第三届LS-DYNA中国论坛

2018年10月26日　　上海

Livermore Software Technology Corporation　　上海仿坤软件科技有限公司（**LS-DYNA** 中国）

LS-PrePost® Introduction/Future Development

3rd China LS-DYNA Forum
Shanghai, China

October 26, 2018

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Introduction

- LS-PrePost is an advanced pre and post-processor designed specifically for LS-DYNA
- LS-PrePost is developed for Windows, Linux and Mac
- LS-PrePost is Free
- Core Functionality
  - Full support of LS-DYNA keyword files
  - Full support of LS-DYNA results files
  - Robust handling of geometry data (new CAD engine)
  - Pre-processing (meshing, model clean-up, entity creation, application)
  - Post-processing (animation, fringe plotting, curve plotting)

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Introduction

- Official Website
  - http://www.lstc.com/lspp
- User Group
  - http://groups.google.com/group/ls-prepost
- Latest Release Version:
  - http://ftp.lstc.com/anonymous/outgoing/lsprepost/4.5/
  - ftp://ftp.lstc.com/outgoing/lsprepost/4.5/
- Beta Version:
  - http://ftp.lstc.com/anonymous/outgoing/lsprepost/dev
- Training notes:
  - ftp://ftp.lstc.com/outgoing/qyan/Class

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Geometry Module

- Reference Geometry
  - ref-axis, ref-plane, ref-coordinate system, ref-point
- Curve
  - Point, Line, Circle(arc), Ellipse(arc), BSpline, Helix, Composite, Break, Merger, Bridge, Smooth, Mid-curve
- Surface
  - Plane, Cylinder, Cone, Sphere, Torus, Fill Plane, Extrude, Revolve, Sweep, Loft, N-Side, Patch, Brdige, Combine, PntsToSurf, MeshToSuf
- Solid
  - Box, Cylinder, Cone, Sphere, Torus, Extrude, Revolve, Sweep, Loft, Fillet, Chamfer, Draft, Thicken, Wedge, Boolean
- Geometry Tools
  - Delete, Extend, **Intersection**, Project, Replace, Offset, **Trim**, Transform, Copy, **Heal**, **Simplify**, Measure, Management

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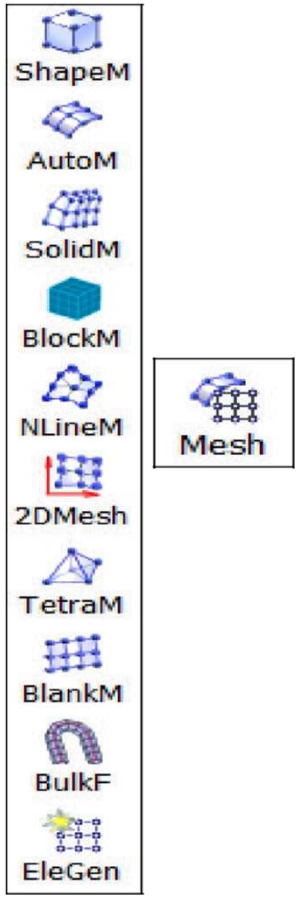
Meshing Module

- simple shape meshing
- surface mesher
- n-line mesher
- solid mesher
- tetrahedron mesher
- element generation
- element edit
- SPH packing
- DES packing



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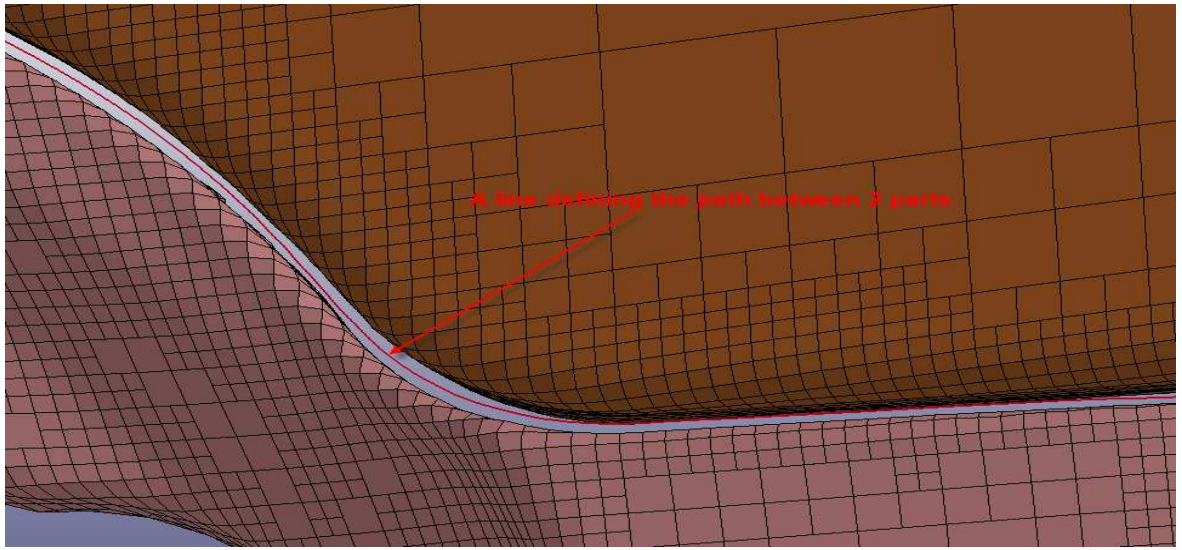
Rapid Modeling - Laser Weld

- 3D solid mesh creation to simulate laser weld
- Very often 2 parts will be jointed together by laser weld, this can be modeled by 3D solid elements created from a line defining the weld



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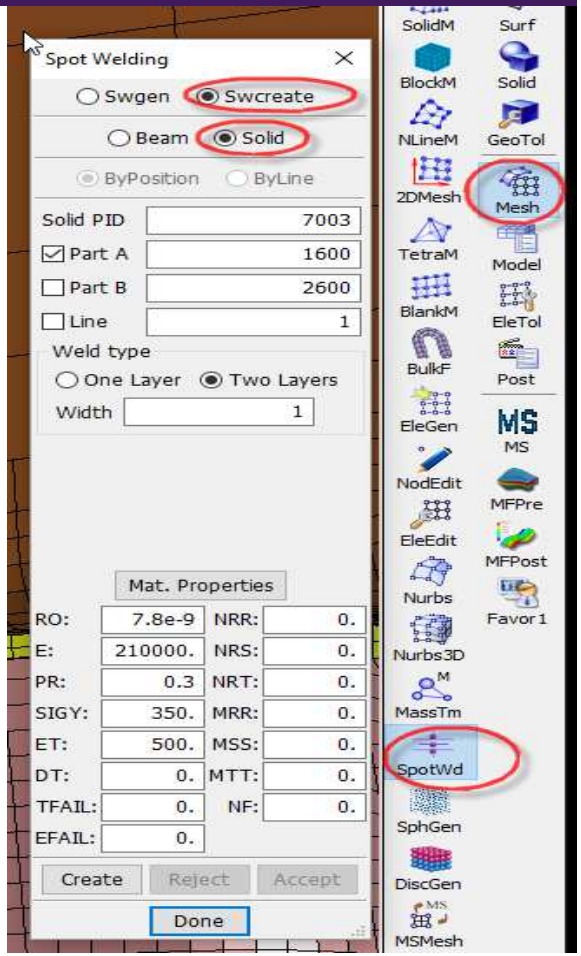
Rapid Modeling - Laser Weld

3D solid element mesh for laser weld

- Pick 2 parts that the laser weld will be interact with
- Pick a line to define the path
- Define1 layer or 2 layers of solids
- Define the width of the solid element
- Material properties can also be defined
- *contact_tied_shell_edge_to_surface will be created



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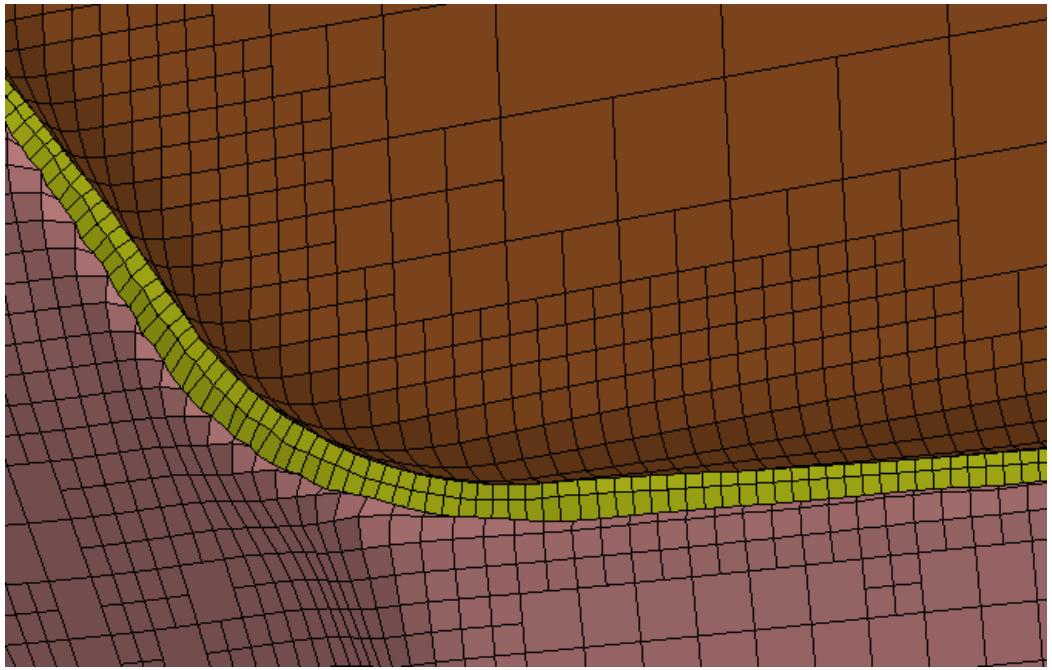
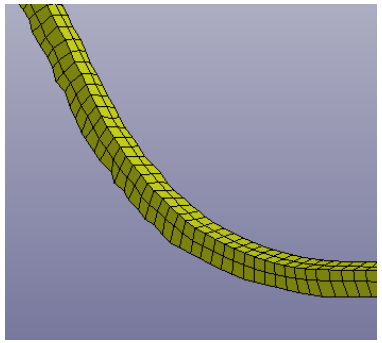
Rapid Modeling - Laser Weld

The solid elements will be created with variable thickness that conform to the gap between the 2 parts





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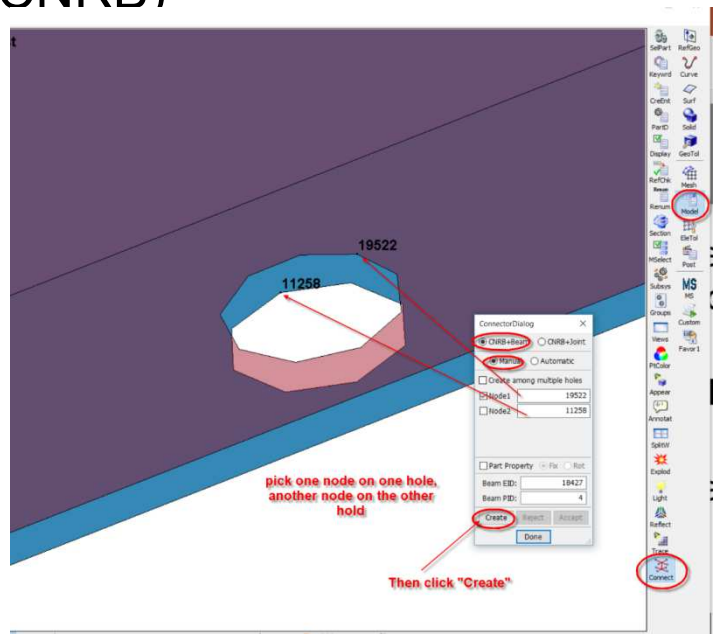
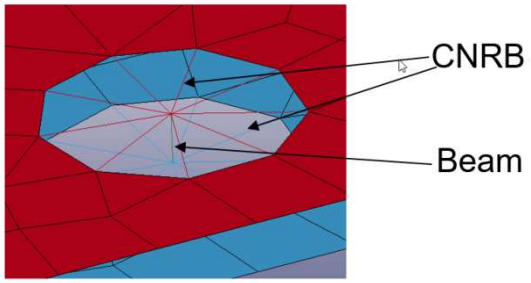
Rapid Modeling - Connectors

- Creation of Joints, Bolts automatically with minimum number of operations and without knowing the required keyword
- Bolt can be constructed with Beam elements and Constrained nodal rigid body (CNRB)





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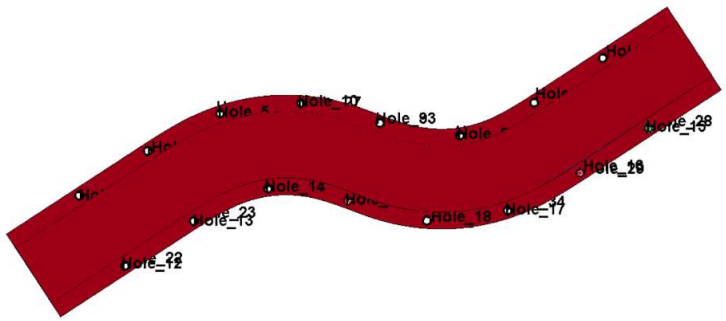
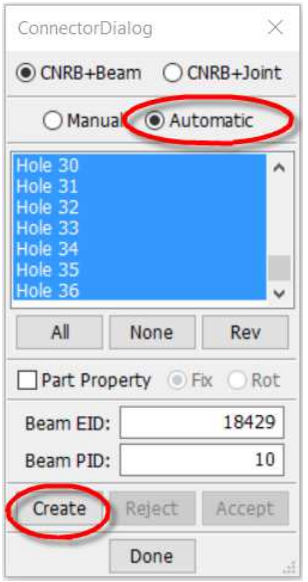
Rapid Modeling - Connectors

- In a situation when there are many (in the number of several hundred or thousands) bolts/joints to be created, automatic option can be used with only one click
- LSPP will automatically find all the matching holes and create the connectors for each set of holes





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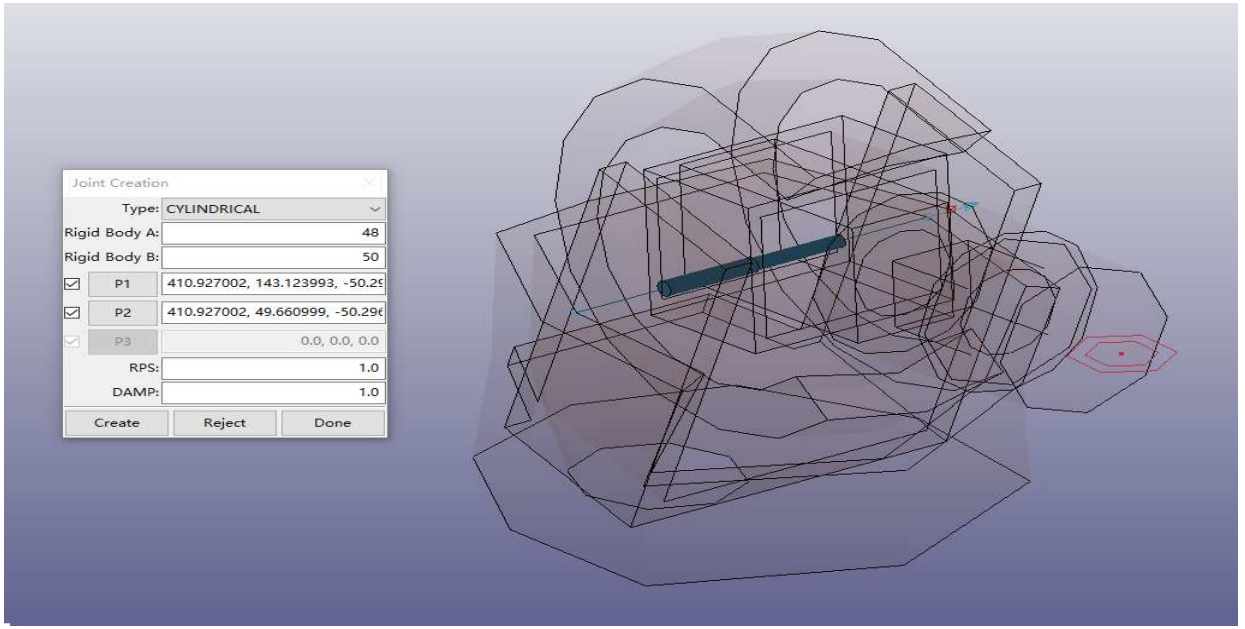
Rapid Modeling - Joint Wizard

- Entity Creation -> Joint Wizard to make the creation of Joint easier. With less than 6 clicks, Joint, which contains several keywords, can be created.



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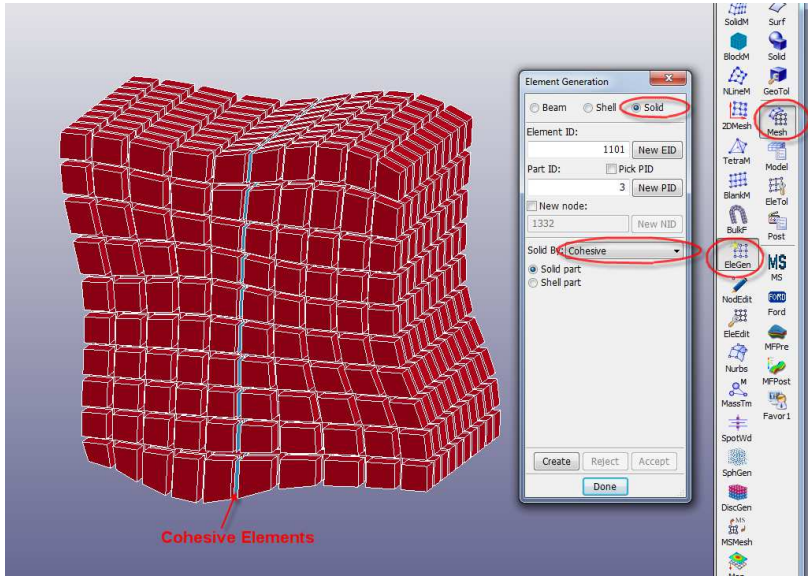
Rapid Modeling - Cohesive Elements

- Creation of Cohesive Elements
- First create a beam part (shell cohesive) or shell part (solid cohesive)
- Then select the shell or solid part and the pre-created beam or shell part



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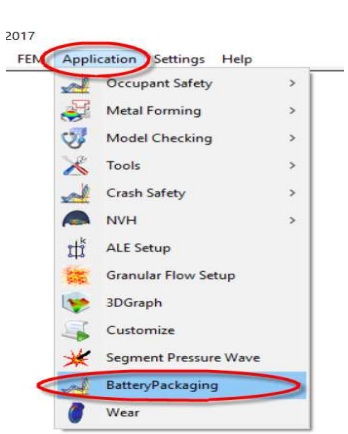
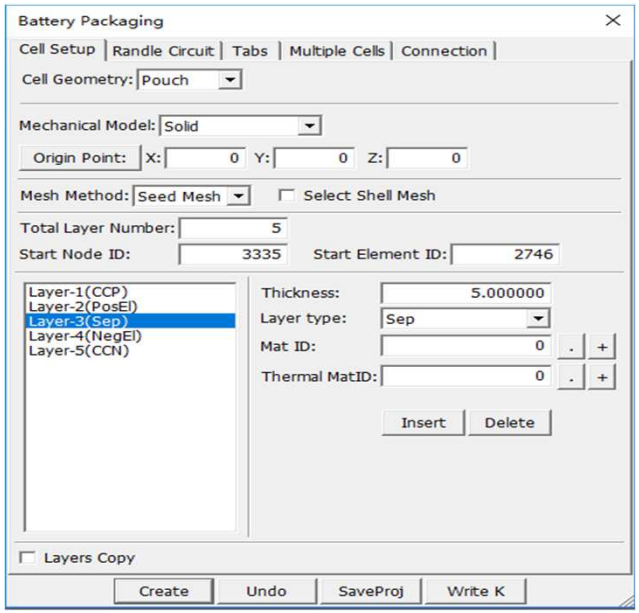
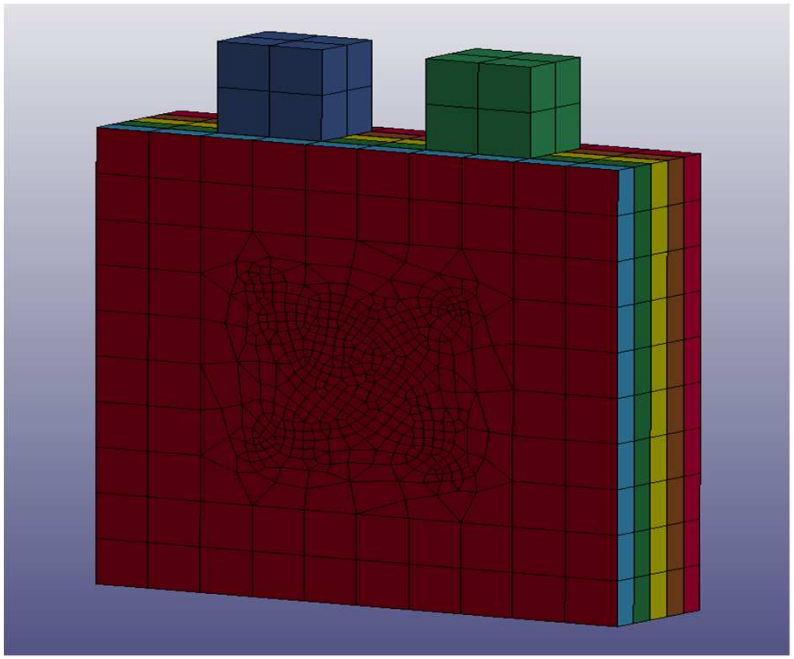
Rapid Modeling - Battery Packaging

- A new application to setup battery packaging analysis for LS-DYNA EM solver







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Rapid Modeling - Keyword Replace

Purpose: To replace a particular field in one of the keyword data

Keyword replaceint KeywordName IDRange FieldID NewValue OldValue

KeywordName – Name of Keyword, e.g. SECTION_SHELL

IDRange – a range of ID in the keyword data to be changed. e.g. first:last:inc, 2001:4001:1, or “All”

FieldID – The field id starting from 0, not 1

NewValue – the new value will be assigned to that field

OldValue – This is an optional input used as a filter, if the existing data match this value, then it will be replaced, otherwise skip. If omitted, all data in the ID range will be replaced

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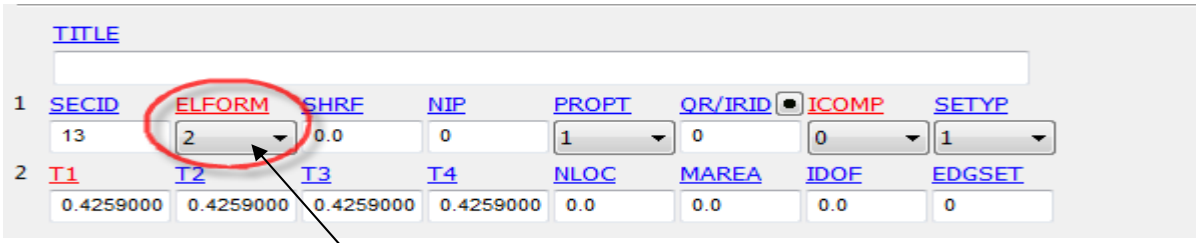
Rapid Modeling - Keyword Replace

Keyword Replace Command

Keyword replaceint KeywordName IDRange FieldID NewValue OldValue



Example: To replace all section shell formulation (ELFORM) from 2 to 16 (elform value not equal to 2 will not be changed)

Command Syntax:

Keyword replaceint SECTION_SHELL all 1 16 2

The IDfield is 1 because it is the second field

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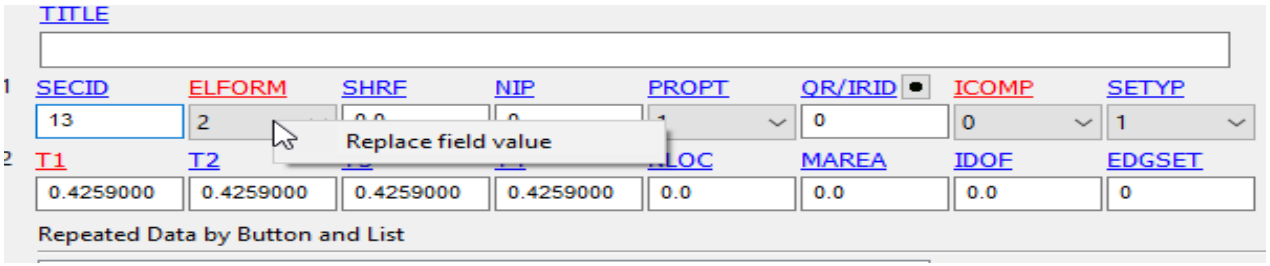
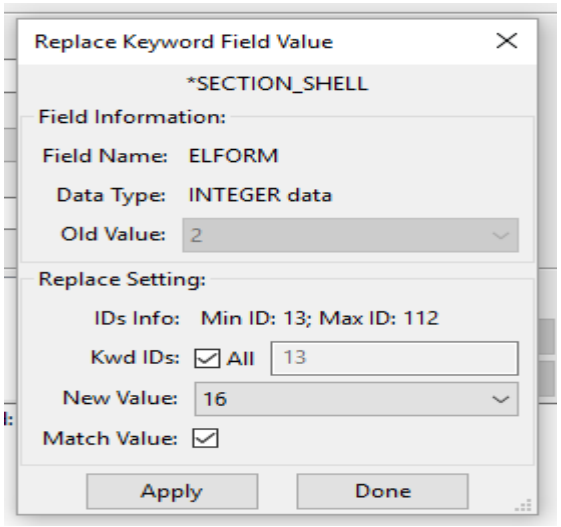
Rapid Modeling - Keyword Replace

The keyword replace command is powerful but the command structure and syntax is not possible to remember

Now this can be done with the help of GUI

Right click on any data field to activate the interface





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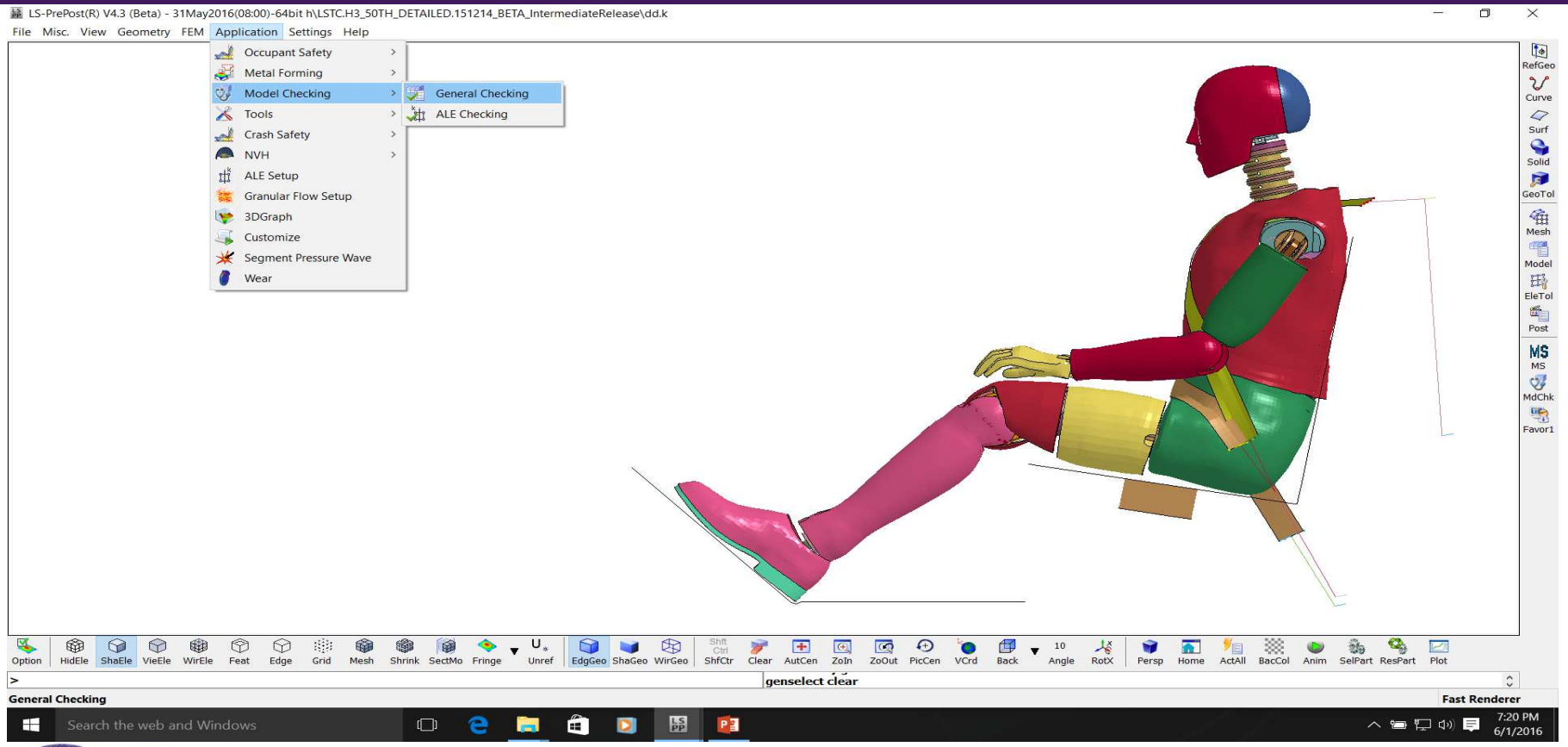
Rapid Modeling – Snapping Nodes

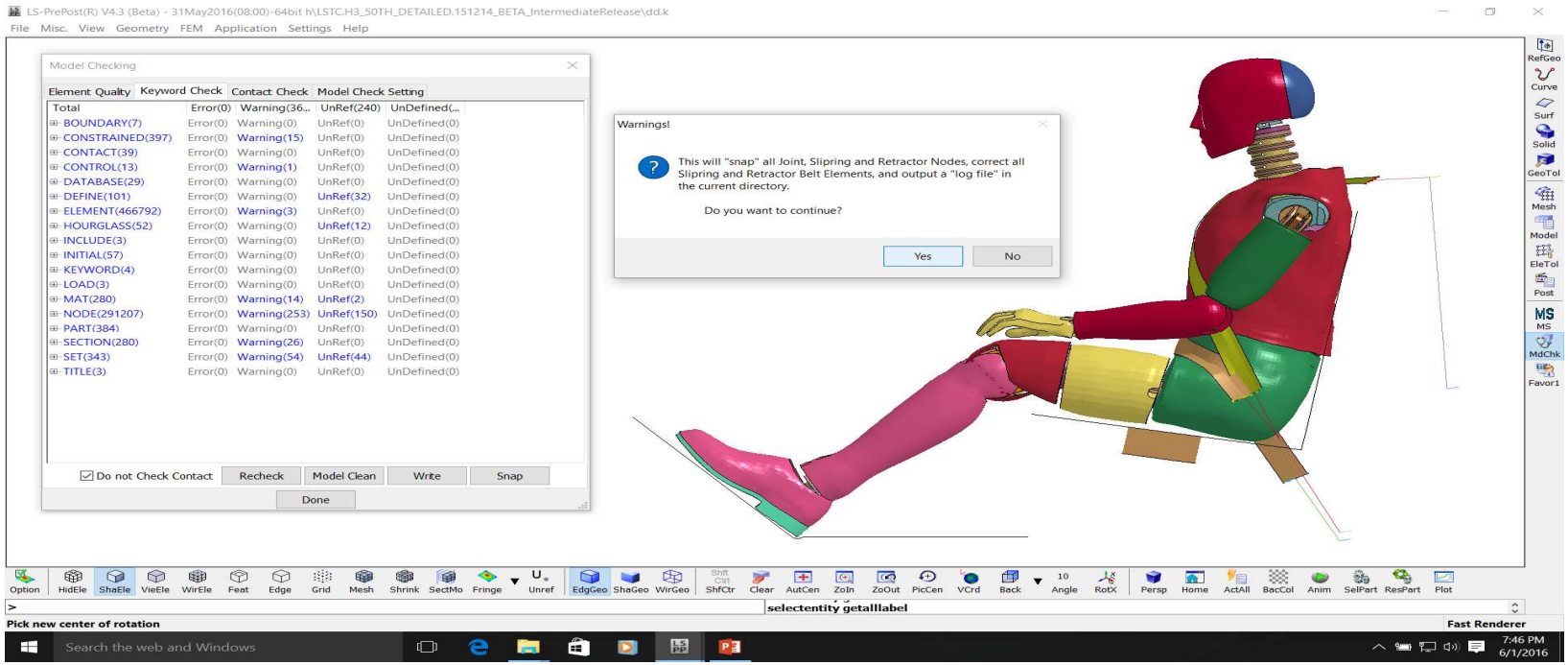
- All Joints, Sliprings and Retractors have “Node Pairs”.
- LS-Dyna would ideally like these Node-Pairs to have “**identical coordinates**” to the last place of decimal. That would ensure **maximum numerical accuracy**.
- Minor inaccuracies lying within the tolerance are accepted by the code but anything beyond that could cause “Error Termination”.
- These are very difficult to correct “manually”.
- LSPP now has the ability to scan through the entire Model and “snap” these Node Pairs together. Done at the “Model Checking” phase. A “log file” is written out giving complete information as to what was done.

Rapid Modeling – Snapping Nodes



Rapid Modeling – Snapping Nodes

In the “New Pop-up Window” press the “Yes” Button. This will “snap” all Joint, Slipring & Retractor “Node Pairs” in the Entire Model.



Scripting Command Language

- Scripting Command Language (SCL) – is a C-like programming language to be executed within LS-PrePost
- Executes LS-PrePost commands
- Allows “if then else”, for, and while loop operations
- Provides API (Application Programming Interface) to extract model and result data from LS-PrePost Data base
- Operations can be done on extracted data to form new data. New data can be output to file or fringed within LS-PrePost
- Most suitable to perform same operations over different part of the model
- Documentation and example are available at ftp://ftp.lstc.com/outgoing/lsprepost/SCLexamples/

Scripting Command Language

LS-PrePost SCL specifics and limitations

LSPP-SCL is like ‘C’ programming language with the following exceptions:

- For integer data declaration, use “Int” not “int”
- For floating point declaration, use “Float” not “float”
- Combined assignments such as i++, i--, --i, ++i, i+=, i*=; are not supported, must use i=i+1; i=i-1; i=i+n; i=i*x; i=i/n;
- Do not typecast data conversion, e.g. Int i; Float x; i = x; (right), i = (Int)x; (wrong)
- Switch case, do….while loop – not supported
- Conditional operation: (boolean) ?: - not supported

Scripting Command Language

There are 2 ways to execute the SCL file

1. Command line:

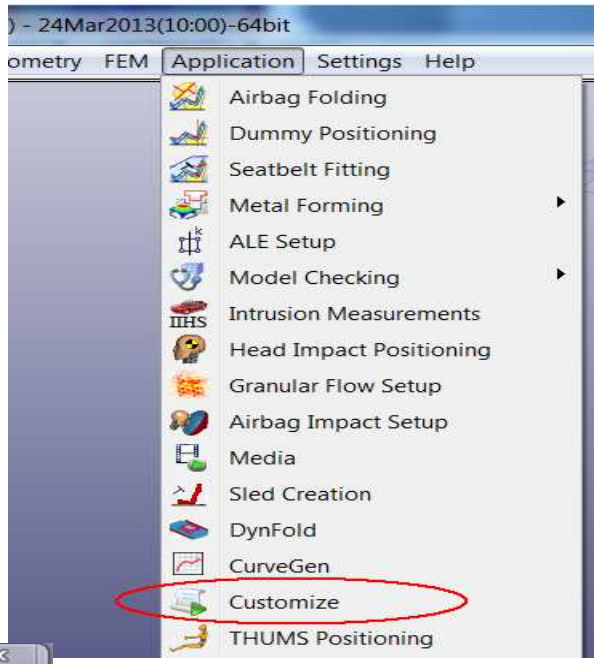
- Run it within the regular LS-PrePost command file, use the “Runscript” command to execute SCL file, parameters can also be passed to the script:
  - Runscript “SCL_filename” [optional parameters]
  - Example: runscript myscript.scl 100, 0.5, 1.2
- When passing the parameters to the SCL, there are API functions to retrieve the parameters within the script

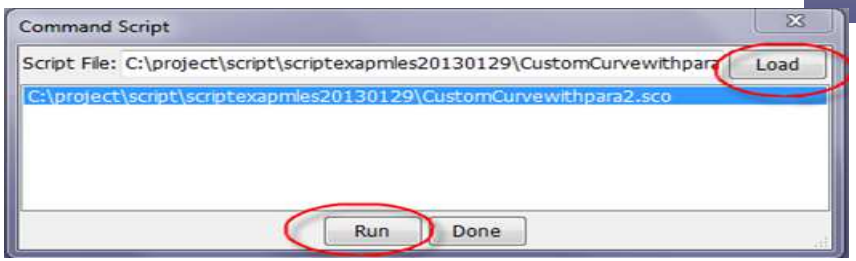
Scripting Command Language

The second way to execute the SCL file

2. User interface:

- Go to the Application pull down menu, select “Customize” and in the pop up dialog, click “Load” to load the SCL file, then click “Run” to execute. Running the script this way cannot pass parameters to the script file





Scripting Command Language

- To download the document on Scripting Command Language, go to the following directory:
  - ftp://ftp.lstc.com/outgoing/lsprepost/SCLexamples

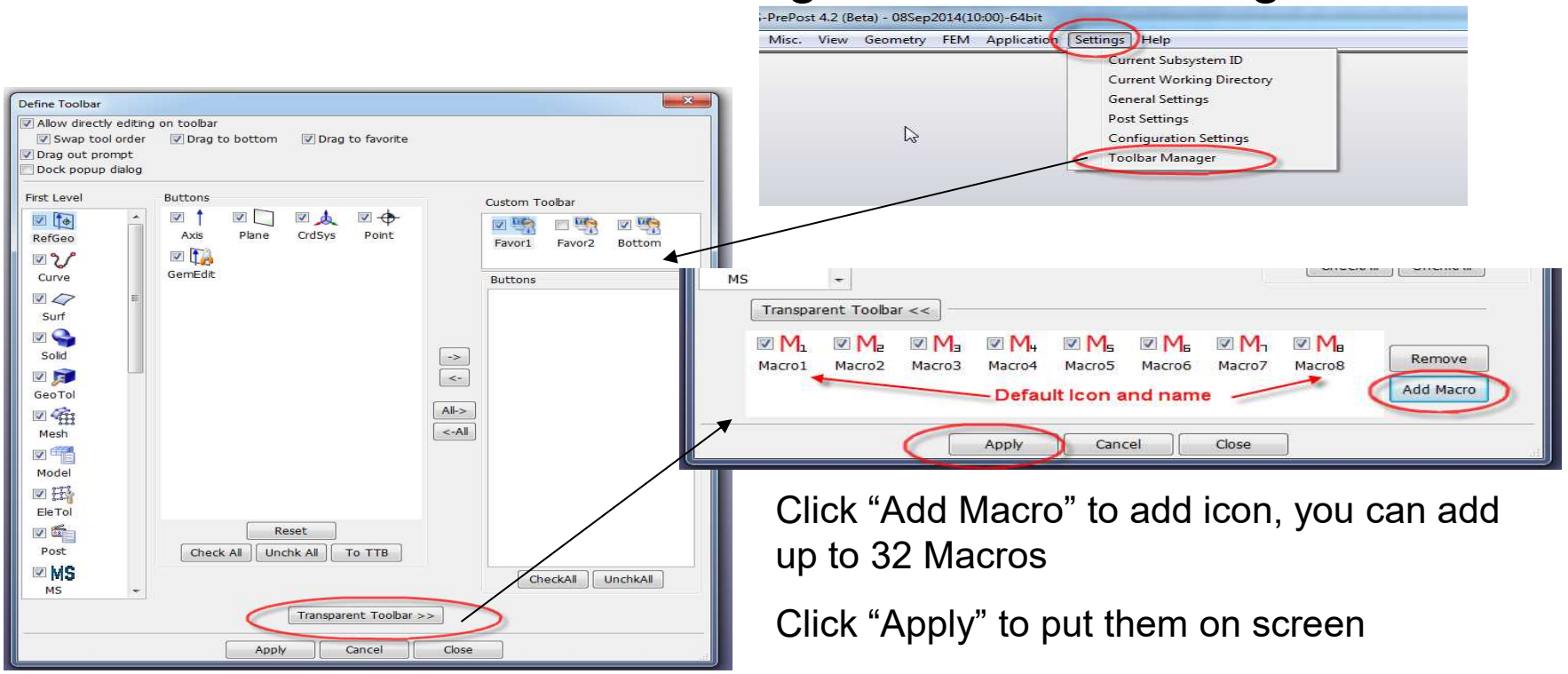
- Lsppscripting.doc – describes how to use the API in Scripting Command Language
- SCL_Examples.zip – file contains examples scripts which demonstrate different operations

Scripting Command Language

```
define:
void main(void)
{
     Int numState;
     Int numEle;
     Int i = 0;
     Int j = 0;
     Float *cur = NULL;
     Float *times = NULL;
     char buf[128];
     numState = SCLGetDataCenterInt("num_states");//获得状态数
     numEle = SCLGetDataCenterInt("num_elements");//获得模型单元数
     cur = malloc(numEle*sizeof(Float));
     times = malloc(numState*sizeof(Float));
     //获得每个状态的时间存储于数组times
     numState = SCLGetDataCenterFloatArray("state_times", 0, 0,&times);
     for( i = 0; i < numState; i = i+1)
     {
         SCLSwitchStateTo(i+1);//迁移状态
         //获得第一主应力 0表示整个模型 MID表示积分层
         numEle = SCLGetDataCenterFloatArray("stress_1stprincipal",0,MID,&cur);
         sprintf(buf, "stress_1stprincipal%d.dat",i+1);
         //结果渲染云图
         SCLFringeDCToModel(0,0,numEle,cur,i+1,buf);
     }
     free(cur);
     cur = NULL;
     free(times);
     times = NULL;
}
main();
```

User Defined Toolbar/Macro Icons

- Go to Pull Down Menu Settings->Toolbar Manager



Click “Add Macro” to add icon, you can add up to 32 Macros

Click “Apply” to put them on screen

Icon itself and the name can be changed

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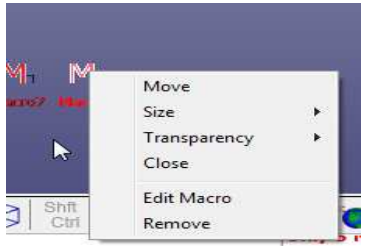
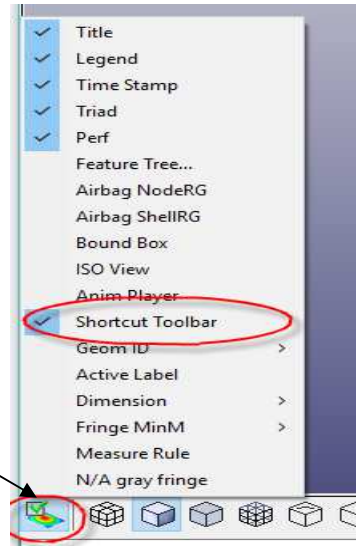
User Defined Toolbar/Macro Icons

- Right click the macro icon to pop up the option menu
  - Move – will move the entire TTB to different location on the screen, left click on the screen to determine the new location
  - Size – option for small or large icon
  - Transparency – 100% to 20% Opaque
  - Close – turn off display of the macro TTB (to turn it back on, use display option)
  - Edit Macro – to edit a selected icon (modify or enter LSPP commands into the macro)
  - Remove – to remove a selected icon





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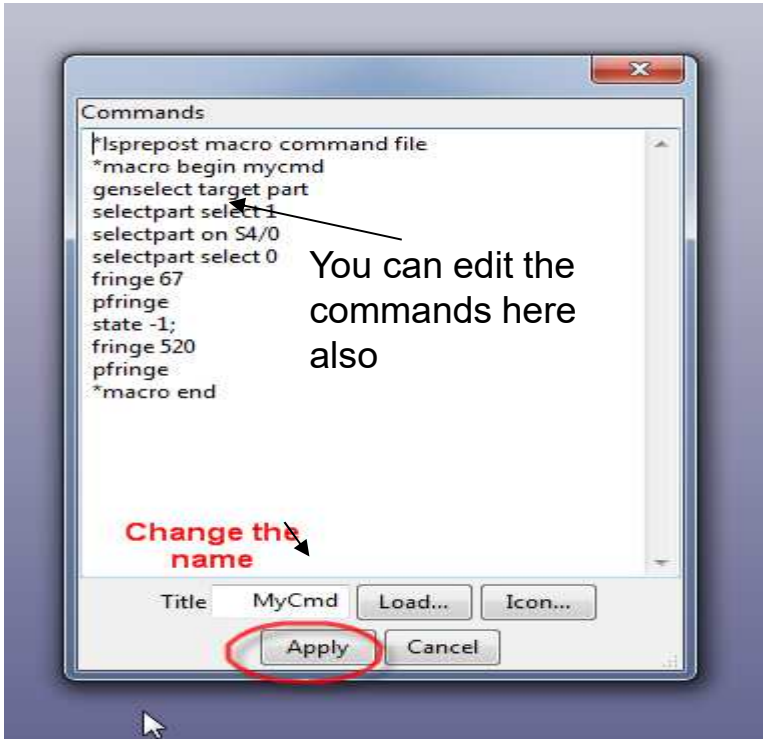
User Defined Toolbar/Macro Icons

- Edit a selected Macro icon – right click the icon and select “Edit Macro”

  - Title – change name of macro
  - Load – load new command file into macro
  - Icon – load user defined icon
  - Apply – apply changes to the macro icon



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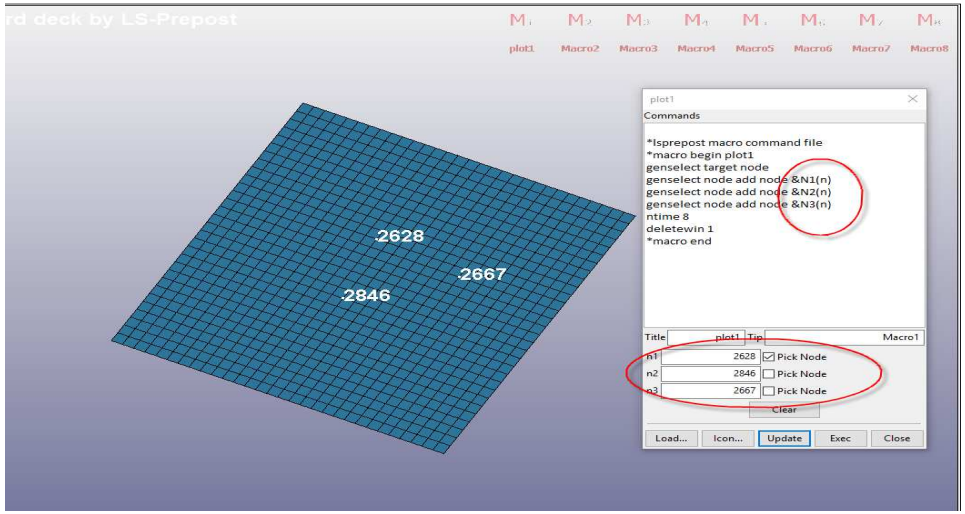
User Defined Toolbar/Macro Icons

- Name started with ‘&’ to signify it is a parameters
- Macro Command can have parameters
- If name has () at the end means it can be picked from screen
- (n) – nodes, (e) – elements, (p) – parts
- If the parameters are fully defined, then left click the icon will execute, otherwise will popup the dialog waiting for parameters to be defined



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User Defined Toolbar/Macro Icons

- Things you should know about the macro icons:
  - The macro icons remain in the configuration directory and will be loaded every time LSPP is launched
  - If you load your own icon, you should not change the location of the icon file, or remove it from the system until you disable the macro
  - Many LSPP commands are model dependent, if apply to a different model, very likely it may not work properly or even crash the program

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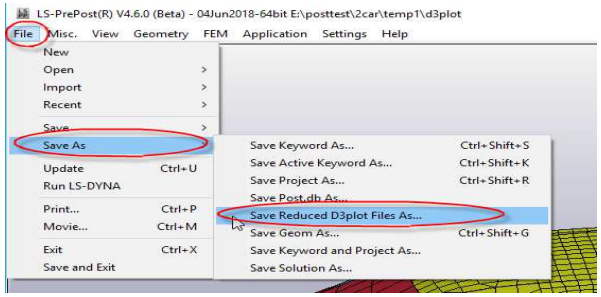
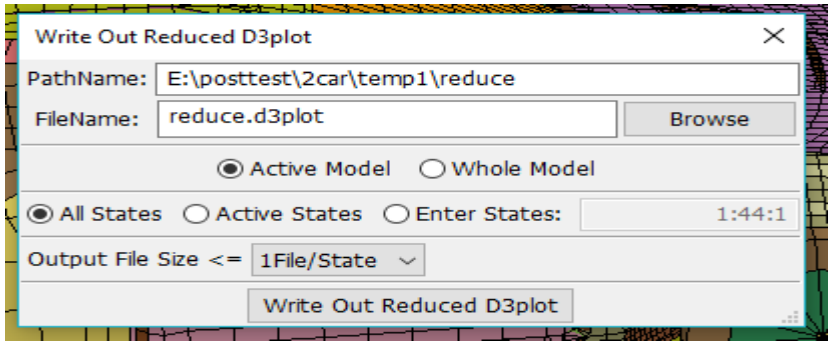
Save As Reduced d3plot files

- Users can save a new d3plot files with only selected parts or selected time states
- All stress/strain components for these parts will be saved.
- It is exactly the same format as the original d3plot
- Option to select file size (1state/file or multiple states/file)
- For now, only the mechanical (Structural) data can be saved





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Metal Forming

- Die System Module(DSM)
  - Create tooling surface
- Multi-Stage Setup
  - Enhancing the progressive die simulation
  - Automating the springback compensation process
- Springback Compensation Setup
  - The drawing tools compensation
  - The trim die compensation
- Lancing Setup
  - Adding the lancing operation in the process of forming
- Best fit Module
  - Assessing the springback prediction accuracy with the scan data
- 3D Draw bead Module
  - Generating the real bead mesh based on the line beads for accurate springback prediction
- One Step
  - To provide users with a user-friendly interface to set OneStep simulation and view the results.
- Blank Size/Trim Line
  - This feature will automatically adjust an initial blank's size and shape so that the formed part will more closely match a given target shape.

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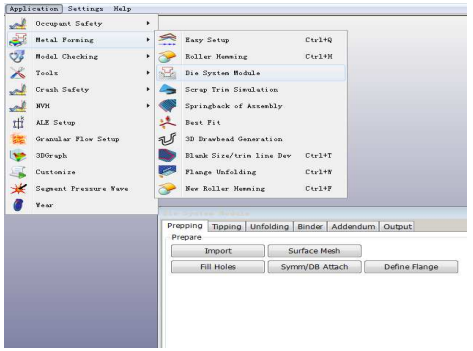
Metal Forming - DSM

Die System Module (DSM) in LS-PrePost 4.5 for our users to create tooling surface when the final part is provided

- Prepping
  - *Prepare the given part for further processing*
- Tipping
  - *Tip the part (the flanges excluded) to the desired draw position*
- Unfolding
  - *Specify how to process the defined flanges*
  - *repair the boundaries*
- Binder
  - *Create the binder profiles and generate the binder*
- Addendum
  - *Create the addendum profiles and patches to generate the addendum*
- Output
  - *Save the created tools and the curves to files*



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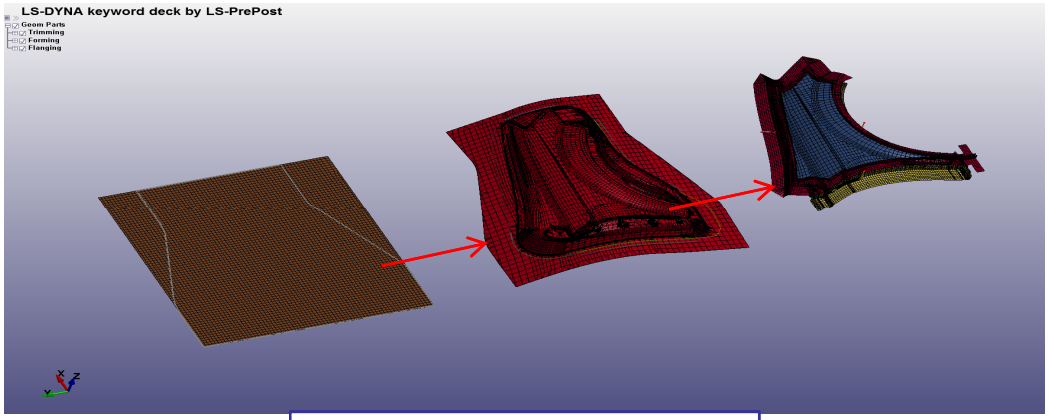
Metal Forming – Multi-Stage Setup

Same processes can be repeated (e.g. trimming, gravity, springback)

Drawing and redrawing processes with different tools can be defined as many as necessary

Various stages can be defined

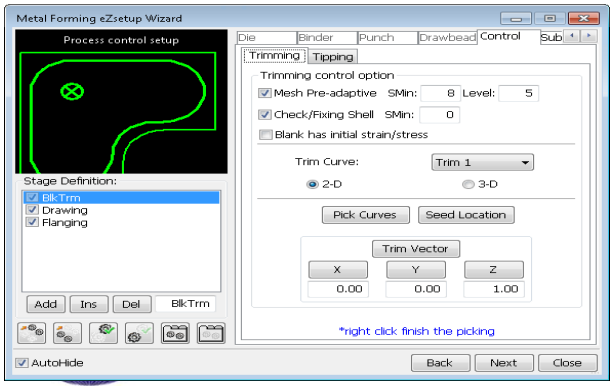


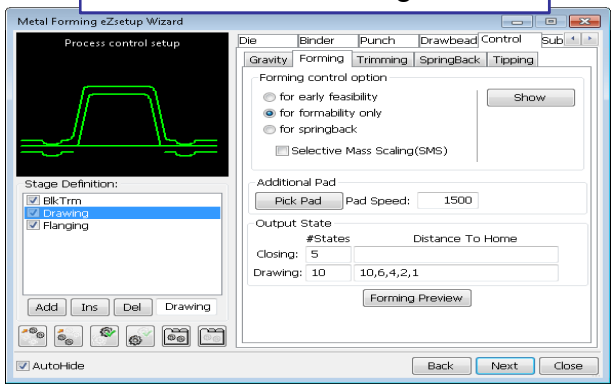
Multiple blanks are supported in the blank definition

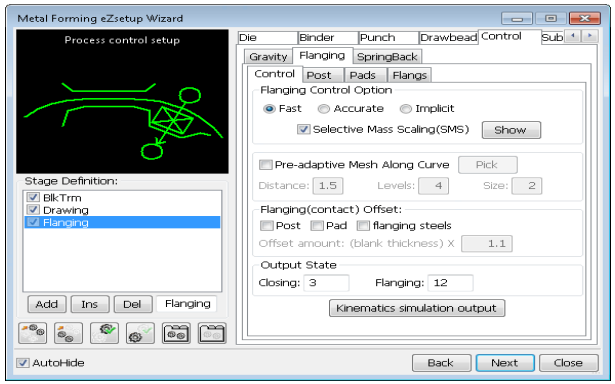
Tipping can be used to transfer the forming part between stages

Flexible flanging definition

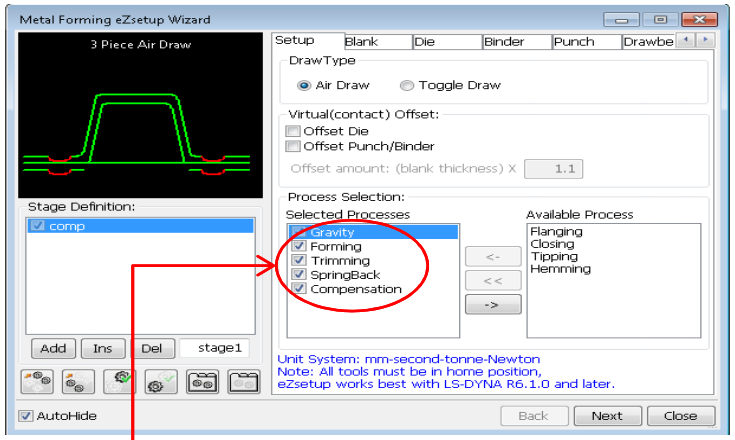
The draw types can be different between stages

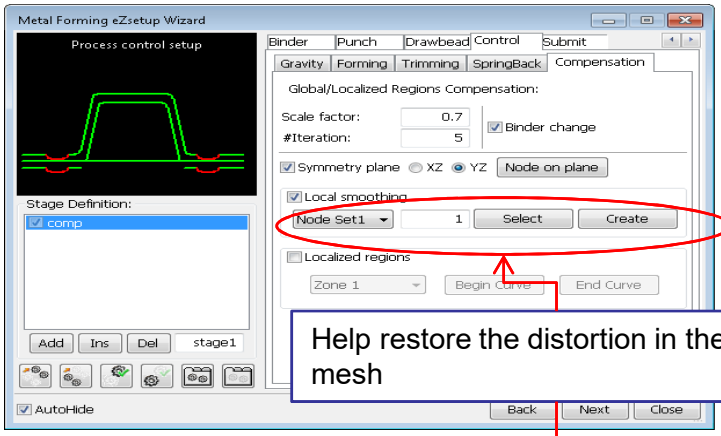






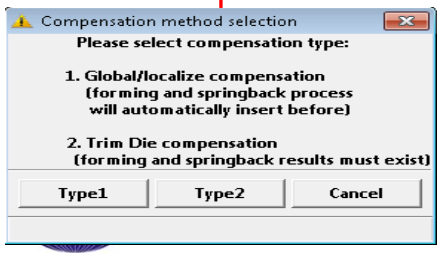
Metal Forming – Spring Back Compensation





Help restore the distortion in the new mesh

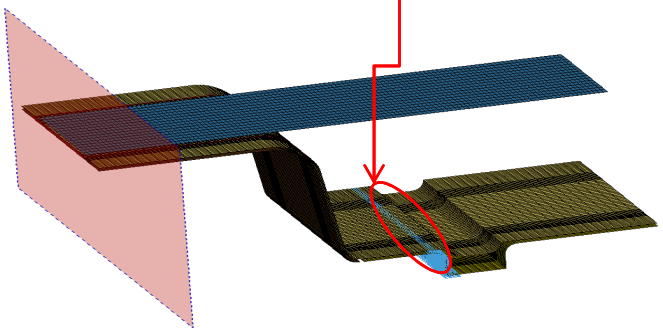
Starting Compensation will automatically add the supported baseline processes



Scale Factor: determines how much of the shape deviation is compensated in one compensation simulation

Binder Change: Whether the binder change will be modified in the compensation.

Localized regions: only the selected regions of the tools will be modified.

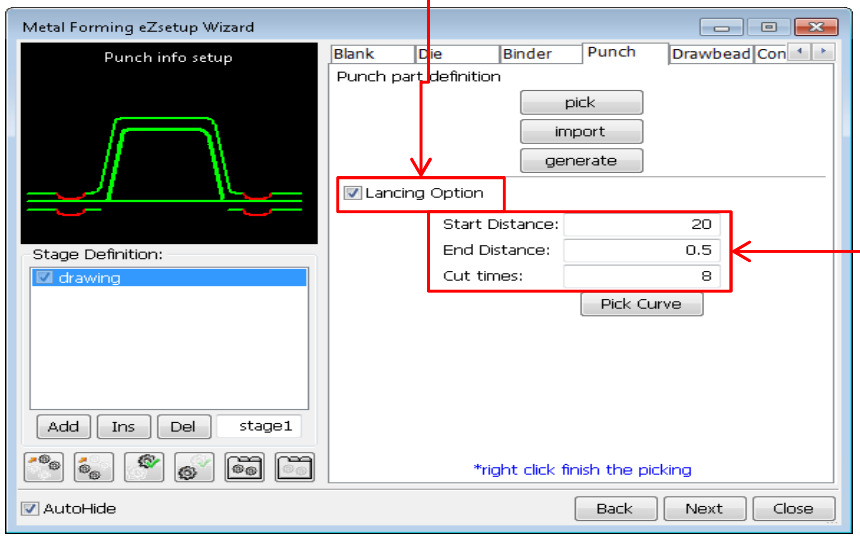


Automatic submission can be performed as the multi-stage simulations

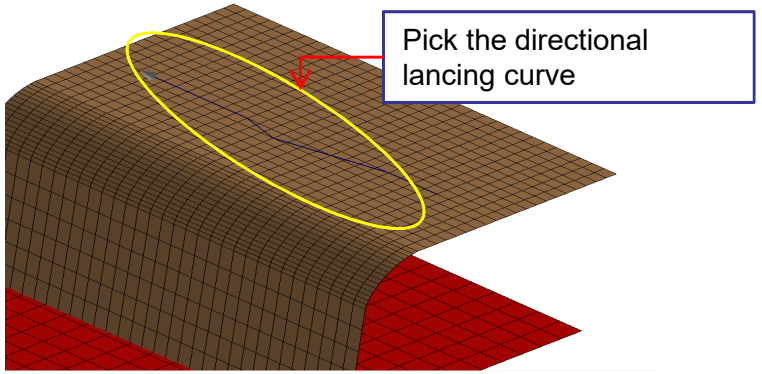
Symmetry of the tools can be considered

Metal Forming – Lancing Setup

Adding lancing in the forming process

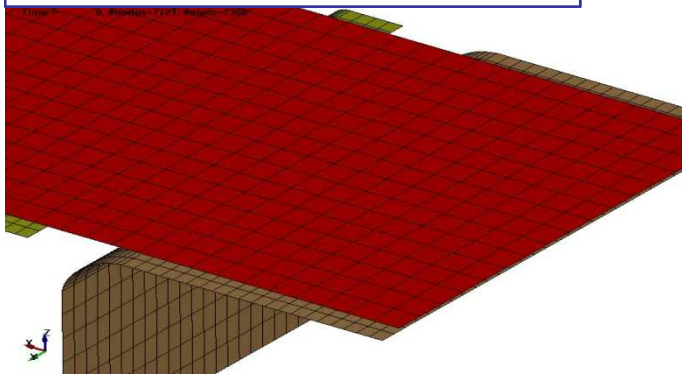


Instant : Only starting location needed (from the home position)
Progressive: Starting and ending locations along with cut times

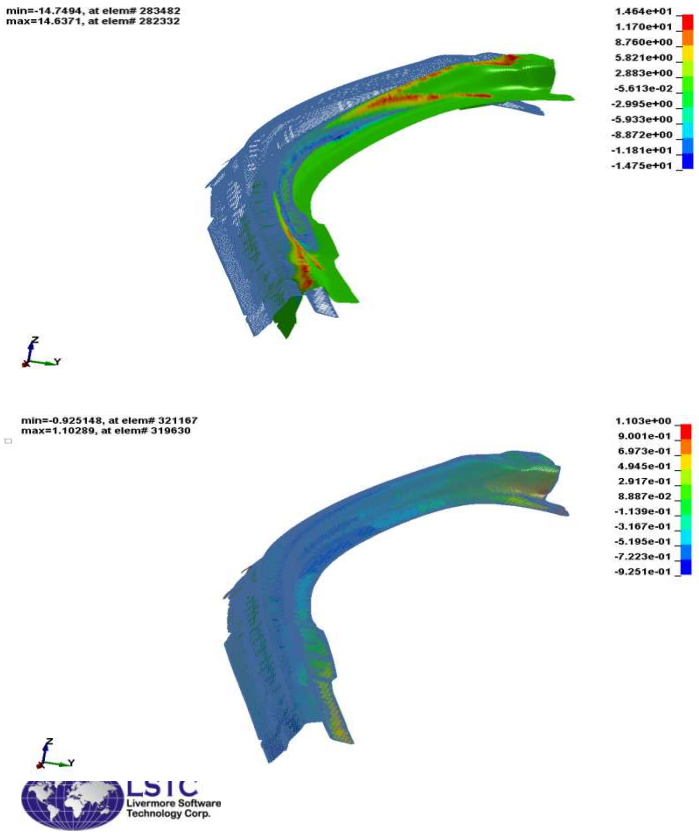


Pick the directional lancing curve

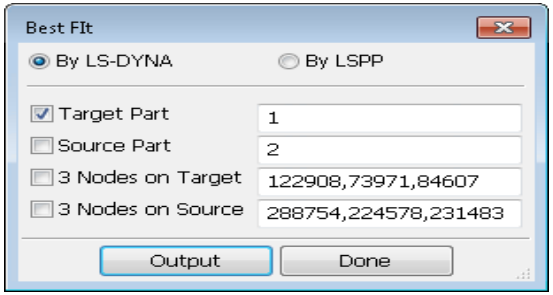
Progressive lancing example



Metal Forming – Best Fit Setup



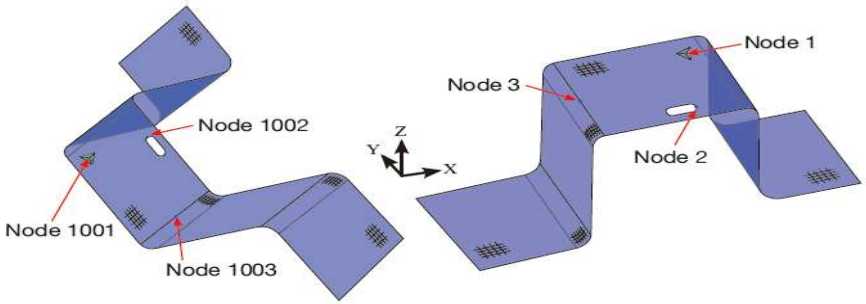
Deviation
Before: (-14.75, 14.64)
After: (-0.925148, 1.10289)



Procedures:
1. Picking the target (e.g. scan data);
2. Pick the source (e.g. predicted mesh);
3. Three optional pairs of nodes to assist the searching procedure (e.g. the angle of the two parts is larger than 30 degrees)
4. Output the keyword file for submission.

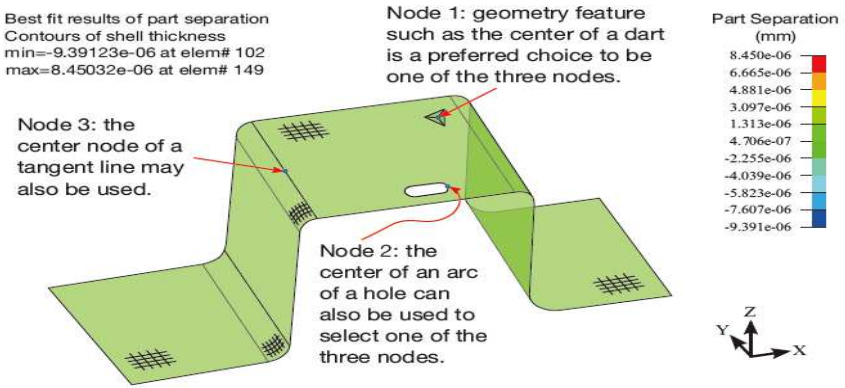
Submission:
1. Double Precision Solver (Beta version);
2. Result file: “Bestfit.out” (Post->FriComp->Thick->Thickness)

Metal Forming – Best Fit Setup



Source mesh

Target mesh



Best fit results - color contour of part separation plotted with "thickness" from the output file "Bestfit.out"

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*More details in LS-DYNA Keyword User's Manual Vol. I

Metal Forming – 3D Draw Bead

- Real bead modeling is necessary for the accurate springback prediction after the formability simulation.
- With the line beads as the center lines, 3D Draw bead module directly generates the real bead mesh on the tooling mesh.
- Flexible functions:
  - Multiple section profiles
    - Smooth transition automatically generated
  - Open or close loop beads
    - Tail section can be created for open beads
  - Two bead types
    - More parameters allowed

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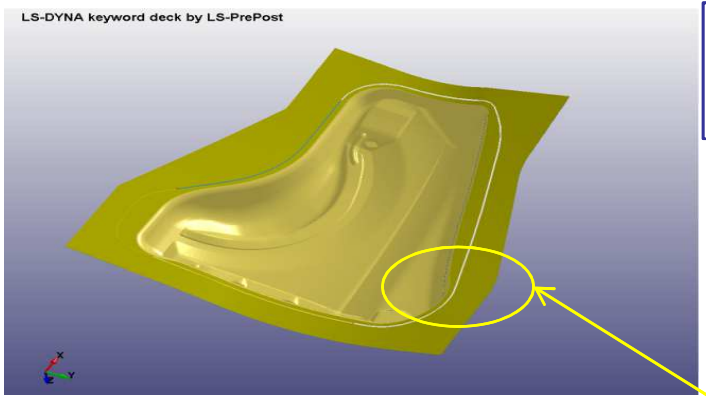
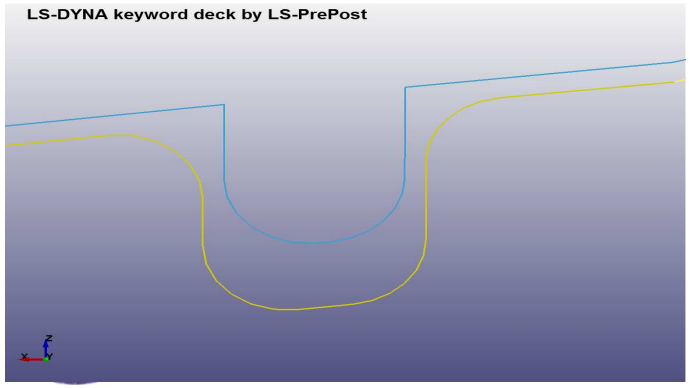
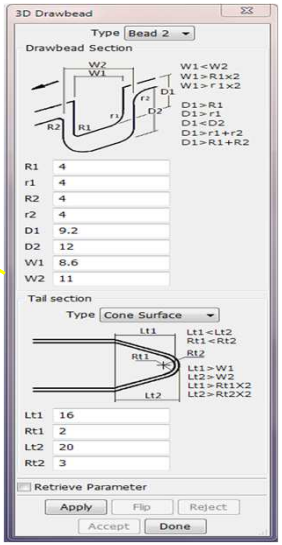
Metal Forming – 3D Draw Bead



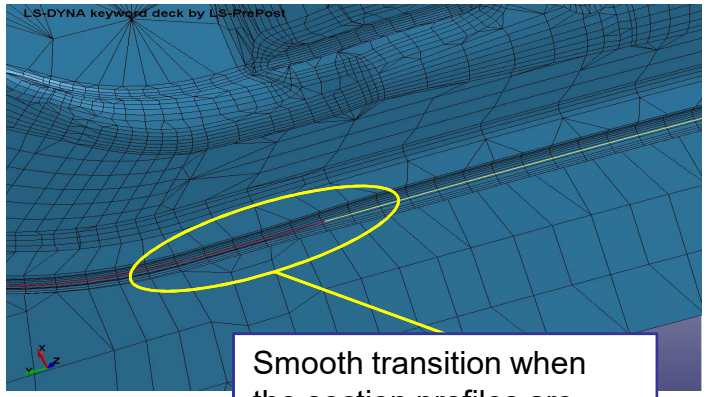
Section cut of the generated real bead mesh



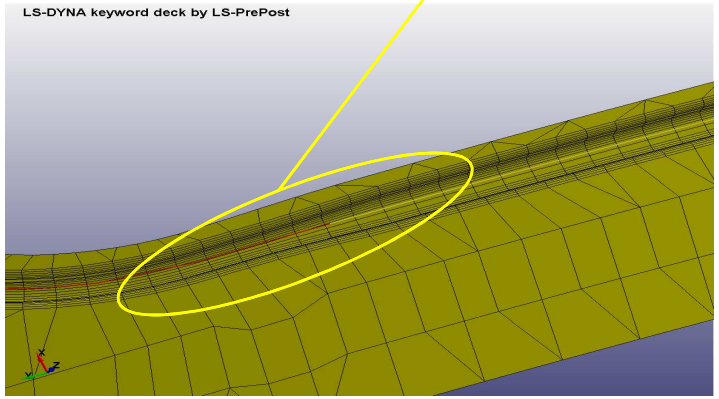
Pick the line bead after specifying the section parameters



Section parameter check to avoid conflicting bead geometry

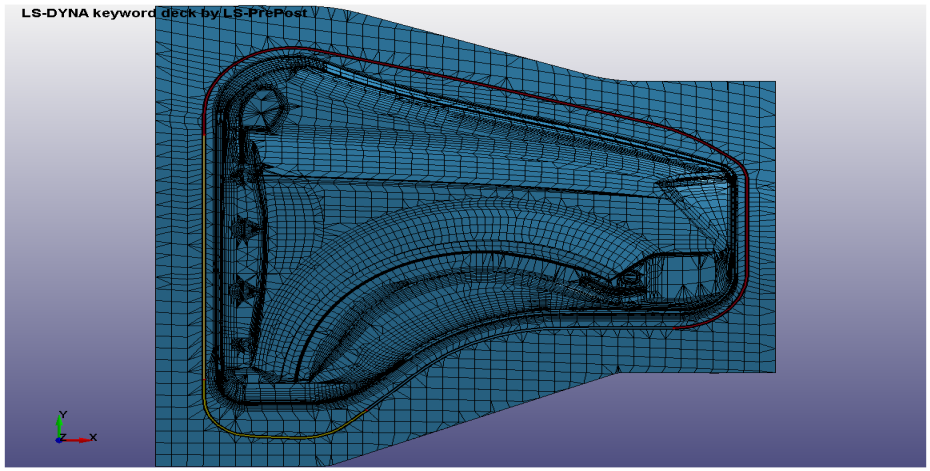


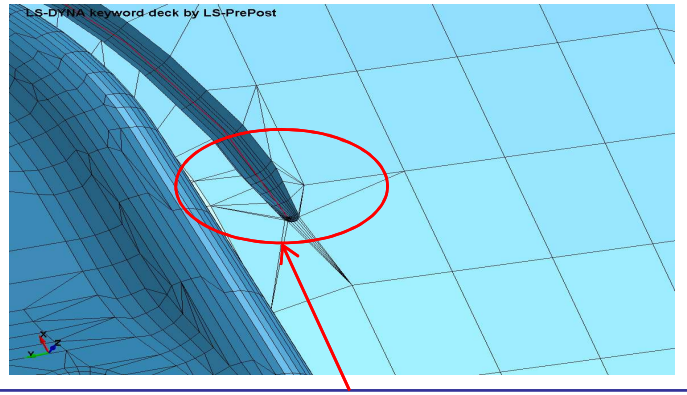
Smooth transition when the section profiles are different



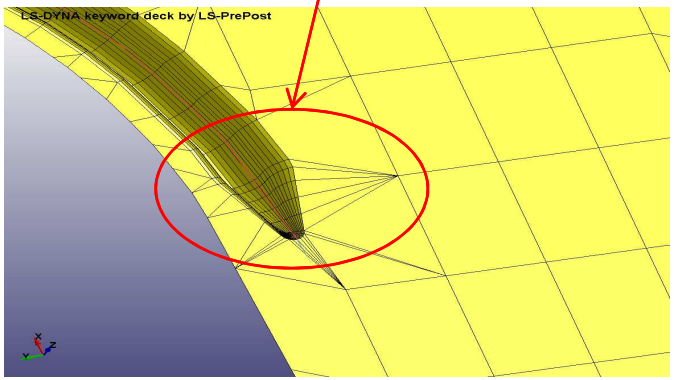
Metal Forming – 3D Draw Bead

Close-loop bead mesh





Tail Sections for the open-loop beads



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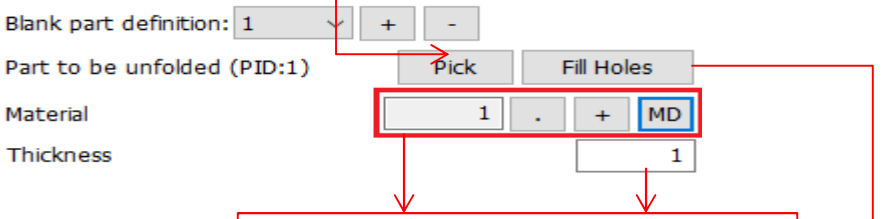
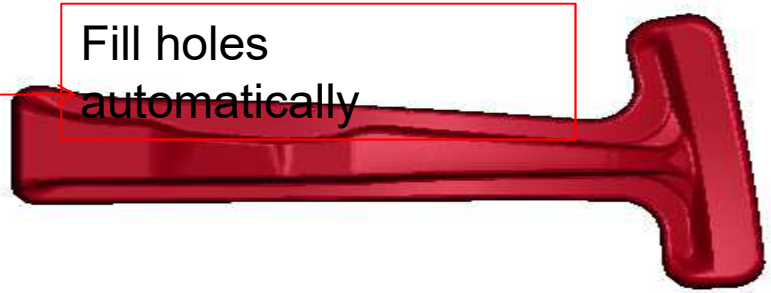
Metal Forming - One Step

Pick the part,take it as the final geometry



Set *material* and *thickness*

Fill holes automatically



NOTE:

- This “part” may involve more than one PID to accommodate welded blanks
- It must be composed entirely of shells
- Its external boundary must consist of a single closed loop

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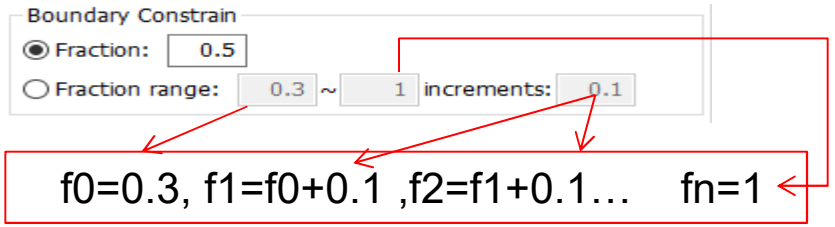
Metal Forming - One Step

Draw bead forces are automatically applied to all nodes along the part boundary. the user must specify the fraction of the fully locked bead force to be applied.



Fraction: Apply a fraction of a fully locked bead force along the entire periphery of the blank

Fraction range: when save keyword file ,a list of input deck with different fraction of fully bead force will be created.

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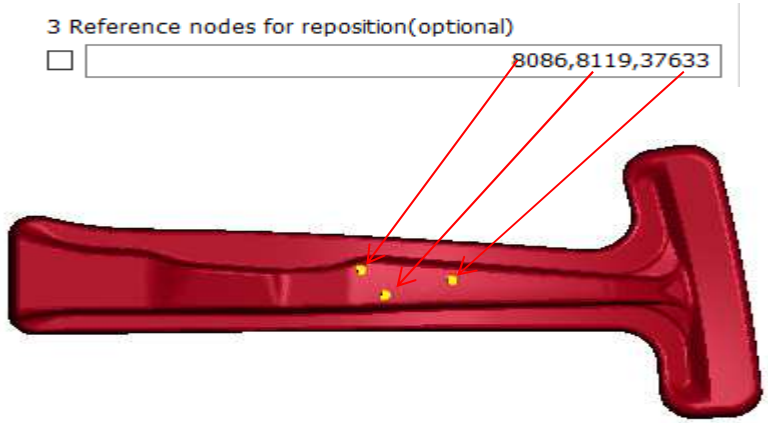
Metal Forming - One Step



Add nodal constraints to prevent rigid body motion, allow users to specify three nodes so that the blank is transformed onto the final part(the input)

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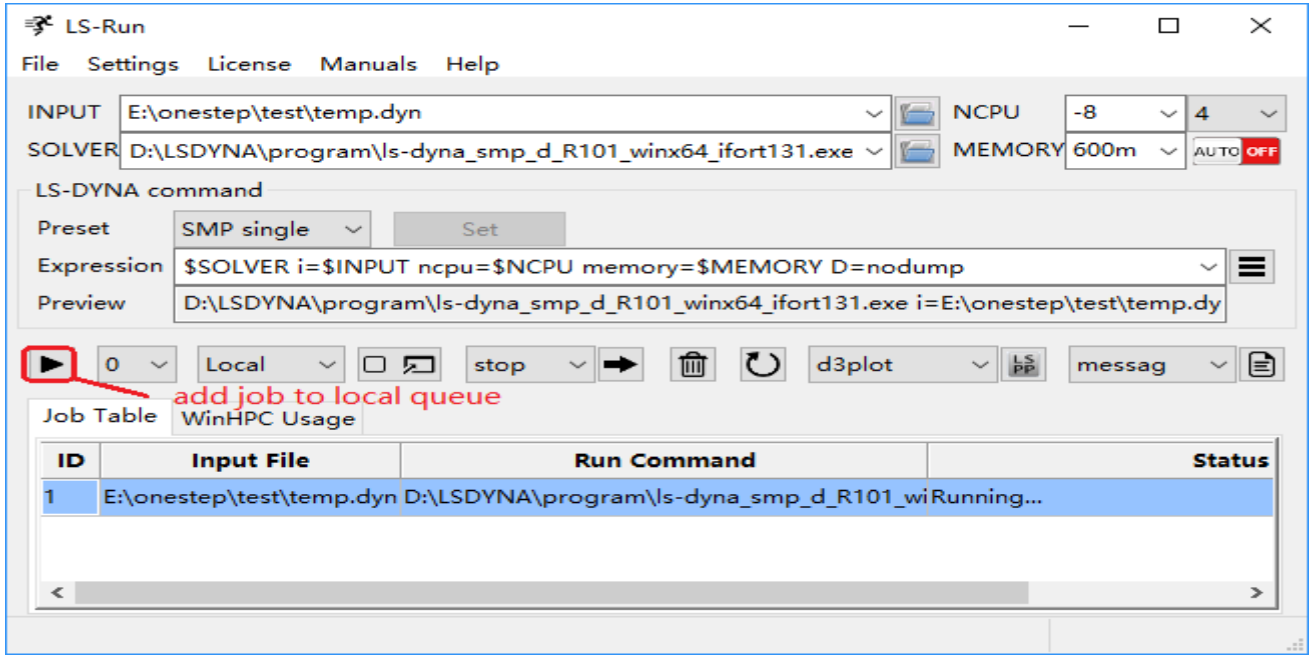
Metal Forming - One Step

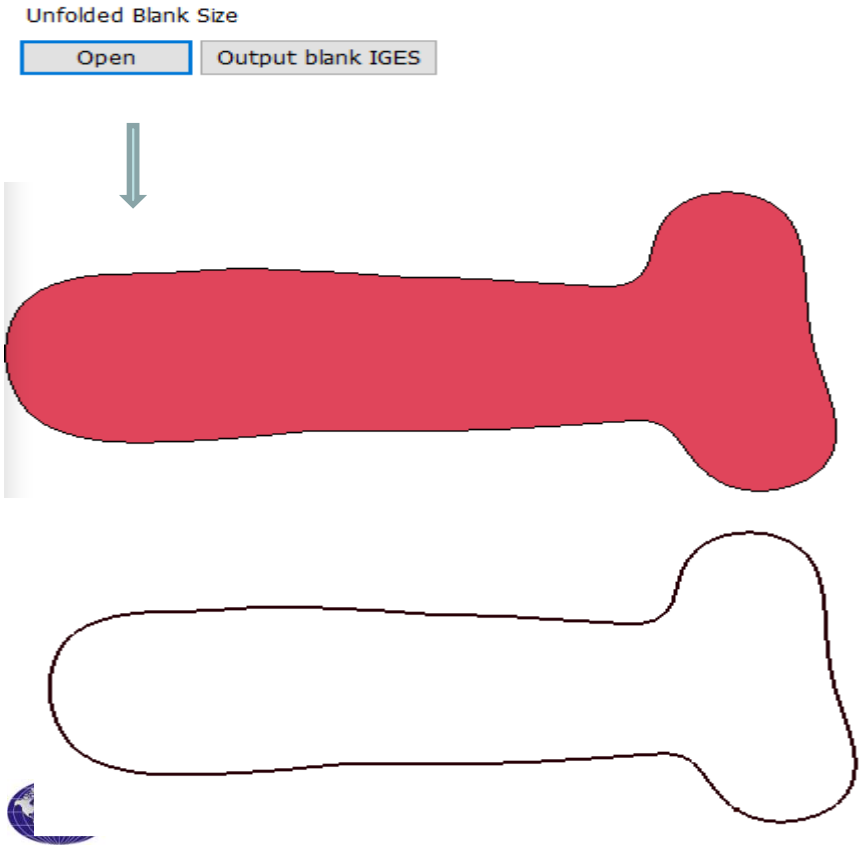
Save kwd: save input deck files into sub folder.
Save proj: save input deck settings into project file.



Run: launch LS-Run

NOTE: After running LS-DYNA, the results will be saved in Sub folder.

Metal Forming - One Step



Open: Get the size of the initial blank(unfolded flat blank)

Output blank IGES: blank outlines can be created in IGES format.

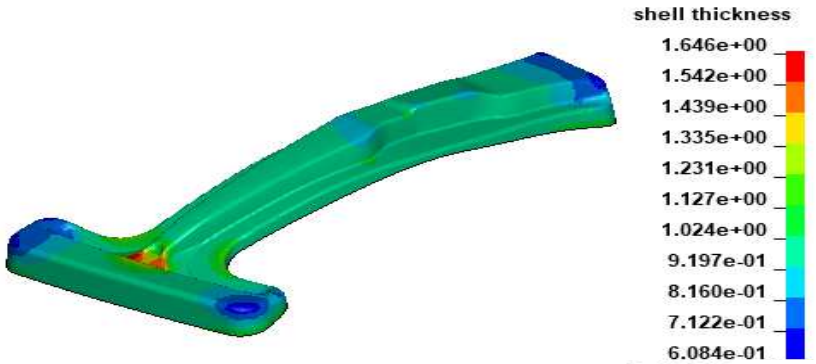
Metal Forming - One Step

Fringe Thickness

Forming result | Reset range | ☐ Reverse colors

Thickness | Thinning | Min: 0.608441

FLD | Plastic Strain | Max: 1.64611

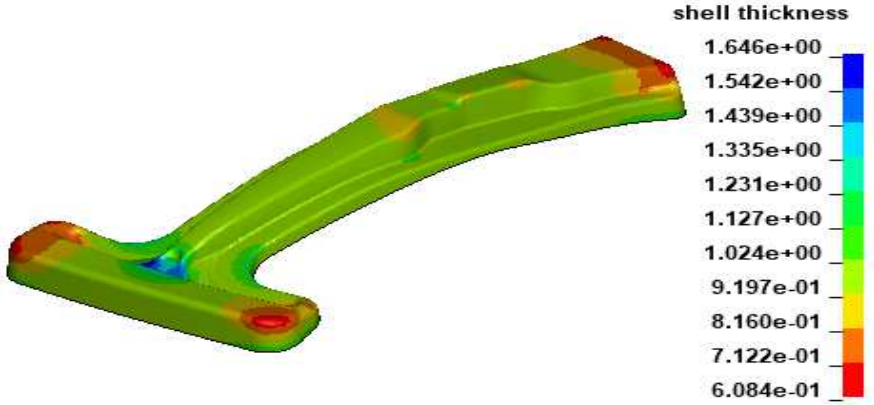


Reverse the fringe color palette

Forming result | Reset range | ☑ Reverse colors

Thickness | Thinning | Min: 0.608441

FLD | Plastic Strain | Max: 1.64611



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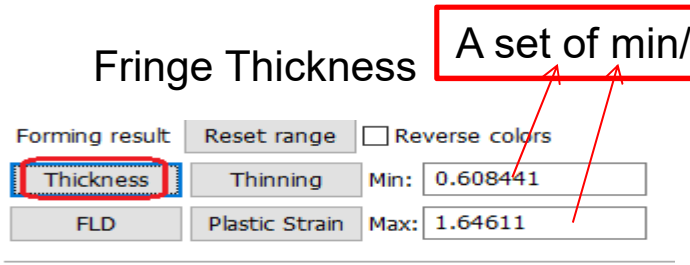
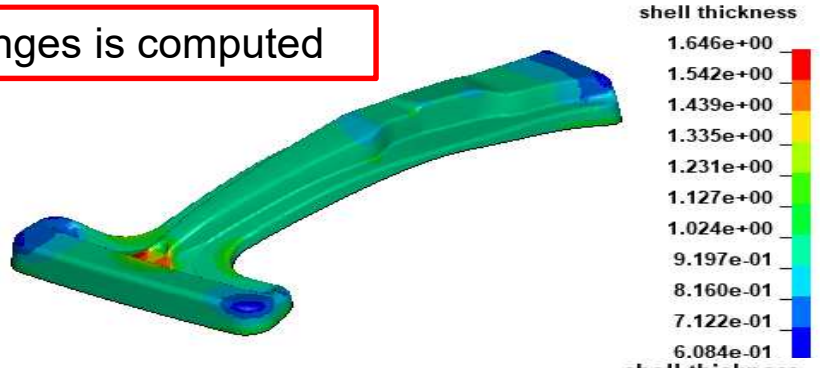
Metal Forming - One Step

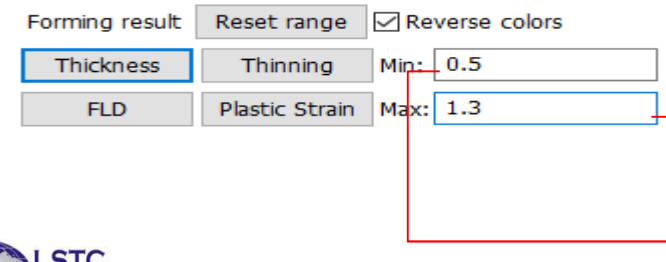
Fringe Thickness

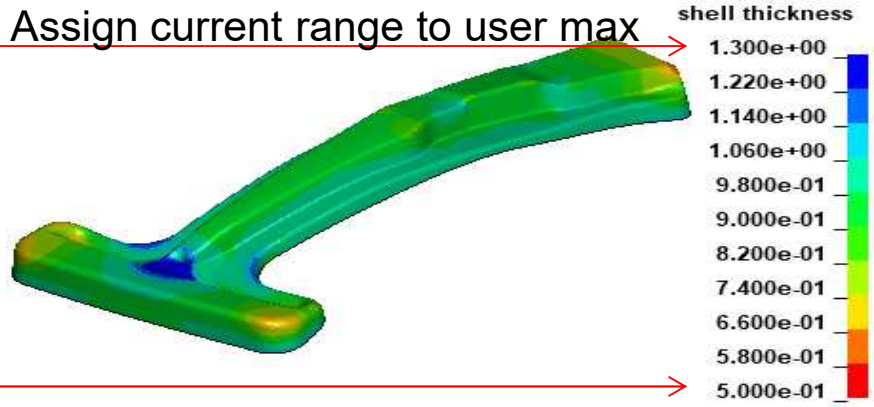
A set of min/max ranges is computed





Assign current range to user max





Assign current range to user min

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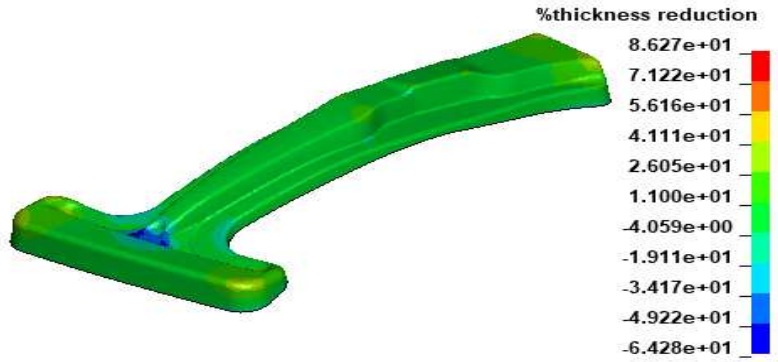
Metal Forming - One Step

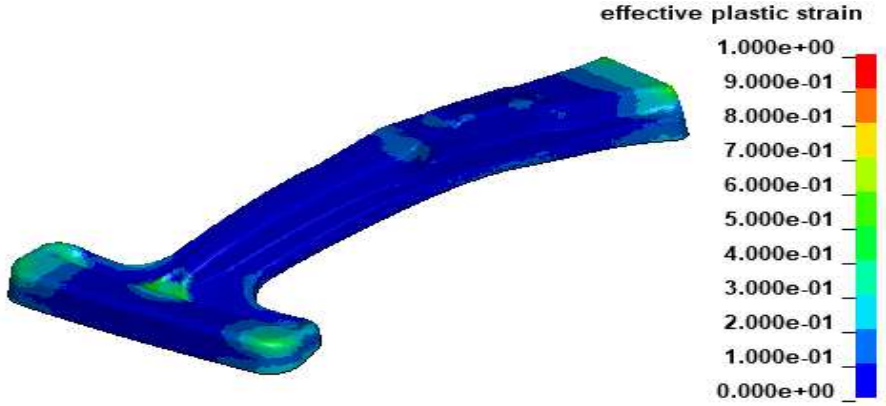
Fringe Thinning

Forming result	Reset range	☐ Reverse colors	
Thickness	Thinning	Min:	-64.2794
FLD	Plastic Strain	Max:	86.2708



Fringe effective plastic strain

Forming result	Reset range	☐ Reverse colors	
Thickness	Thinning	Min:	0
FLD	Plastic Strain	Max:	1



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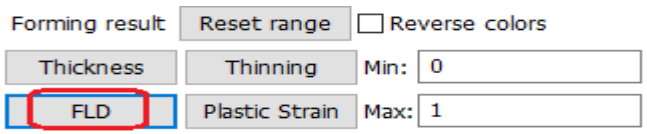
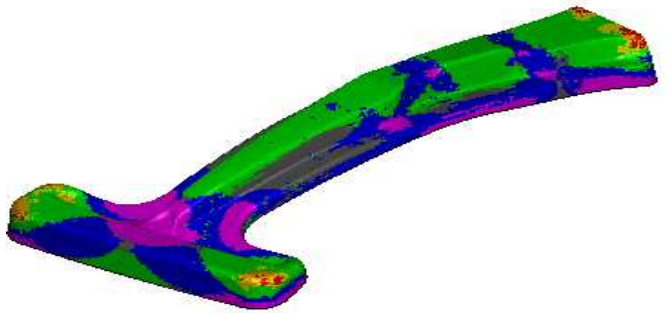
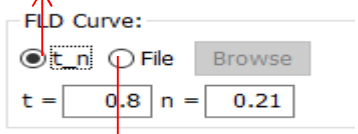
Metal Forming - One Step

FLD formability

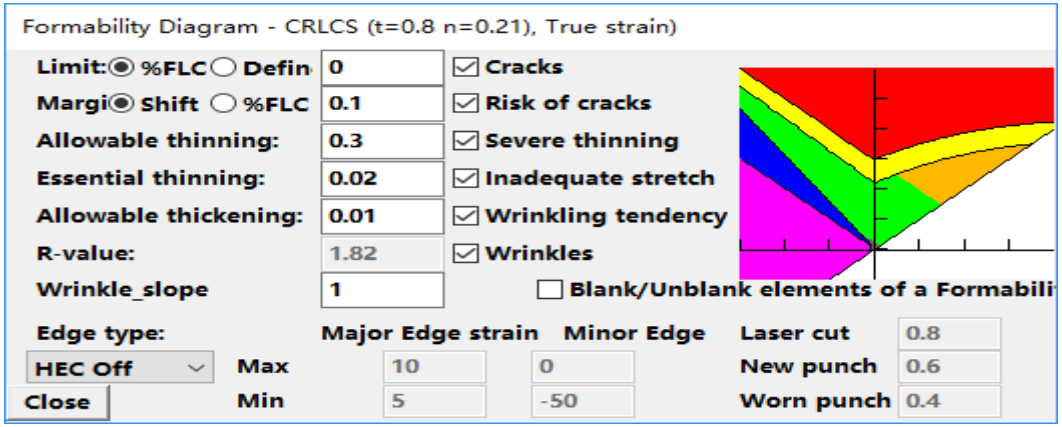




Calculate FLD curve by setting thickness and index

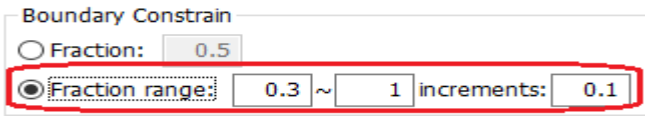


Read forming limit curve points from a file

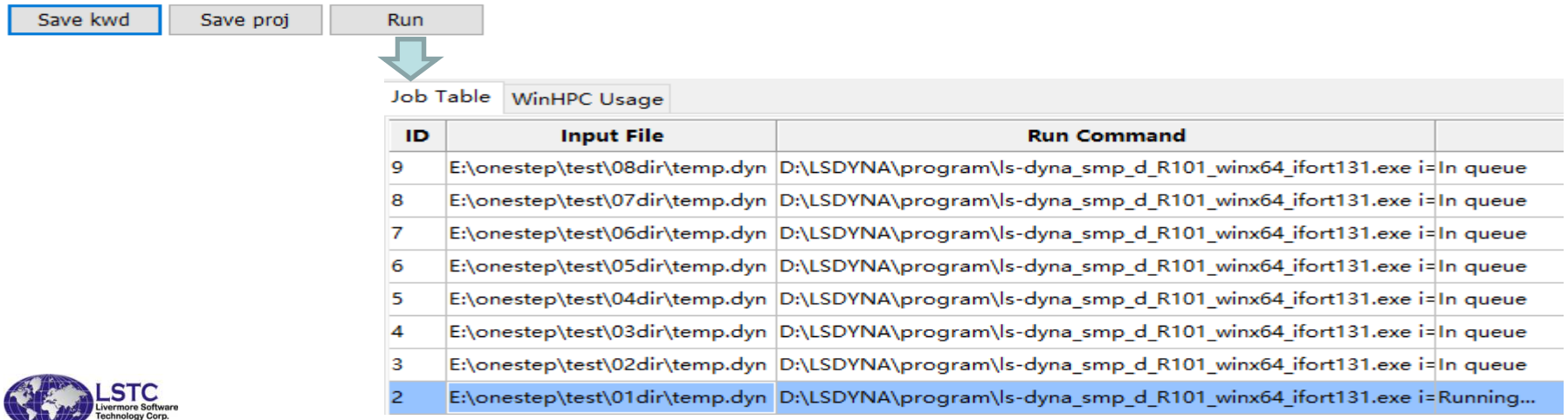


Metal Forming - One Step

Do you remember the "Fraction range"?



If "Fraction range" selected, a group of results adopted different fraction value will be created.



ID	Input File	Run Command	
9	E:\onestep\test\08dir\temp.dyn	D:\LSDYNA\program\ls-dyna_smp_d_R101_winx64_ifort131.exe i=	In queue
8	E:\onestep\test\07dir\temp.dyn	D:\LSDYNA\program\ls-dyna_smp_d_R101_winx64_ifort131.exe i=	In queue
7	E:\onestep\test\06dir\temp.dyn	D:\LSDYNA\program\ls-dyna_smp_d_R101_winx64_ifort131.exe i=	In queue
6	E:\onestep\test\05dir\temp.dyn	D:\LSDYNA\program\ls-dyna_smp_d_R101_winx64_ifort131.exe i=	In queue
5	E:\onestep\test\04dir\temp.dyn	D:\LSDYNA\program\ls-dyna_smp_d_R101_winx64_ifort131.exe i=	In queue
4	E:\onestep\test\03dir\temp.dyn	D:\LSDYNA\program\ls-dyna_smp_d_R101_winx64_ifort131.exe i=	In queue
3	E:\onestep\test\02dir\temp.dyn	D:\LSDYNA\program\ls-dyna_smp_d_R101_winx64_ifort131.exe i=	In queue
2	E:\onestep\test\01dir\temp.dyn	D:\LSDYNA\program\ls-dyna_smp_d_R101_winx64_ifort131.exe i=	Running...

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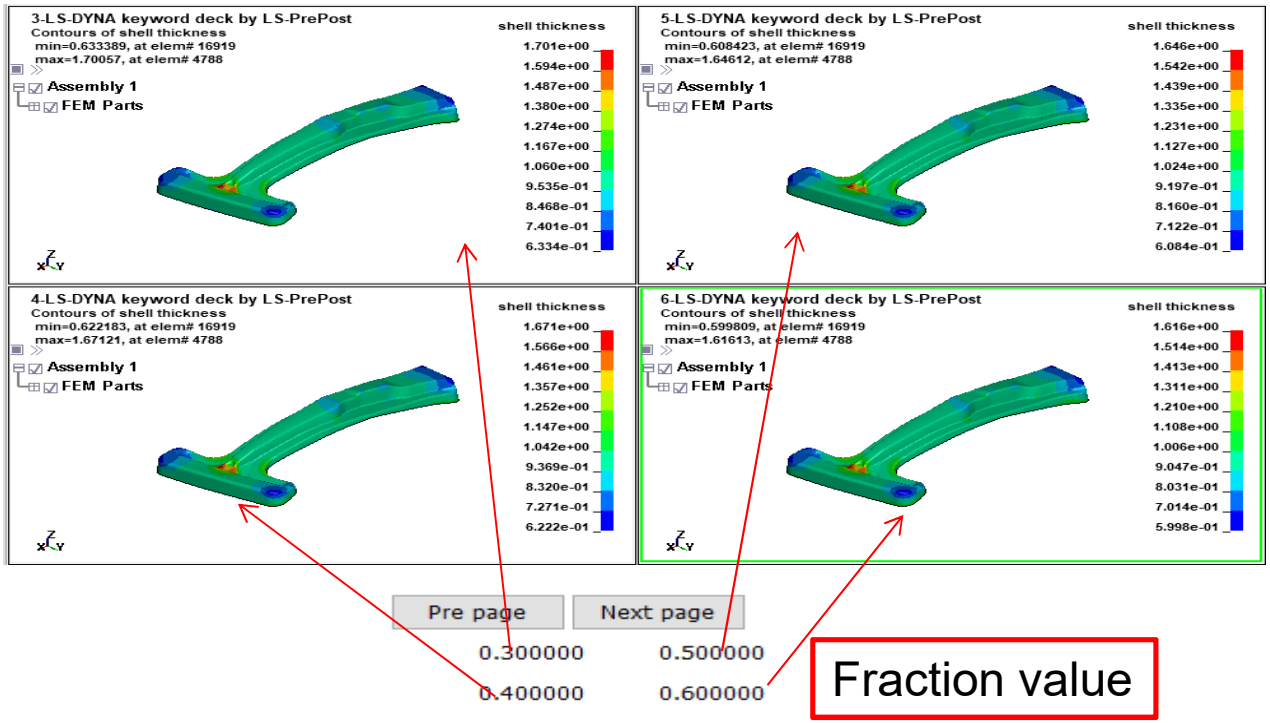
Metal Forming - One Step

Fringe the results with split window



Pre page: Plot the previous 4 results

Next page: plot the next 4 results

Take Thickness fringe as an example

Metal Forming - Blank Size

- This feature will automatically adjust an initial blank's size and shape so that the formed part will more closely match a given target shape.
- Thus it has three inputs
  - The initial blank
  - The corresponding formed part
  - The desired result, in the form of a boundary curve or a full mesh.

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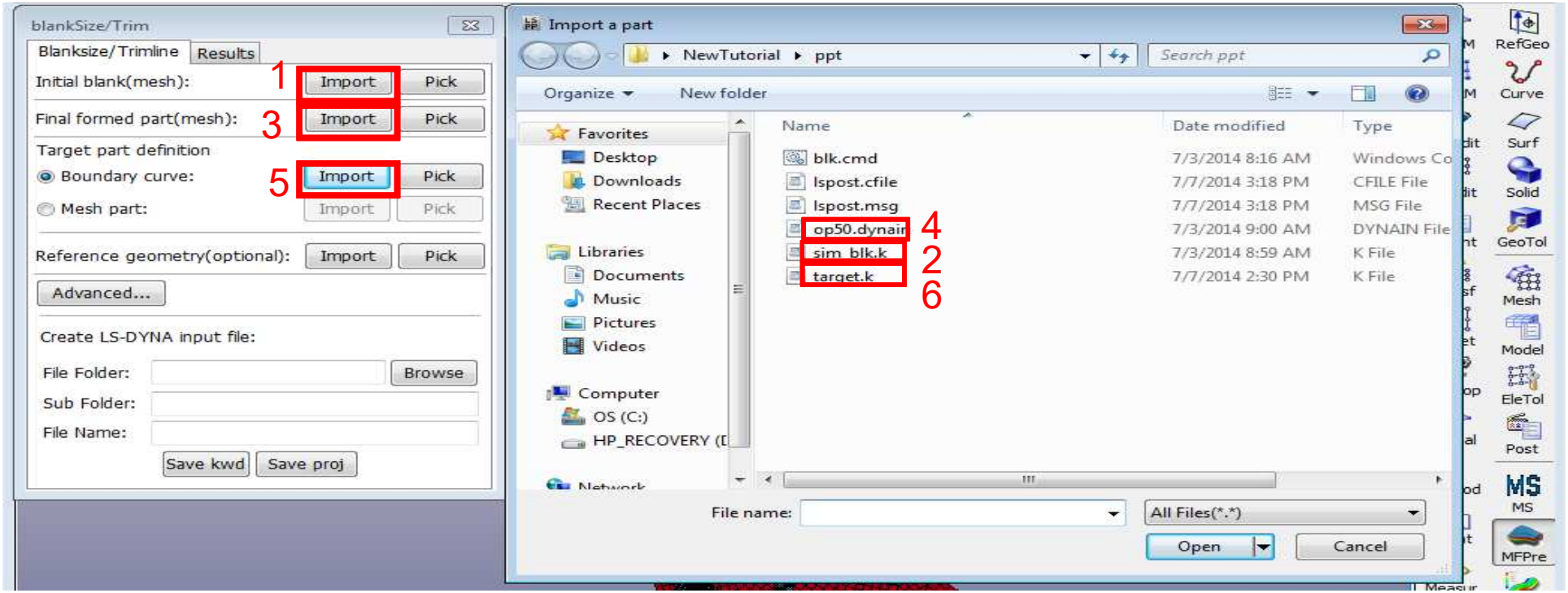
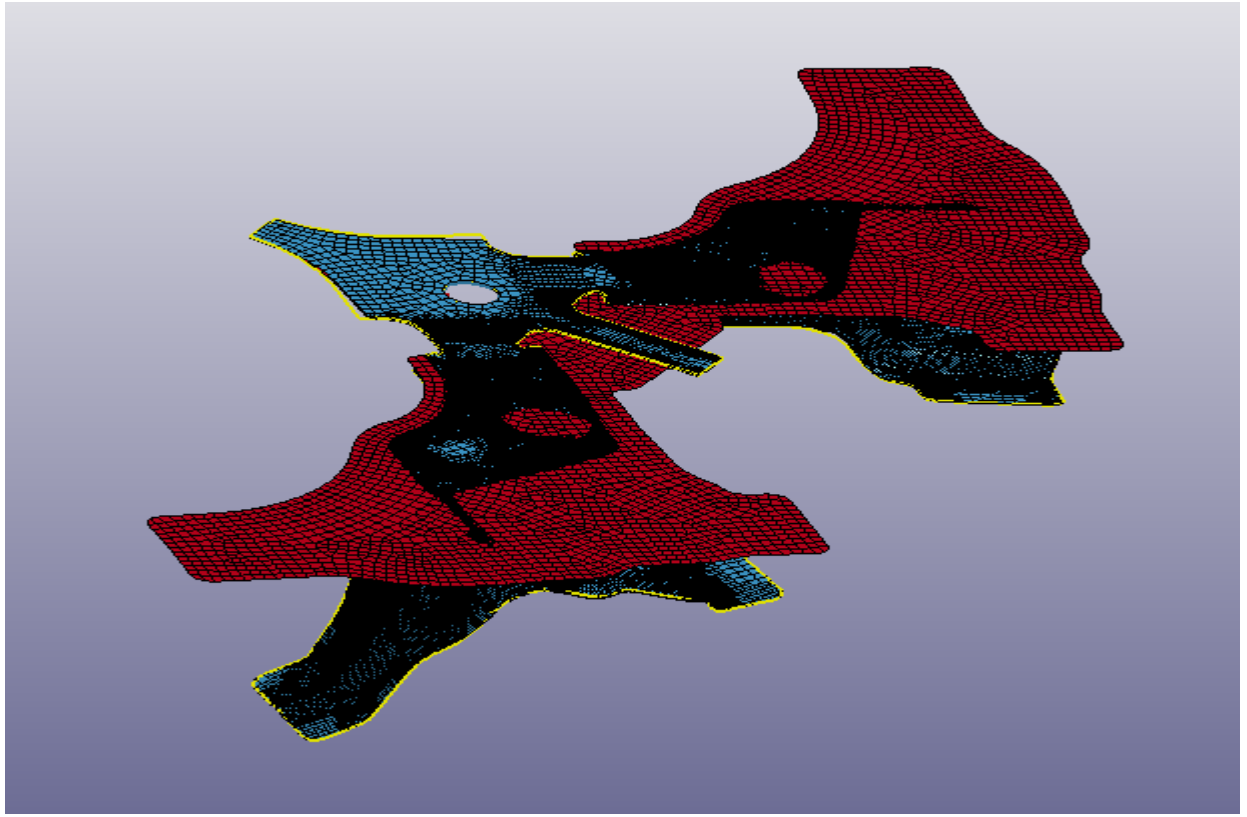
Metal Forming - Blank Size

Import the blank, formed piece, and then the target



Metal Forming - Blank Size

- The model should look like this at this point.
- Notice how the yellow target curve does not fit perfectly around the formed piece.
- By the end of this process we will have another curve around the blank, telling us how the blank should look to fit perfectly into the target curve at the end.



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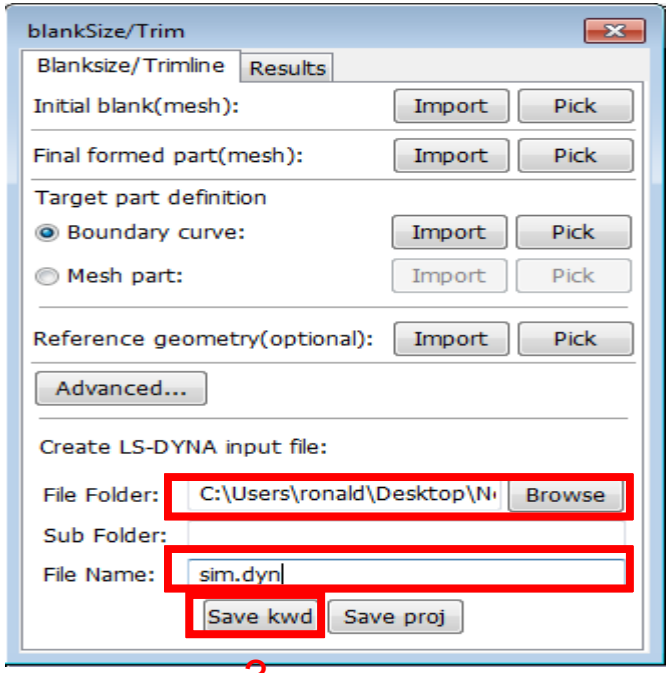
Metal Forming - Blank Size

Create Dyna input file



- Running the sim.dyn file created here causes LS-DYNA to run a calculation of blank size, rather than the usual finite element simulation.
- The results are .ibo files, rather than the usual d3plots. We will convert a .ibo file into .iges on the next slide.
- Run this file through LS-DYNA before proceeding.
- Upon creating this sim.dyn file, PrePost will also create duplicate files of the blank, formed part, and target curve and name them initial.k, final.k, and target.k

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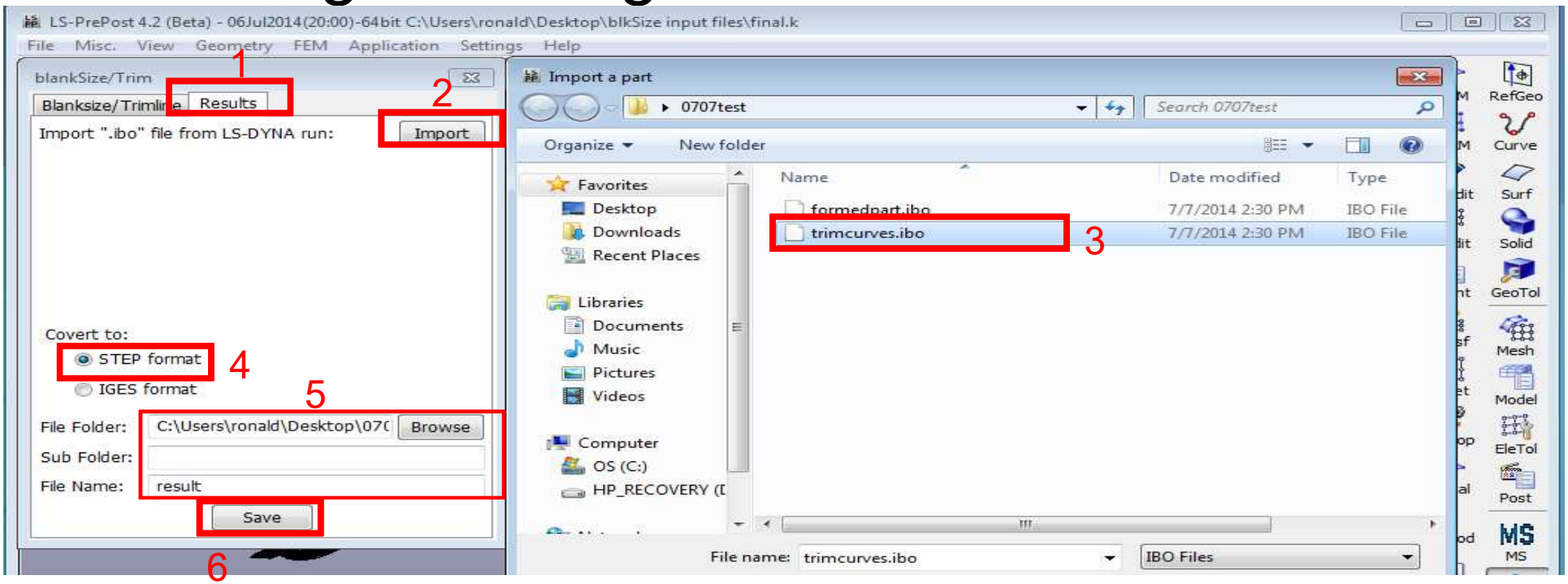
Metal Forming - Blank Size

Converting .ibo to .iges



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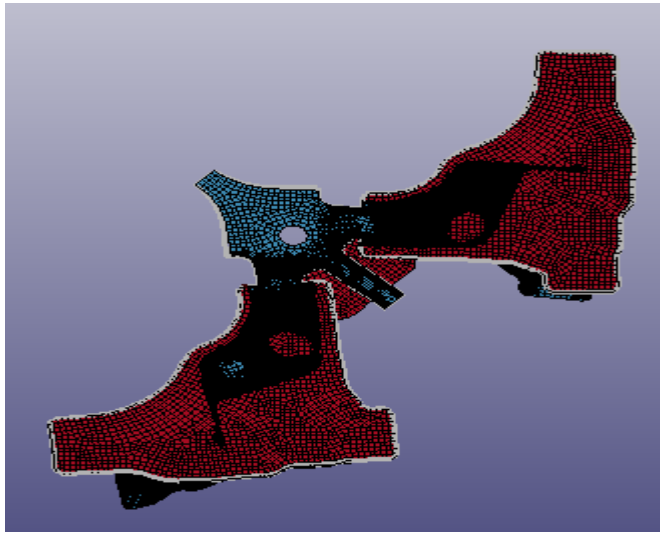
Metal Forming - Blank Size

- Now import the new result.iges that we just made, in the usual fashion (File->Import->IGES File). You should see a new curve appear around the blank.



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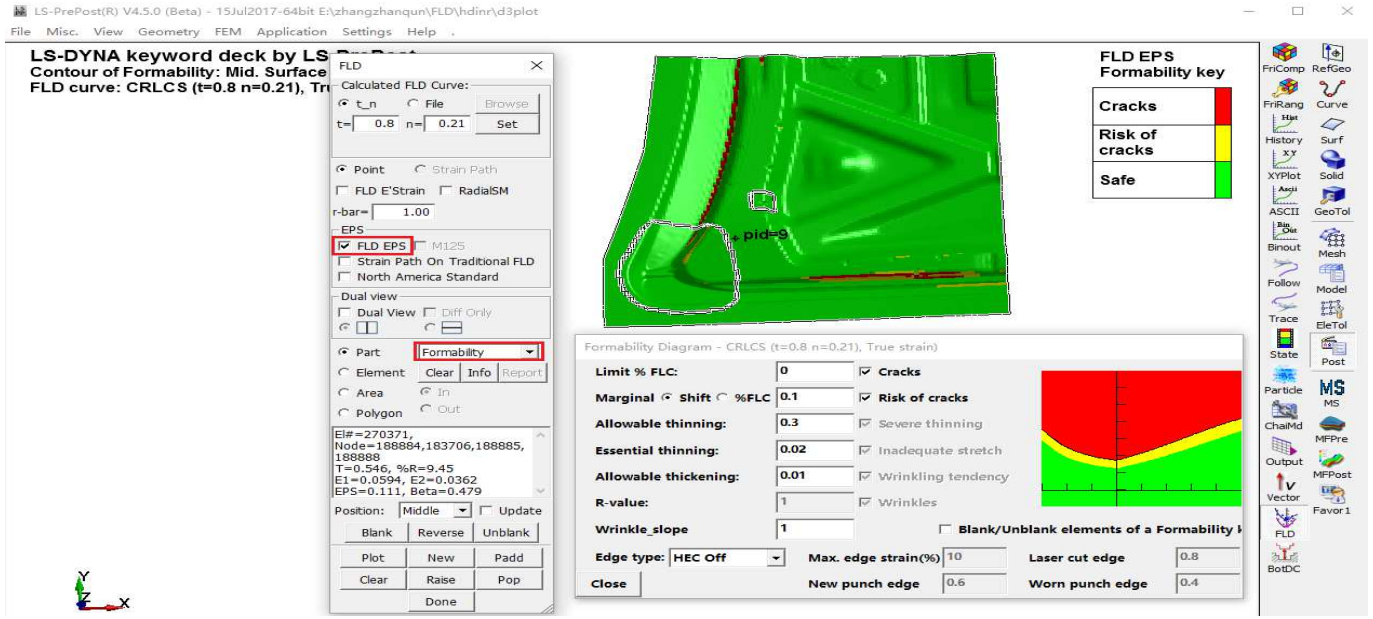
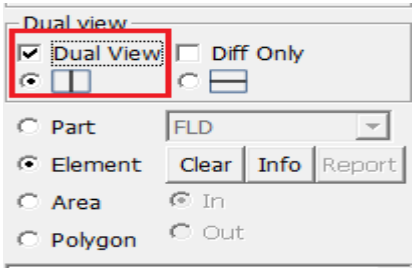
Metal Forming - EPS FLD

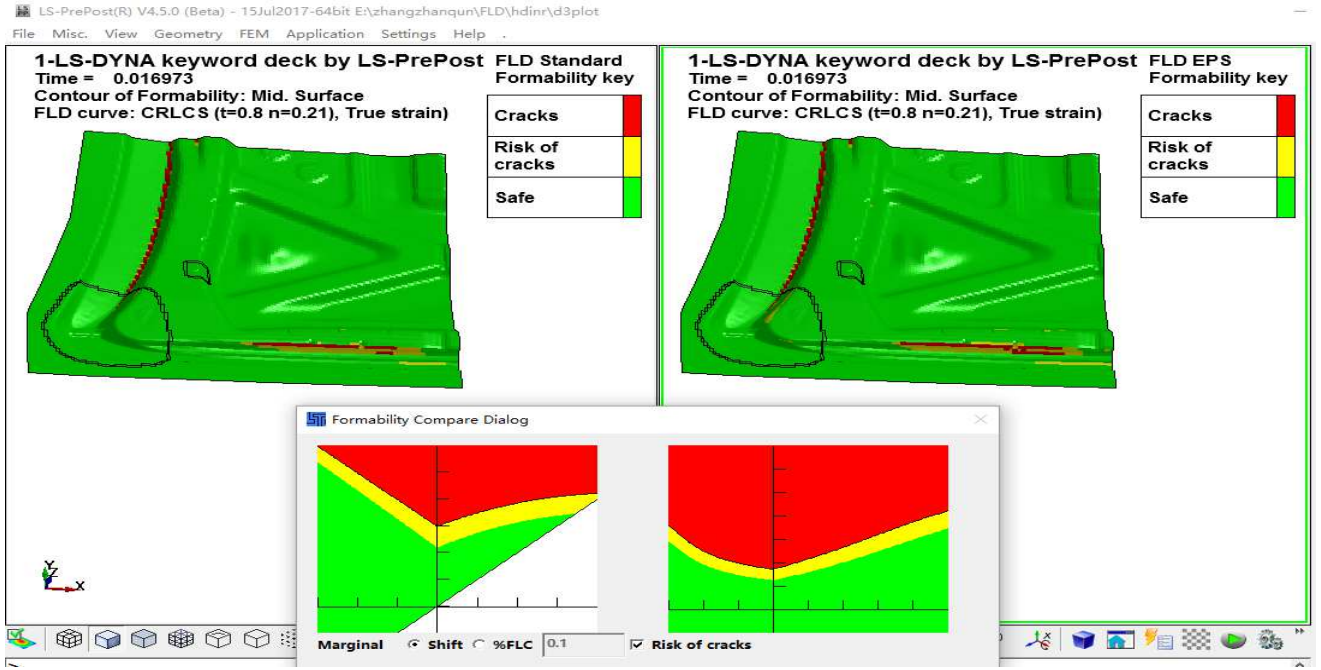
- Add EPS (Effective Plastic Strain) FLD in the FLD interface
- Once the FLD EPS is checked and the r-value is input , the formability diagram will show the EPS FLD results with three colors : Red:crack,Yellow:marginal,Green:safe



Metal Forming - EPS FLD

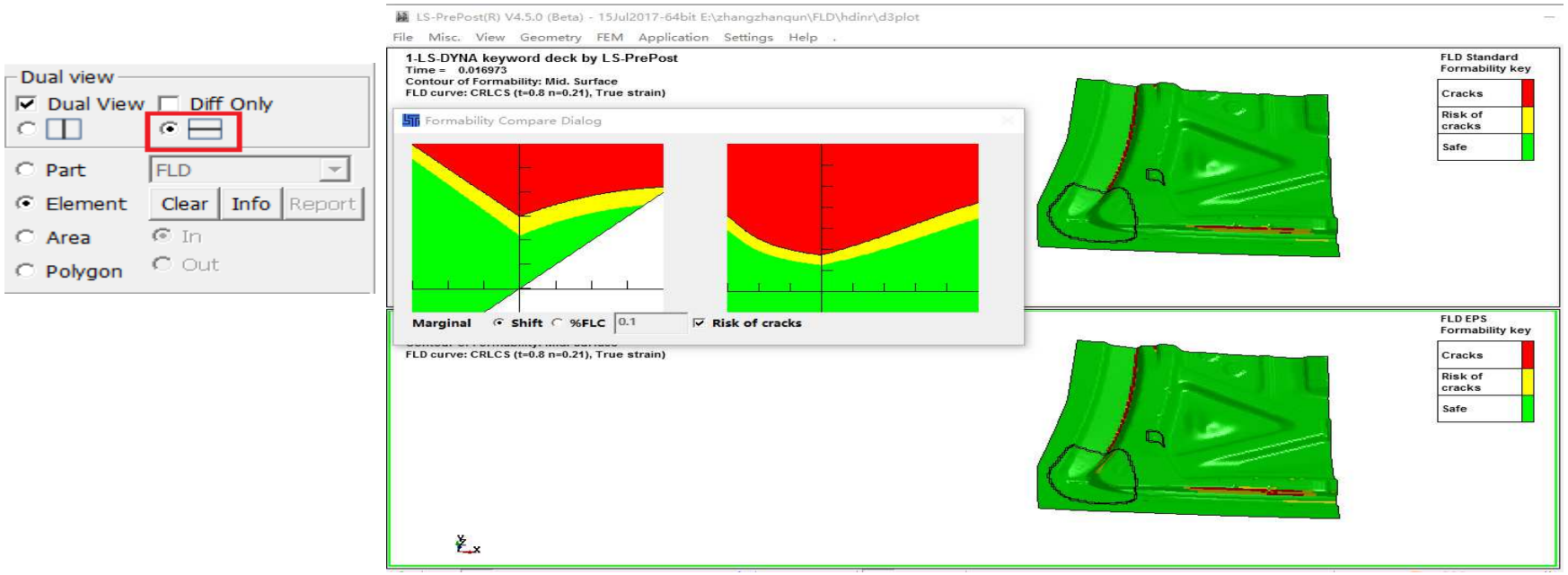
- Add “Dual View” button – once it is checked, screen divided into 2 windows, one shows Traditional FLD, one shows the EPS FLD





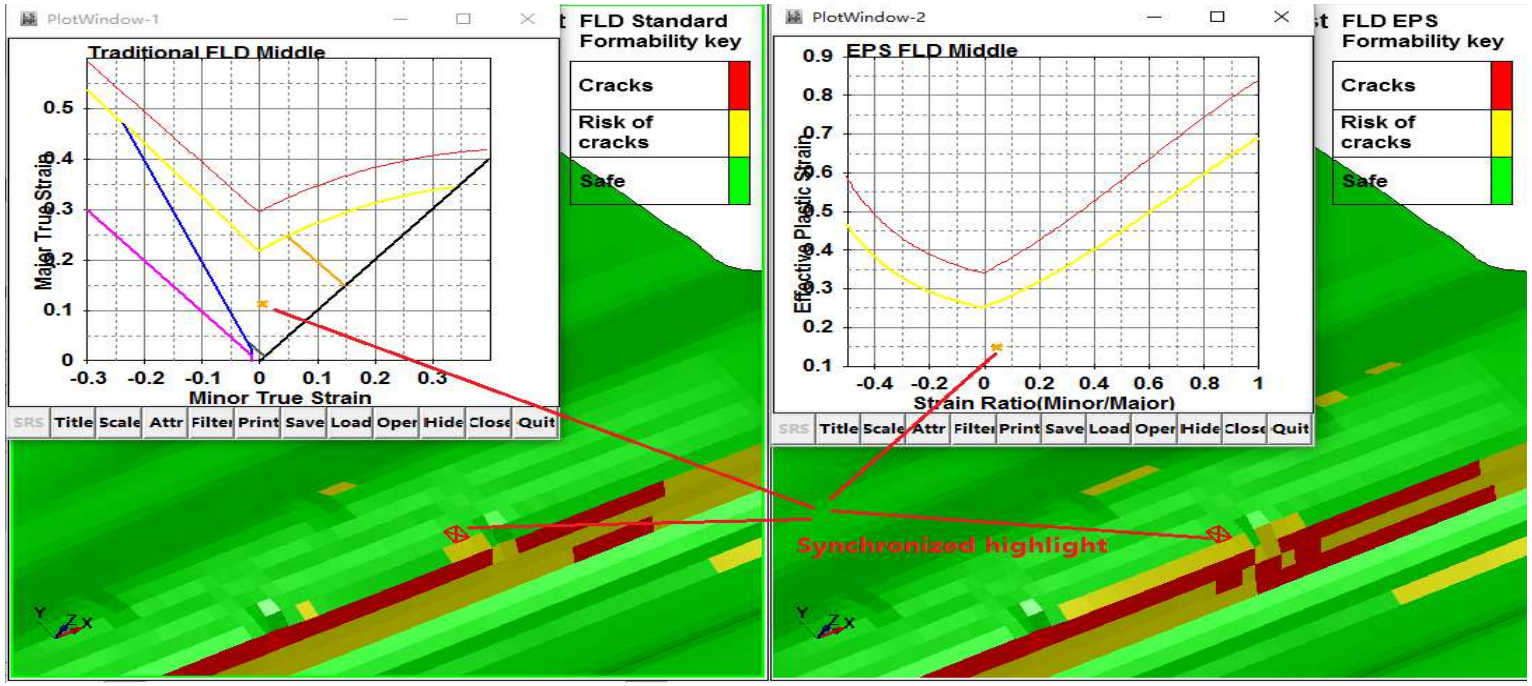
Metal Forming - EPS FLD

- Add “Dual View” button – once it is checked, screen divided into 2 windows, one shows Traditional FLD, one shows the EPS FLD



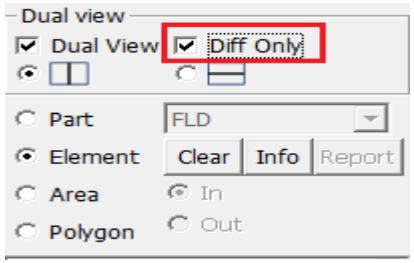
Metal Forming - EPS FLD

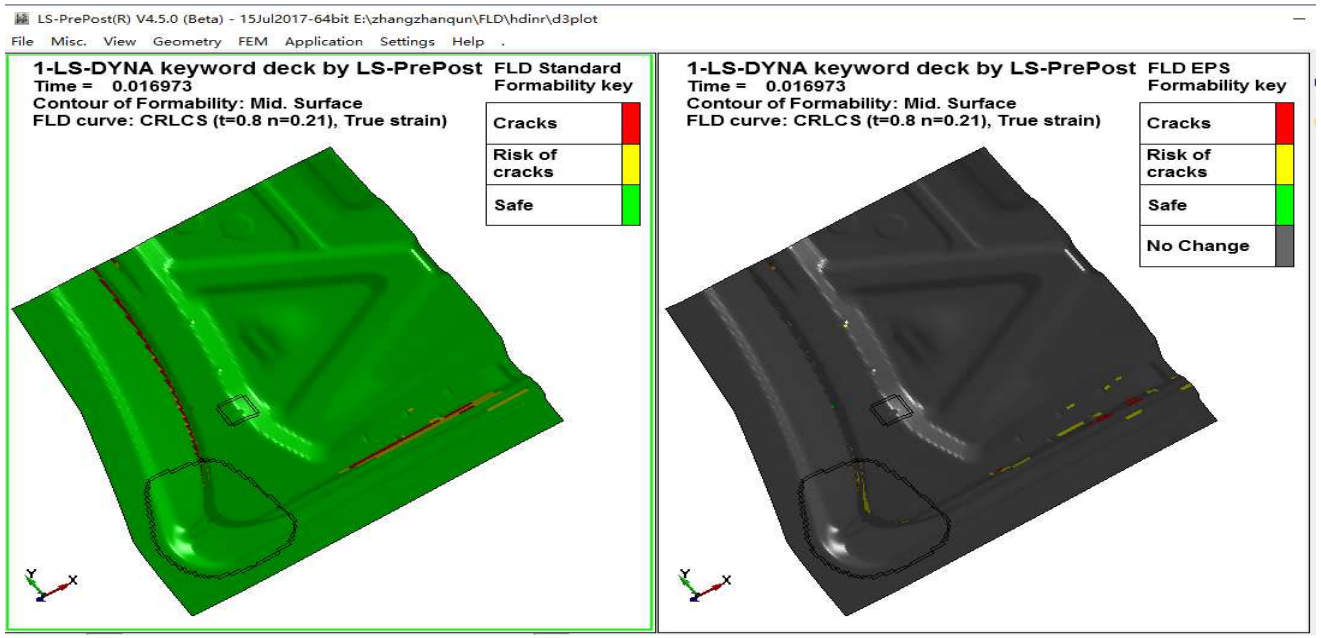
- Synchronized highlighted element on both contours when user click on the element



Metal Forming - EPS FLD

- Compare EPS FLD and Traditional FLD contours , for the different color areas ,keep and display the contour colors, for the same color areas , change the color to grey in EPS FLD window





NVH

- *DATABASE_FREQUENCY_BINARY_{OPTION}

Database	LSPCode	Data Contents
D3SSD	21	Steady state dynamics
D3SPCM	22	Response spectrum analysis
D3PSD	23	Random vibration PSD
D3RMS	24	Random vibration RMS
D3FTG	25	Random vibration fatigue
D3ACS	26	FEM acoustics
D3ATV	27	BEM Acoustic Transfer Vector

- Ascii Databases

FRF: frf_amplitude, frf_angle, frf_real, frf_imag
BEM acoustics: Press_Pa, Press_dB, bepres, fringe_*, panel_contribution_NID,
SSD: elout_ssd, nodout_ssd, …

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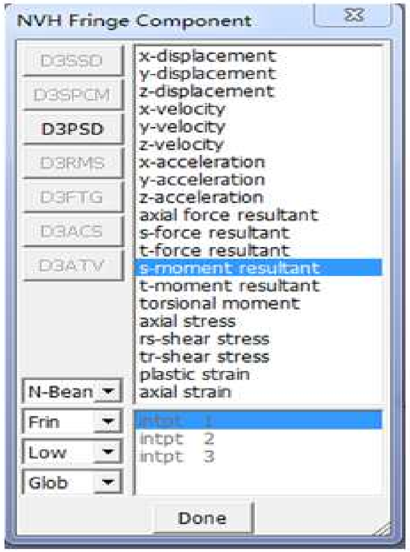
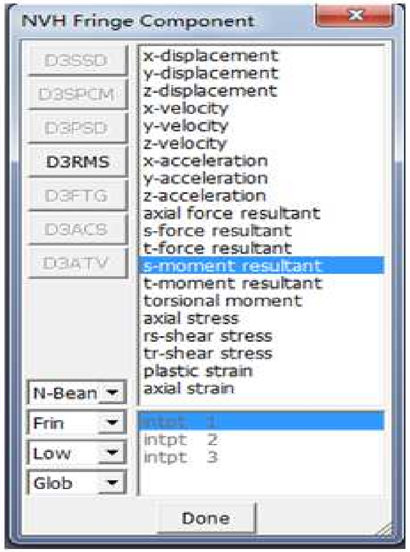
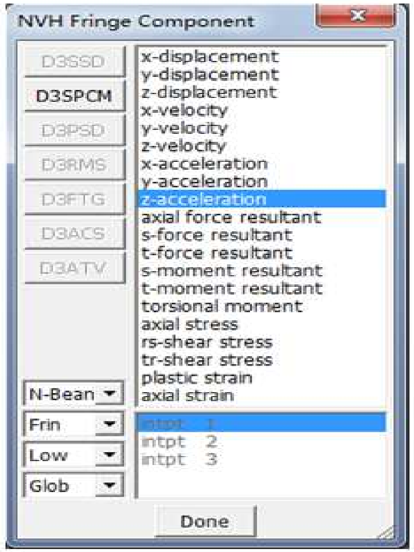
- Each analysis type has its own interface, unique fringe components
- LS-PrePost will automatically recognize the analysis type and pop up the corresponding interface







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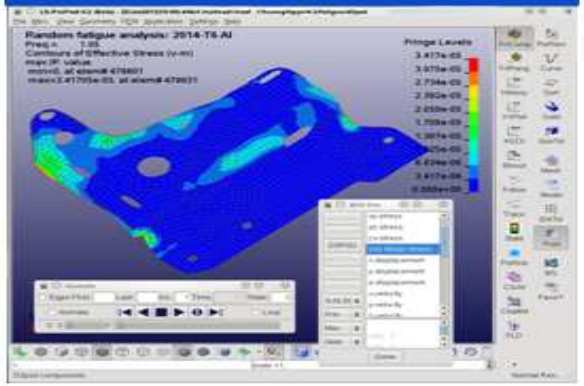
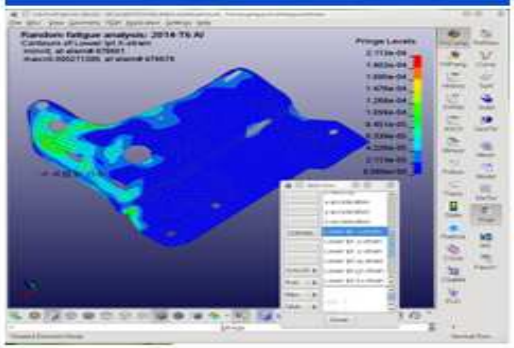
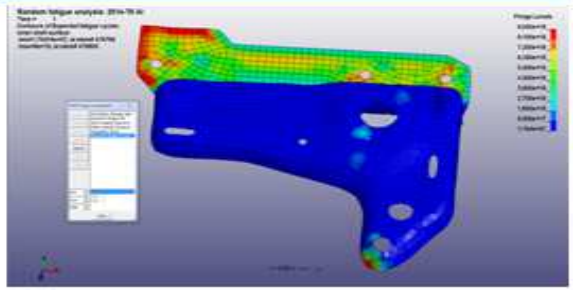
D3PSD



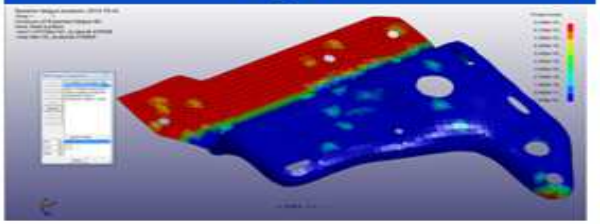
D3RMS



D3FTG Fatigue Cycle



Fatigue Life



NVH

- NVH Job Setup
- The 6 NVH analyses are:

  FRF – Frequency Response Function

  SSD – Steady State Dynamic

  Random Vibration Analysis

  Response Spectrum Analysis

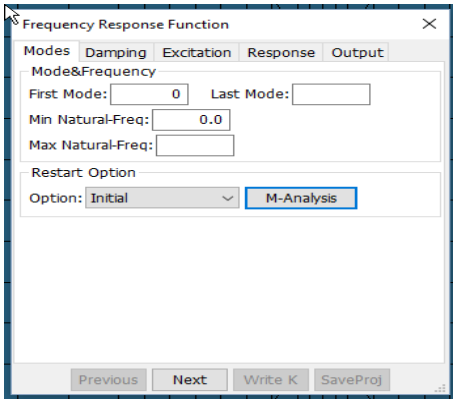
  BEM – Boundary Element Method for Acoustics

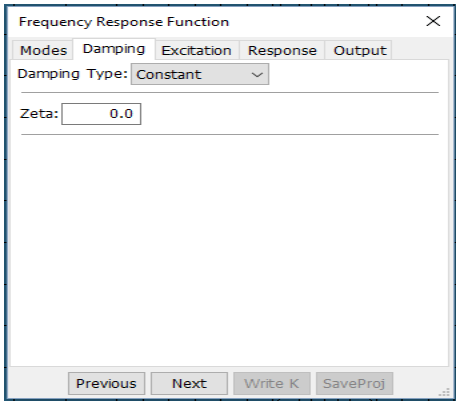
  FEM – Finite Element Method for Acoustics

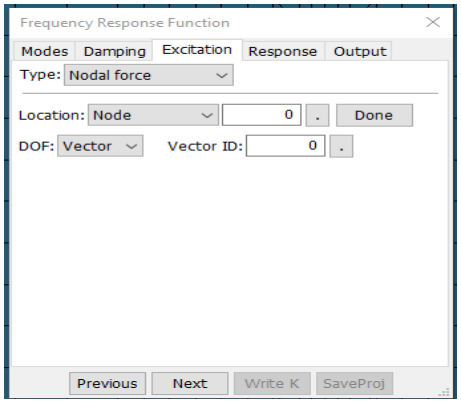
- Users should not have to know all the necessary keyword data for each type of analysis. LS-PrePost will create all required keyword cards

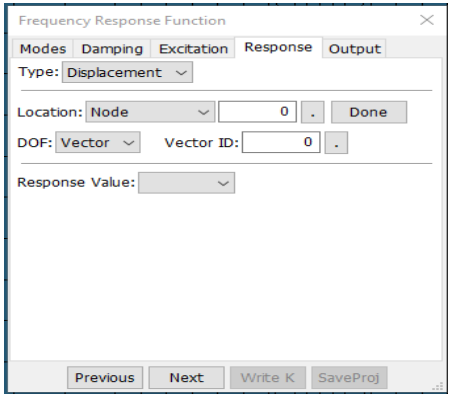
NVH

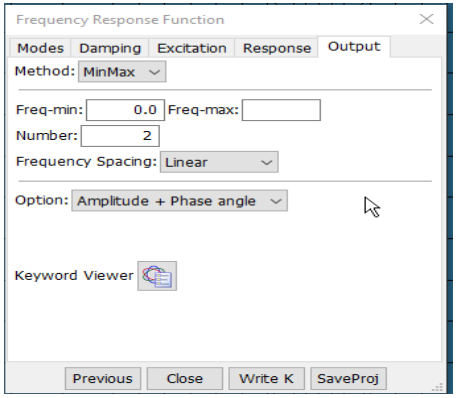
An example of the Interface to setup FRF analysis





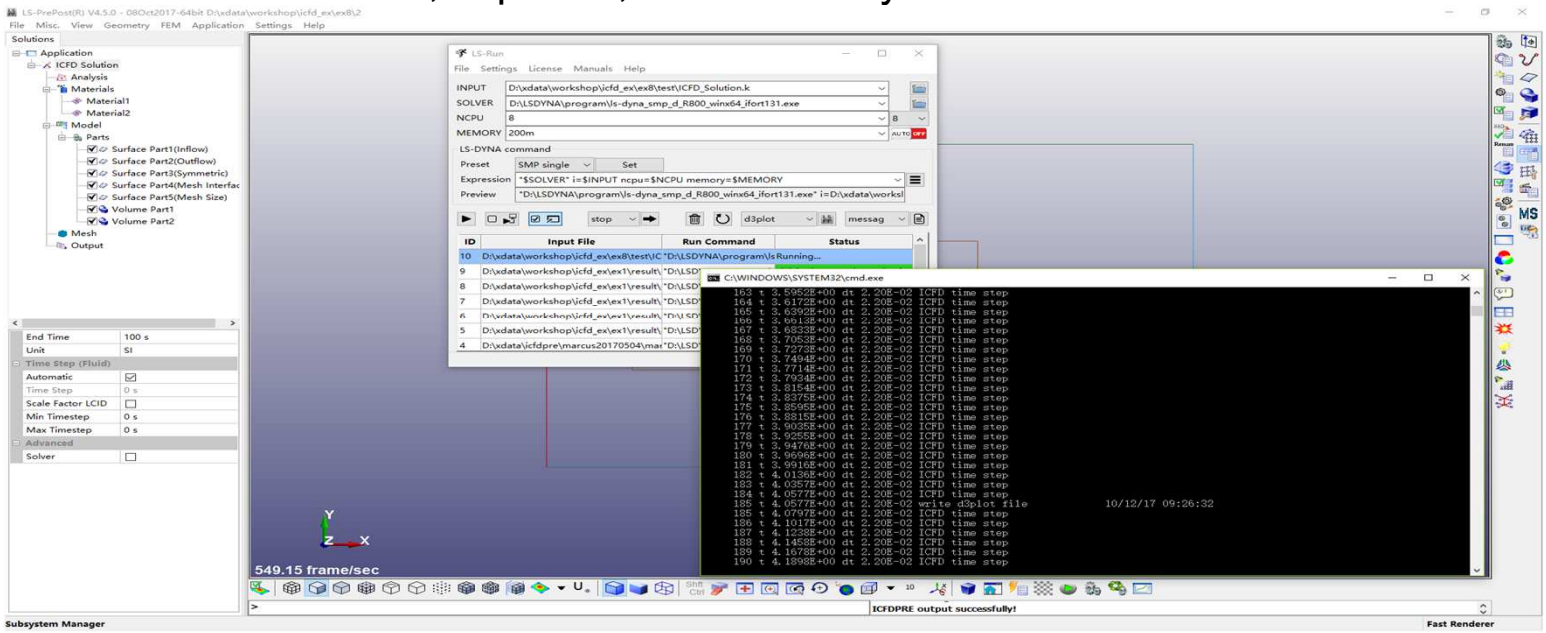






ICFD - Pre Processing

- A new “Solution Explorer” is used for ICFD pre-processing setup, this interface allows user to build an entire LS-DYNA input file for ICFD analysis without knowing the required keyword data
- The solution can be saved, exported, or run directly

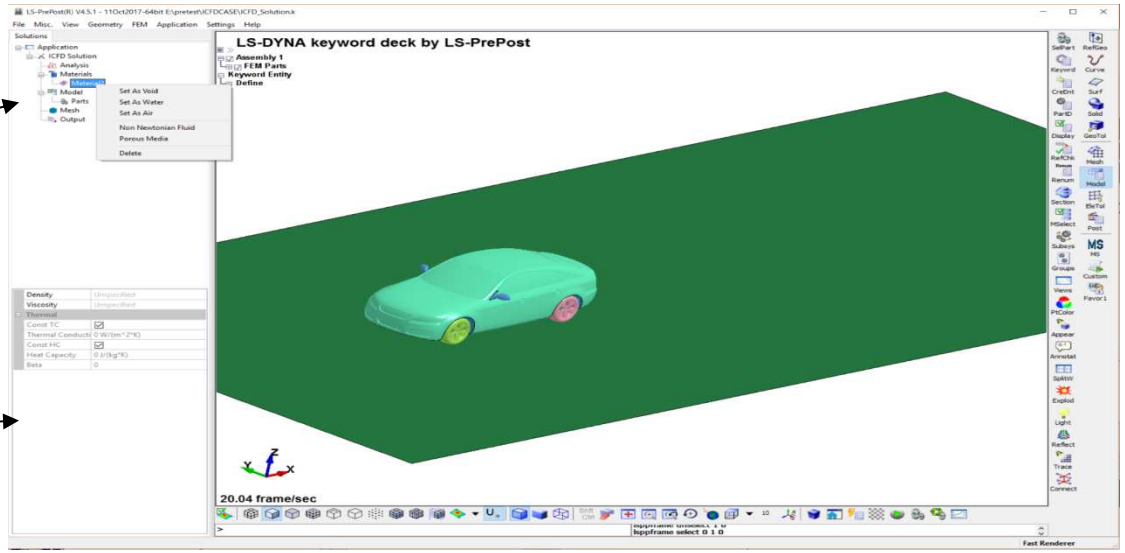


ICFD - Pre Processing

- The Solution Explorer interface has an “Application Tree” that defines the analysis type, material, part data, boundary condition, loading, output, etc.
- Each of these entities use the “Property Interface” to define all related parameters and data

Application Tree

Property Interface



ICFD - Post Processing

- Since the official release of the ICFD solver in LS-DYNA R7.0 version, developments have been continuous and the number of users has been steadily growing.
- Currently LS-PrePost offers some tools in order to post treat the results from the ICFD solver based on its solid mechanic counterpart.
- However, the requirements for CFD post treatment are often quite different and challenging. This meant that a radically new approach was needed for LS-PrePost to meet those specific requirements.
- LS-PrePost 4.2 will be the first version to incorporate post treatments specific to the ICFD Solver and to CFD solvers in general.
- LS-PrePost 4.3 has further improved its capability in the post-treatment of ICFD results

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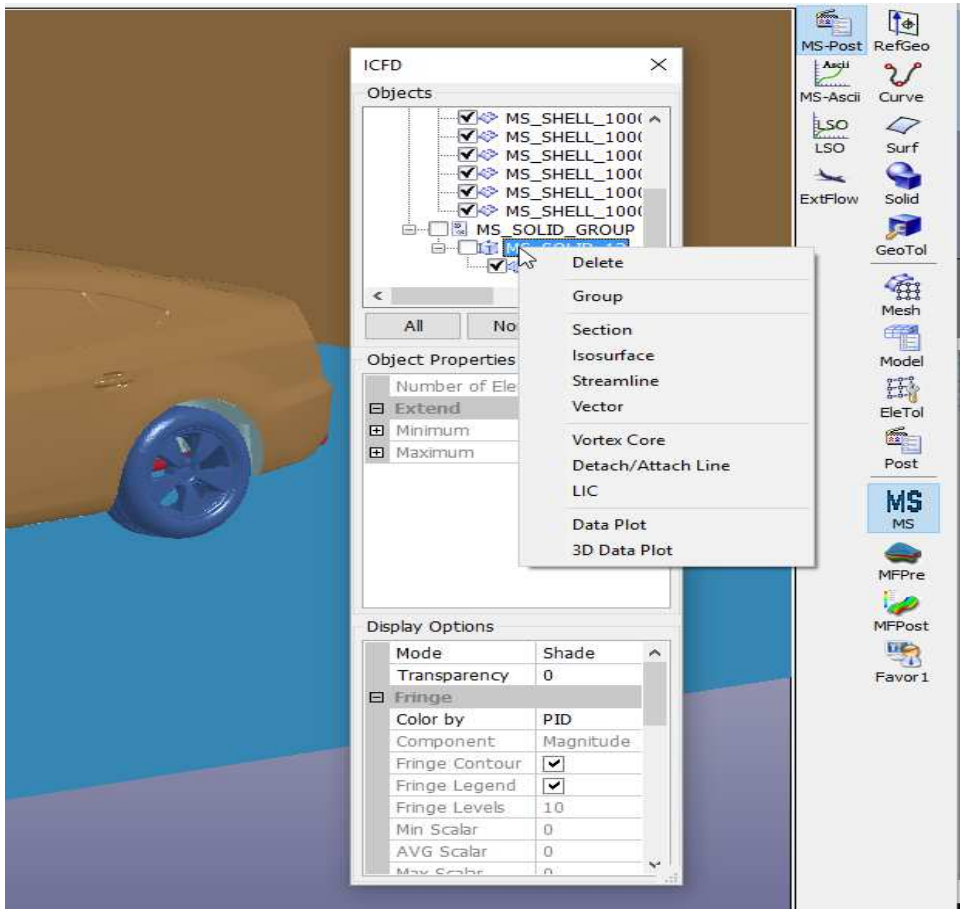
ICFD - Post Processing

The MS Button activates the new ICFD post-processing interface

Each part is an object, right click on the object to select entity, multiple entities can be applies to the object

Each entity will has its own display options

The entities are section plane, iso-surface, streamline, vector, vortex core, detach/attach line, LIC, data plot, and 3D data plot



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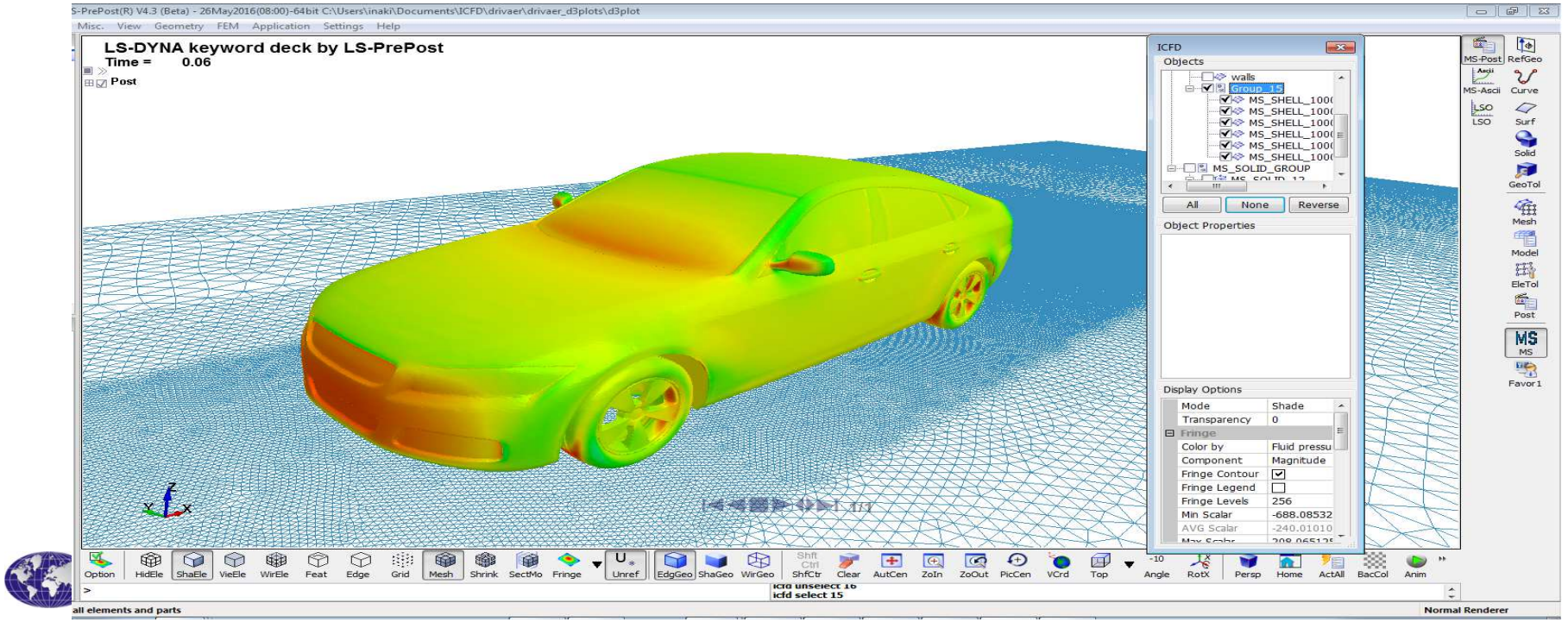
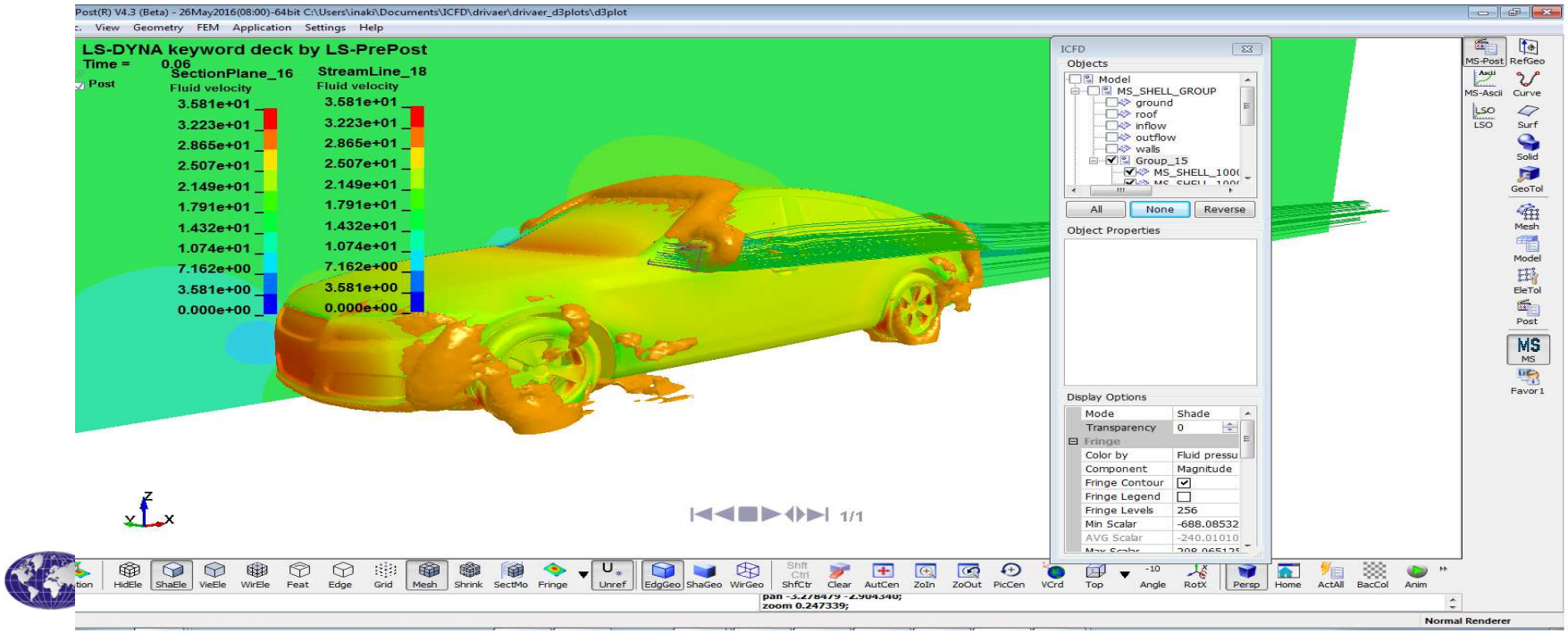
ICFD - Post Processing

In the present case, the surface parts composing a road vehicle are displayed, colored by the pressure field, along with the domain floor, displayed in Wire mode



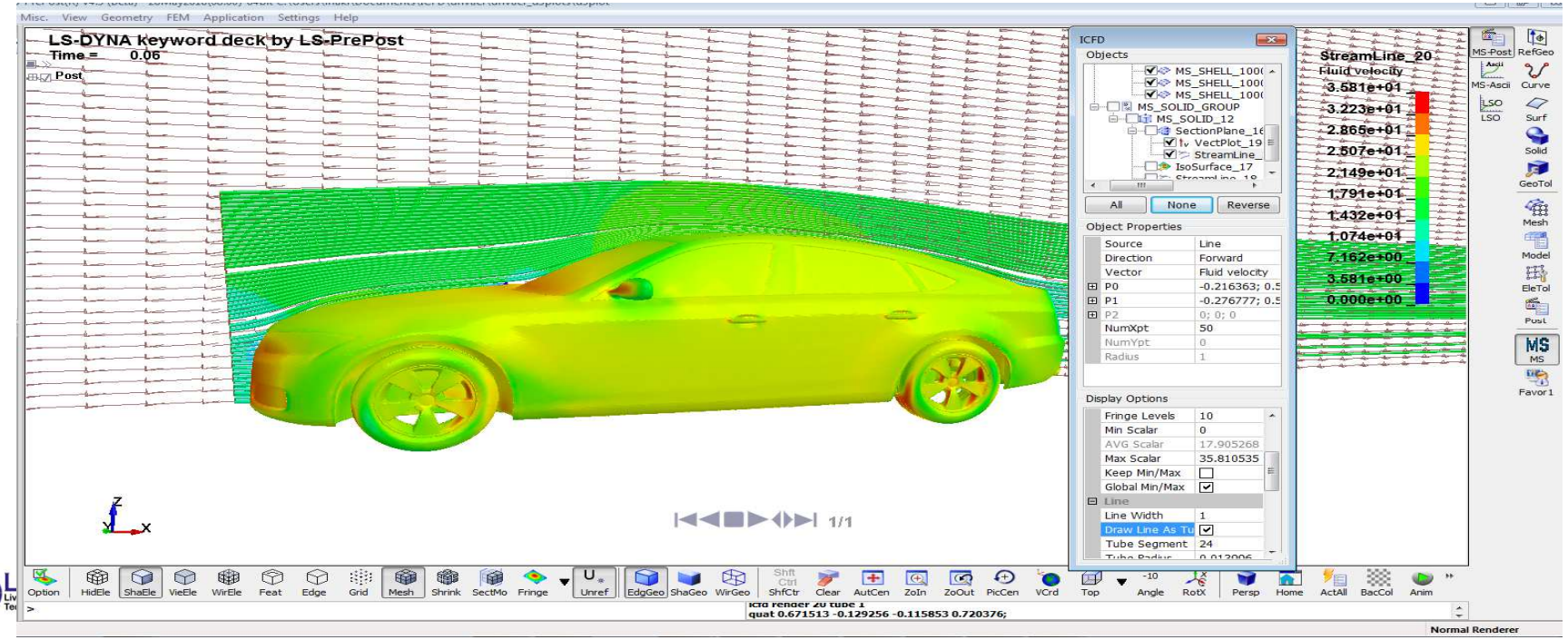
ICFD - Post Processing

In the present case, a section plane, streamlines and an iso-surface have been applied on the fluid volume. Note that the Streamline and Section Plane have been colored by velocity and each has its own independent fringe bar



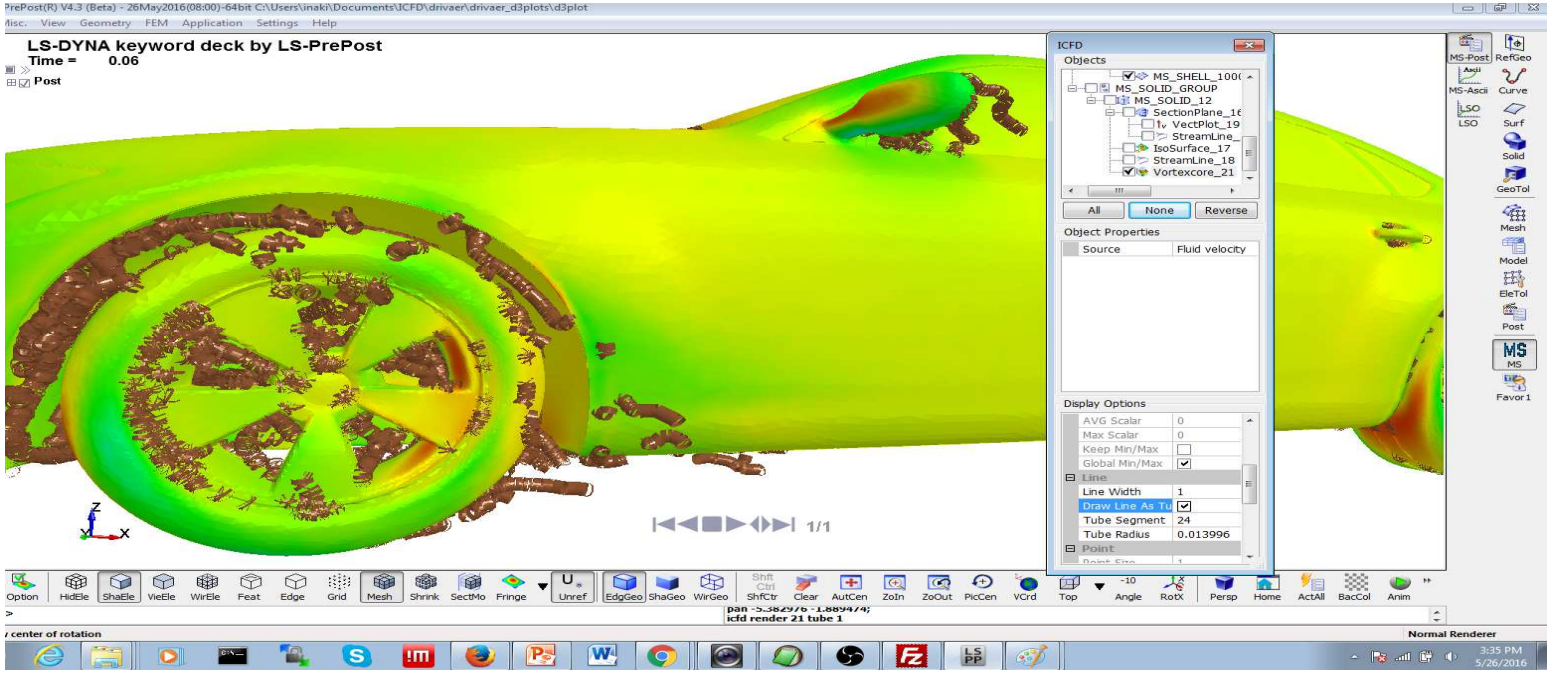
ICFD - Post Processing

Another example, here Vectors and Streamlines objects have been created by applying on the Section Plane rather than on the volume. Again, the streamlines have been colored by velocity



ICFD - Post Processing

More advanced tools are available for a better comprehension of the flow. In this case, the Vortex Cores are captured and displayed allowing the user to quickly identify regions of interest, where flow separation or turbulent effects may occur



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