
  - Can be downloaded from:
    ftp://ftp.lstc.com/outgoing/lsprepost2
- More extensive Metal stamping process setup for different stages
- Tool meshers refinement
  - Reduce memory requirement
  - Be able to select different geometries (surfaces) for different meshing parameters
  - Assign part IDs to different surfaces
- Save project file for future restart

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Current Developments

- Post-processing report – generate report in HTML format
- Multiple models section cut with ability to measure
- 64bit version to post-processing of very very large models (> 2 million elements) with many states
- Fast graphics rendering by parallel processing for very large models
- Use standard GUI interface toolkit for both Unix and PC/Windows