New Features in LS-PrePost and its Future Development

11th German LS-DYNA Users Forum 2012

October 9-10, 2012

By
Philip Ho
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Outline of Talk

- Current status of LS-PrePost and the different releases
- New GUI of LS-Prepost 3.x/4.0
- New graphics rendering in 4.0
- Other New Features in LS-PrePost 3.2/4.0
- Current and future developments
- Summary and Conclusion

Version 3.2

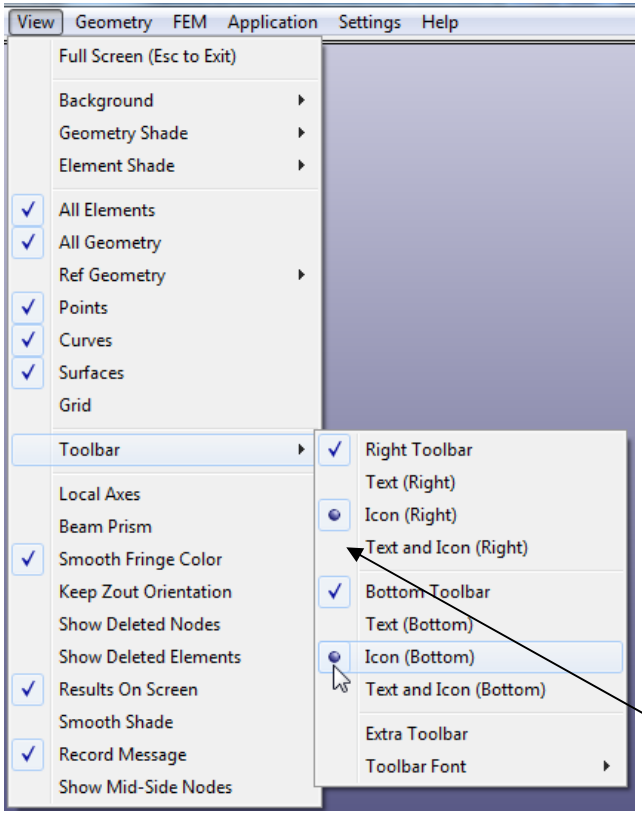
- Is the current release of lsprepost
- Still support the old interface (version 2.4) users can toggle between old interface and new interface by F11 function key
- Tools to help users to transition from old to new interface
- Support Linux 64-bit systems, Windows 32bit and 64bits, Apple Mac OSX
- Continue to improve in stability, robustness and features
- Download: http://ftp.lstc.com/anonymous/outgoing/lsprepost/3.2

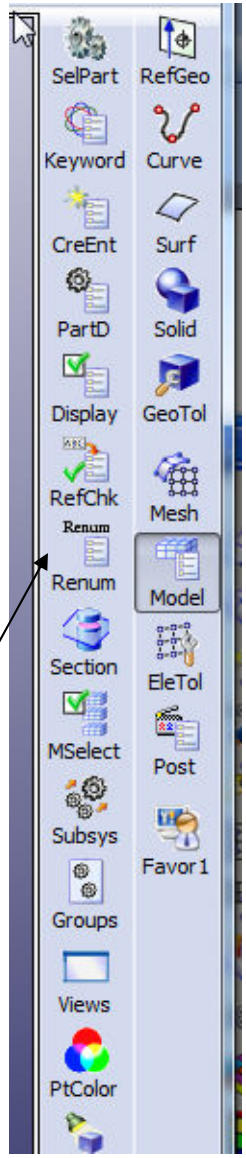
Beta Version 4.0

- Version 4.0 uses new rendering technique to render the finite element model results in many times faster than the older versions of LS-PrePost
- In its final testing stage before formal release in mid-November, 2012
- Requires graphics cards that support openGL version 3.3 and higher
- Enter CNTL-L twice before loading data to disable new fast rendering
- Download:

  http://ftp.lstc.com/anonymous/outgoing/lsprepost/4.0

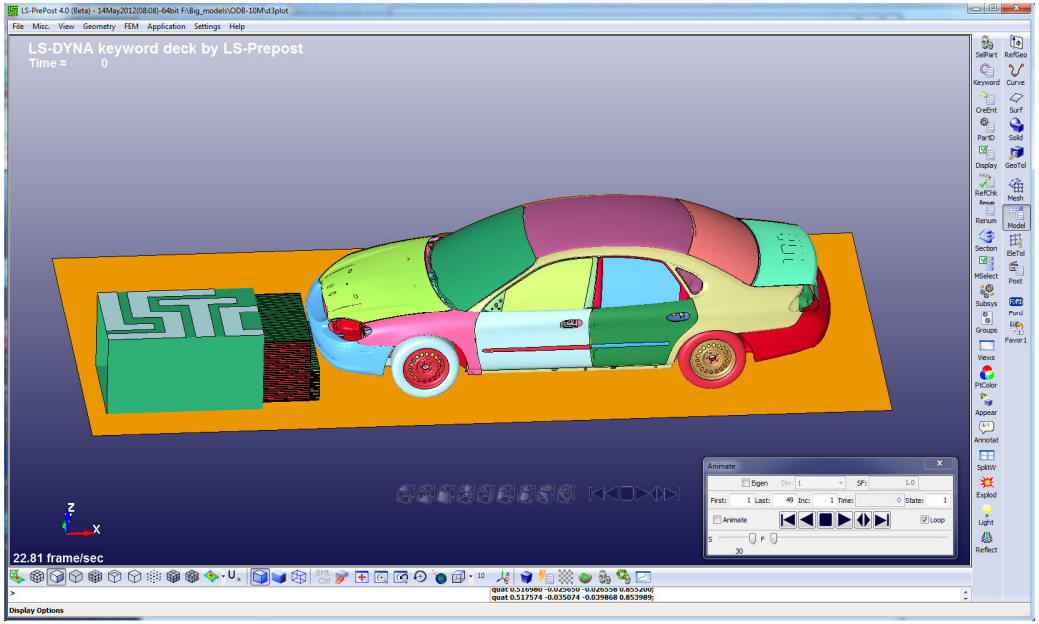
LS-PrePost 3.2/4.0 GUI



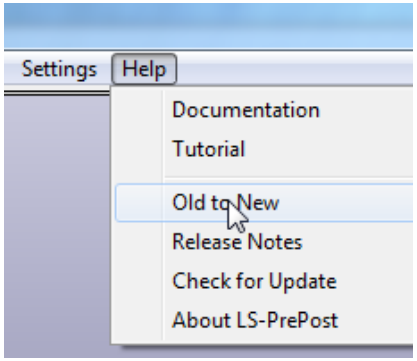


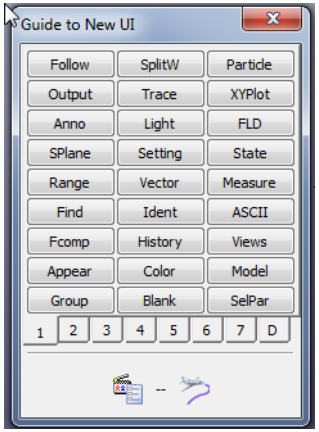
Toolbar without text

Toolbar with text



Old to new interface guides users to the icons in the new interface

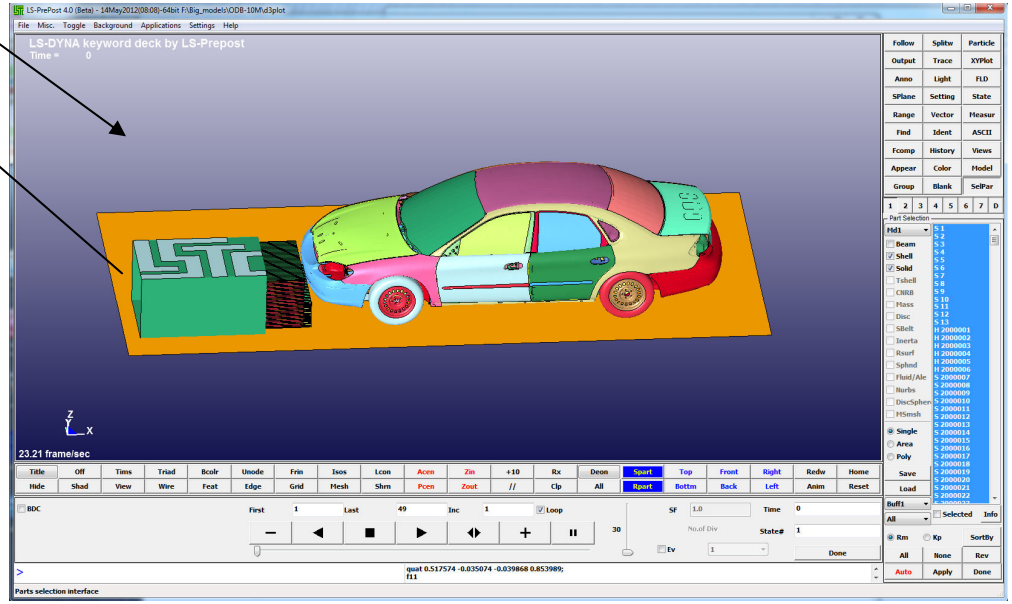




Function key

F11

Switch between the old and new



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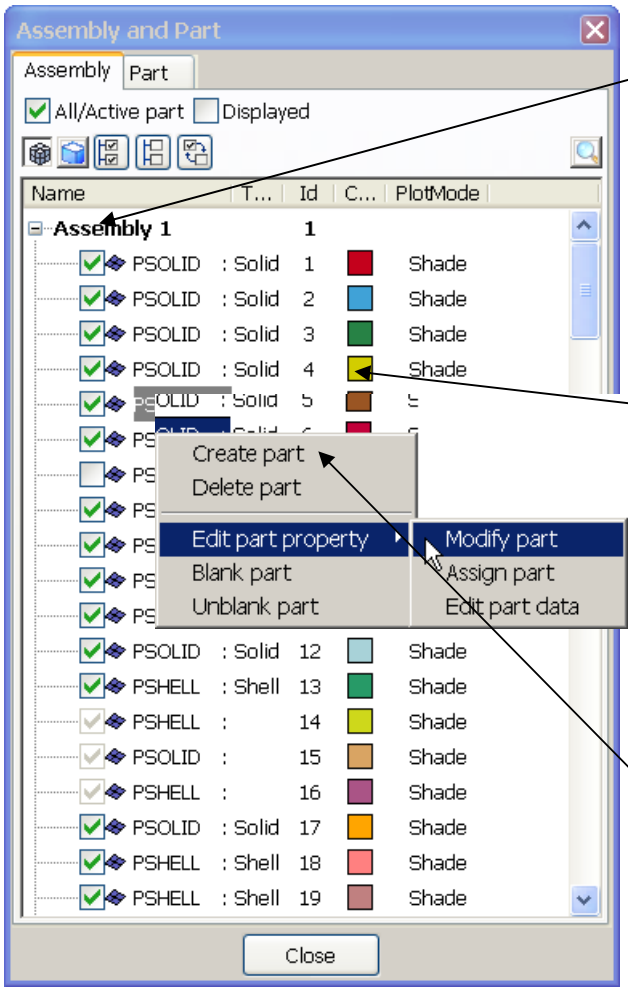
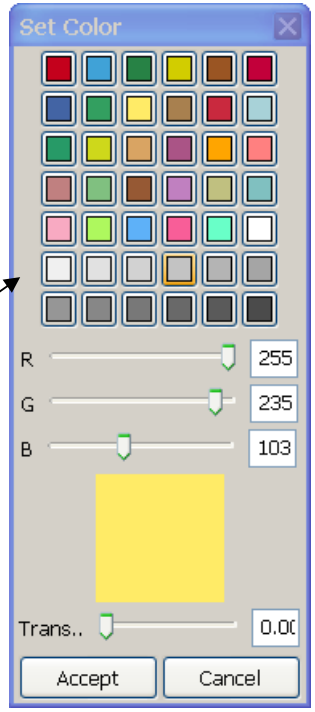
LS-PrePost 3.2/4.0 GUI



Assembly consists of geometry data and FE data

Right click on the color box to activate part color interface

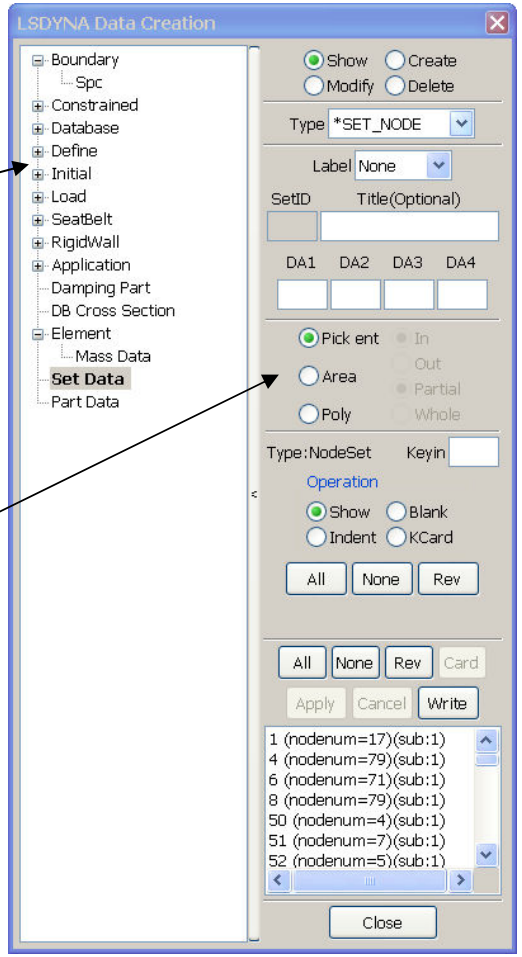


Right click on the part name to activate different operations

LS-PrePost 3.2/4.0 GUI

All LS-Dyna data entity operation from old interface Page 5 are consolidated into one single tree

Each data entity will has its own interface in this area



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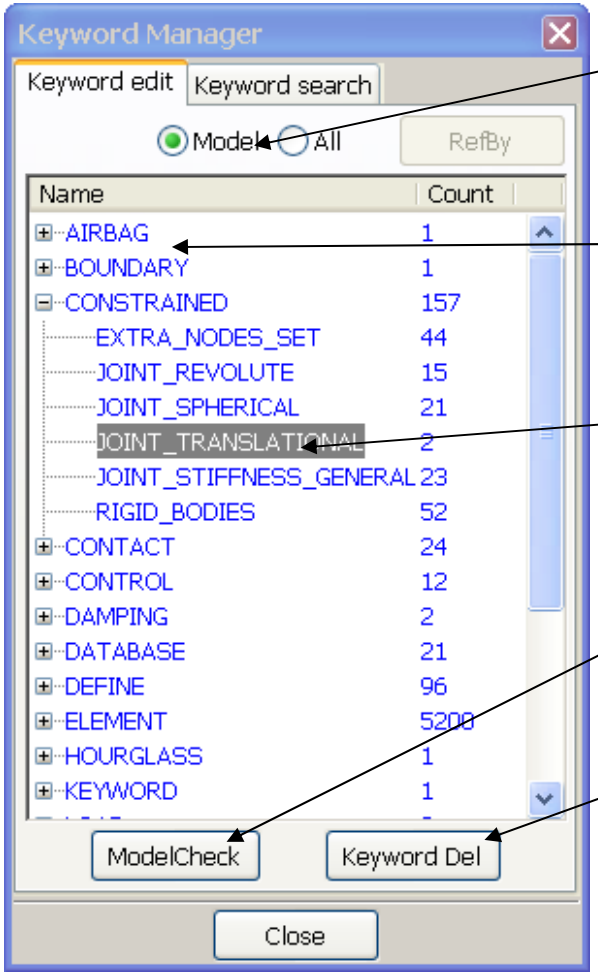
LS-PrePost 3.2/4.0 GUI



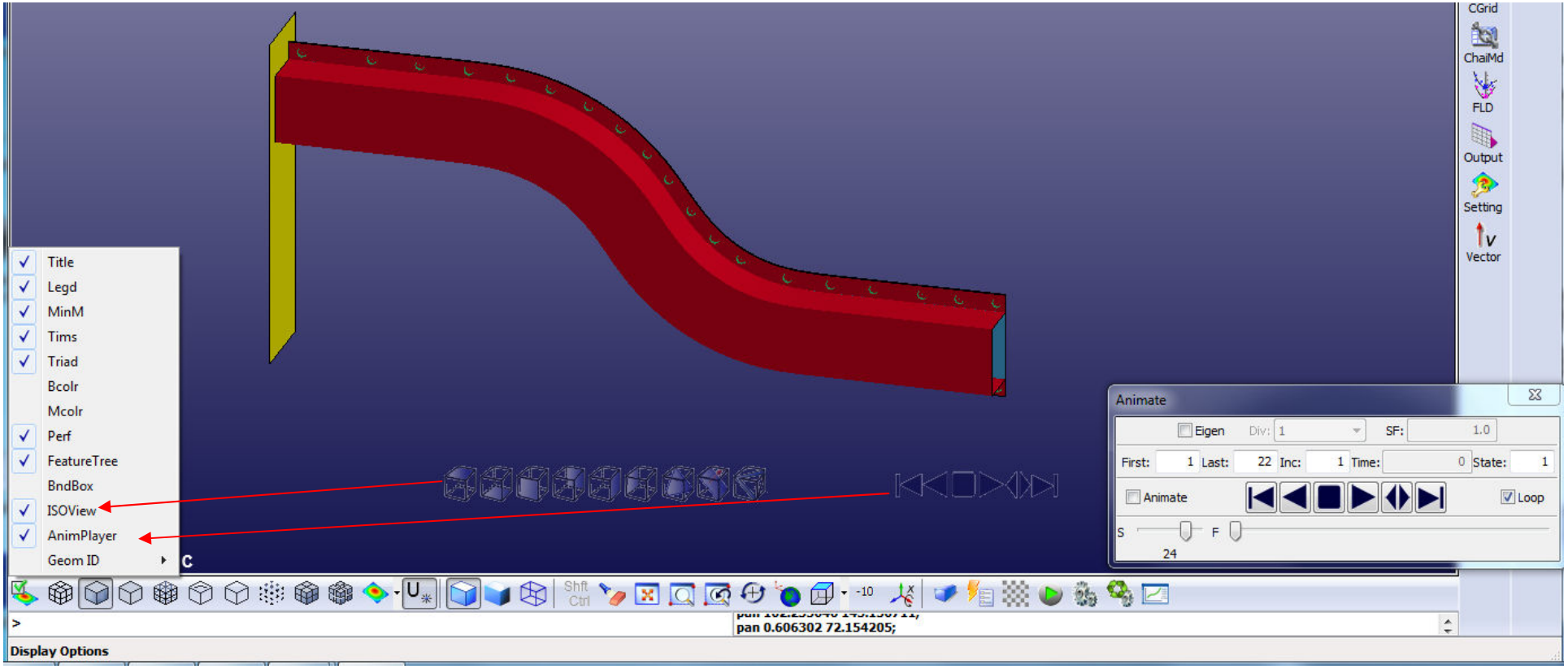
Choose data for this model or All Keyword data

A data tree to list all Keyword data

Double click the sub keyword name to pop up the keyword form

Model check can be activated from here

Keyword data can be deleted here



- Semi transparent view control
  - Can be moved to any position on the graphics windows
  - Can be changed to smaller size
  - Beside the regular 6 views, there are iso view and cutting plane control
- Semi transparent animation control
  - Can be moved to any position on the graphics windows
  - Small foot print compare to the Animation dialog
- Both controls can be turned on and off in the “Display Options” icon

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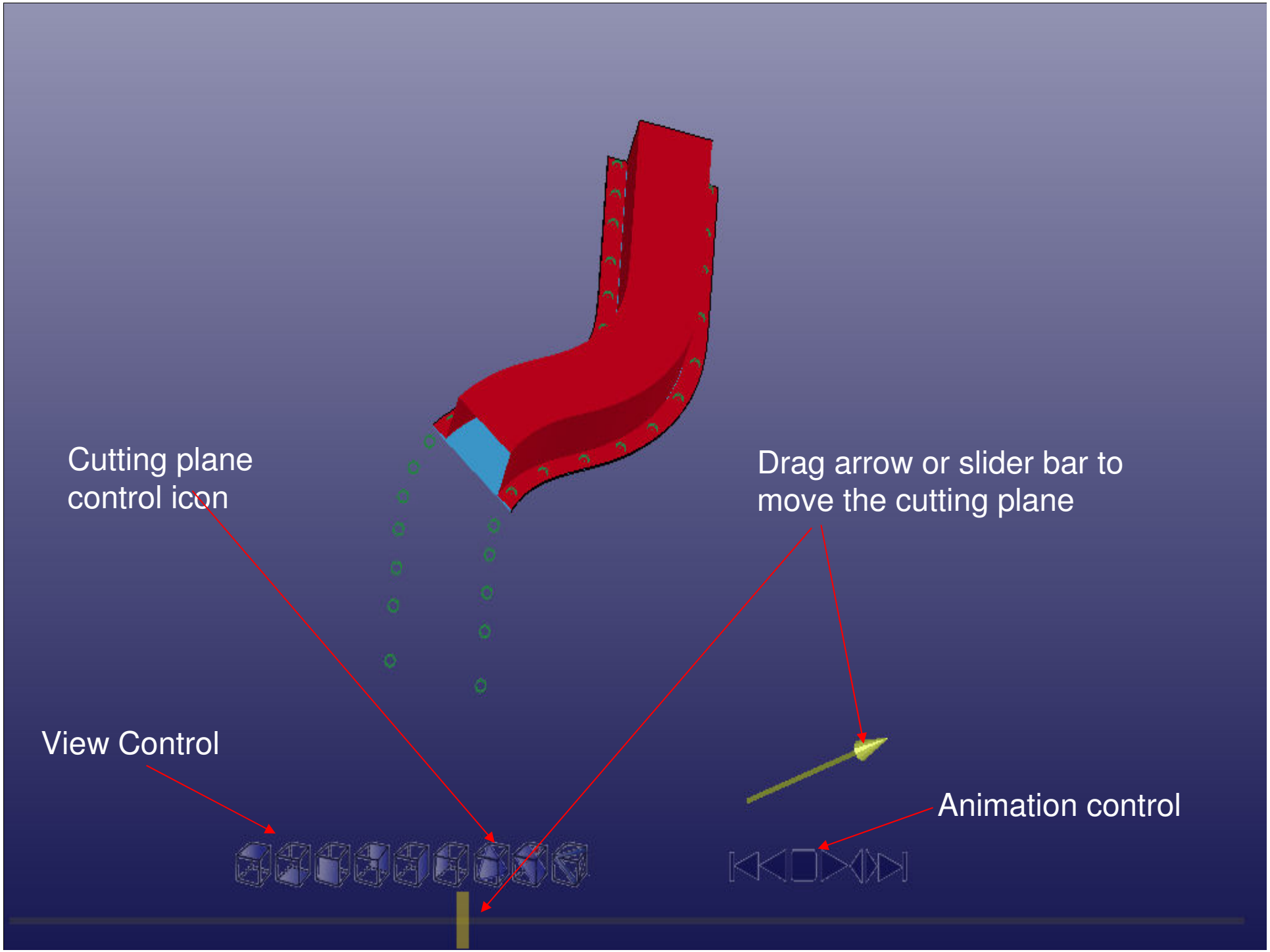
Cutting plane
control icon
Drag arrow or slider bar to
move the cutting plane
View Control
Animation control

Configuration and Setup

- Starting from LS-PrePost version 3.2, each version has its only setting and configuration directory
- The LS-PrePost configuration file resides in the following directory:
- Windows: %AppData%\LSTC\LS-PrePost4.0
- Linux: $HOME/LSTC/LS-PrePost4.0
- The directory contains configuration, last touch information, and recent files history

New Graphics Rendering in version 4.0

- Taken from a visualization research project at UCSD that was funded by Honda R&D North America (Ed Helwig)
- Part based data structure – more efficient data organization
- VBO – Vertex Buffer Objects reduce data communication between CPU and GPU
- GLSL – OpenGL Shading Language to compute polygon normal on GPU, no need to compute normal in CPU and to store it in main memory
- Viewport Culling – any part not within the viewport will not be rendered
- Sub-Part – divide a very large part into sub-part to utilize viewport culling

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New Rendering Performance

- 5.65million elements (4.29m Shells, 1.36m solids, some beams, 1680 parts), 59 states
- On HP Z800 8-core, with Nvidia Quadro 6000, timing in frames/sec

	Old	New
Static Rendering	2.1	30.4
Animation 1st loop	1.3	14.2
Avg. Animation	2.1	16.5

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New Rendering Performance

- 10.65million elements (8.44m Shells, 2.21m solids, 5223 beams, 816 parts), 49 states
- Spot weld beam was drawn as circle
- On HP Z800 8-core, with Nvidia Quadro 6000, timing in frames/sec

	Old	New	Speed up
Static Rendering	1.2	22.1	18
Animation 1st loop	0.4	10.2	--
Avg Animation loop	1.25	10.5	8.4

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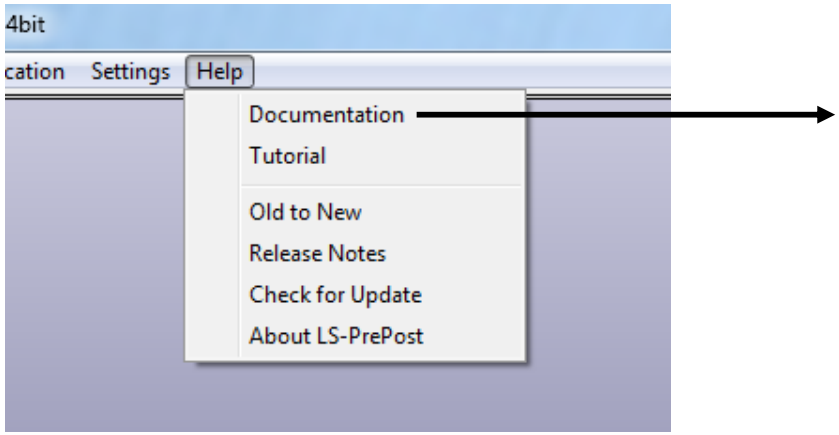
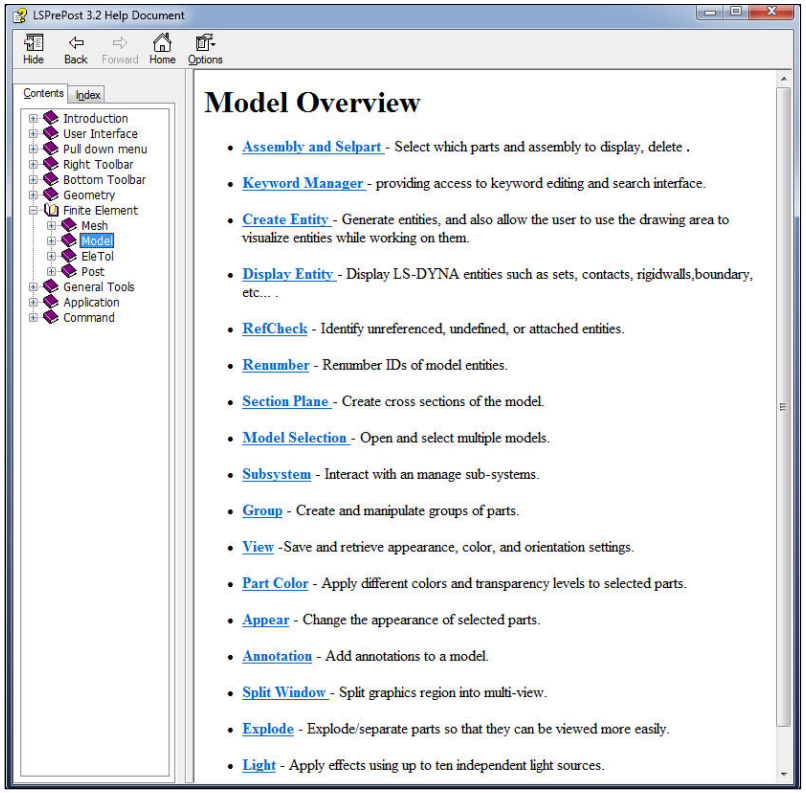
User group and Online Documentation

- User Group – more than 2200 members as of May, 2012
  - http://groups.google.com/group/ls-prepost
- Documentation and tutorials can be accessed from the pull down HELP menu





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Other new features and improvements in LS-PrePost3.2/4.0

Batch mode Operation – (-nographics)

- Batch mode operation with full graphics capability using LS-Prepost
- Run lsprepost 3.2 with command file and use -nographics
- Works very well on PC/Windows platforms
- Has limitations on Linux platforms:
  - Machine to run lsprepost with –nographics must have OpenGL and X capability
  - Local machine that remote logs into to the remote machine also must have OpenGL and X capability
  - If the above conditions not met, use the Linux virtual frame buffer (Xvfb) for batch mode:
    - Xvfb :2 -screen 0 1074x800x24

LS-PREPOST Features for LS-980

- Support for Multi-physics keywords: *CESE, *ICFD and *EM
- Multi-physics keyword files can be displayed and edited
- Models can be a mixture of Multi-physics and Mechanical meshes
- ICFD modeling can be 2D or 3D with mesh adaption (re-meshing)
- Support for ICFD LevelSet functions

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LS-PREPOST Features for LS-980

- LS-980 output is an extension to the standard d3plot. LS-PrePost recognized that Multi-Solver output data is presented in the files and is flagged to read the data according to which Multi-physics is found.
- Each solver has a different format and different output variables. These can be scalar or vector quantities

LS-PREPOST Features for LS-980

- Output fringes are available via the Fcomp menu and Extend button. If the model contains mechanical parts the standard buttons are used like Stress, Ndv, etc.
- Streamline for Multi-Solver vectors via the Trace menu and the Streamline button.
- Section plane vectors.
- Stochastic particles.

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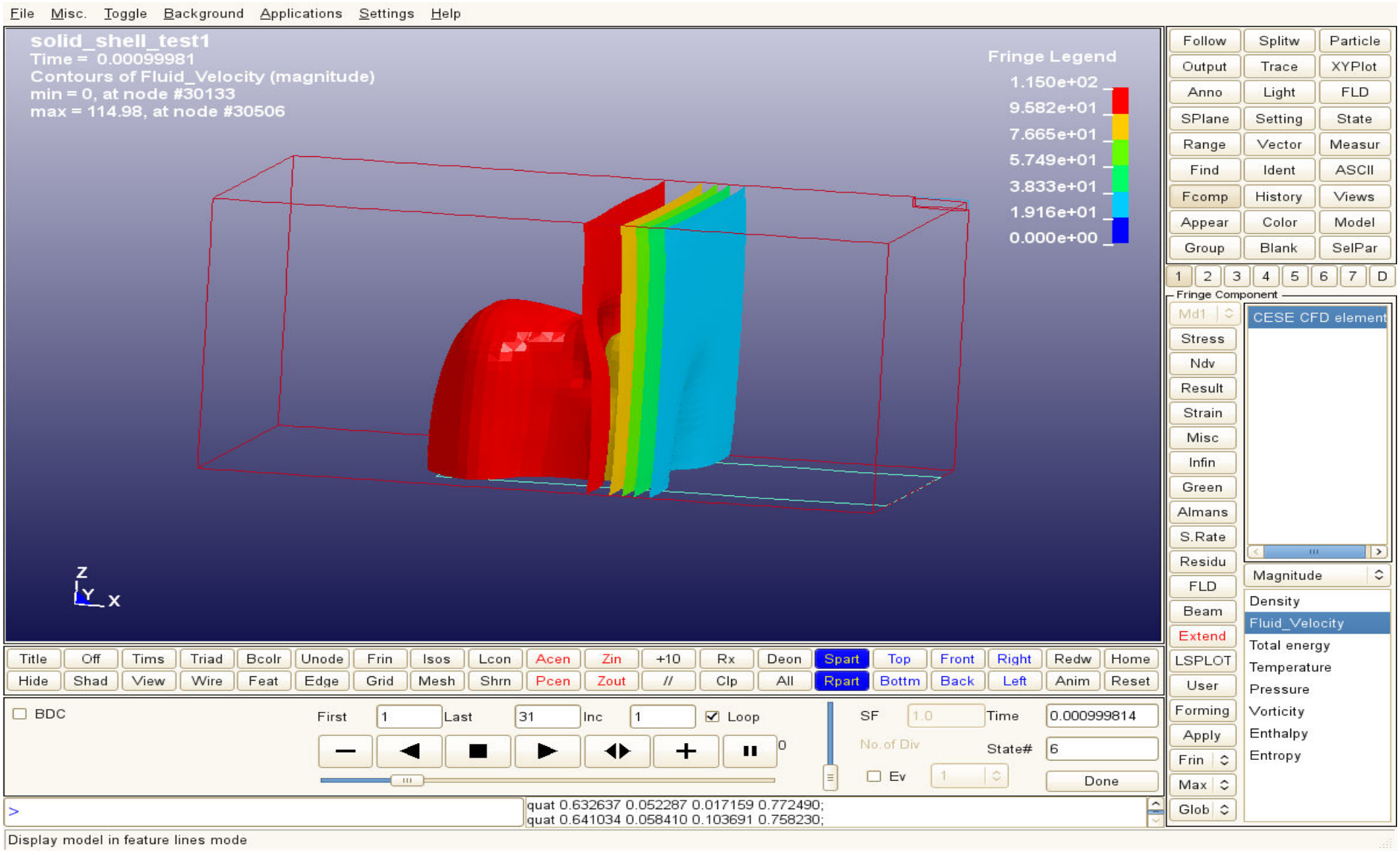
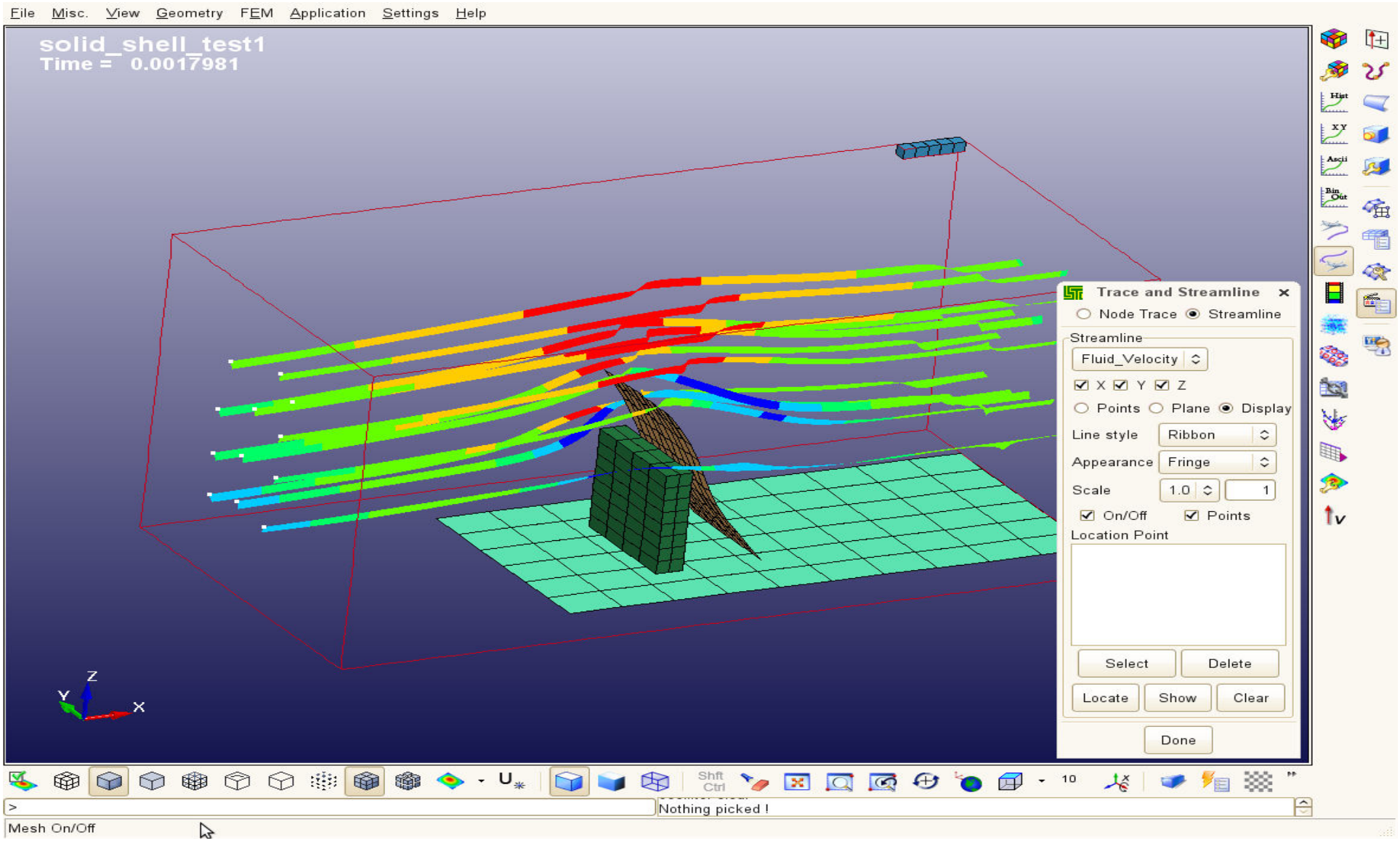
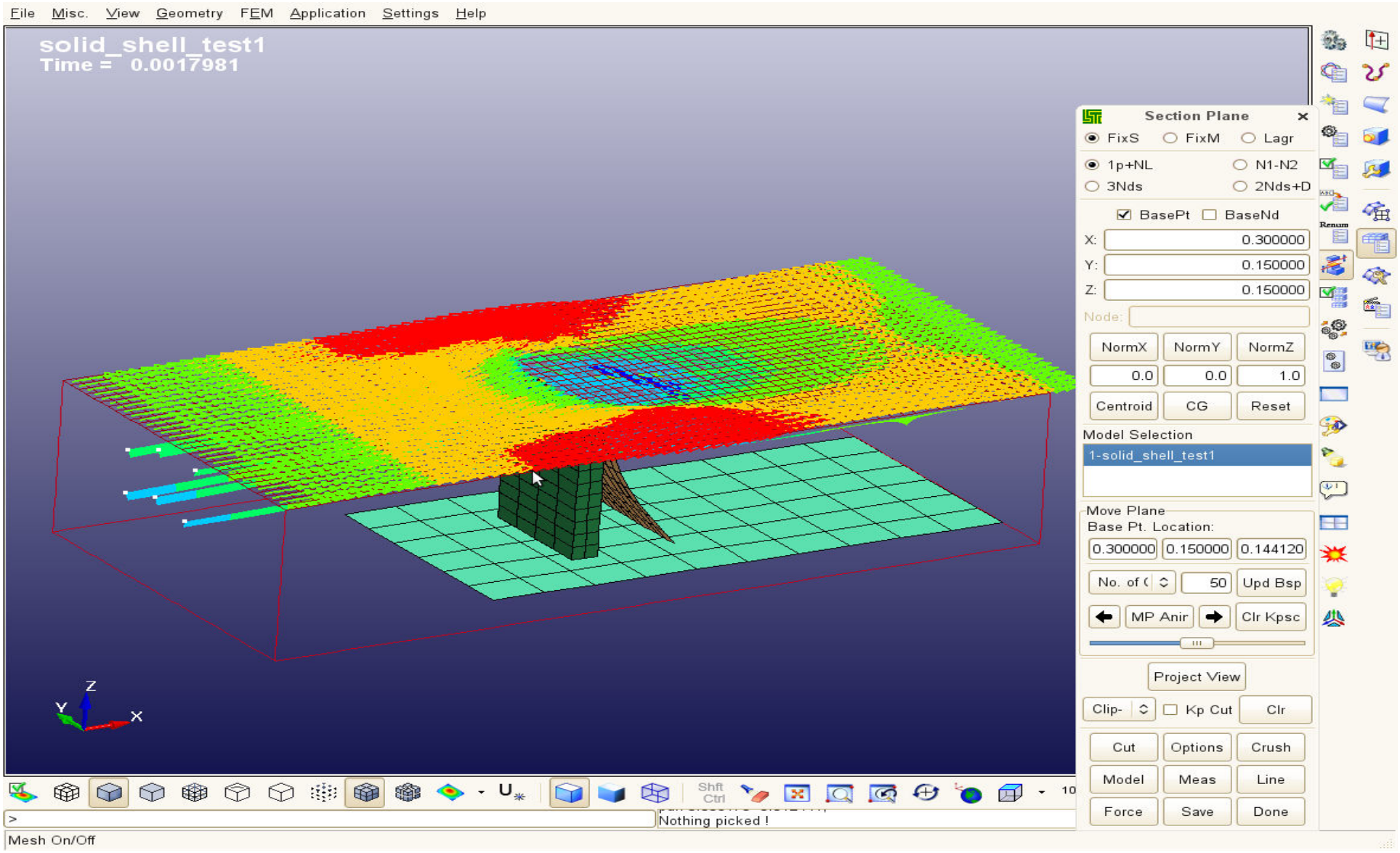
Fringe plots as Iso-surface



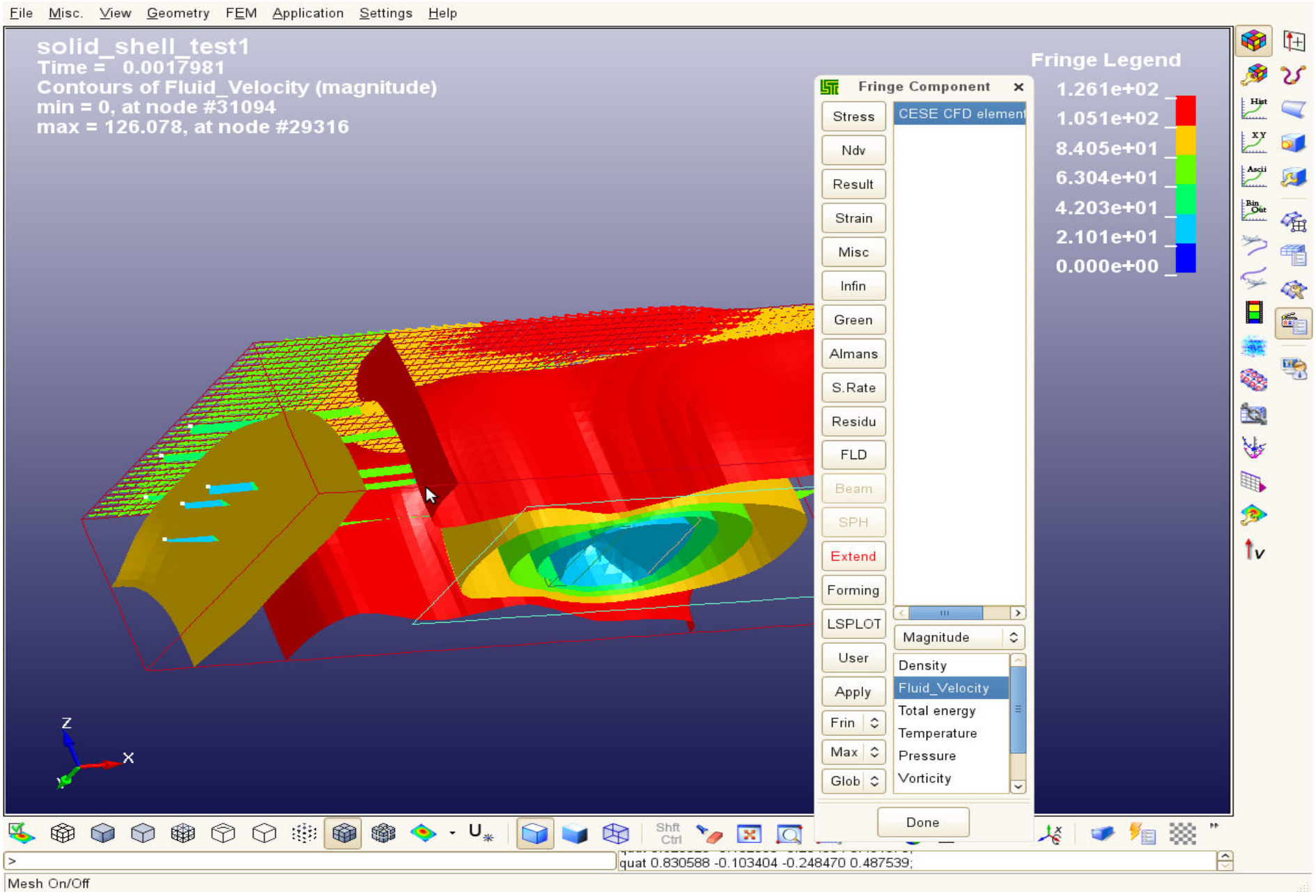
Streamlines of velocity



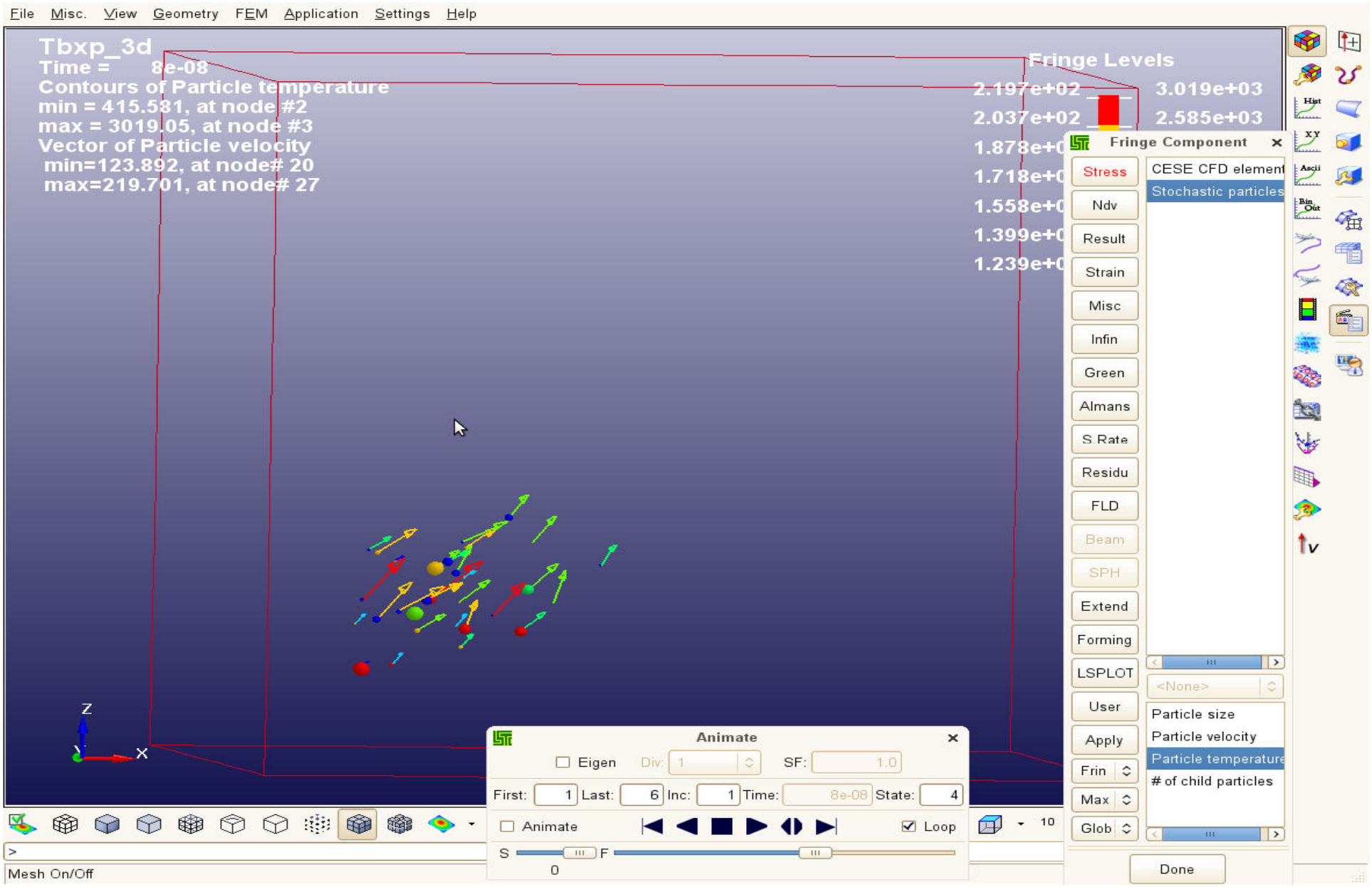
Section plane velocity vectors



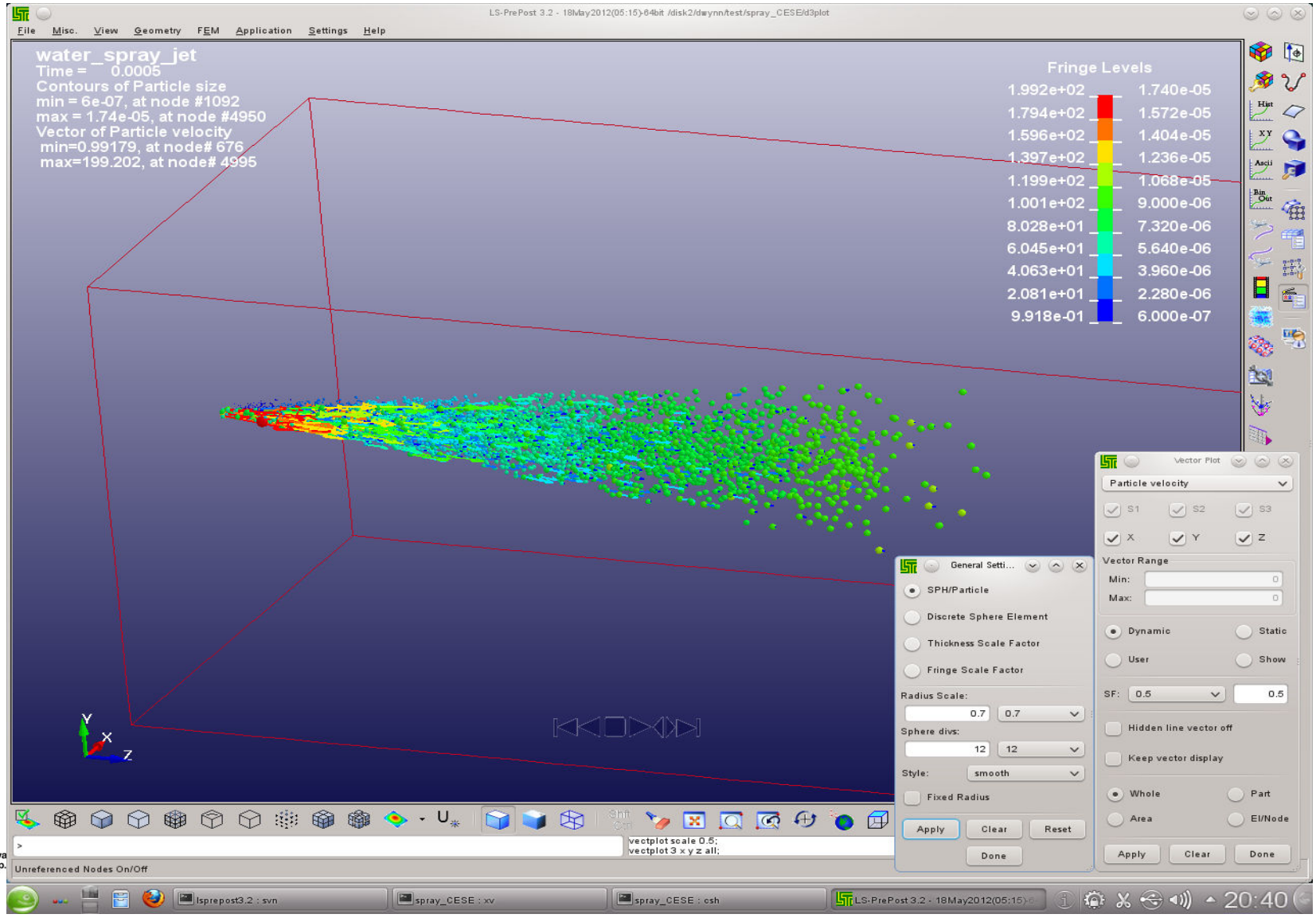
Iso-surface, s-plane vectors, and streamlines



Stochastic particle fringe and velocity vector



CESE with stochastic particles, fringe by size with velocity vectors



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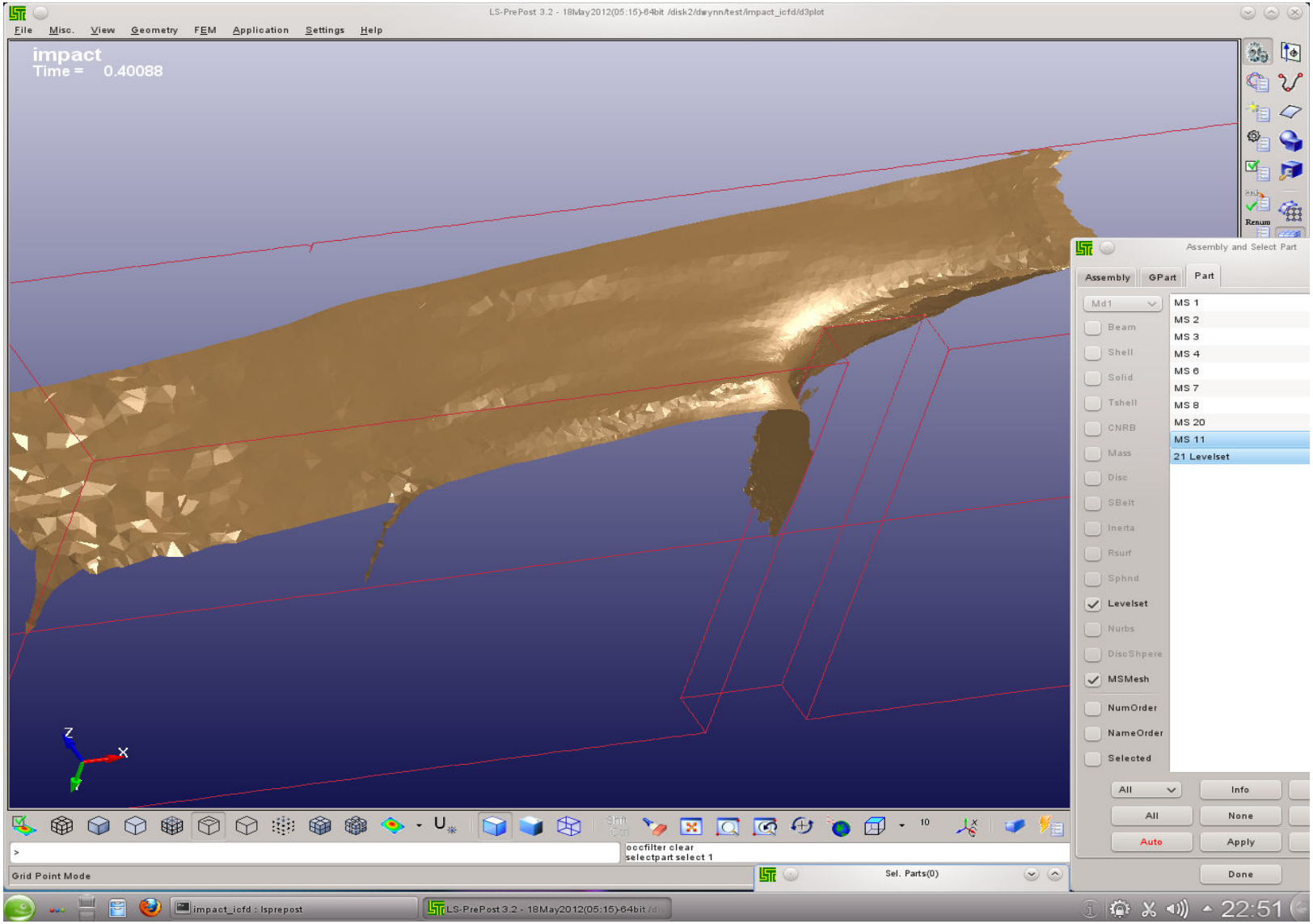
Levelset surface is invoked in the SelPar menu only if the data is in the d3plot, and can be manipulated like a part.



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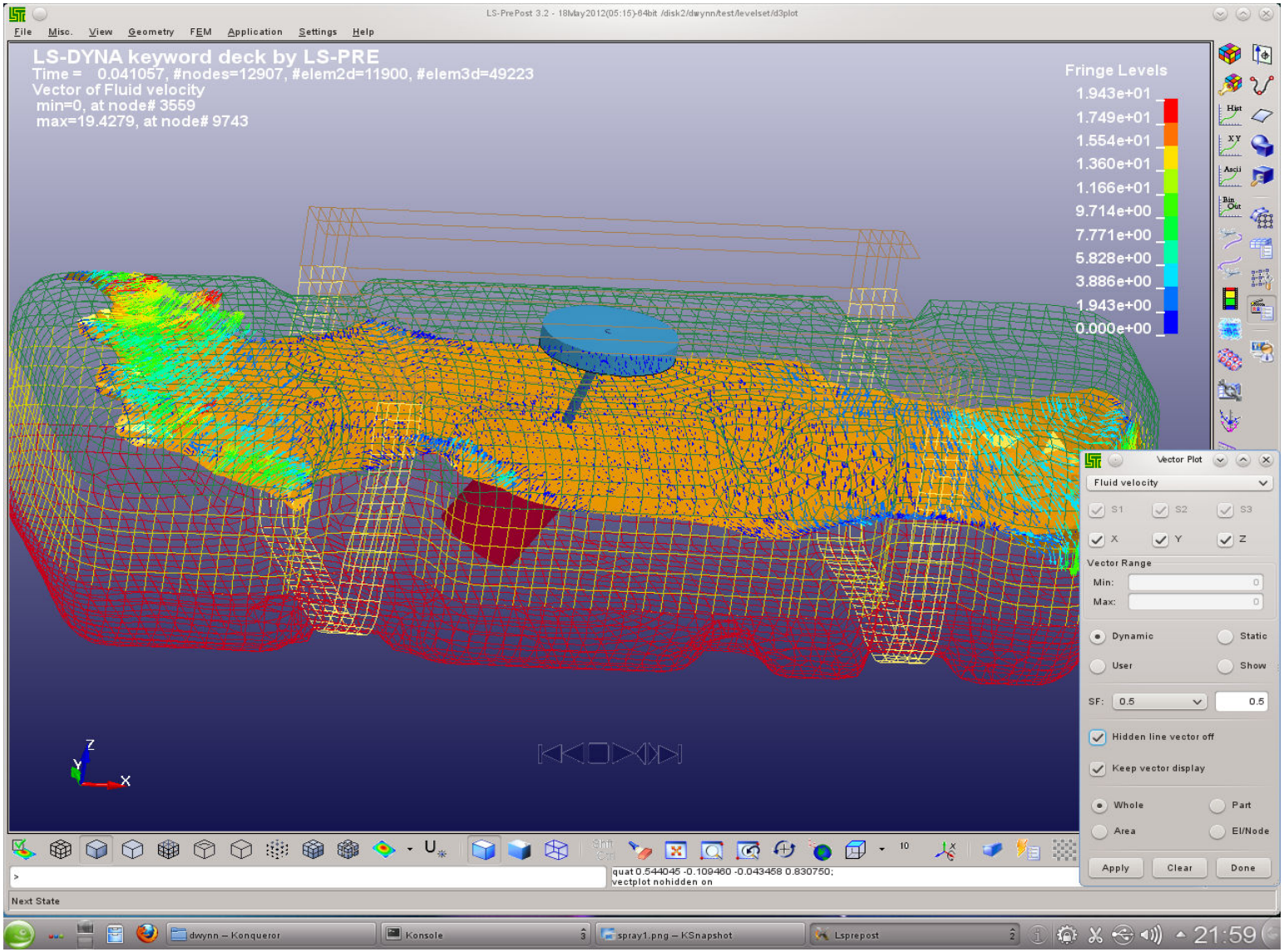
Fuel Tank Fluid Surface shown by Levelset part. Levelset can be fringed with CFD variables, and with velocity vectors on the surface



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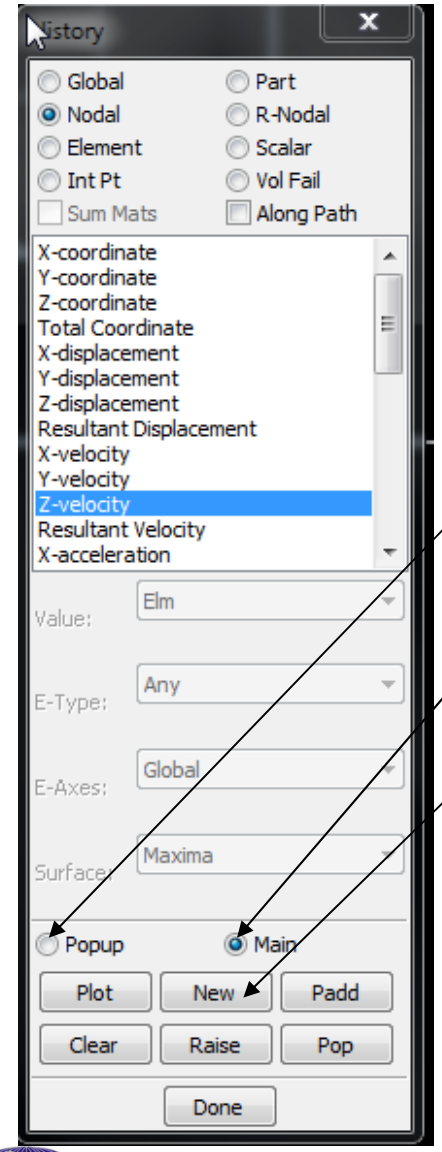
New XYPLOT layout



- New XY plot interface allows xy plots to be drawn to main graphics windows, or to a separate page with multiple plots per page

Select “Popup” for the old XY plot interface

Select “Main” to activate new XY plot interface

“New” button will plot the xy data in the new port, if the page is full, then new page will be created automatically

In the bottom toolbar, this icon to activate page control

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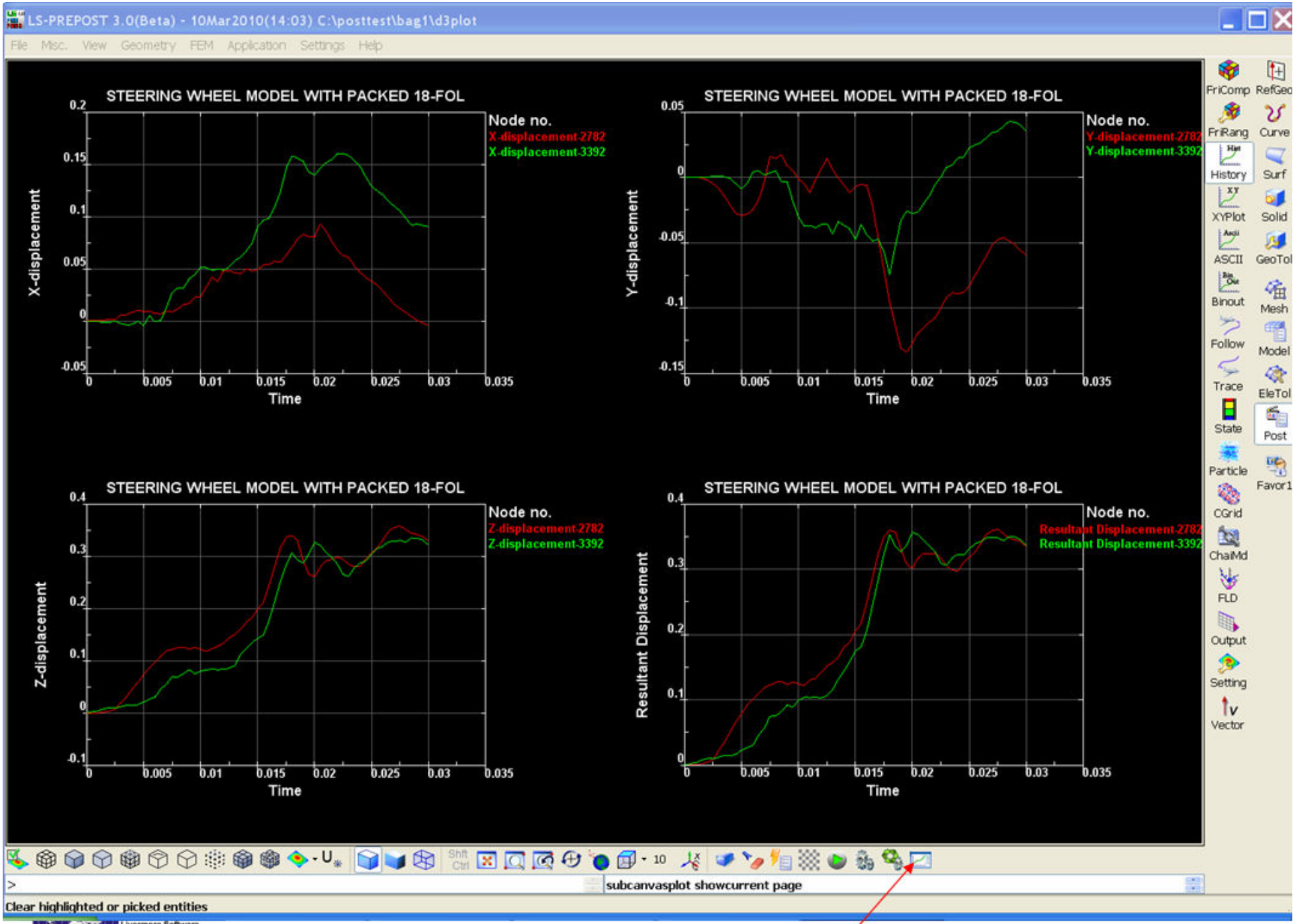
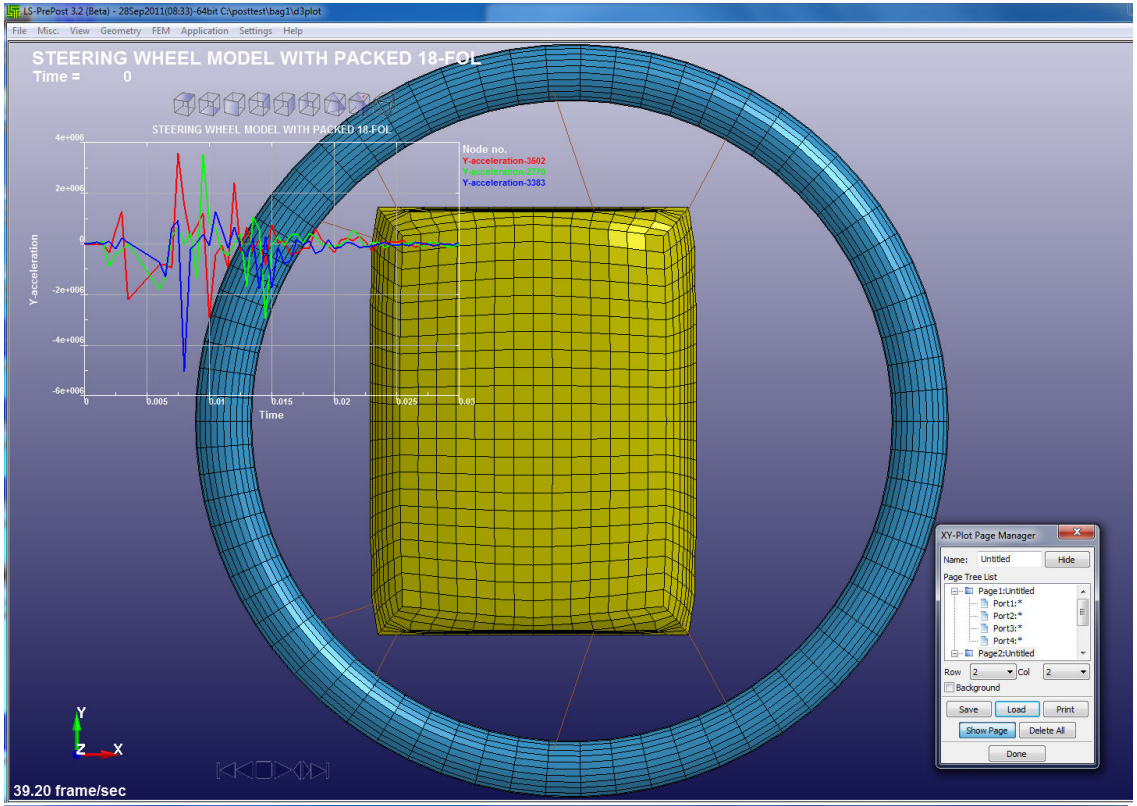
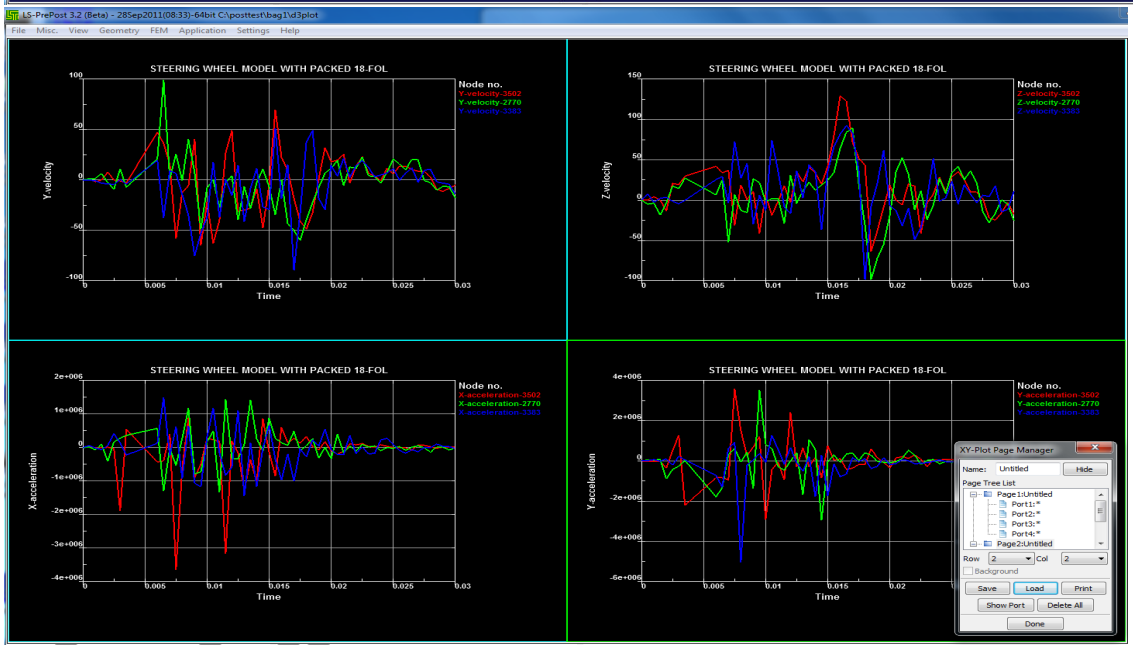
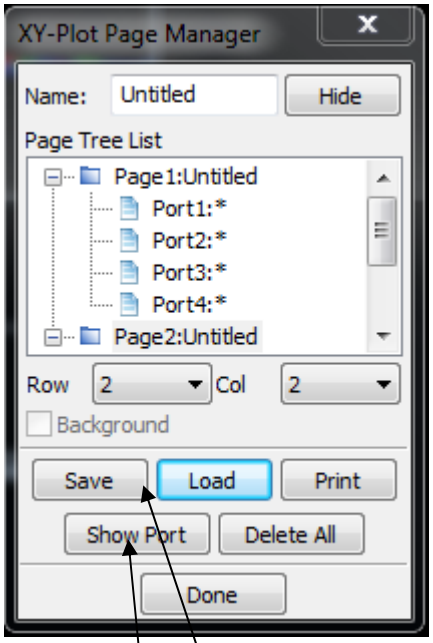


XY graph icon to switch back







Show Port/Show Pages to toggle between main window and plot window pages

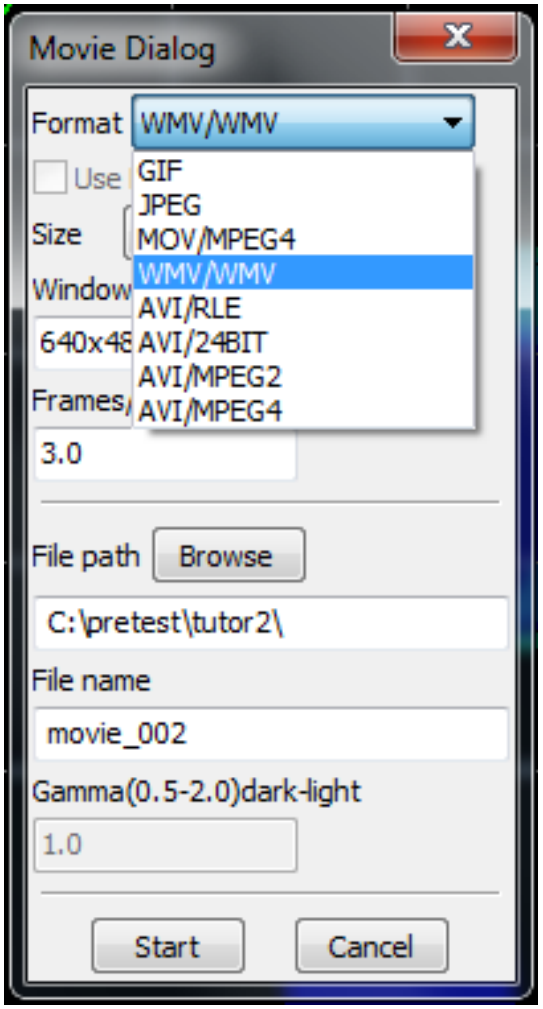
Save/Load buttons to save plots into a file and can be loaded back into lsprepost in another session

New Movie Formats

- .gif – Graphics Interchange Format
- .avi – Audio Video Interlaced
- .wmv – Windows Media Video
- .mov – Apple Quick Time Movie

Both .wmv and .mov format are small in size, but not good quality

24bit .avi gives the best quality but very big in size



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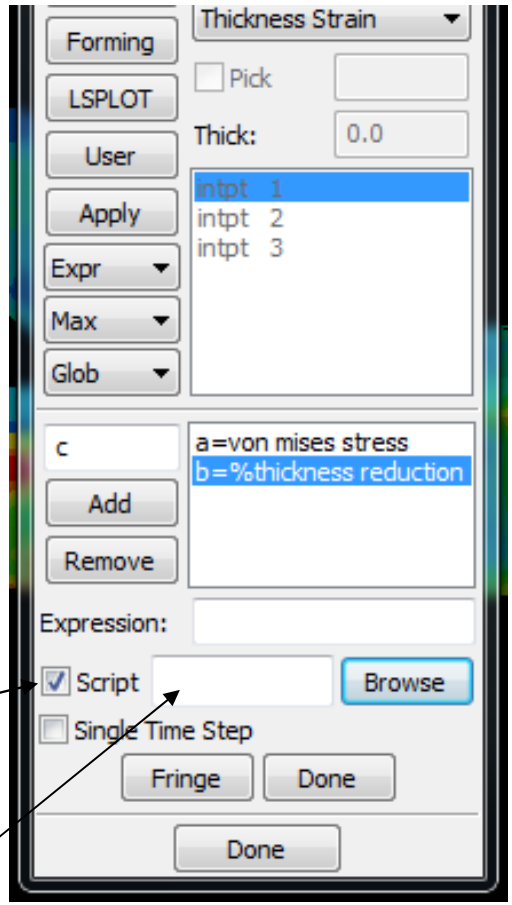
Fringing by Script

- In the fringe expression interface, use script (a programming code) instead of an expression
- Assign components to variables
- User writes the script (code) to perform whatever data manipulation to get final result



Check this box for using script

Enter script file name here or use file browser

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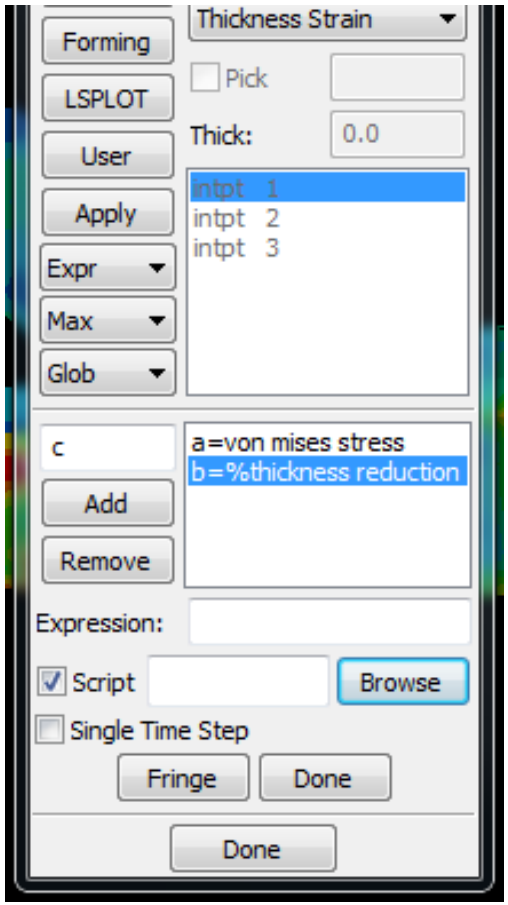
Fringing by Script

- Example of the script, it is a formatted ascii file

```
/* a = some stress value   b = %ThicknessReduction   */
define:
Float MyExpressFunc(Float a, Float b)
{
      Float ret = 0.0;
      if( a < 0 && b > 0.2)
      {
         ret = 3.0;
      }else if ( a >= 0 && a < 0.05 && b > 0.22)
      {
         ret = 2.0;
      }else if ( a >= 0.05 && b > 0.25)
      {
         ret = 1.0;
      }
      return ret;
}
```



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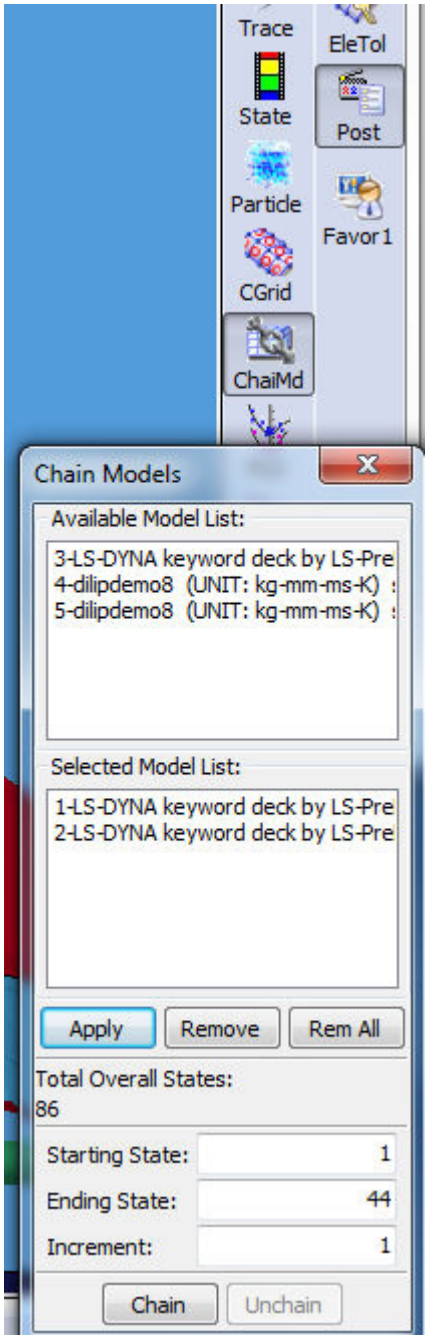
Model Chaining

- To chain multiple sets of post-processing result into one continuous animation
- Read in as many d3plot file sets as need to be chained, each will be a separated model
- Set drawing primitives like transparency, drawing mode, etc. for each individual model
- Go to Post->ChaiMd, select the model from the list and click Apply
- After selecting all models, click “Chain” to apply chaining, then animate
- This is not a new feature, but was not introduced in the past



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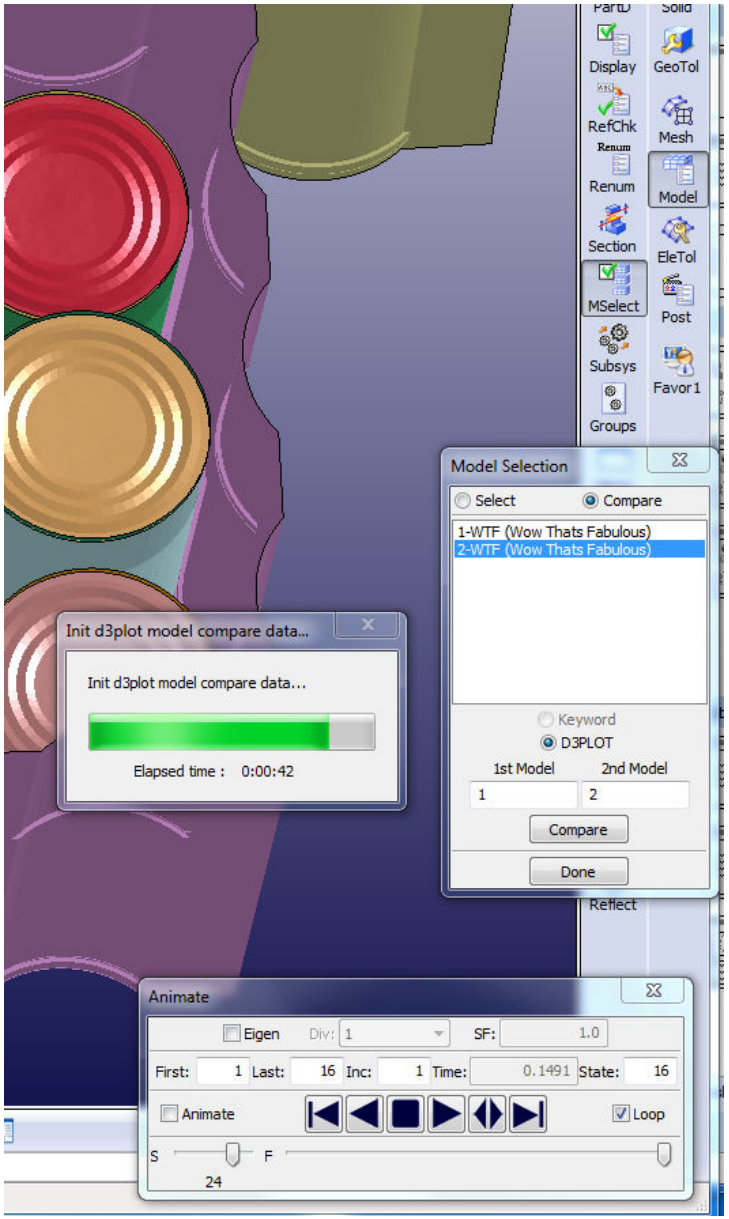
Model Compare for Post-Processing

- Read in 2 sets of d3plot files
- Model should be similar
- Go to Post->MSelect, and select 1st and 2nd model for comparison
- Click “Compare” and wait for the data processing (will take time depends on model size)
- Compare will show different data in the following categories:
  - Summary
  - Global
  - Displacement
  - Stress
  - Strain



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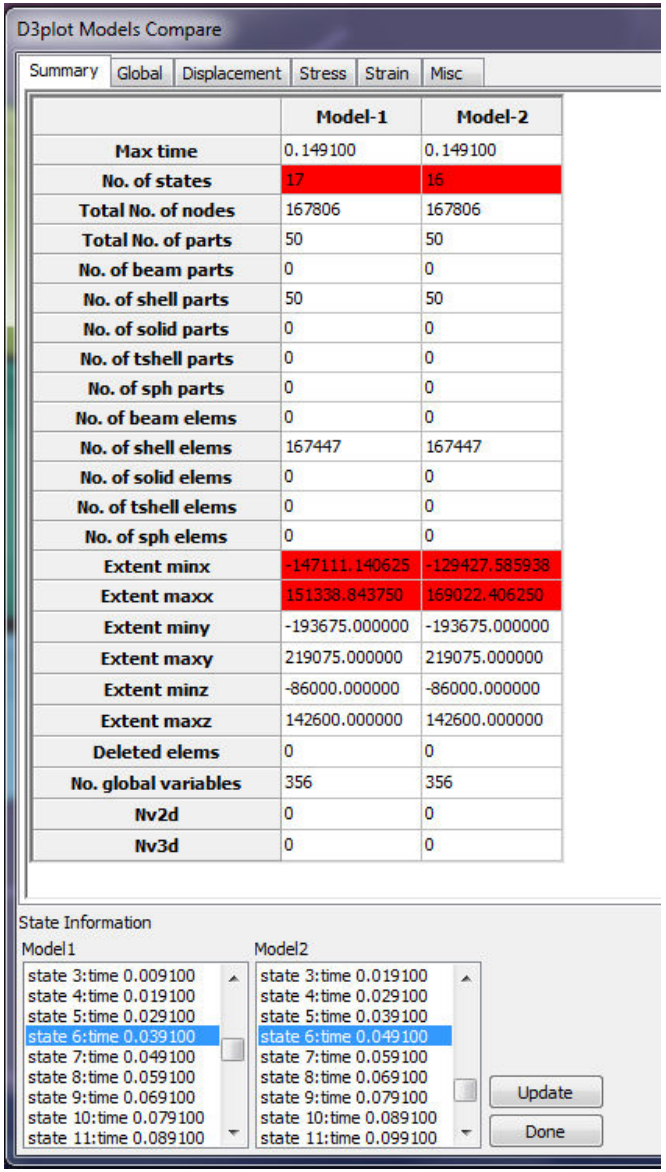
Model Compare for Post-Processing

- Summary – basic model information
- Global – global energy results
- Displacement – the 3 global min/max values of displacement with node IDs
- Stress – the six global min/max stress values with element IDs
- Strain – the size global min/max strain values with element IDs



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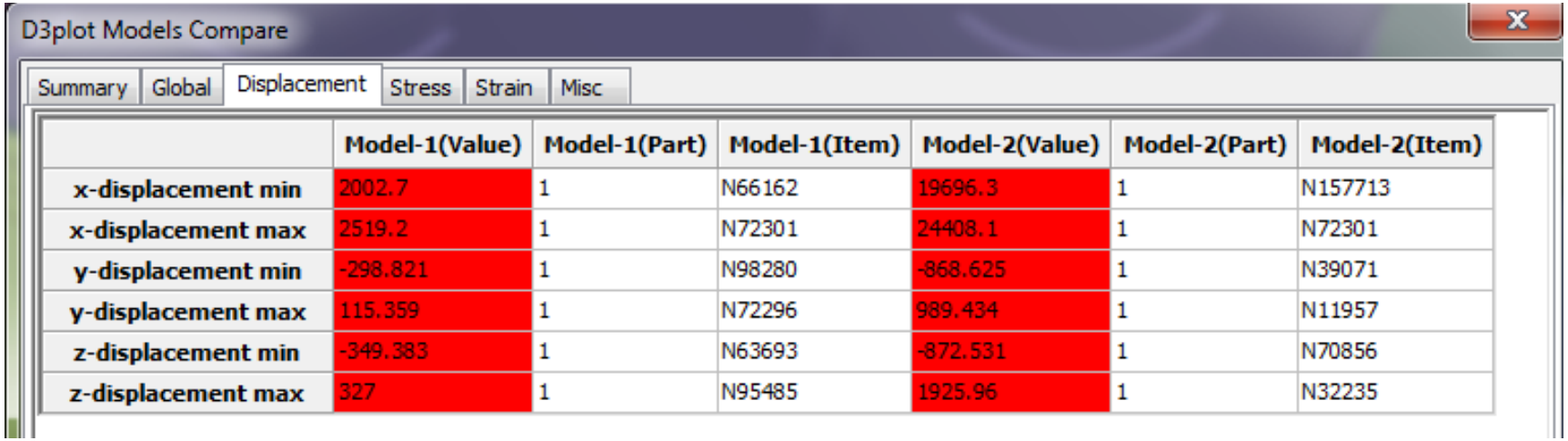
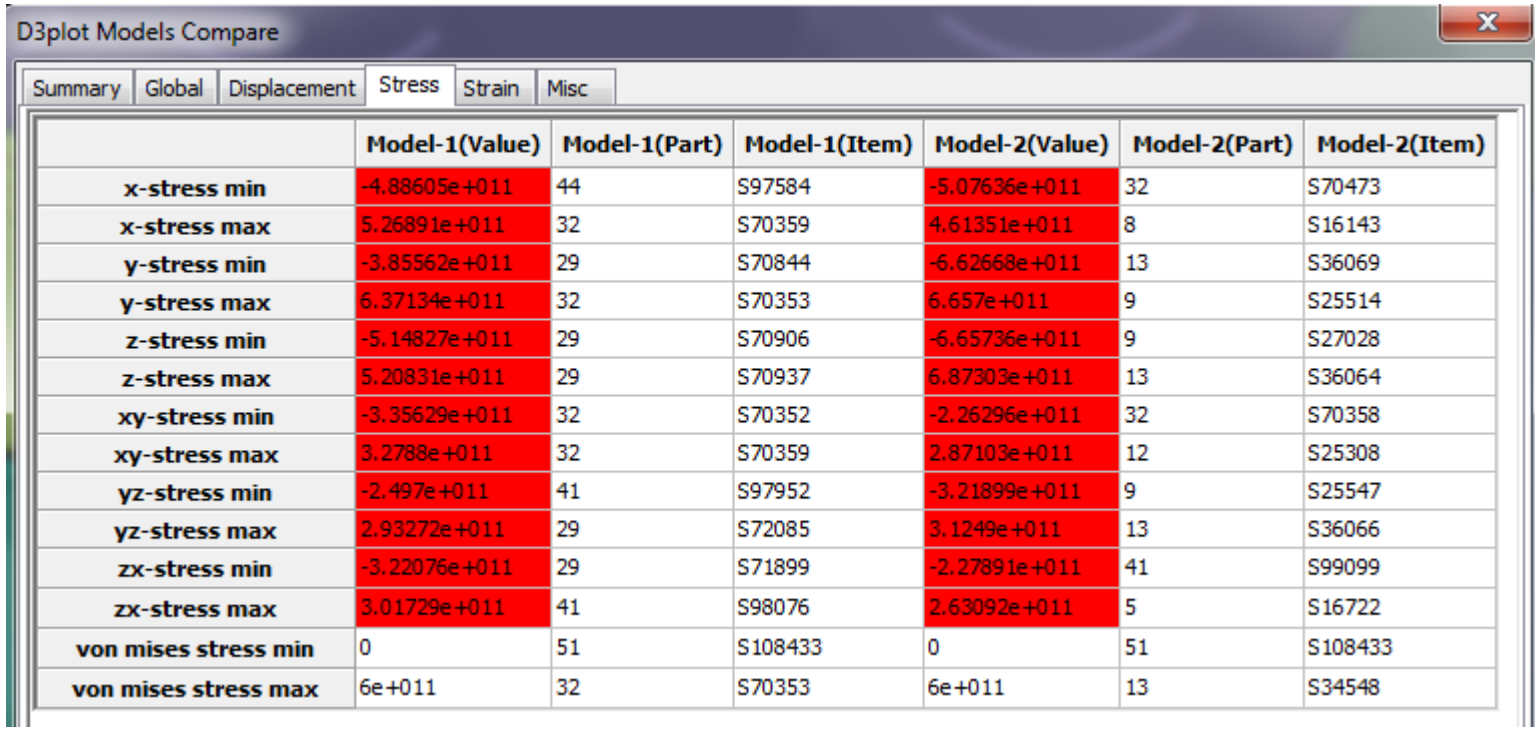


	Model-1(Value)	Model-1(Part)	Model-1(Item)	Model-2(Value)	Model-2(Part)	Model-2(Item)
x-displacement min	2002.7	1	N66162	19696.3	1	N157713
x-displacement max	2519.2	1	N72301	24408.1	1	N72301
y-displacement min	-298.821	1	N98280	-868.625	1	N39071
y-displacement max	115.359	1	N72296	989.434	1	N11957
z-displacement min	-349.383	1	N63693	-872.531	1	N70856
z-displacement max	327	1	N95485	1925.96	1	N32235

Displacement value compare table



	Model-1(Value)	Model-1(Part)	Model-1(Item)	Model-2(Value)	Model-2(Part)	Model-2(Item)
x-stress min	-4.88605e+011	44	S97584	-5.07636e+011	32	S70473
x-stress max	5.26891e+011	32	S70359	4.61351e+011	8	S16143
y-stress min	-3.85562e+011	29	S70844	-6.62668e+011	13	S36069
y-stress max	6.37134e+011	32	S70353	6.657e+011	9	S25514
z-stress min	-5.14827e+011	29	S70906	-6.65736e+011	9	S27028
z-stress max	5.20831e+011	29	S70937	6.87303e+011	13	S36064
xy-stress min	-3.35629e+011	32	S70352	-2.26296e+011	32	S70358
xy-stress max	3.2788e+011	32	S70359	2.87103e+011	12	S25308
yz-stress min	-2.497e+011	41	S97952	-3.21899e+011	9	S25547
yz-stress max	2.93272e+011	29	S72085	3.1249e+011	13	S36066
zx-stress min	-3.22076e+011	29	S71899	-2.27891e+011	41	S99099
zx-stress max	3.01729e+011	41	S98076	2.63092e+011	5	S16722
von mises stress min	0	51	S108433	0	51	S108433
von mises stress max	6e+011	32	S70353	6e+011	13	S34548

Stress value compare table

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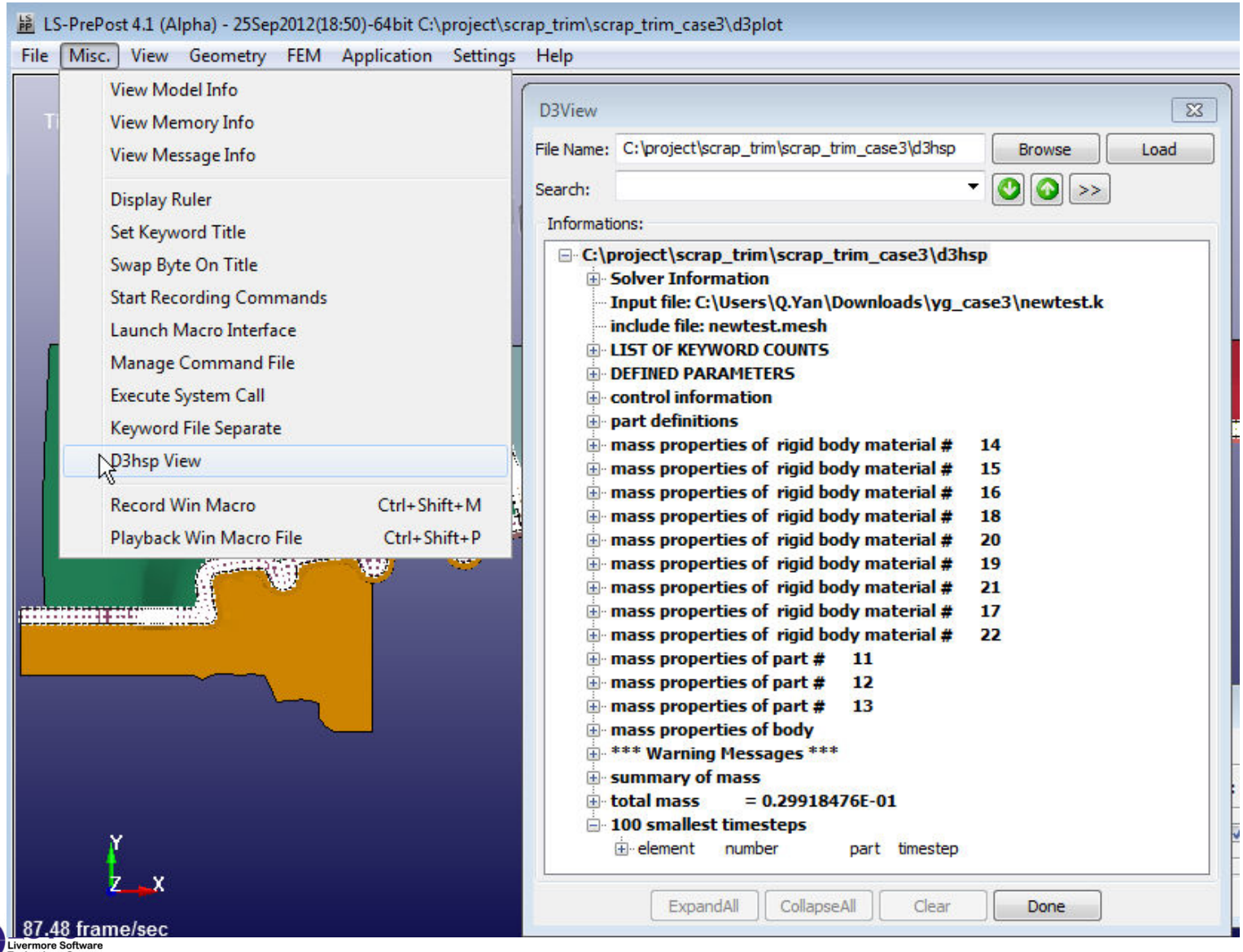
D3HSP file viewing

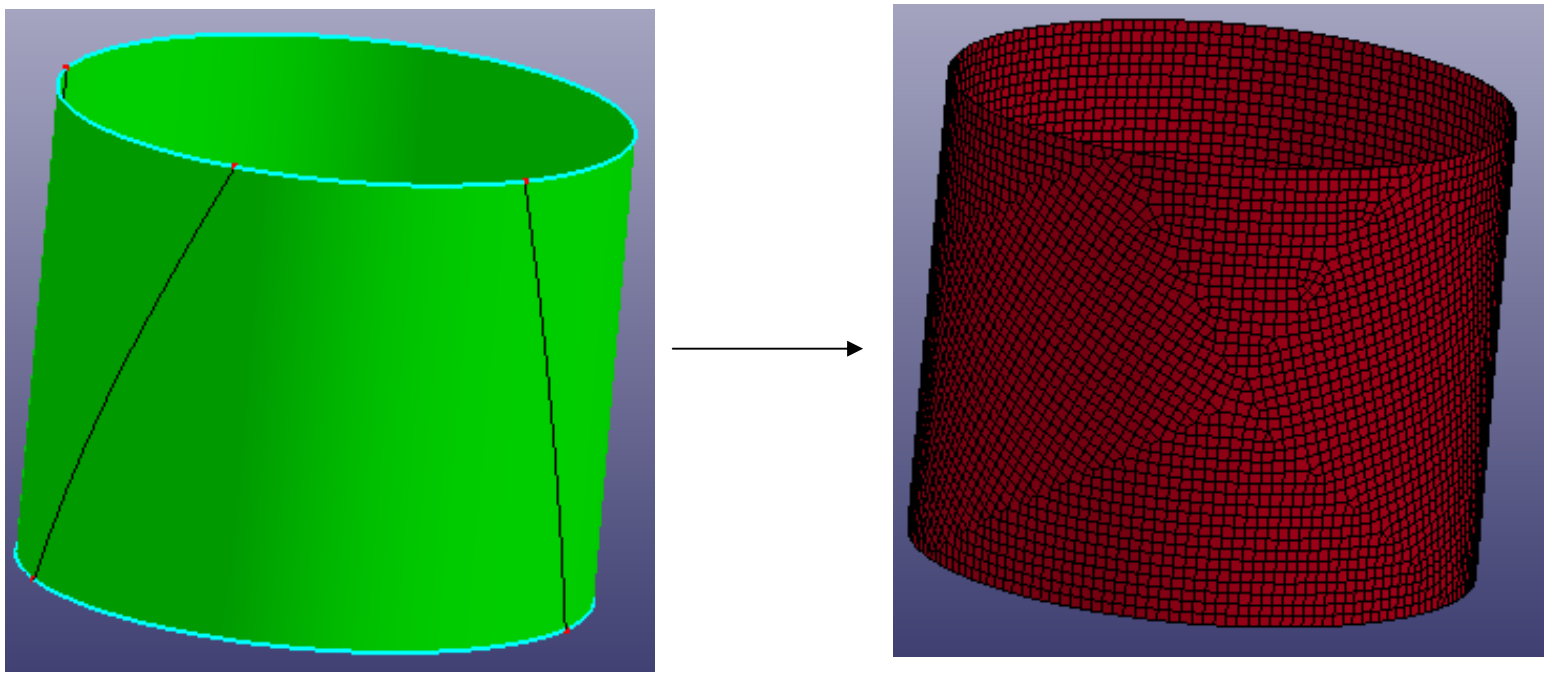
- d3hsp file contains a lot of information for the LS-DYNA run
- LS-PrePost reads the information from this file and organizes them into a tree/list structure for easy reading
- Key phase search is possible
- Launch d3hsp view in Misc pulldown menu
- Only available in version 4.0 and later

d3hsp file viewing



Suppress Boundary lines for surface meshing

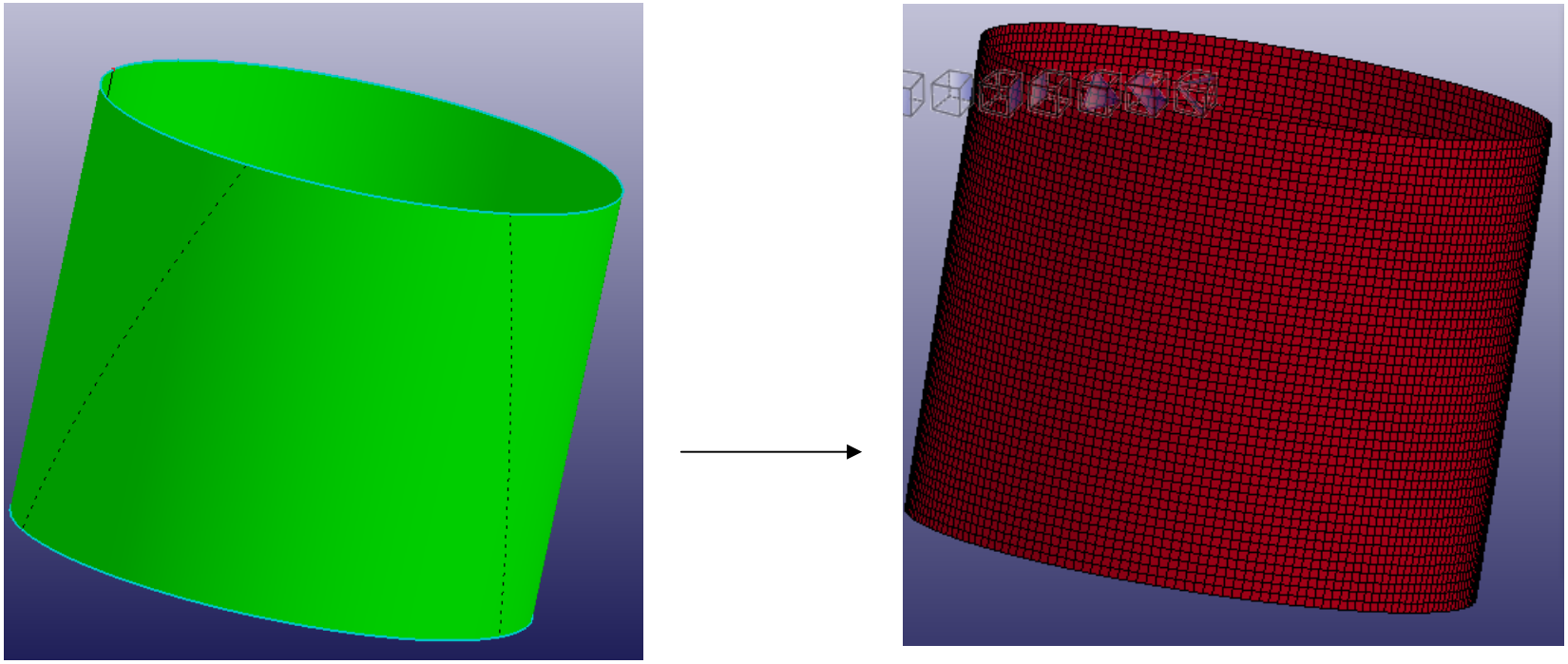
- Common boundary lines between two surfaces can be suppressed to form a joint surface, this will allow mesh across boundary lines to give a better mesh



Boundary lines not suppressed

Suppress Boundary lines for surface meshing

- Auto meshing after boundary lines suppressed



Boundary lines suppressed

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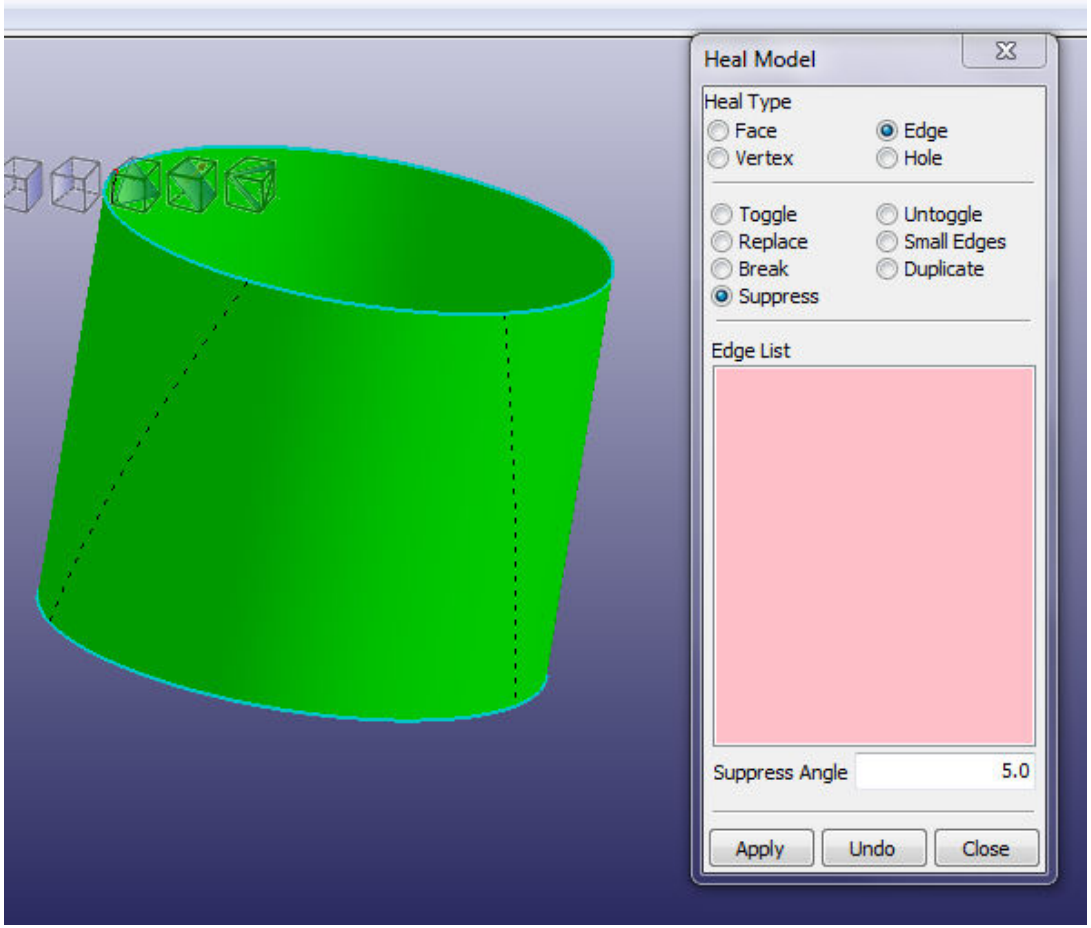
Suppress Boundary lines for surface meshing



- To suppress a boundary line on the surface: go to GeomTool->Heal, select Edge, and then select Suppress
- Click boundary lines to highlight, then click Apply
- Suppressed boundary lines will be drawn in dash form

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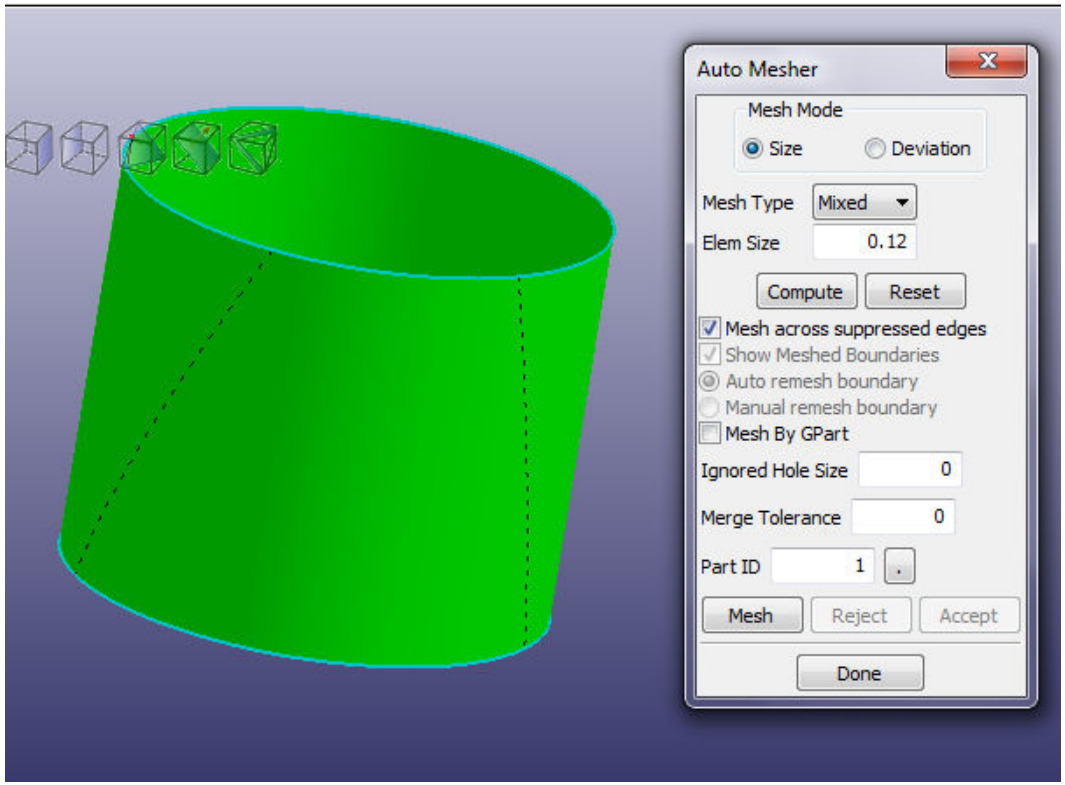
Suppress Boundary lines for surface meshing



- To mesh surface with suppressed line, go to Auto mesher, enter size and check “Mesh across suppressed edges”

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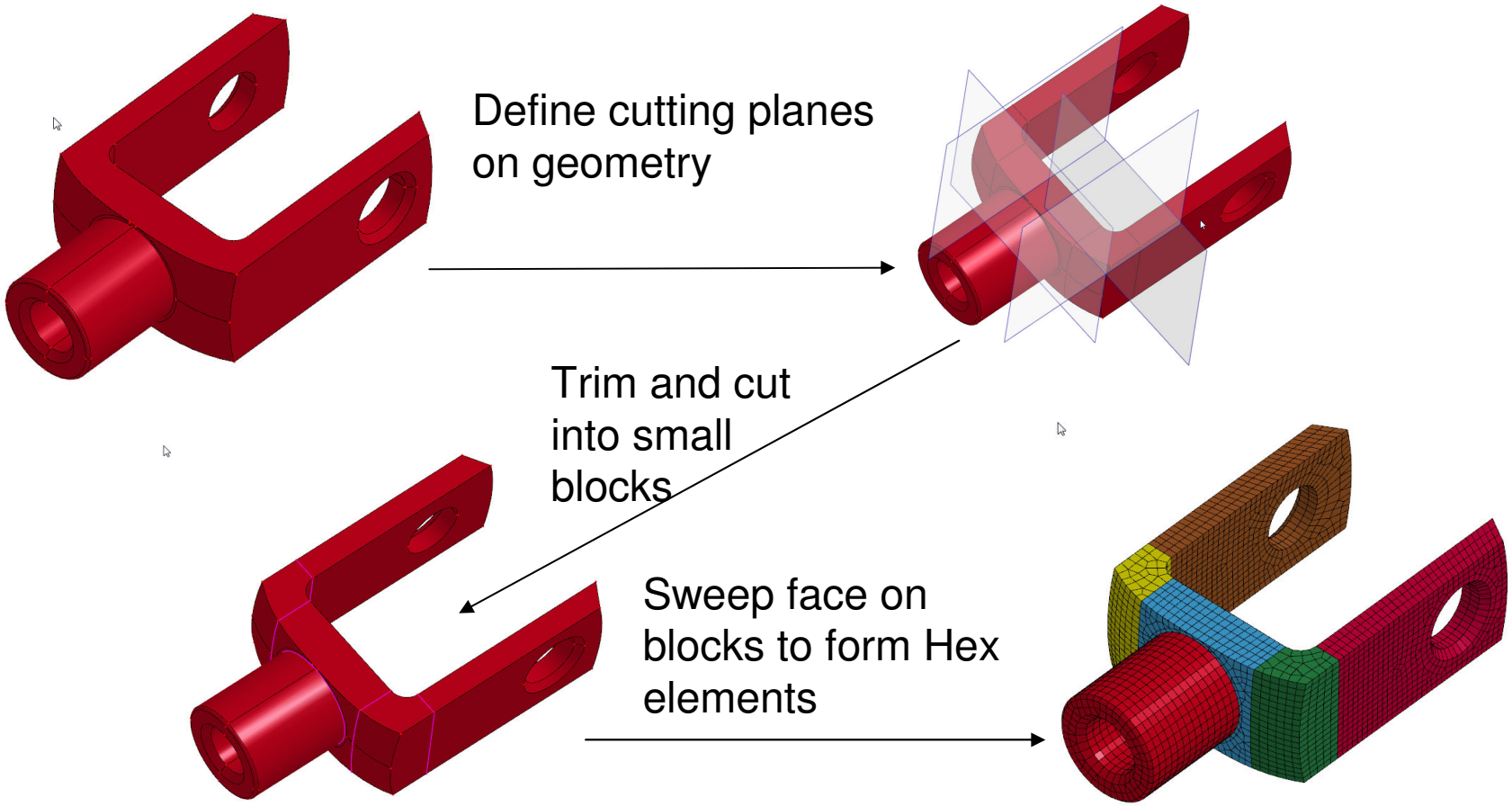
Solid Meshing with Hex Element

- Solid meshing by blocks - using cut and dice method and then sweeping



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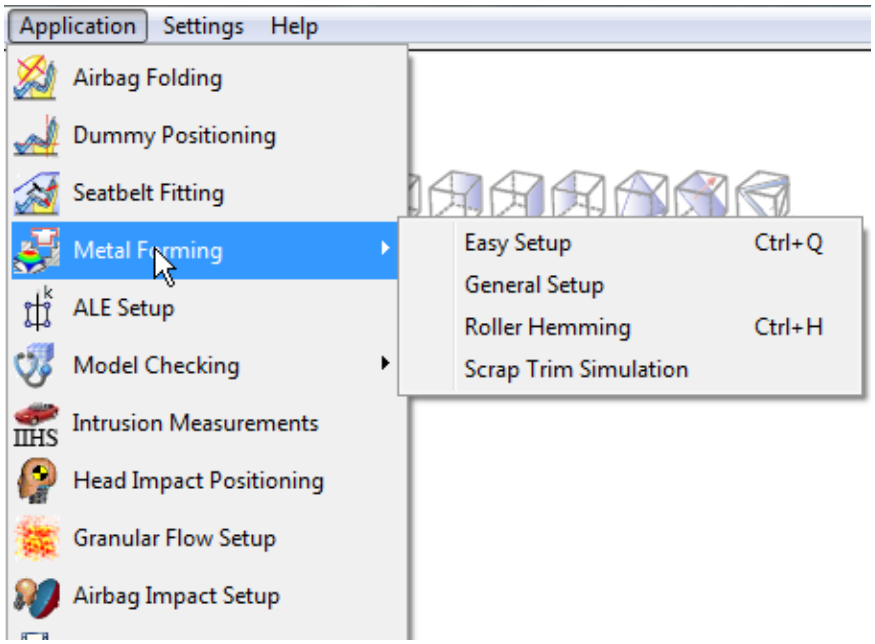
Metal Forming Application



Metal Forming Graphics User Interface (GUI) is designed to ease the setup of a stamping simulation input data using LS-DYNA.

- **Easy Setup**
- **General Setup**
- **Roller Hemming**
- **Scrap Trim Simulation Setup**

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Metal Forming → Toolbar

- **Metal Forming Pre-processing**
- **Metal Forming Post-processing**

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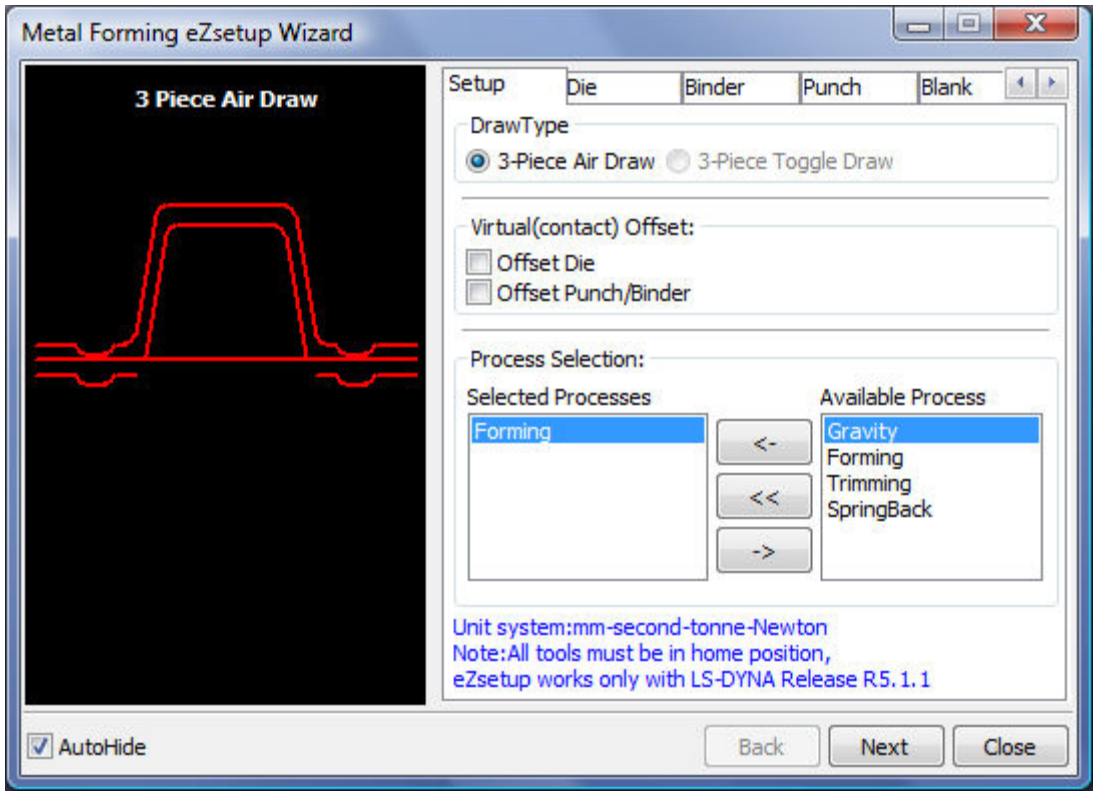
Metal Forming → eZsetup



- Standard draw type
- Step-by-step tool definition
- Easy draw bead modeling
- Automatic tooling position
- Multiple processes
- User control options

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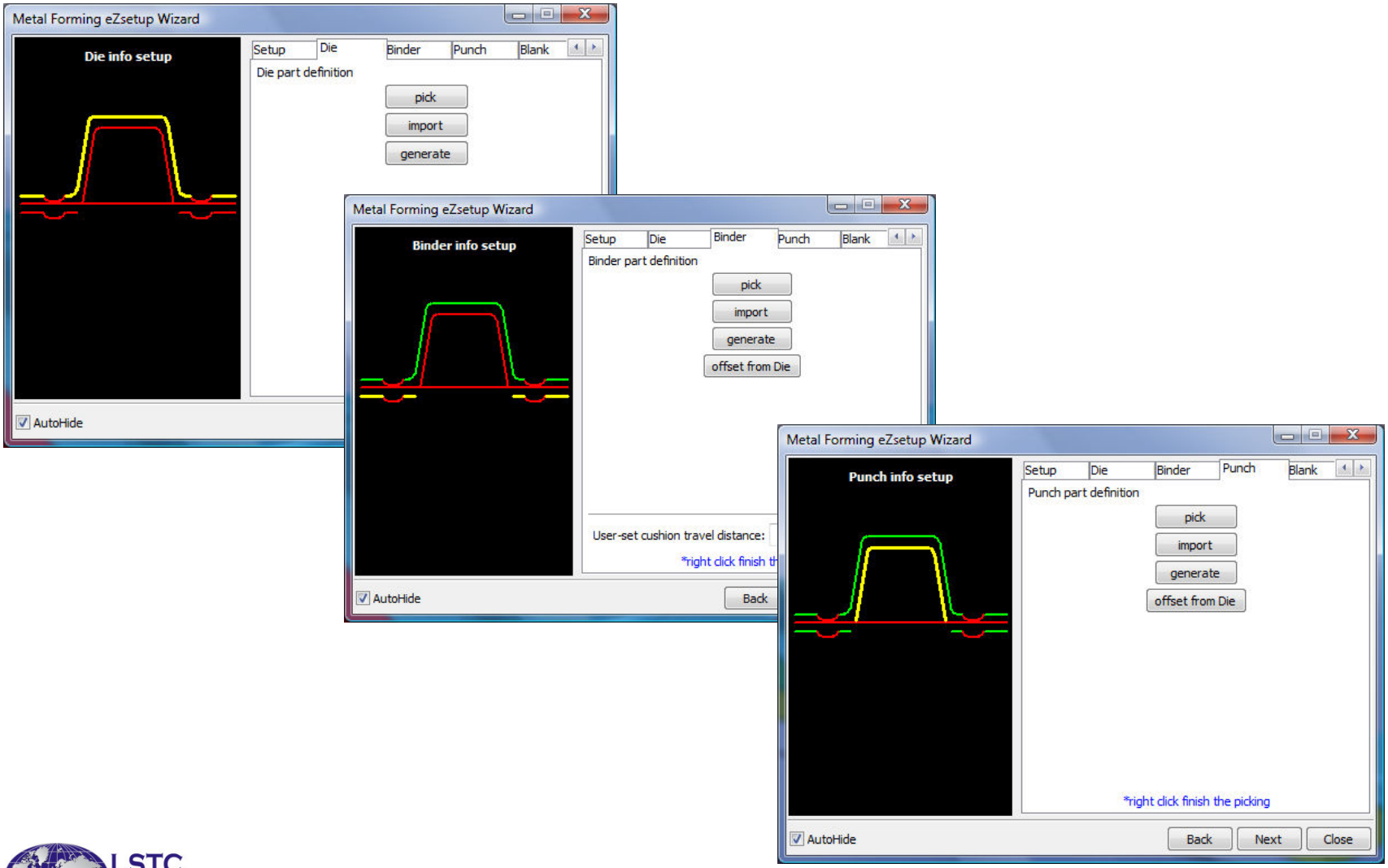
eZsetup →Tool definition



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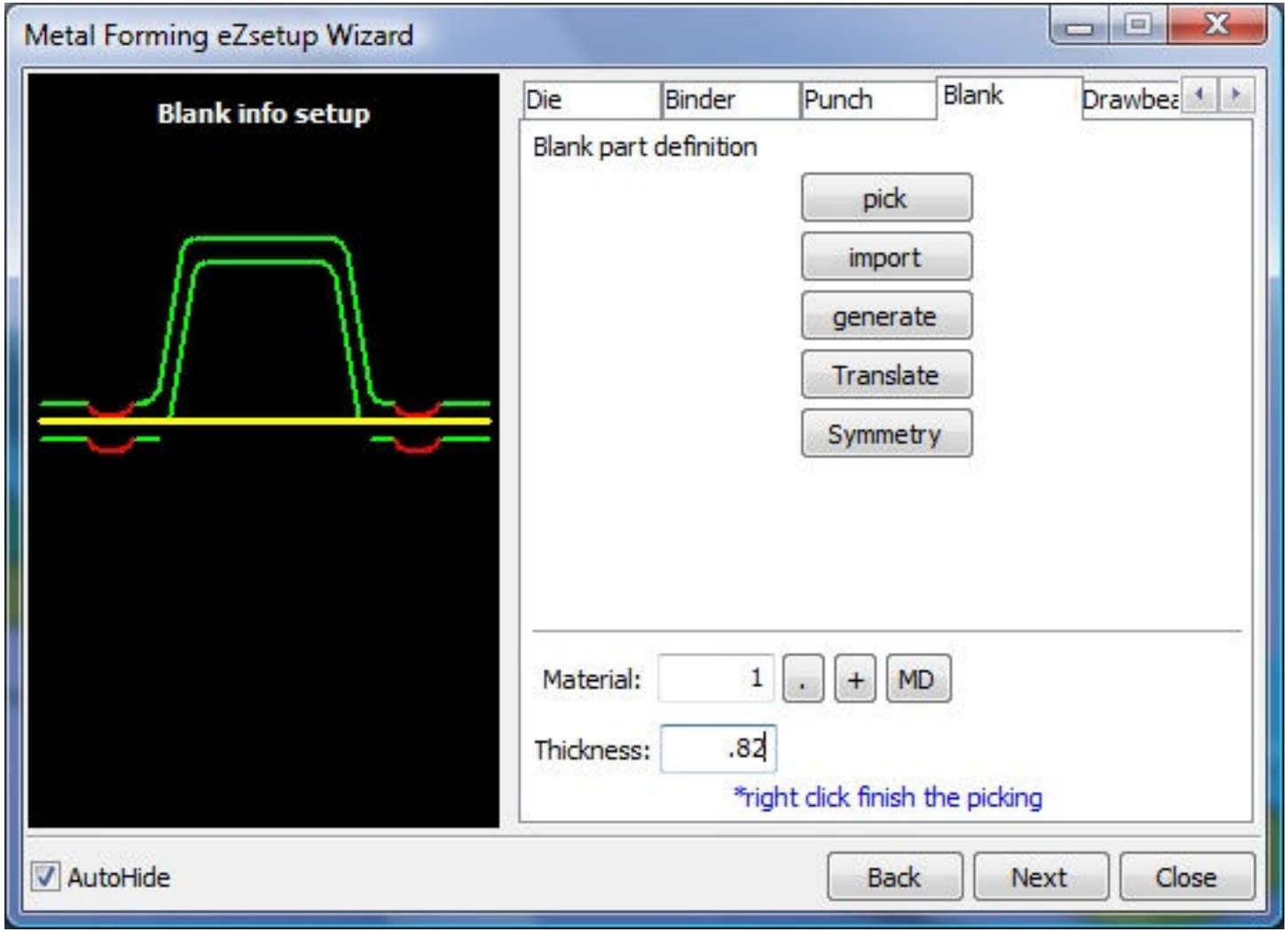
eZsetup →Blank definition



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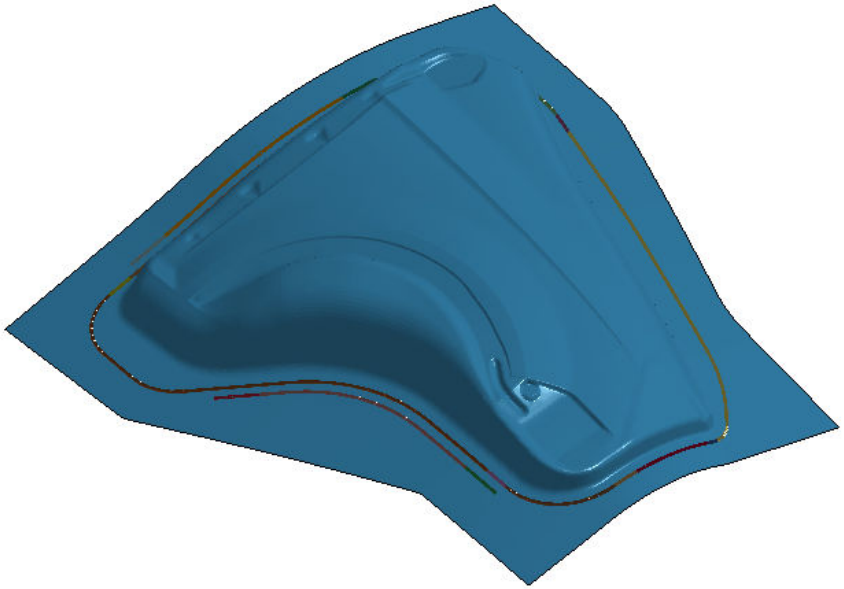
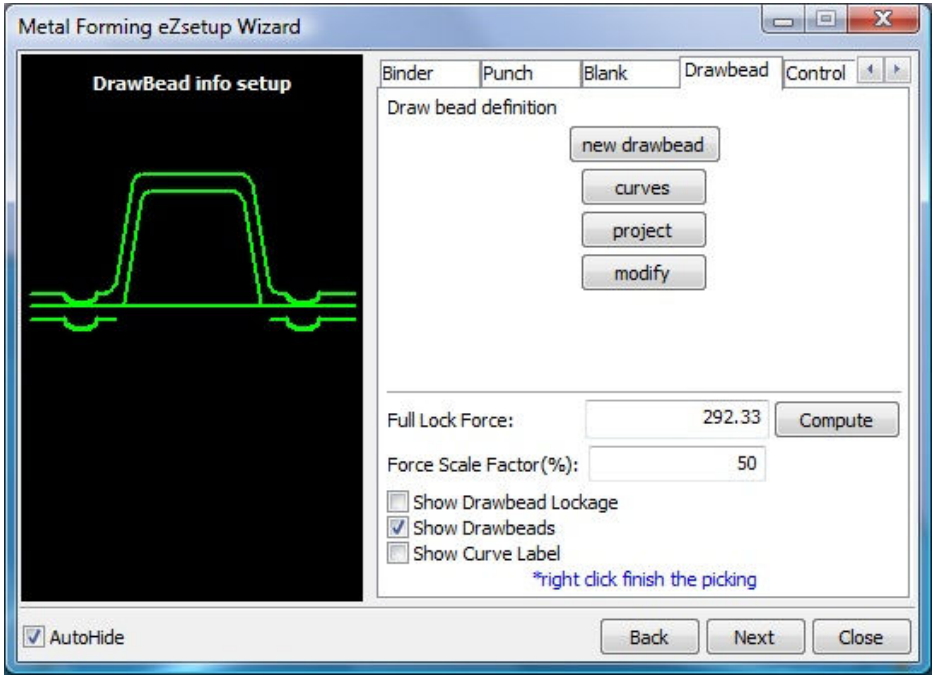
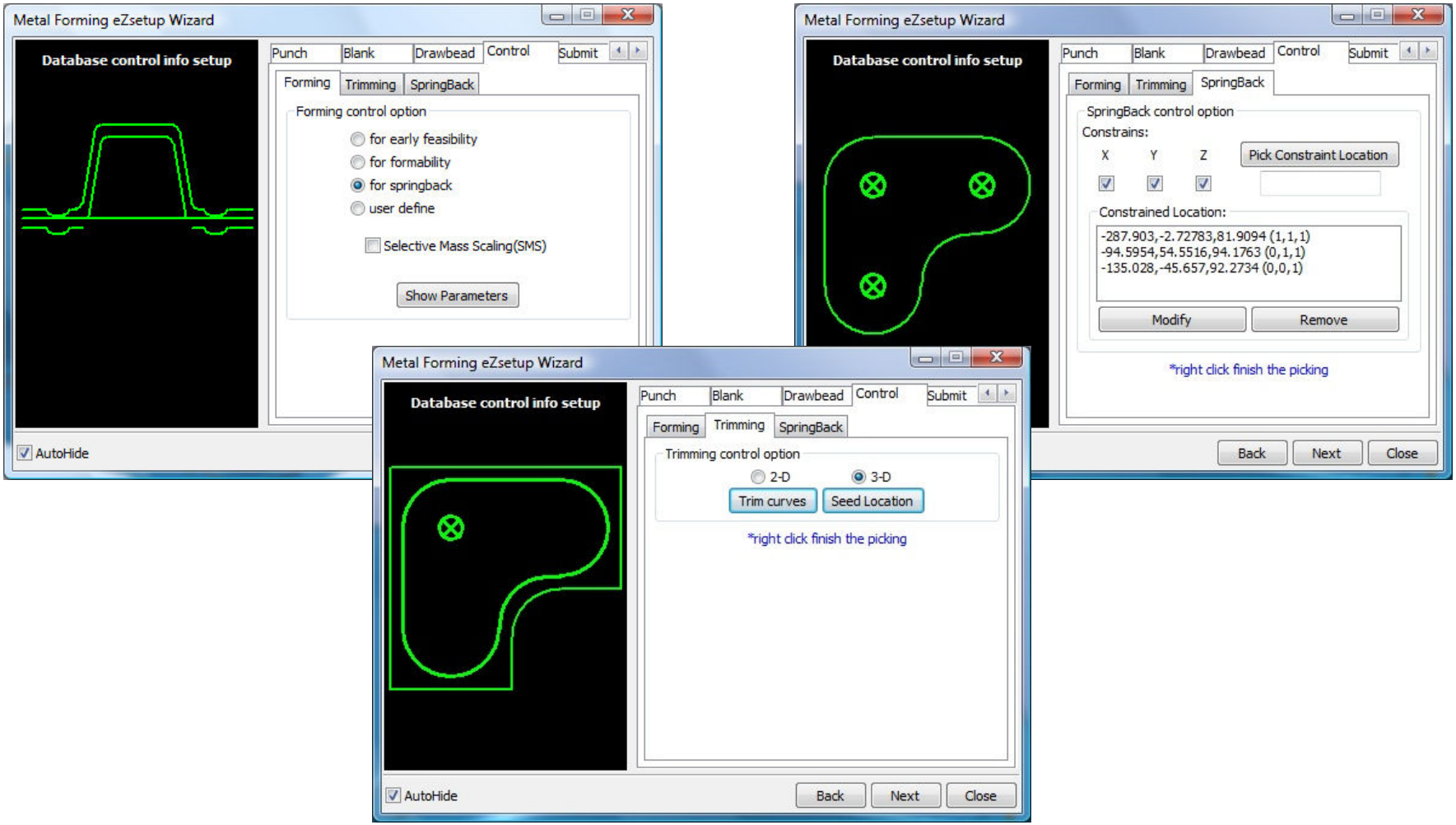
eZsetup →Drawbead modeling





eZsetup →Processes control



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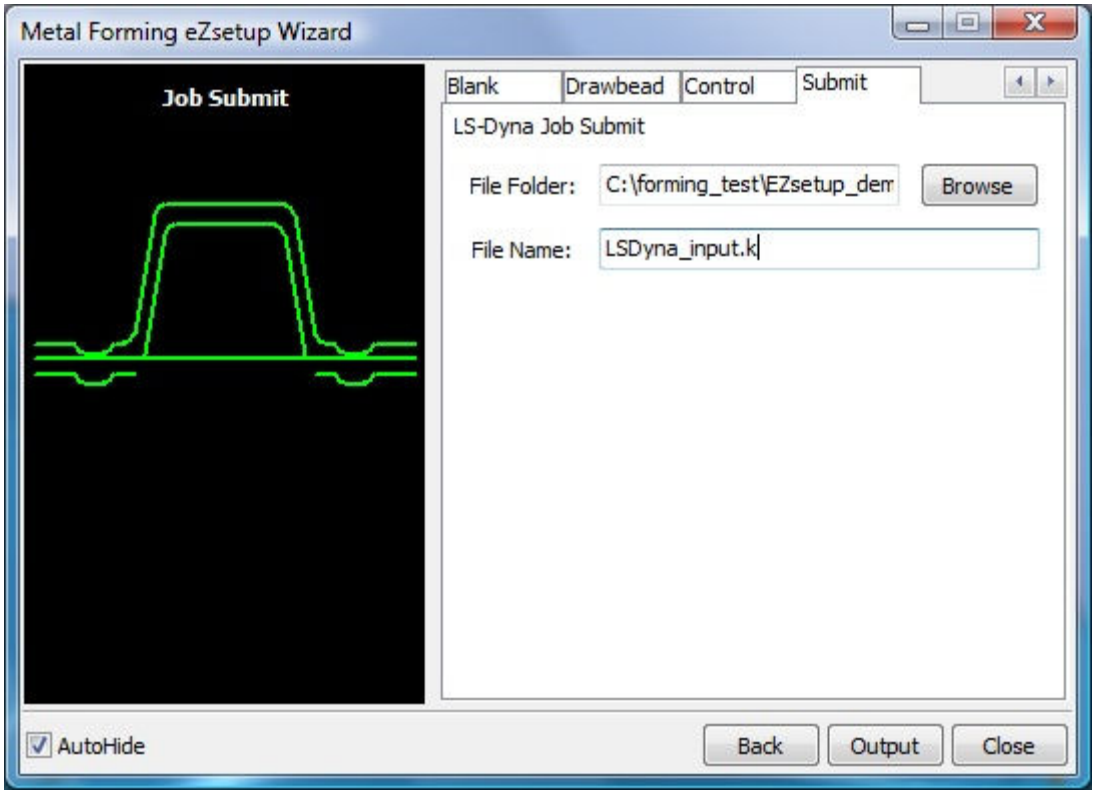
eZsetup →LSDyna job submit



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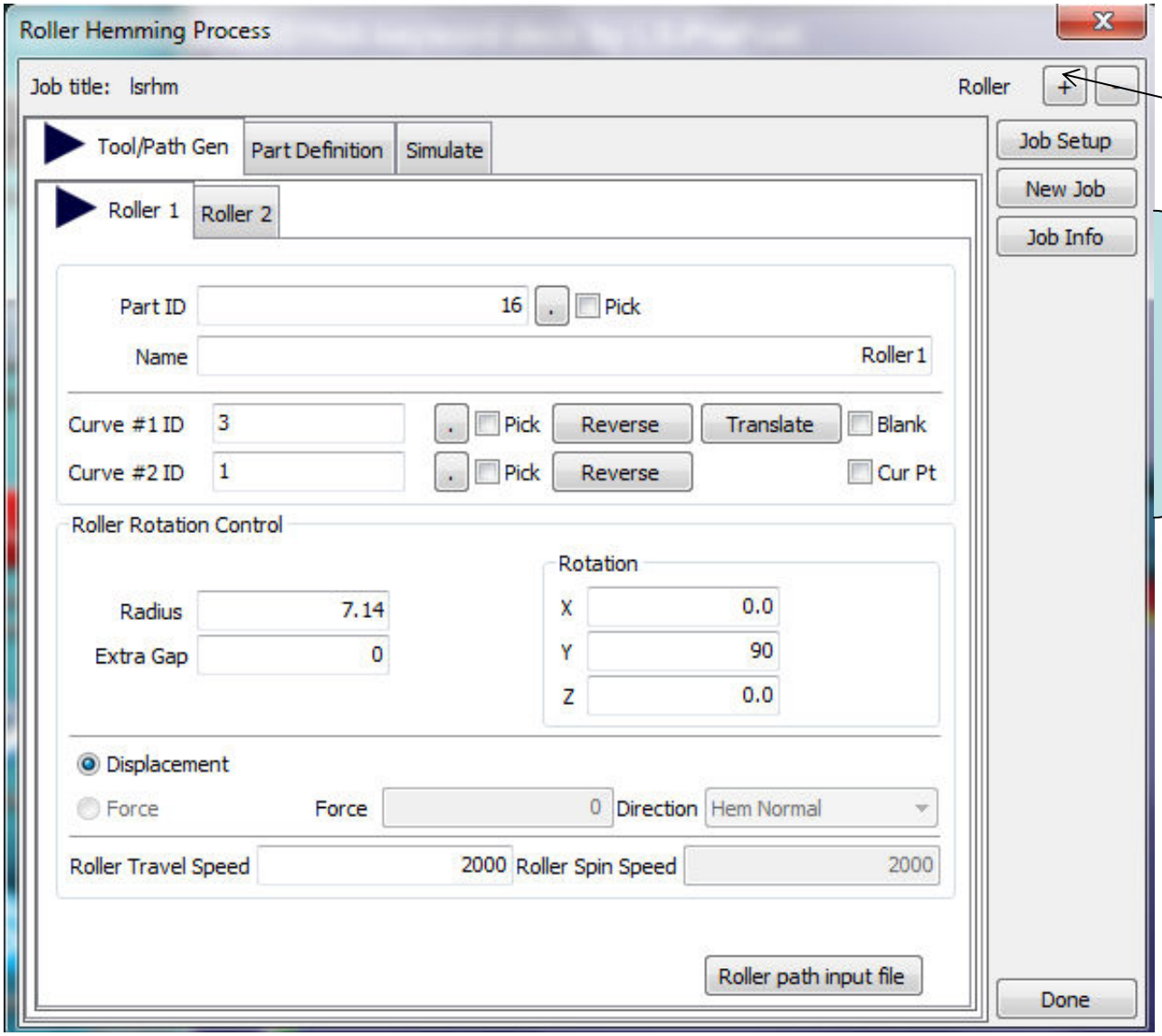
Roller Hemming Setup

- To setup for Hemming simulation
- Starting with model mesh and roller mesh
- Define roller orientation and traveling path
- Define flange parts and inner part
- Define contact information between rollers and flange parts
- A complete LS-DYNA keyword input file will be setup ready to run hemming simulation

Roller Hemming Setup

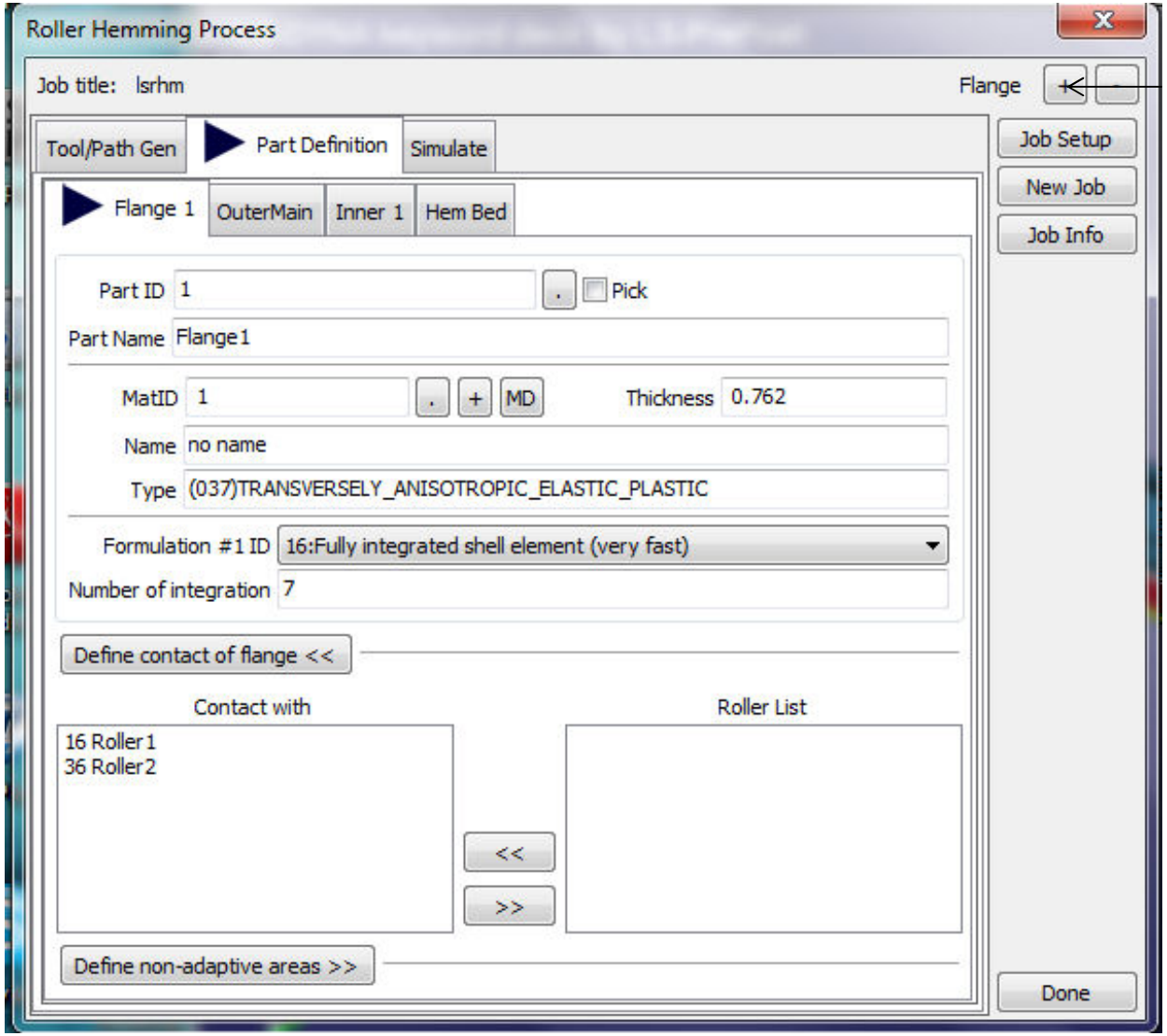


Use + button to add as many roller as needed

Roller definition and traveling path defined by curves

Roller orientation

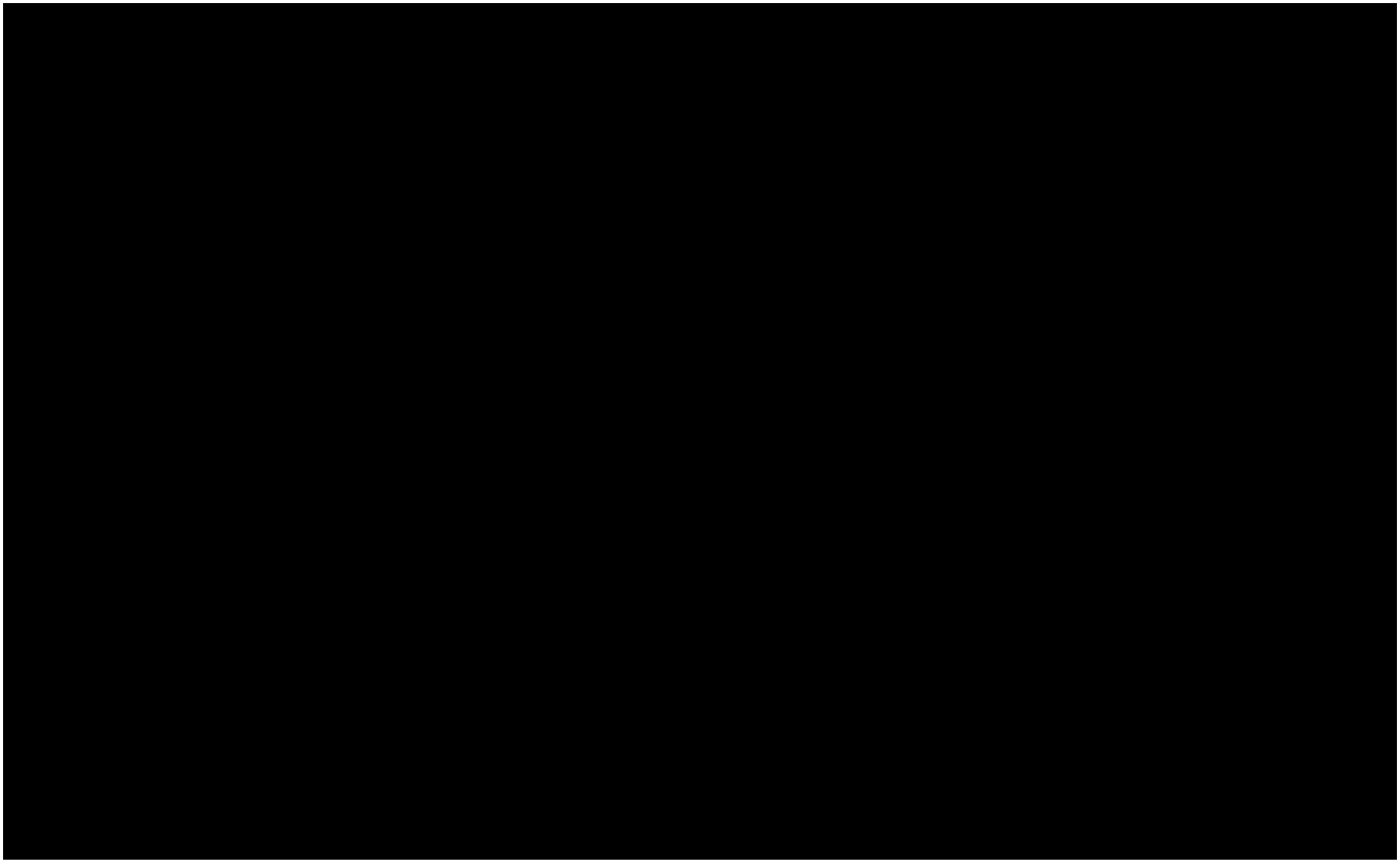
Roller Hemming Setup



Use + button to add as flange parts

Flange part definition

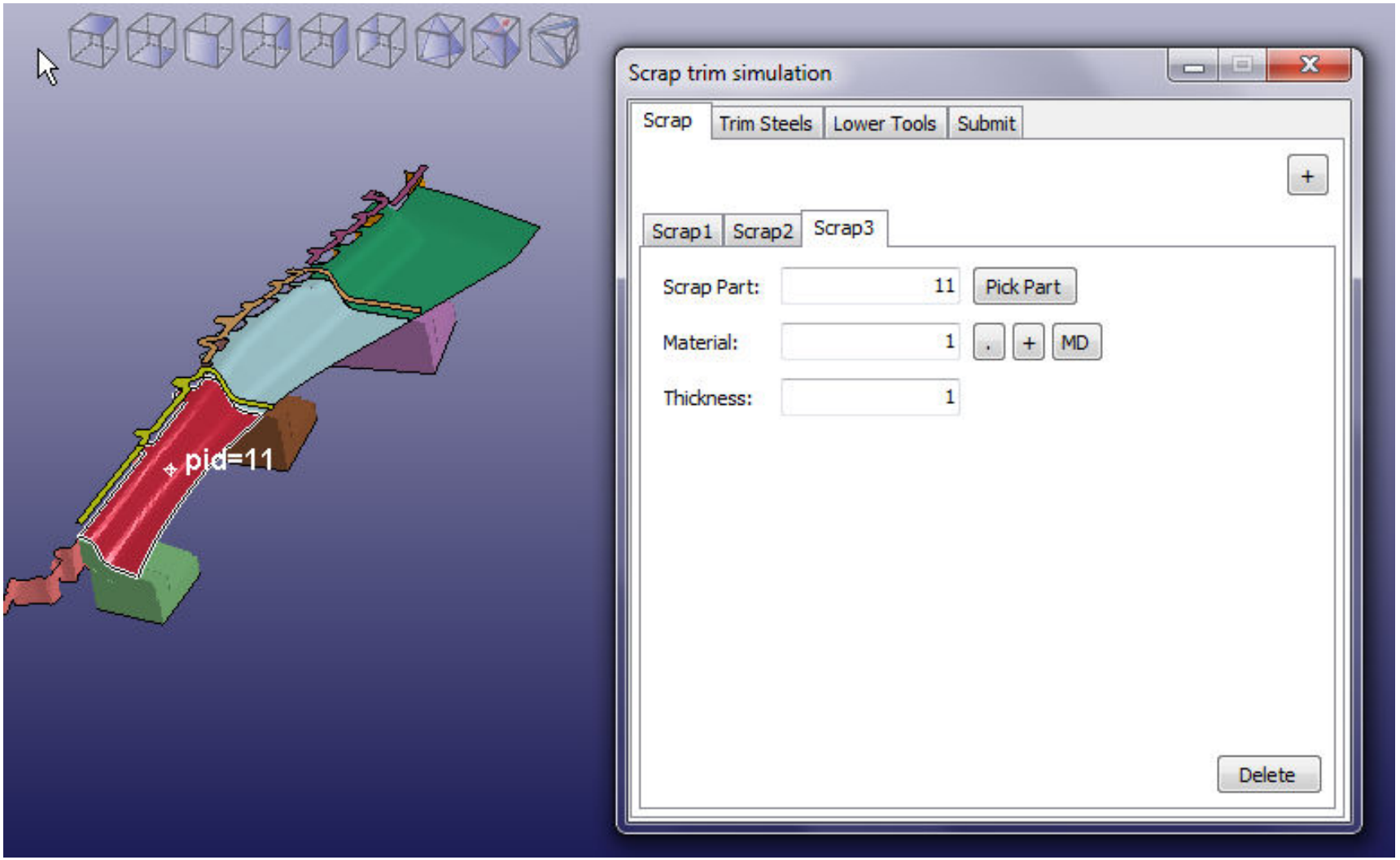
Contact definition



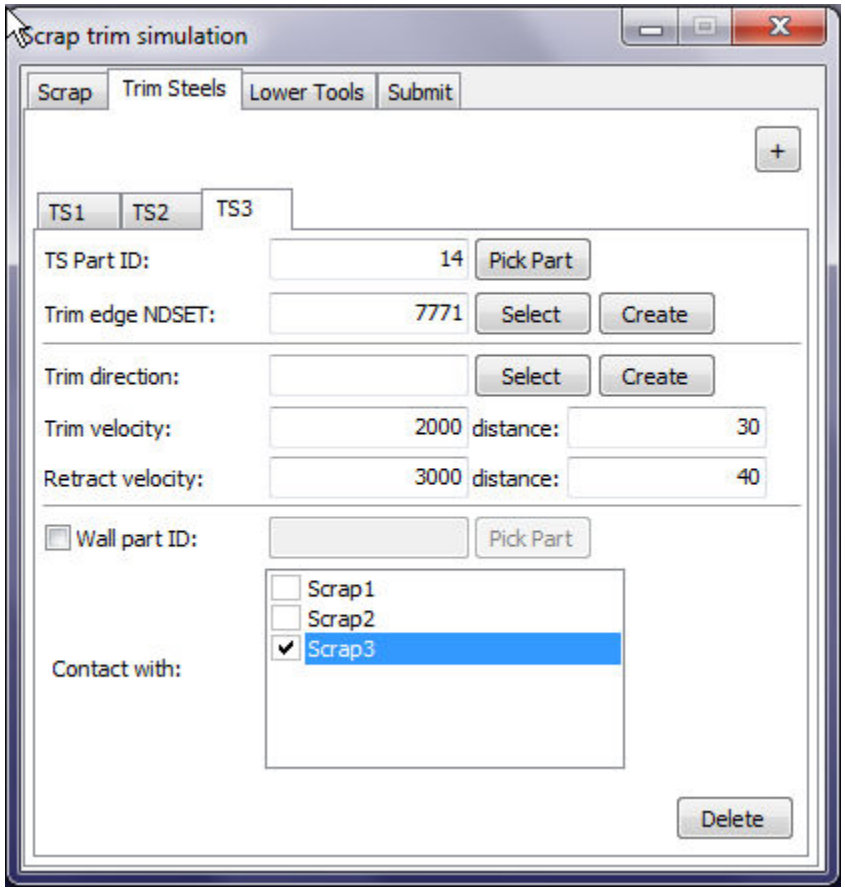
Scrap Trim Simulation Setup

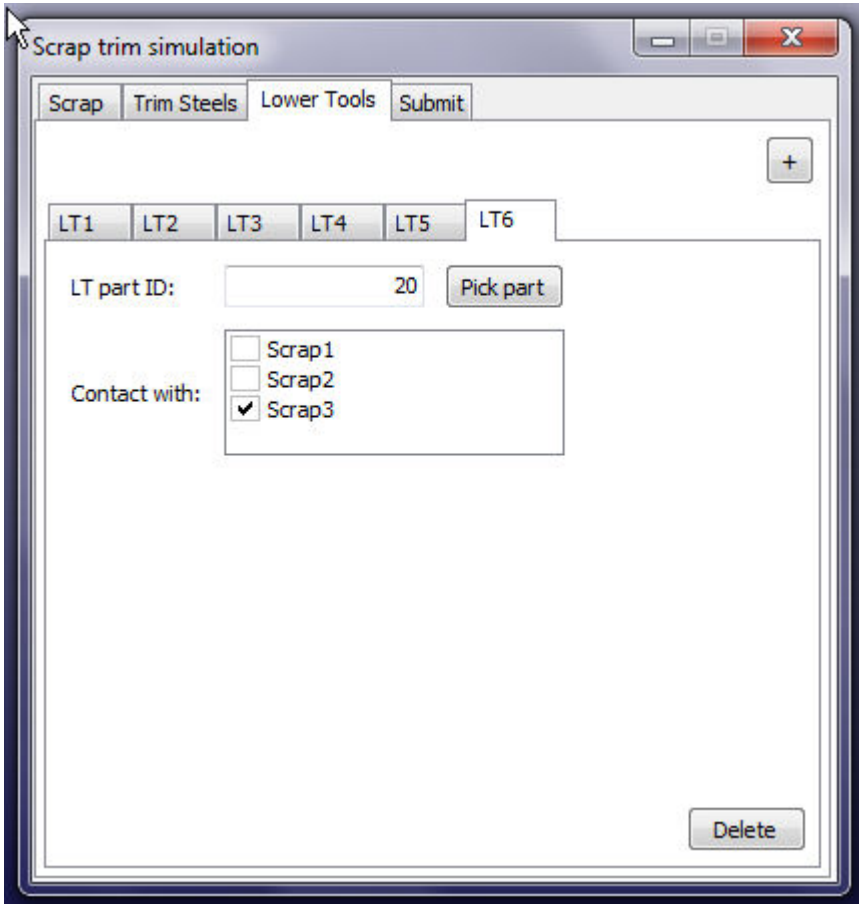
- To setup for LS-DYNA scrap trimming simulation
- Define scraps
- Define trim tools, trim direction, trim velocity and retract velocity
- Define lower tools that will obstruct the scrap fall
- Define contact relationship between all tools

Scrap Trim Simulation Setup

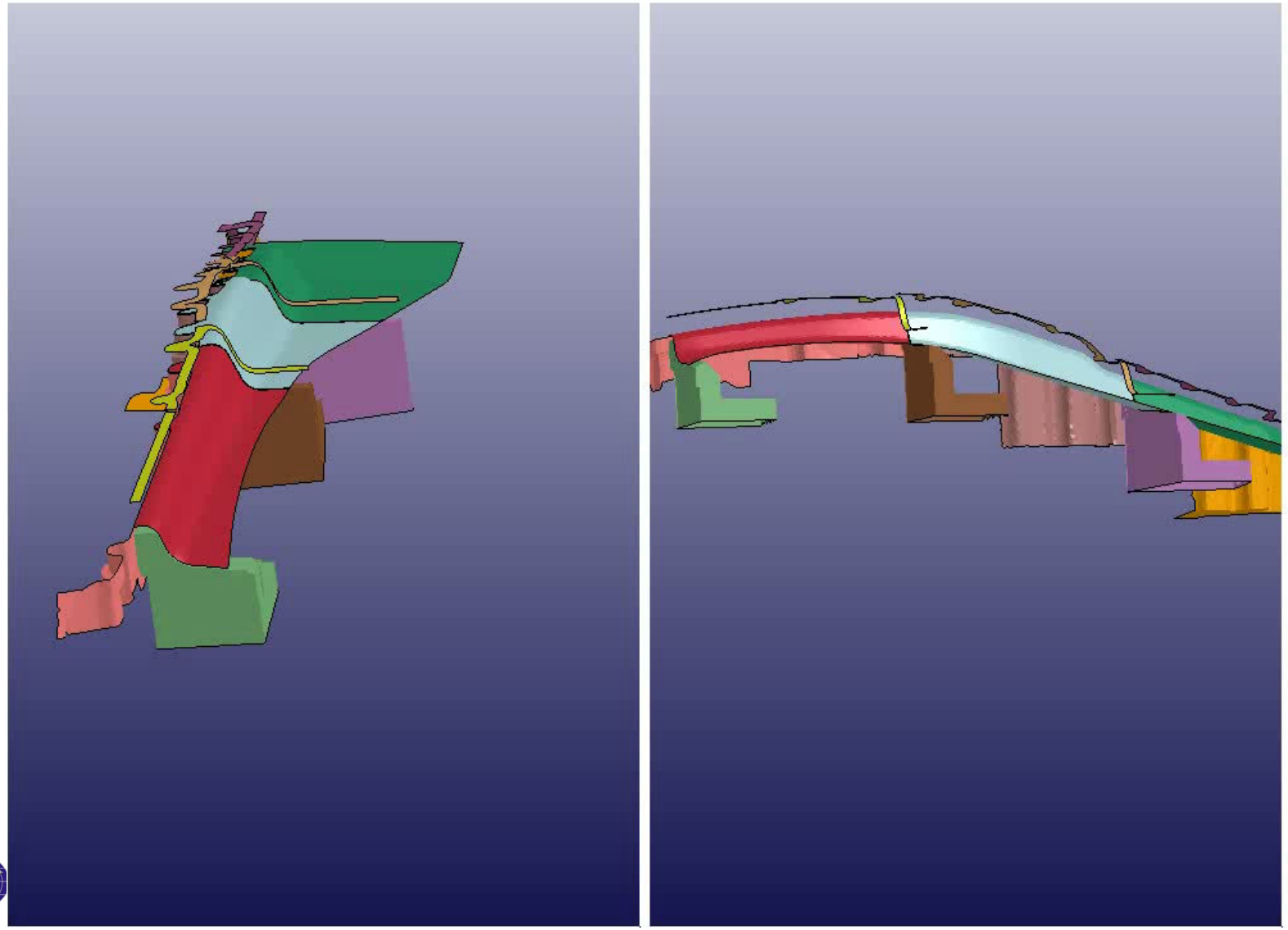


Scrap Trim Simulation Setup





Scrap Trim Setup



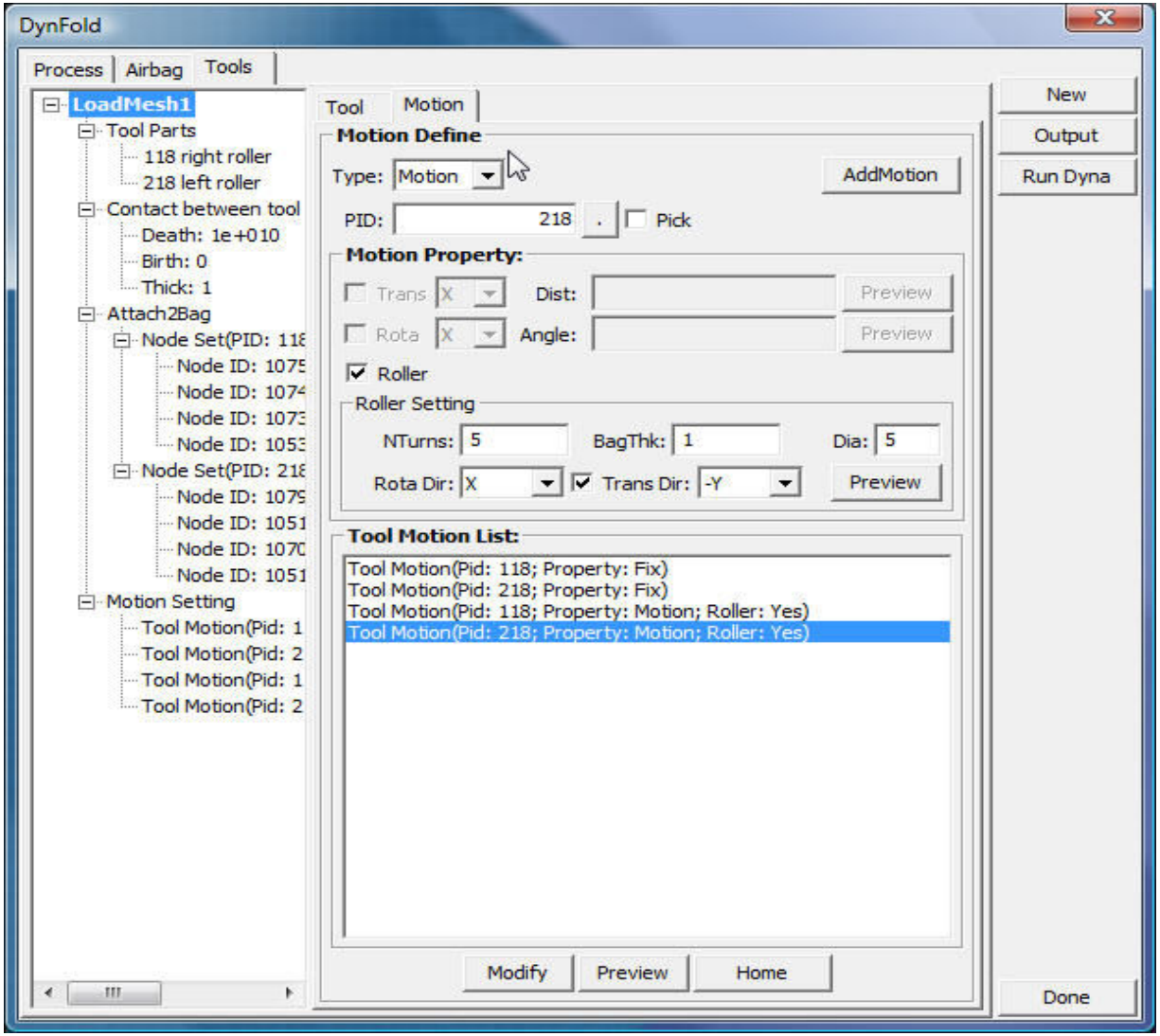
DynFold Application

- Dynfold is designed to prepare input files for simulation based airbag folding process. Typical physical airbag folding process is done in 4 to 5 steps (runs of LS-DYNA).
- Dynfold user interface is designed to setup one step at a time. Often the deformed shape at the end of one folding step is used as a starting mesh for the next step.
- The airbag model is expected to have nodes, elements, part, section and material defined before using this interface.
- The physical folding process is generally of the following form:
  a. hold the bag in position while being folded
  b. clamp a portion of the bag to a folding tool
  c. Apply motion to the tool in translational direction or rotational direction or combination of both.
- At present 4 folding tools are supported: Loadmesh, SPC, BPMF(BOX), Stitching and Tuck

DynFold Setup Process

- Define Parameters: Define Project Step Name, Termination time, airbag tool Material Parameters.
- Load Airbag: Load finite element mesh, Position airbag by translate, rotation, etc.; show airbag, or turn off show.
- Define Airbag Folding Tools, currently there are four kinds of tools
  - Load meshing:
    - Load tool meshing file; Define tool attaching to bag.
    - Define Load Meshing Tools Motion.
    - Preview tool motion (Home position and Final position)
  - Spc_Birth_Death, BPMF(Box), Stitch

- Spc_Birth_Death, BPMF(Box), Stitch
  - Define boundary spc node set.
  - Define Constrained
  - Define Birth and Death time.
- BPMF(Box)
  - Define Original and Final position of the Box.
  - Define contact between box and airbag parameters .
  - preview of Original/Target position of the box in graphics view .
- Stitch
  - Define Stitch parts and parameters.
  - Define Get stitch start position and direction.
  - Define stitch Birth and Death time



Define part Motion with motion property

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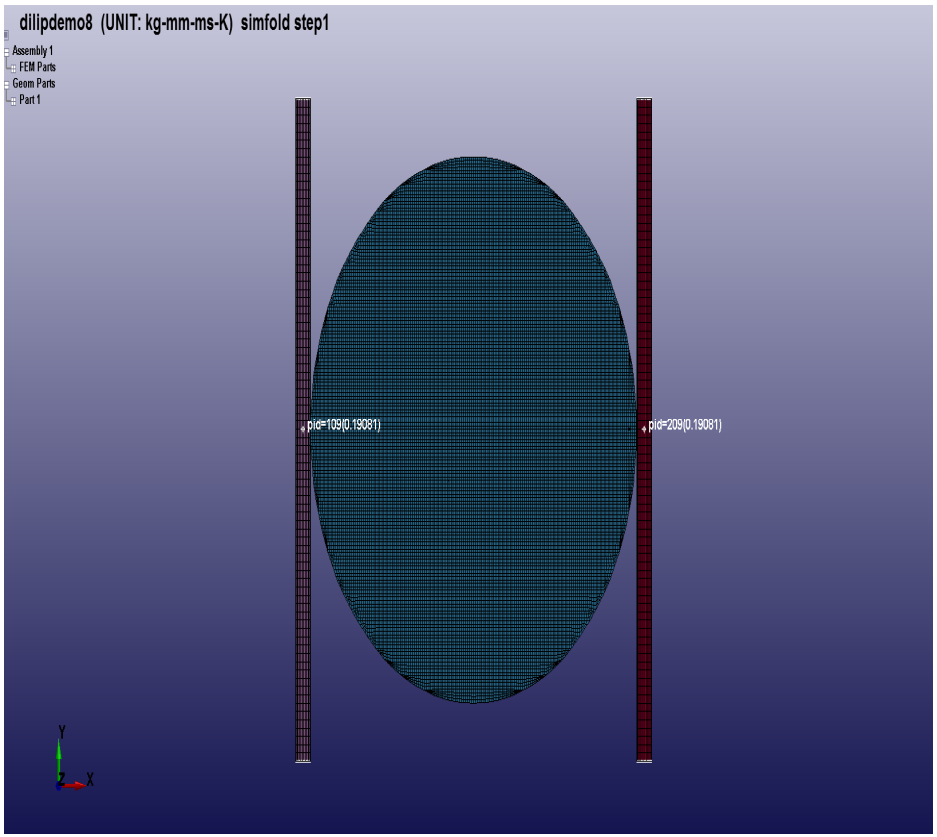

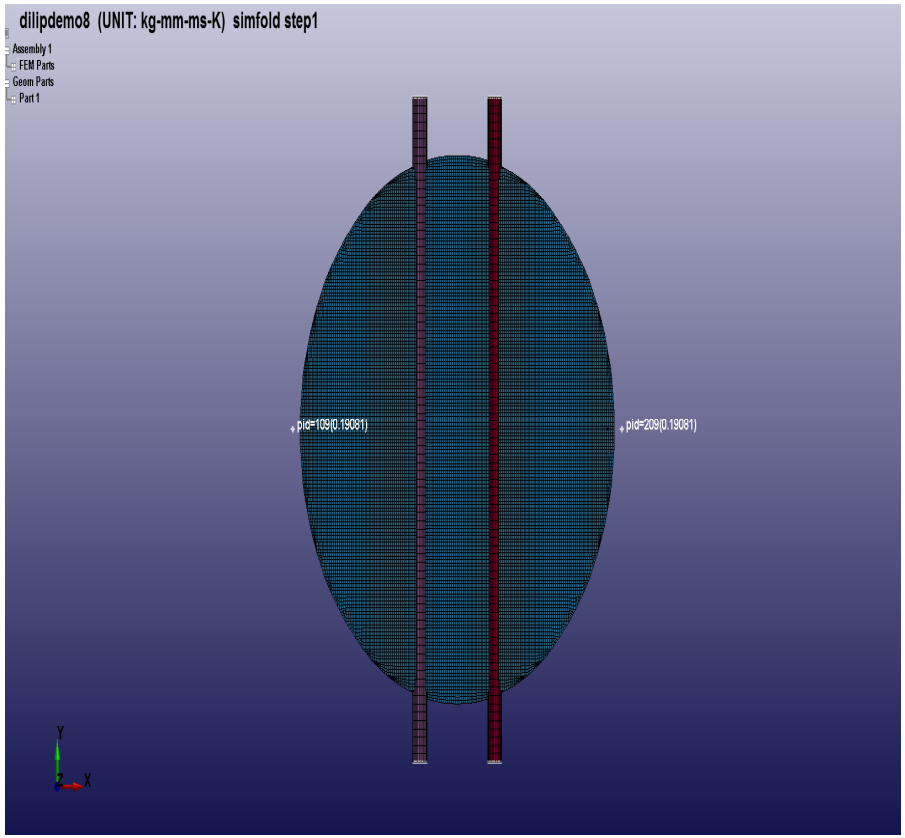

Preview tool motion Home position(left) and Final position (right)

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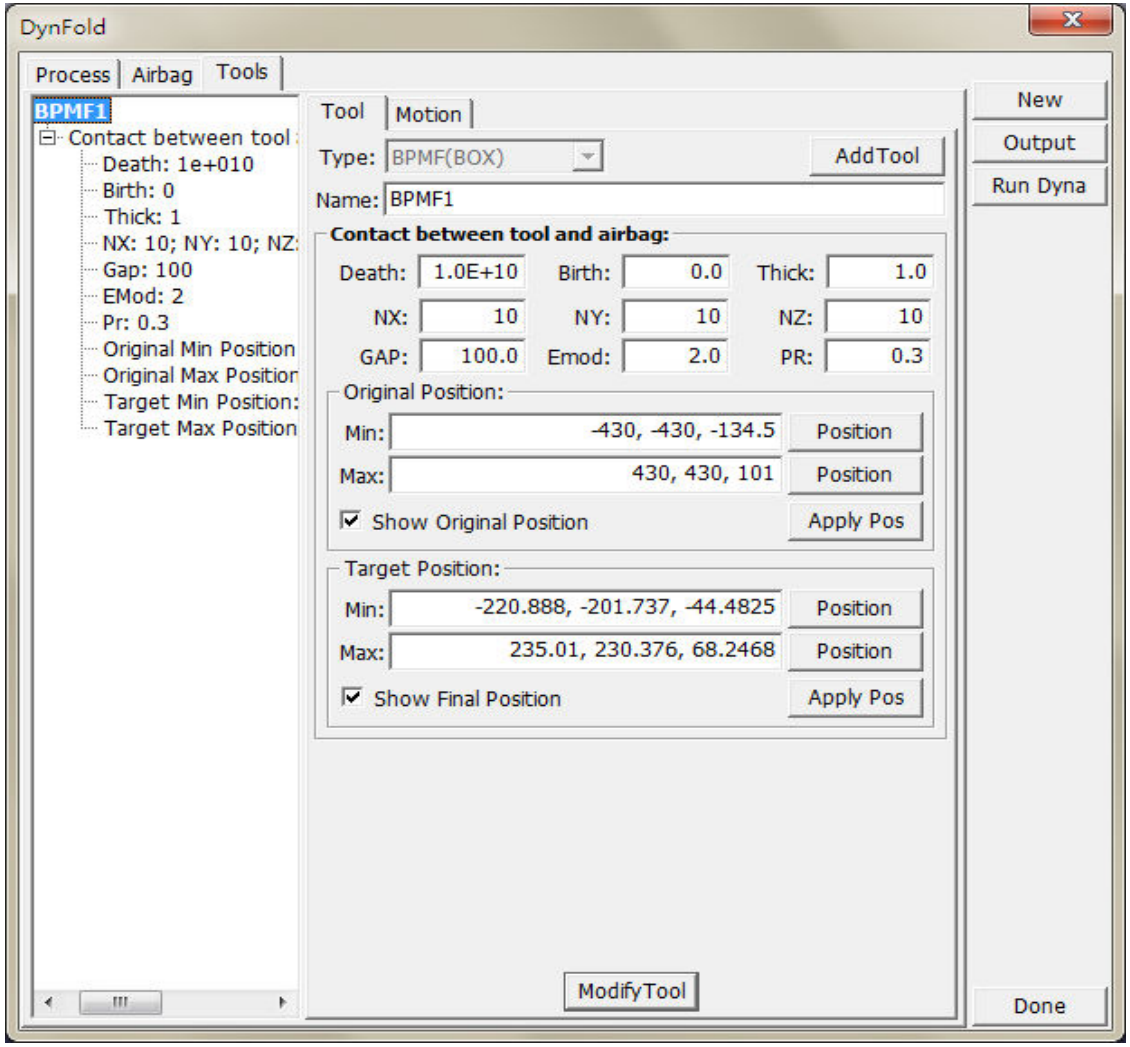
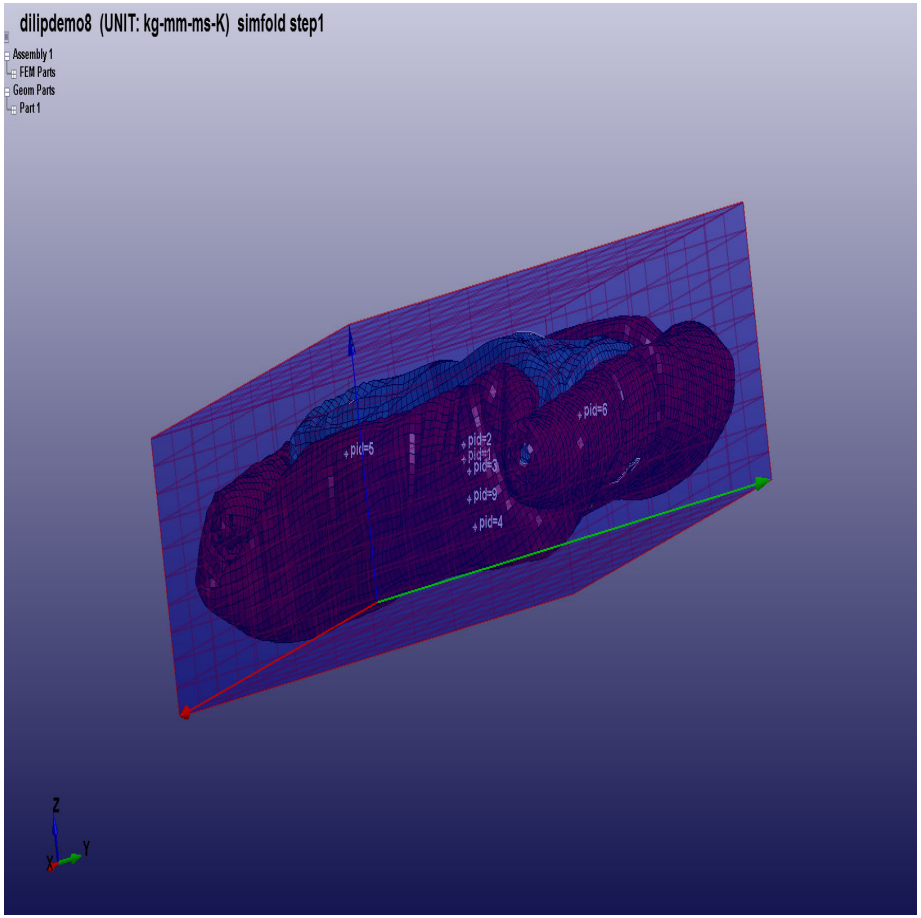
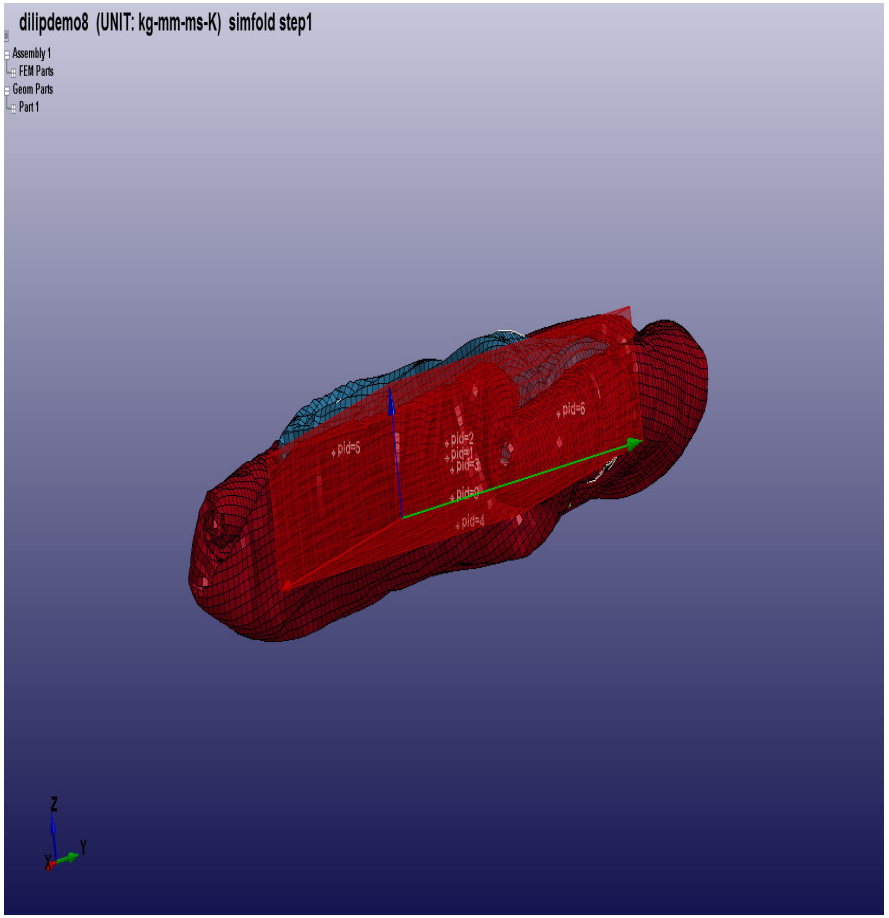


Tool BPMF(Box): define Original and Final position of the Box





Define and Preview tool box original position and target position

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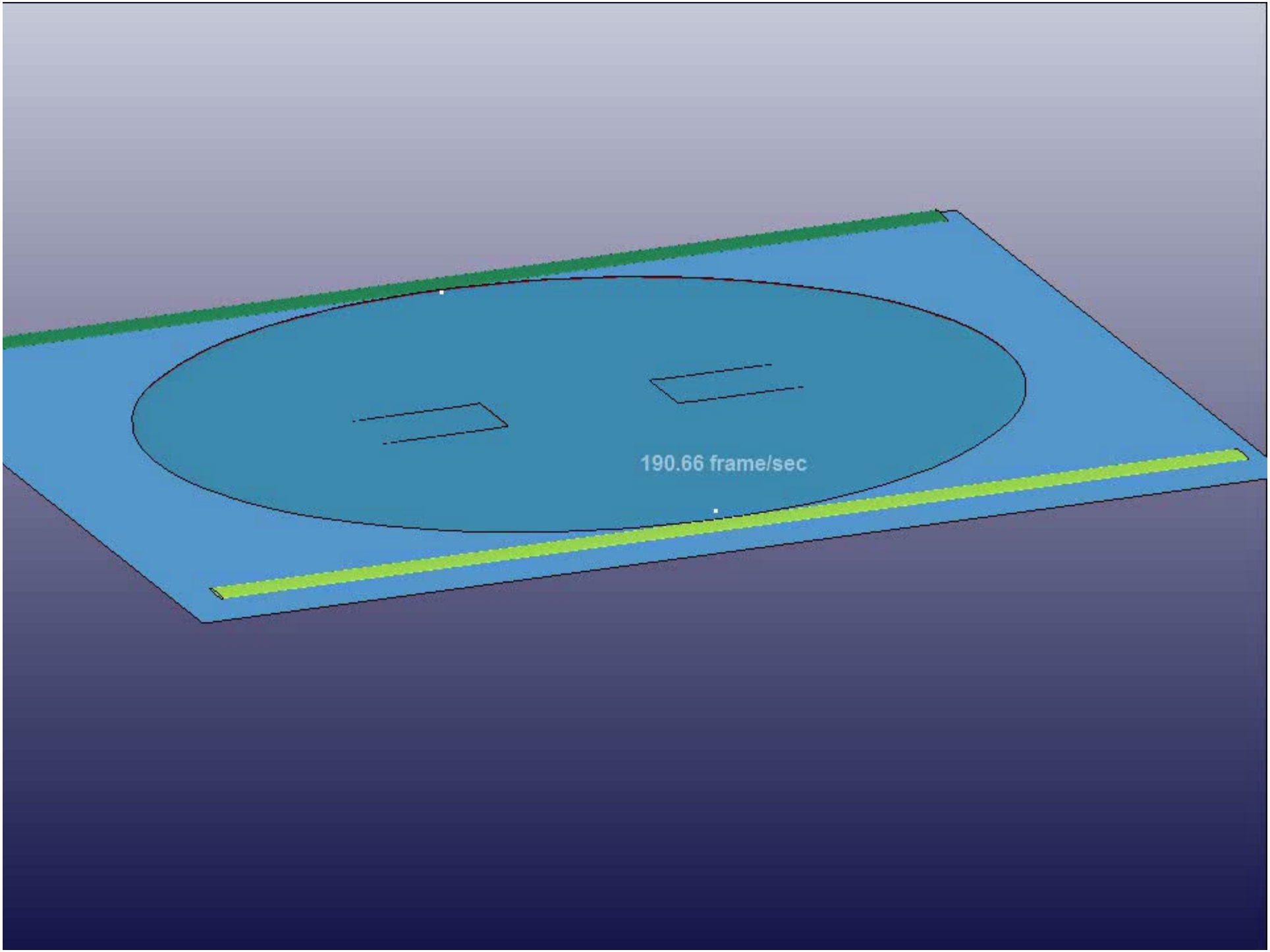
190.66 frame/sec

*Airbag_shell_reference_geometry

- *Airbag_shell_reference_geometry is the required data for airbag deployment in LS-DYNA
- LS-Prepost creates this data by asking user to pick the parts that make up the airbag in 3D final configuration and unrolled them into 2D flat panels.
- Element IDs are preserved with new nodal coordinates

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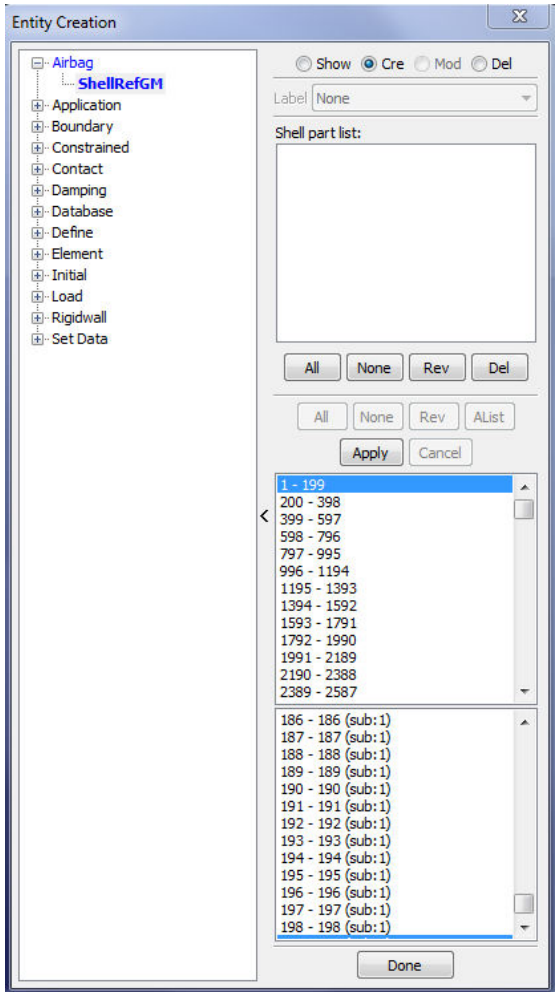
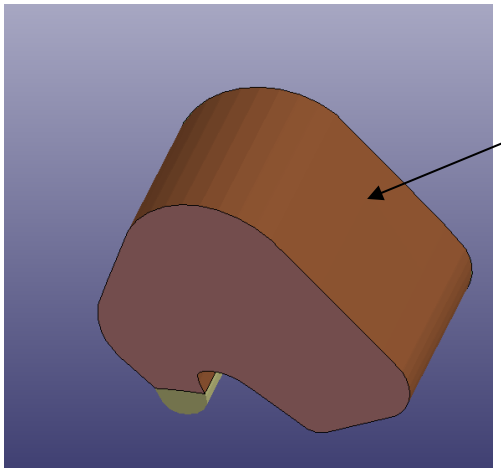
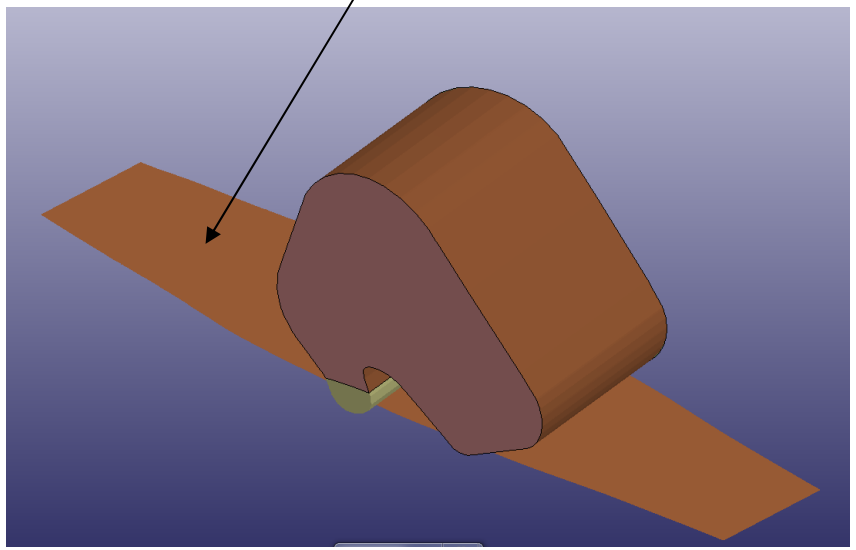
*Airbag_shell_reference_geometry





Pick this part to be unrolled

*Airbag_shell_ref_geometry



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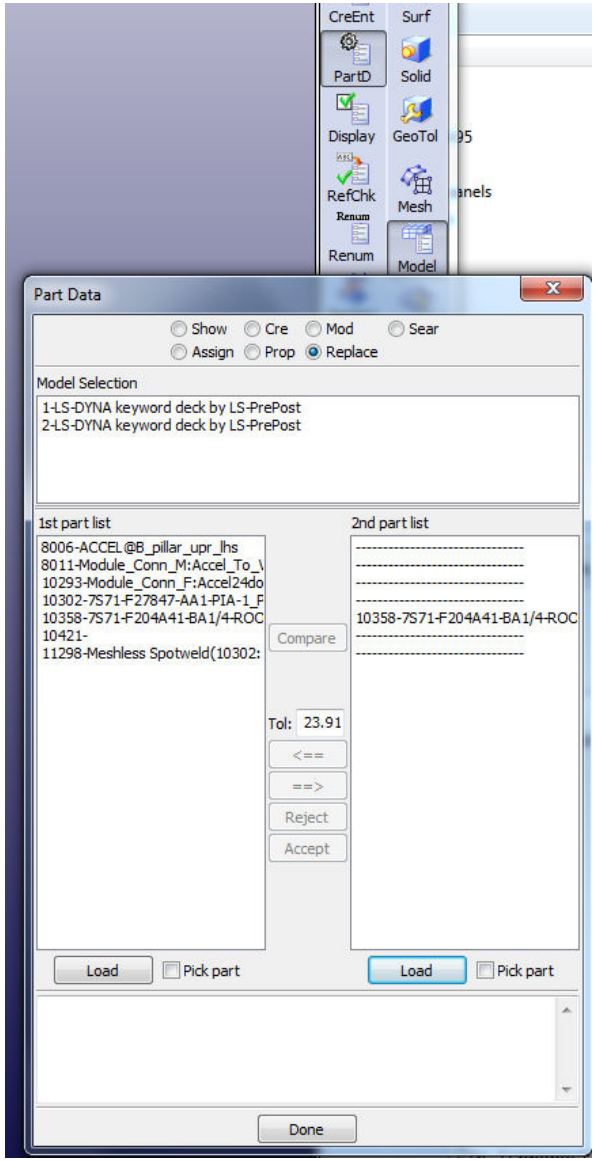
Part Replace

- Model->PartD->Replace
- To replace a part with another part
- The 2 parts do not need to be the same in no. of elements/nodes.
- Connection between others part will be done automatically when it is possible



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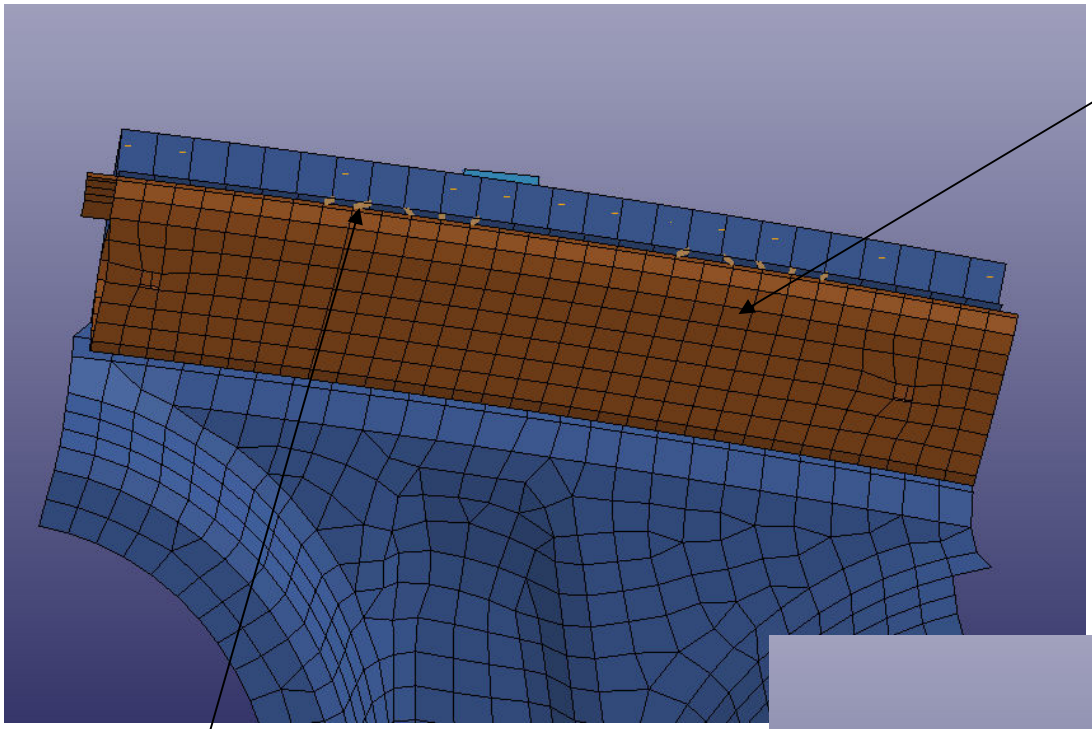
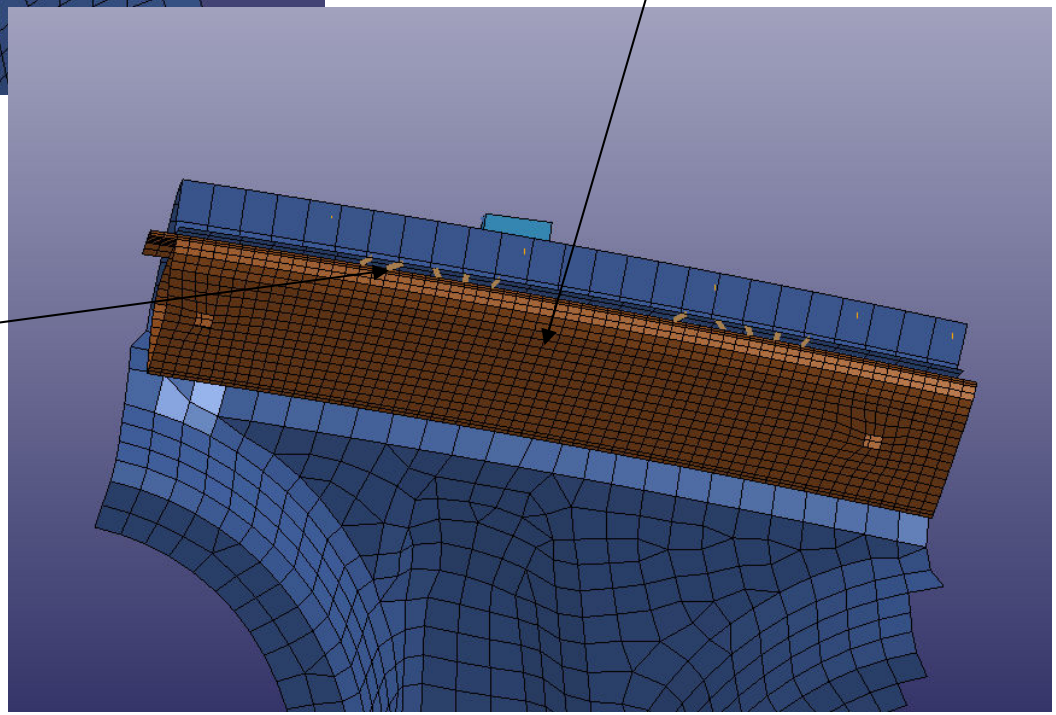


Old part

New part



Beams are connected properly automatically

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Other Miscellaneous Improvements

- Many bugs have been fixed in geometry engine
- Improved mid-surface generation from solid model
- More robust trimming and solid cutting
- Improved automatic solid meshing
- More robust LS-DYNA model checking with auto fixing
- Particle, temperature post-processing data and multiple models support in FEMZIP format
- Solid element and seatbelt element splitting
- Element edit with check, locate and repair

Current and Future Developments in LS-PrePost

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User written script for repetitive operations

- C-like programming scripting language to execute LS-PrePost commands
- Allows “if then else”, for, and while loop operations
- Uses LS-PrePost DataCenter to extract model data: like no. of parts, part ID, no. of elements, no. of nodes, etc.
- Extracted data can be used as variables to perform operations
- Most suitable to perform the same operations over different part of the model

User written script

Sample script to extract no. of parts and all part IDs, then draw each individual part and print it to a file with the part id as file name

```
/*LS-SCRIPT:PartId repeat cmd*/
DataCenter dc;
Int partnum, *ids;
define:
void main(void)
{
Int i = 0;
char buf[256];
Int modelId;
modelId = GetCurrentModelID();
DataImportFrom(&dc,modelId);
partnum = DataGetValidPartIdList(&dc,&ids);
for(i = 0; i < partnum ; i = i+1)
{
sprintf(buf,"m %d",ids[i]);
ExecuteCommand(buf);
ExecuteCommand("ac");
sprintf(buf,"print png part_%d.png LANDSCAPE nocompress gamma 1.000
      opaque enlisted \"OGL1x1\"", ids[i]);
ExecuteCommand(buf);
}
free(ids);
} main();
```

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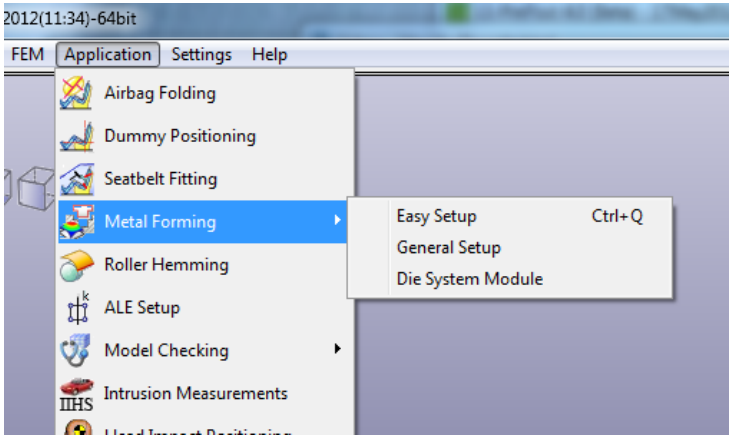
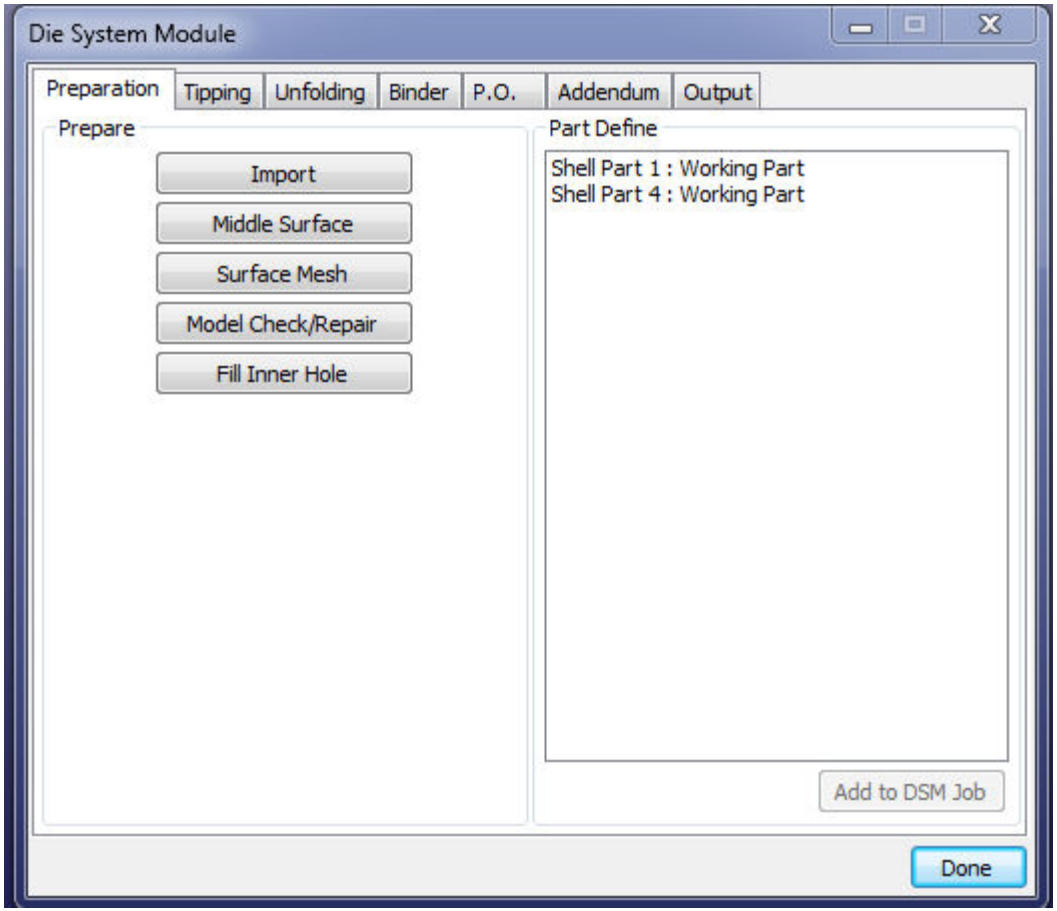
Metal Forming - Die System Module

- Complete metal forming Die design system





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Metal Forming - Die System Module

- Provides a user friendly interface to design the complete tooling system
  - Starting from CAD geometry
  - Tipping: make sure that the part can be made without undercut
    - Many options are available to allow user to check and position the part with a desired orientation
  - Binder design is fully parametric
    - User can easily manipulate the binder surface
  - Addendum design – obtain a smooth surface that is tangent to both the tool part and the binder
    - To make sure that the part can be deformed correctly
    - Parametric patch method will be employed
  - Initial blank size estimation – one step solver

Other Current Developments

- Multiple section cuts
- Section cuts for particle elements (SPH, CPM, Discrete elements)
- Section cuts for CFD data

Summary

- New GUI provides better look and feel, also yields maximum windows space for graphics, at the same time old interface is still available to user
- Capabilities in the geometry engine allows CAD data to be modified and repaired before meshing and therefore eliminate tedious mesh modification
- New rendering in Version 4.0 employs the latest rendering techniques in OpenGL, speeds up the rendering by many times, viewing and animation of very large models now is possible
- LS-DYNA model data check is a very important tool to ensure the validity of the data before running LS-DYNA
- Scripting language will be further developed to provide much more powerful capability

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Conclusion

- LSTC is committed to continue to develop and enhance LS-Prepost by improving its stability, robustness and user friendliness
- New features have been added continuously to keep up with the development of LS-DYNA both in the post-processing and pre-processing
- New Applications have been implemented to let user do special LSDYNA job setup easily and quickly
- Users' feedback and suggestions are always welcome

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