Current Status of LS-PrePost® and the New Features in Version 4.2

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1 Introduction

LS-PrePost is an advance pre and post-processor that is delivered free of charge with LS-DYNA. It is designed and developed specially to support LS-DYNA in pre-processing and post-processing all in one single code. The main features in the pre-processing include CAD geometry creation and manipulation. A wide range of meshing capabilities including automatic mesh generation for surfaces, hexahedron and tetrahedron elements generation for solid. Comprehensive LS-DYNA keyword data support. Other non-mesh data creation and editing, model checking, and special applications such as Metal Forming, Airbag Folding, Dummy Positioning, Seat Belt Fitting, etc. For post-processing, LS-PrePost 4.2 provides time sequent animation of the model with rendering in fast rendering mode that is many times faster than the old version of LS-PrePost. Stress/strain and other elemental data can be fringed in color band with range setting dynamically or statically or by user defined. Extensive x-y plotting is also available for history data. LS-PrePost also can read smaller time step history data files created by LS-DYNA such as Binout file or ASCII files. LS-PrePost 4.2 also provides a Scripting Command Language (SCL) that accepts and executes LS-PrePost commands and can be programmed by user to extract LS-DYNA result data, user can then manipulate these data to create new data set that can also be feedback into the rendering system for visualization. In this presentation, we will introduce some of the new features that are available in version 4.2. We will also discuss the current development work for the future version.

2 Current Status

The LS-PrePost version 4.1 has been released since April 2014, it has been a stable version of LS-PrePost that includes the fast rendering as default rendering mode. Since then, there are many new keyword data and new capabilities implemented in LS-DYNA, in order to support the never ending new feature in LS-DYNA; LS-PrePost version 4.2 has been available for beta testing. The version 4.2 serves as a test platform for user to test new ideas and new features that are needed but not implemented in the released version. In May 2015, the version 4.2 has been formally released. From then on, only bugs will be corrected in version 4.2. Both versions 4.1 and 4.2 support Windows 7/8.0/8.1 in both 32bit and 64bit OS. For Linux versions, the following favors of Linux are supported: Red hat 5.0/6.0 (Centos 5.0/6.0), Suse Enterprise 10/11, OpenSuse 10/11/12/13, and Ubuntu 12. LS-PerPost also supports Apple OSX. The current version of LS-PrePost can be down load from LSTC's ftp site:

ftp://ftp.lstc.com/outgoing/lsprepost/4.2/win64 for 64bit windows
ftp://ftp.lstc.com/outgoing/lsprepost/4.2/win32 for 32bit windows
ftp://ftp.lstc.com/outgoing/lsprepost/4.2/linux64 for all Linux versions
ftp://ftp.lstc.com/outgoing/lsprepost4.2/apple for Apple OSX

3 New Features in version 4.2

The major improvements in LS-PrePost can be categorized in the following areas:

3.1 Geometry and Meshing

We continue to improve the geometry capability of LS-PrePost in version 4.2, this includes new curve sketch by rectangle, circle, ellipse, ellipse arc, parabola. Also supports mirror transformation for curve Sketch. Add Guided edge/wire constraint for loft surface creation. The final loft result can be constrained by the supported curves.
We also optimize the middle surface generation algorithm. Optimize middle surface pair searching and add final extended/connecting constraint for the resulting surfaces.

Add geometric dimension measure (Bottom Toolbar, Display Options, Dimension). Current Dimension Measure only support edges' length labeling.
In Meshing, we have added variable mesh size in the surface auto meshing, By entering the minimum and maximum element size, LSPP will try to create smaller elements on area that has high curvature and intersection, and will create larger elements on large flat surfaces. We also added remeshing for a select area such that existing boundary nodes will be connected to the new mesh. For automatic tetrahedron meshing, now user can choose more than one part to be meshed. If geometry is given that is an enclosed solid volume, users can create the triangular surface mesh in the same interface before going into the tetrahedron mesh.

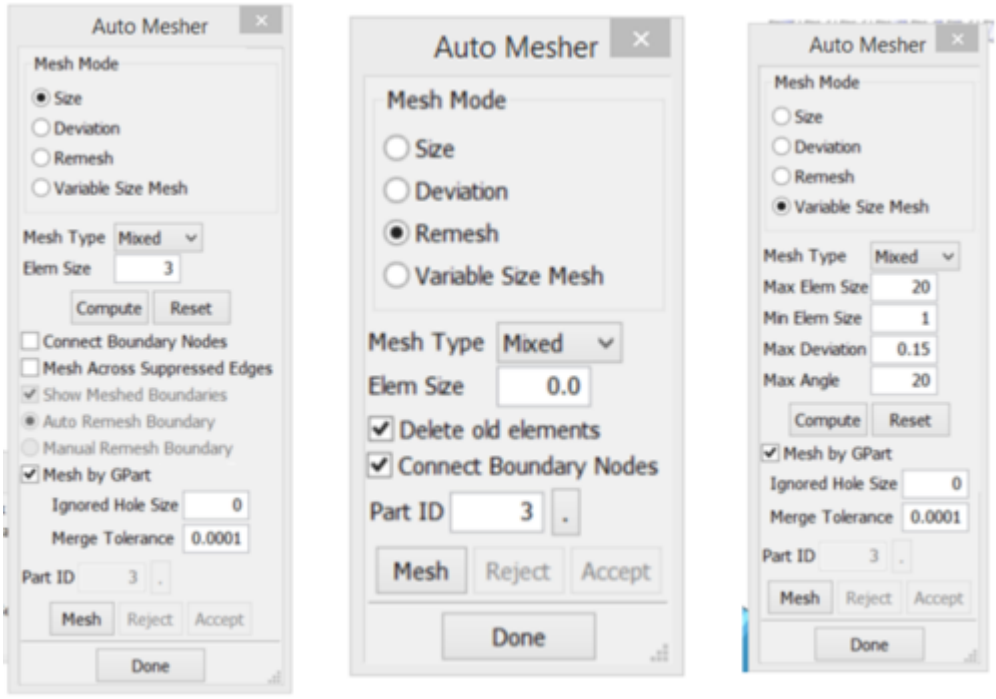

Fig.1: Interfaces for different auto mesh type

3.2 Reading and writing

3.2.1 LS-PrePost 4.2 supports reading and writing of long format, this is the 20 column per field format that is supported in the latest LS-DYNA keyword file. However, for the regular version of LS-PrePost, the integer numbers still is stored as 32bit, therefore, number larger than 2 to the power of 31 will not be supported yet. Real number also is stored in 32bit and therefore only up to 7 digit accuracy will be used. There will be a true double precision version of LS-PrePost in the very near future that will store all integer number and floating number in 64bit, that version will be able to give 15 digits accuracy for floating numbers and very large (15 digit) integer numbers.

3.2.2 Now LSPP can read FEMZIP INTFOR (interface force file), and SPH data in the FEMZIP format.

3.2.3 Keyword data with PGP encryption now is supported for reading and writing, the data started with "BEGIN PGP" and "END PGP" will be kept and be output to the file without loss of data.

3.3 New Keyword data support

Many new keyword data have been added in the latest LS-DYNA, the keyword reader in LS-PrePost 4.2 is also keeping up with the latest published known new keyword data. These include all the

keywords for frequency domain analysis, ICFD analysis, *element_generalized_solid, *element_generalized_shell, *element_shell_nurbs_patch, *parameter_local, *expression_local, just to name a few.

3.4 General Pre-Processing

3.4.1 Add options in the creation of 20-node and 27-node solid elements in the ELGEN->Solid interface. The Hex8_to_Hex20 and Hex8_to_Hex27 options allows user easily to convert 8 node solid element into high order solid element.

3.4.2 Add Composite option in the IDENT interface, this will allow user to view and identify composite layer material direction and layer make up.

*3.4.3 Improve processing of *INCLUDE_TRANSFORM data to keep it more consistent with how LS-DHYNA processing them. Also support nested ID offset in *INCLUDE_TRNAFORM*

3.4.4 Airbag Reference Geometry now can be identified, edited, reverse their normal like regular shell elements.

3.4.5 In Constrained Nodal Rigid Body interface, now user can turn on the "Auto Create" button, such that when node selection is finished, a right mouse click will create the CNRB data, and do not need to click the "Apply" button.

3.5 Post-Processing

3.5.1 Post-processing for Frequency Domain databases –

All frequency domain analyses now have their own interface

File Name	Analysis Type
D3SSD	Steady State Dynamics
D3SPCM	Response Spectrum Analysis
D3PSD	Random Vibration PSD
D3RMS	Random Vibration RMS
D3FTG	Random Vibration Fatigue
D3ACS	FEM Acoustics
D3ATV	BEM Acoustic Transfer Vector

Table 1: Different Frequency Domain Analysis type and their file name

- Each analysis type will has it own interface with its component listing. Showing Frequency instead of Time,

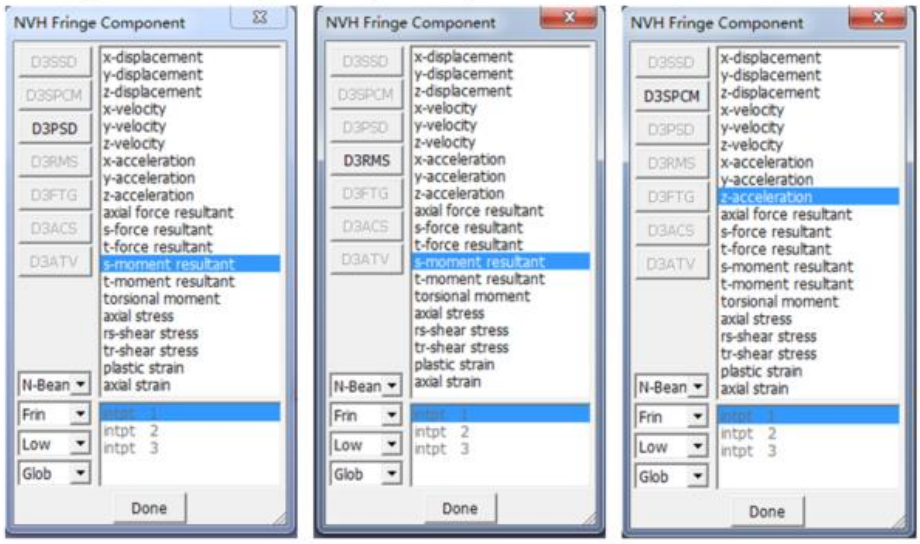

Fig.2: Interfaces for different Frequency Domain Analysis type

- Change component lists by element types.

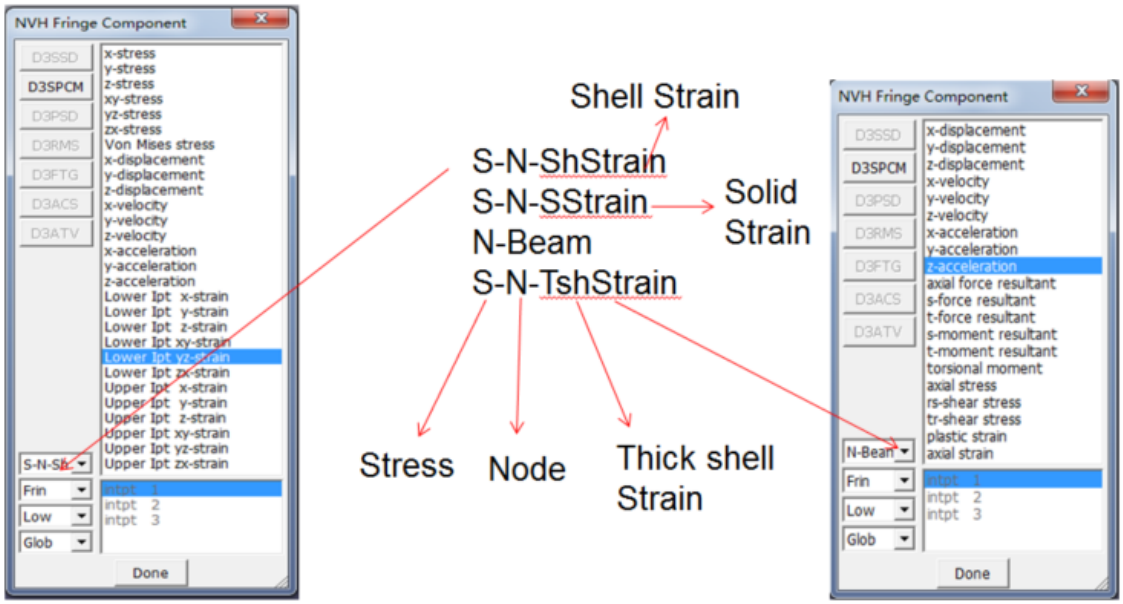

Fig.3: Explanation of the Stress/Strain and node selection for fringing in Frequency Domain Analysis

3.5.2 Post-Processing for ICFD

For ICFD analysis, a new interface has been developed, using object and tree to add and subtract each type of visualization. The visualization type are Section Plane (with multiple planes can be defined), Iso-surface, Streamline, Vector, Vortex Core, Detachment/Attachment line and Line Integral Convolution (LIC)

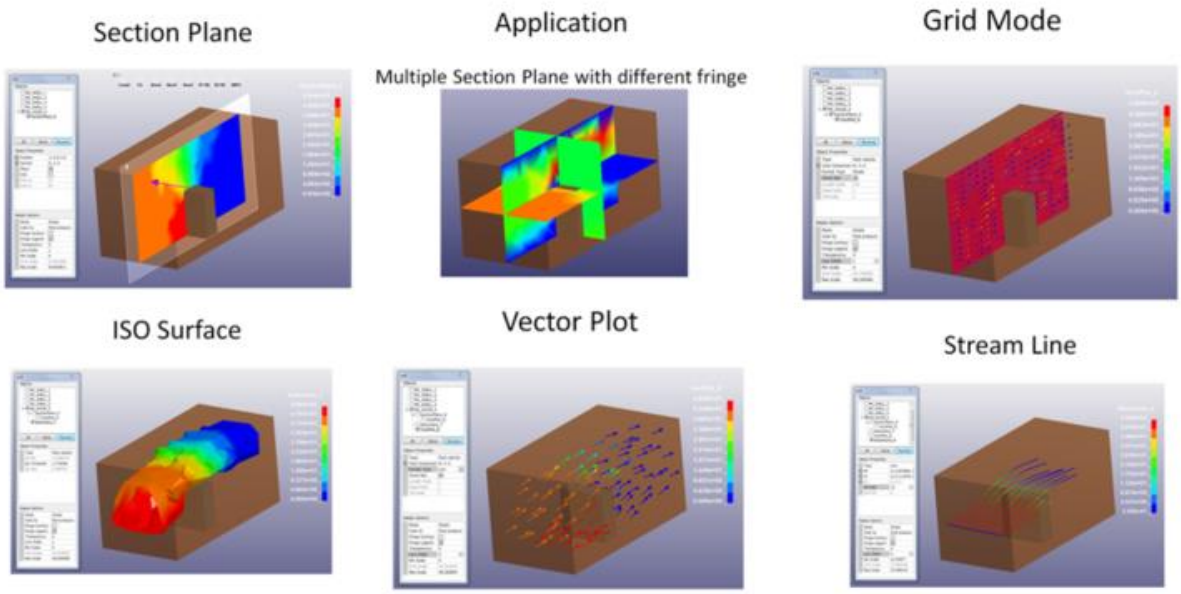

Fig.4: Different rendering options for the ICFD post-processing

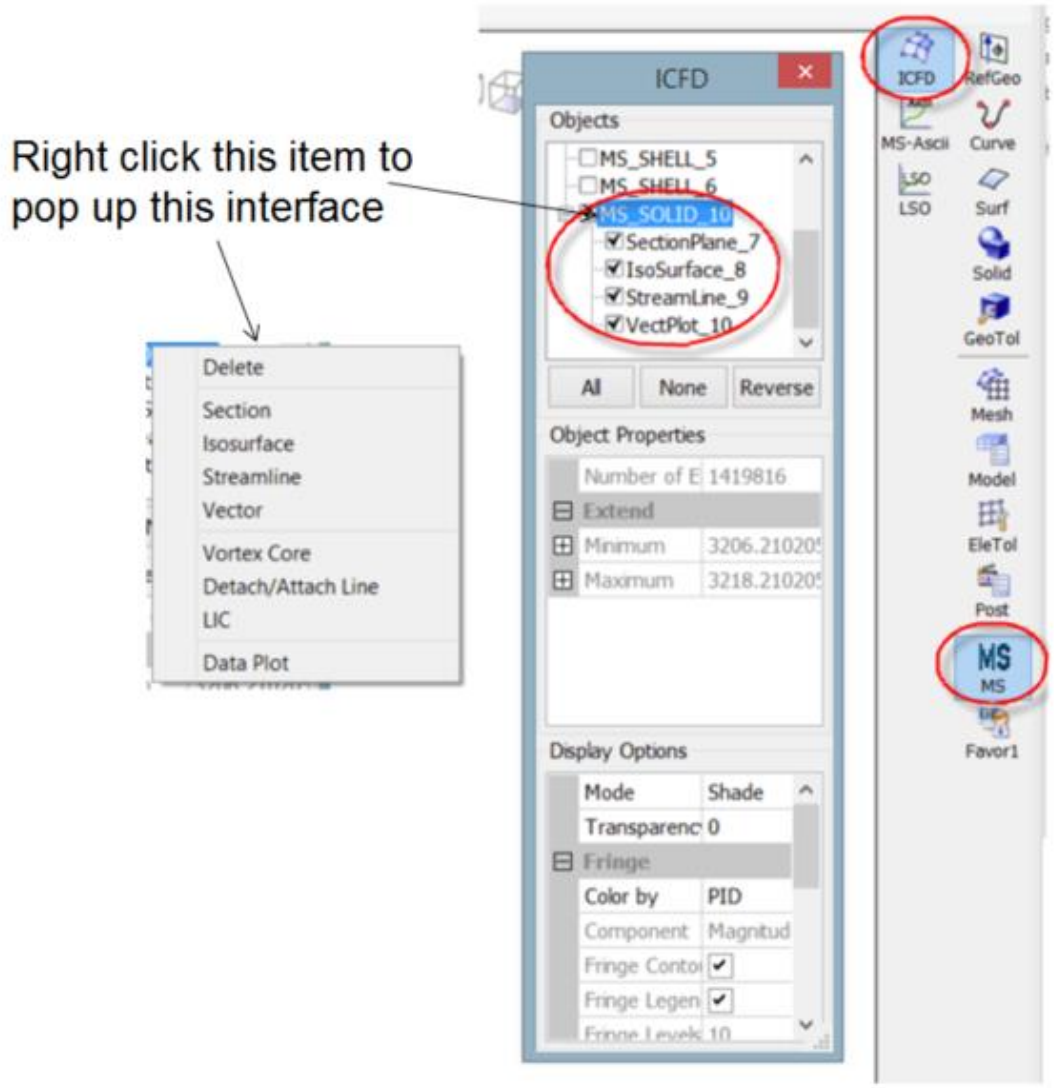

Fig.5: Interfaces for the new ICFD post-processing

3.6 Plotting, and 3D graph system

3.6.1 Colour Map for XY plot – A different representation of the xy graph

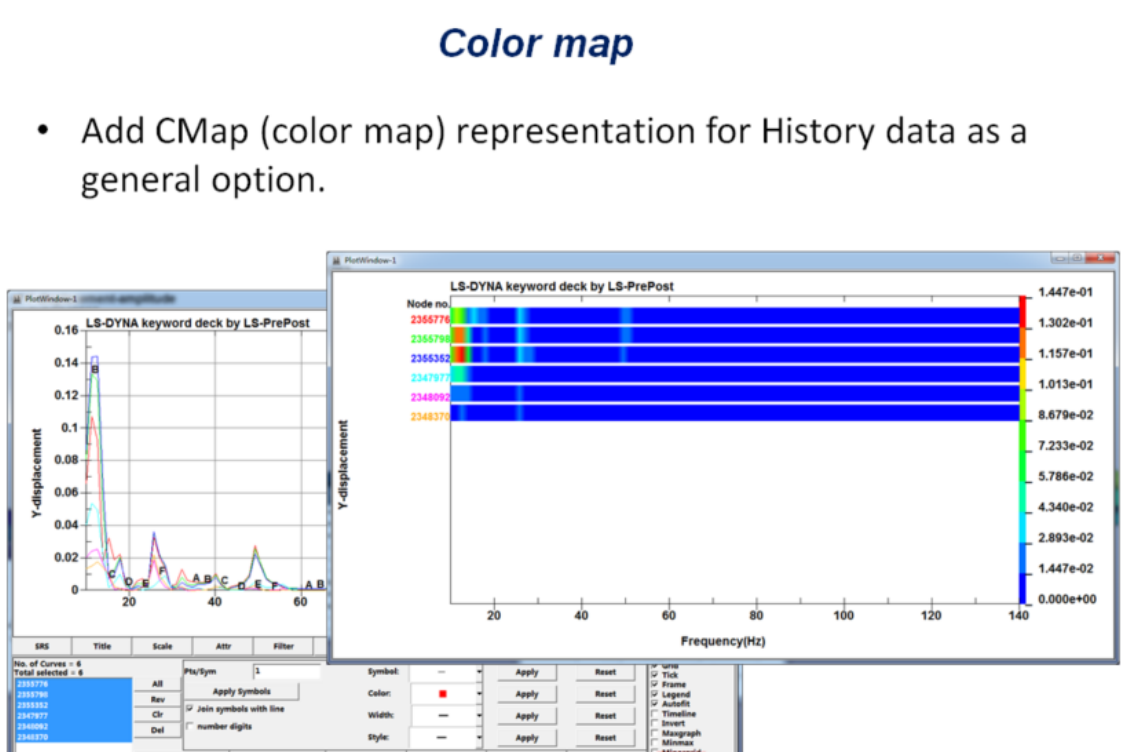

Fig.6: Color Map representation for curves

3.6.2 3D graph System – A 3D graph system has been developed to display 3D cures in the XYZ coordinate space as graph. This will serve as a utility tool for future applications that need to display 3D curves. 3D surface can be formed from a set of 3D graphs that gives better representation of the data points.

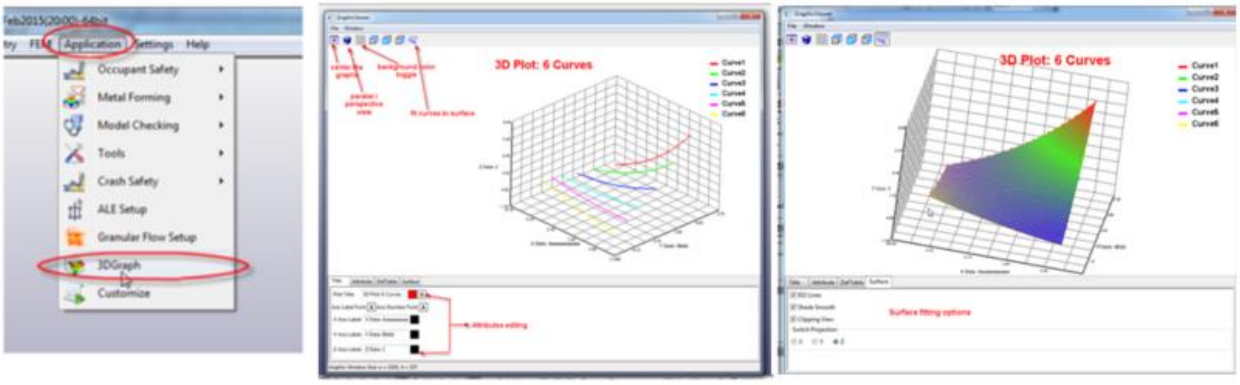

Fig.7: 3D graph system, plot curves and fit surface to curves

3.7 Isogeometry element support

LS-PrePost 4.2 now can create trimmed LS-DYNA Nurbs Patch shell elements. This is in preparation for the upcoming capability in LS-DYNA that can handle trimmed geometry.

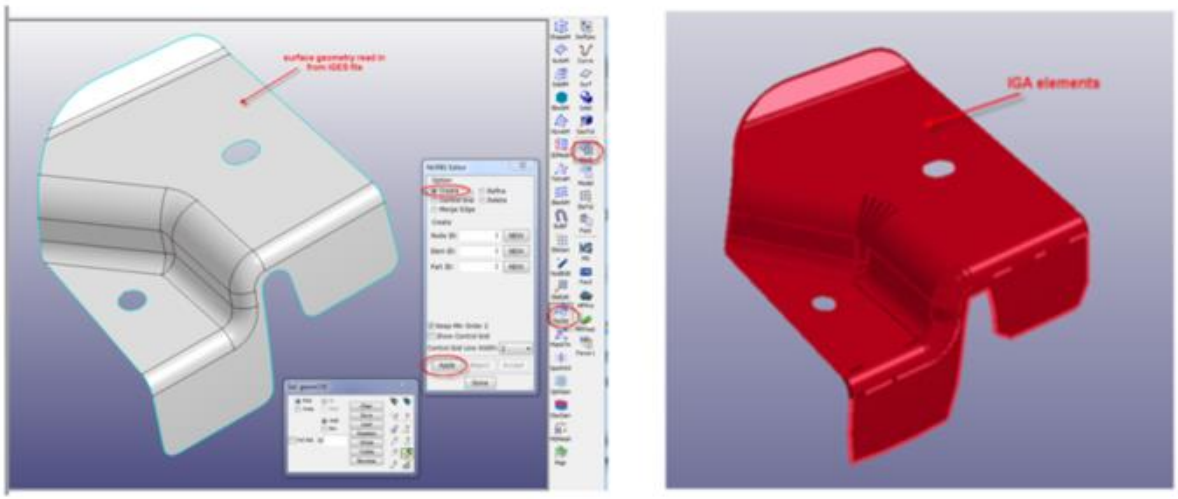

Fig.8: Convert trimmed geometry into trimmed ELMENT_NURBS_PATCH elements

3.8 DES (Discrete Element Sphere) support

The Discgen now will pack DES elements into an enclosed volume with variable sized particles. A set of sizes can be input into the interface to give a wide range of different size particles. Post-processing for the DES elements has also been updated such that if a particle is not active (a flag from LS-DYNA stored in the database), the element will not be rendered.

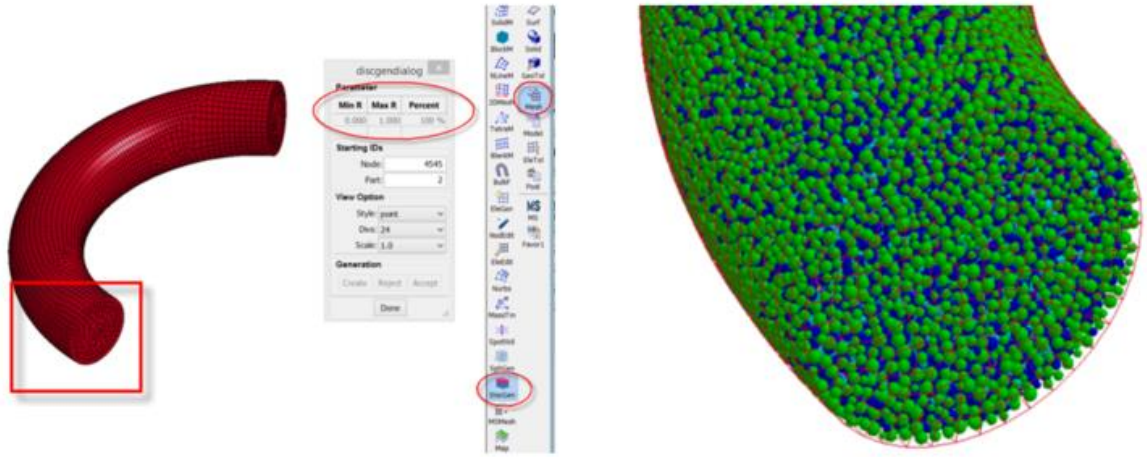

Fig.9: Create DES elements in enclosed shell volume

3.9 Applications

3.9.1 Metal Forming EZSetup - Metal forming EZSetup was developed to allow user to setup a keyword data file to run LS-DYNA stamping applications. This feature was available since version 4.0. However, in the previous versions of the EZSetup, a process (gravity, closing,

forming, trimming, etc.) cannot be used more than once in the setup. In the new version 4.2, one can setup multiple stages, with each stage has multiple processes. For example, a setup that consists of 4 stages, stages 1 includes gravity load, closing, and drawing. Stage 2 includes trimming and spring back, stage 3 includes tipping, stage 4 includes flanging and spring back. Therefore, in this one single setup, there are totally 8 processes to be run one after the other with only one single LS-DYNA job submitting.

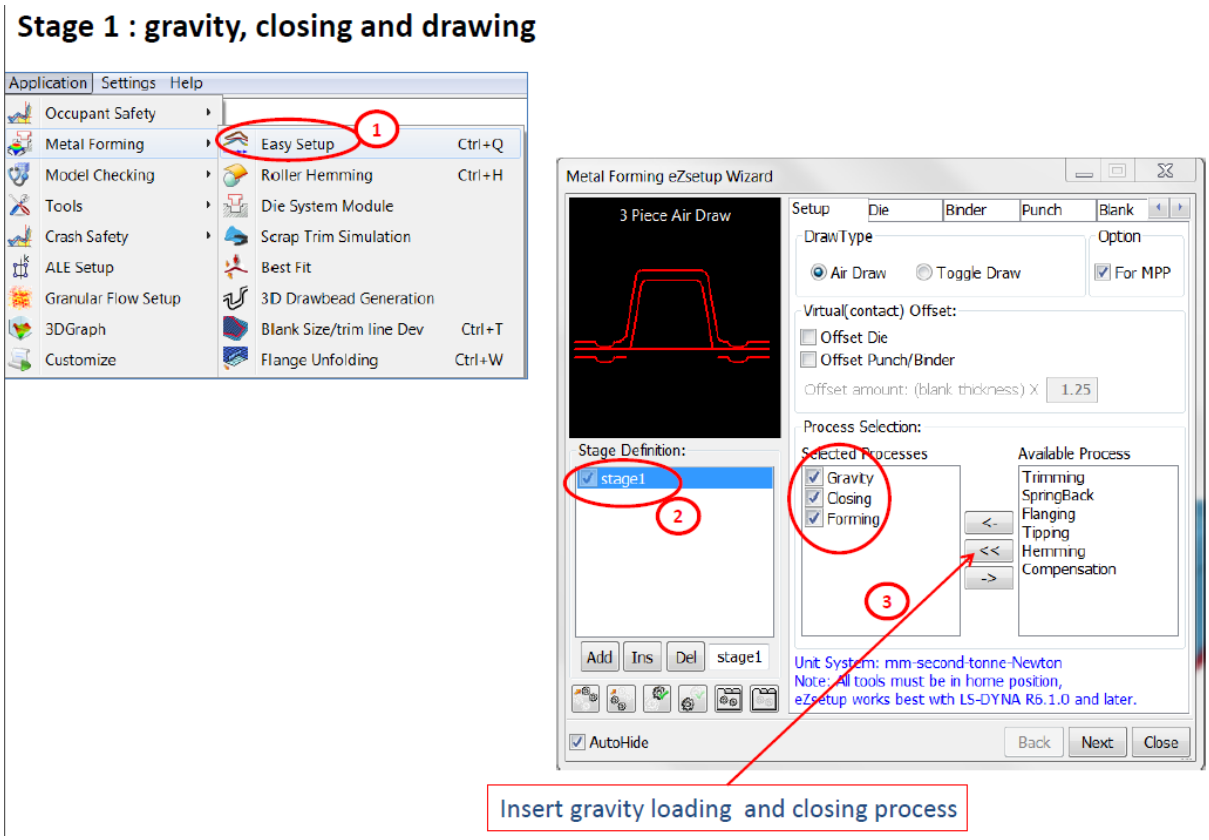

Fig.10: Metal Forming EZSetup interface

3.9.2 Metal Forming New Roller Hamming – A newly revised roller hamming interface has been implemented to replace the old roller hamming. In this new interface, the roller can be created automatically, can also be previewed with its position and other parameters to be adjusted accordingly. The Ham bed and the inner part also can be created automatically.

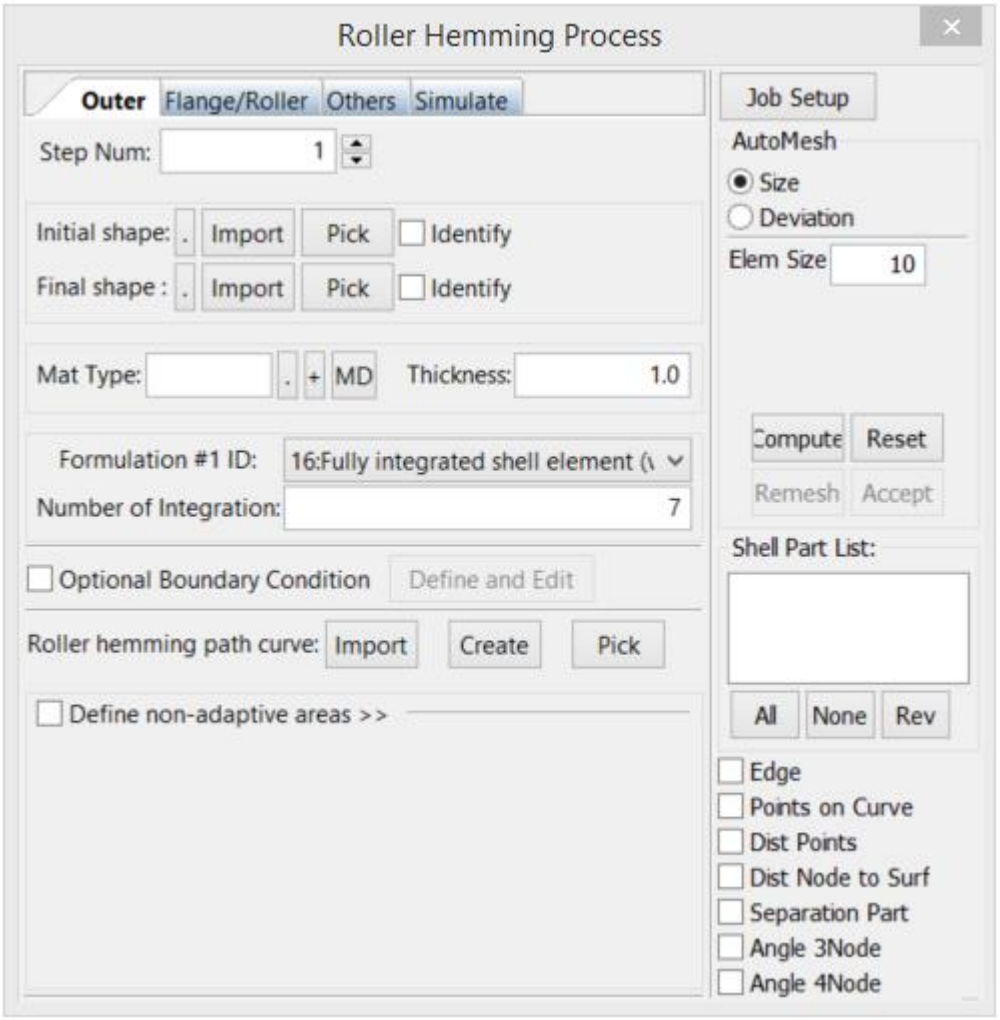

Fig.11: New Roller Hamming Interface

3.9.3 SCL (Scripting Command Language) – The SCL API has been improved with feature to get measurement results from the Measurement Commands, for example, user now can issue a command to measure the volume of a particular element, the command will generate the value and print it in the message dialog, now this value can also be obtained in the SCL code, then the user can use this value to further process whatever his/her needs

4 Current and Future Development

The new development version of LS-PrePost 4.3 has been started; this version will be available for testing soon. Newly requested features and development work will be implemented in this version. The current and future development works are:

4.1 Double precision version –

The regular version of LS-PrePost stores all data in 32bit format, thus largest integer number can only be 2 to the power of 31 which is about 2,147,483,648, and for floating point number

only up to 7 digits accuracy is possible. In the double precision version, all data will be stored in 64bit format, thus very long integer ID will be possible, and also, floating point number can be up to 15 digits accuracy. The drawback of this version is it will require double the amount of memory to store the model data. Another short coming is it can only handle double precision d3plot file

4.2 Preprocessing setup for ICFD and Frequency Domain Analysis

Often setting up LS-DYNA analysis requires not only the knowledge of the application itself, user also need to have the in depth knowledge of all the necessary keyword data that is necessary to make LS-DYNA run properly. This makes it hard to learn how to use LS-DYNA, particularly new applications like the ICFD analysis and the Frequency Domain Analysis. To overcome this problem, LS-PrePost will build setup interfaces for these 2 analyses. It will follow the format like Metal Forming EZSetup with input forms and guide the users step by step to complete the setup. Users only need to know the requirements of the application itself, LS-PrePost will compile all the necessary keyword data and fill in all the required fields in order to run LS-DYNA successfully. We are hoping to extend this approach to other applications in the future.

5 Summary

LS-PrePost has been improved steadily over the past many years. LSTC is committed to continue the development and enhancement of LS-PrePost. Improving the robustness and stability of LS-PrePost is always our first priority. Keeping up with the newly developed features in LS-DYNA and supporting them properly is also our mission. We always look forward to user's feedback and suggestions. User's request for new features is always welcome and highly evaluated.