New Features
of LS-PrePost 3.0

Philip Ho

LSTC

Summary:

The introduction of the new LS-PrePost 3.0 will be presented here. A completely redesigned graphical user interface has been implemented in the new version of LS-PrePost 3.0. Tool bars and icons are being used for the main manual system to replace the old text based button system. The icons can be set to have text or without text. The new interface provides the maximum possible graphical area for the model rendering at the same time allow users to define their own toolbar with frequently used icons put together as they like. Besides using icons from the toolbars, a pull down manual system can also be used to reach to the function interfaces. Popup windows are used for each functional operation. Only one functional operational will be active at one time. Users can easily switch between the old and new interfaces if they do not feel comfortable in using the new interface. Also, an old to new interface button system has been implemented to transition users from the old interface to the new interface. Another major feature in LS-PrePost 3.0 is the newly developed geometry processing engine. The geometry processing engine is based on Open Cascade Technology 6.3. LS-PrePost 3.0 supports basic geometry entities such as lines, surfaces, and solids. It supports shape fixing and reshaping, such as fixing hole, small edge removal, vertex reposition and deletion, small face removal or face extension. It also supports faces stitching to provide better meshing result in the auto mesher. Geometry data can be imported via Iges or Step file format, while modified geometry also can be exported in iges file format. Surfaces can also be created from existing mesh using LSTC's own reverse engineering module.

Beside the new interface and geometry processing engine. New applications have been added to the LS-PrePost3.0 such as the Roller Hemming job setup and the LS-DYNA ALE job setup. An application frame work has been created such that new applications can be easily added in the future.

New Features of LS-PrePost 3.0®

7th European LS-DYNA Conference

Salzburg

Philip Ho

May 14, 2009

Outline of talk

- Introduction
- New GUI in version 3.0
- Geometry Engine in version 3.0
- New Applications

    Roller Hemming setup

    ALE setup

- Outlook

Introduction

- LS‑PrePost is an advanced pre and post‑processor that is delivered free with LS‑DYNA
- Core Functionality
  - Full support of LS‑DYNA keyword files
  - Full support of LS‑DYNA results files
  - Post‑processing (animations, fringing, curve plotting, etc…)
  - Pre‑processing (meshing, clean up, entity creation)
- Online Resources
  - Official Website: http://www.lstc.com/lspp
  - User Group: http://groups.google.com/group/ls-prepost

Current Status of LS-PrePost

- LS-Prepost 2.4 is the current release
  - Download:
    http://ftp.lstc.com/anonymous/outgoing/lsprepost/2.4
  - Available for all Unix, Linux and windows
- LS-PrePost 3.0 is available for Alpha testing
  - Download:
    http://ftp.lstc.com/anonymous/outgoing/lsprepost/3.0
  - Version 3.0 only available for Windows 32bit, 64bits and Linux 64bit

LS-PrePost 3.0 GUI

- LS-PrePost 3.0 uses toolbars and icons
- Provides the maximum graphics rendering space
- Icons with text or without text
- User configurable toolbars
- Functionality can be activated from icon or from pull down menu
- Only 2 popup dialogs at any one time
- Location of popup dialogs will be memorized

5

LS-PrePost 3.0 GUI

Toolbar without text

Toolbar with text
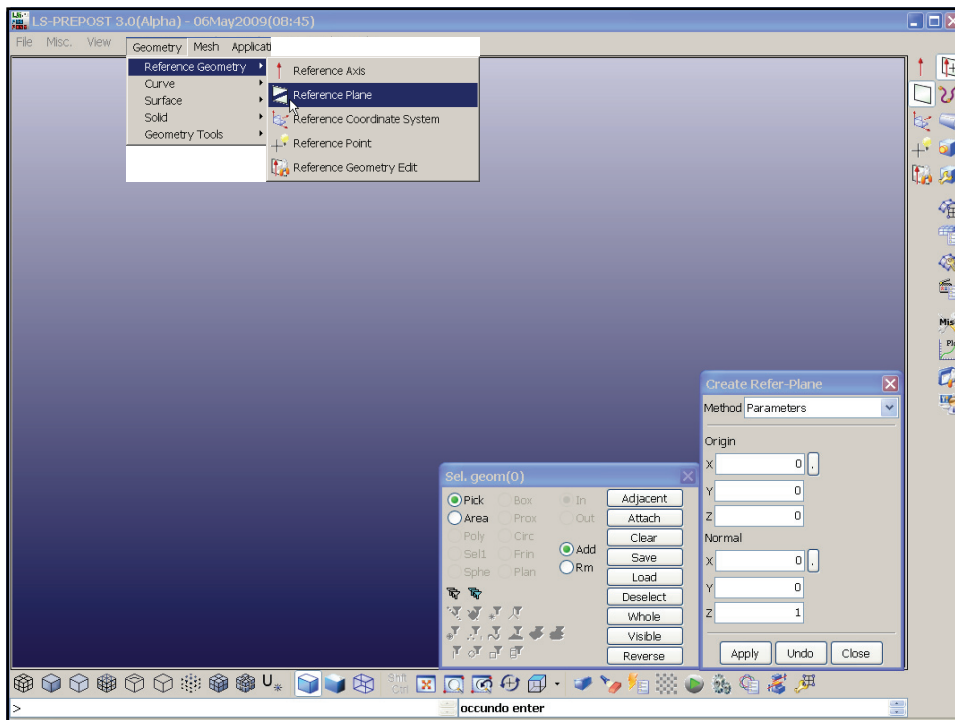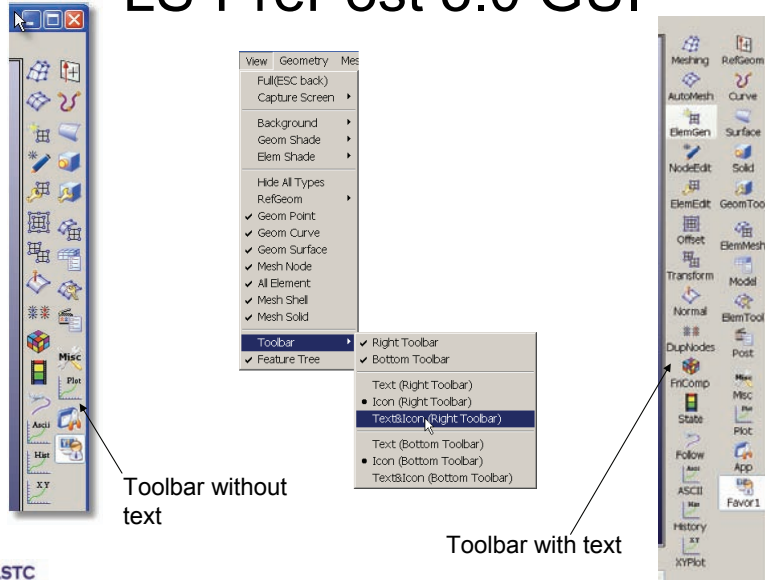
LS-PrePost 3.0 GUI

- Old interface still available and fully functional
- New and old interfaces can be switched with 1 key press (function key f11)
- An Old2New interface can transition users to the new interface without searching for the new icons
- Not all functions are available in new interface at this moment

9
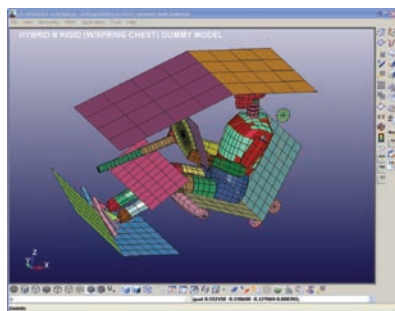
Function key

F11
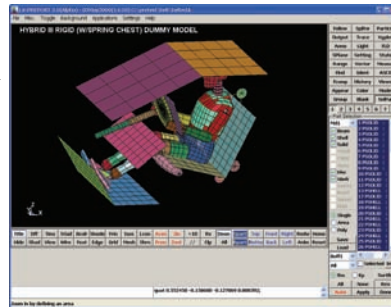
Old to new interface guides users to the icons in the new interface
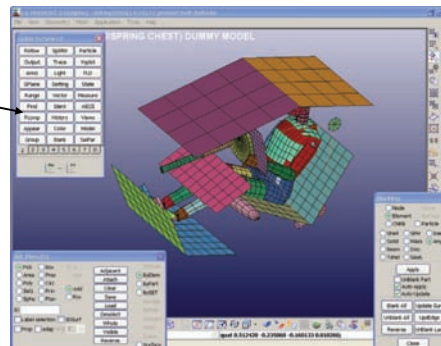
LS-PrePost 3.0 GUI

- Many functional interfaces have been changed to make it more intuitive and efficient
  - Selpart
  - Keyword input/edit interface
  - Model transformation
    - Translate, Scale, Rotate, Transform, Reflect and Project
  - LS-DYNA data creation interfaces
  - Configuration setting

LSTC
Livermore Software Technology Corp.

11
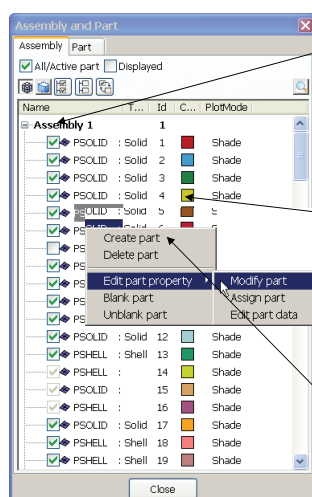
LS-PrePost 3.0 GUI

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

LSTC
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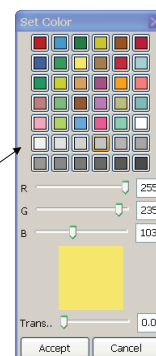
12
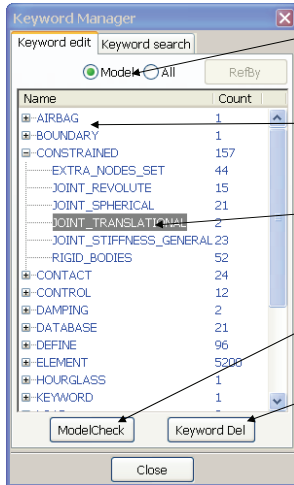
LS-PrePost 3.0 GUI

Choose data for this model or All Keyword data

A tree form 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

13

LS-PrePost 3.0 GUI
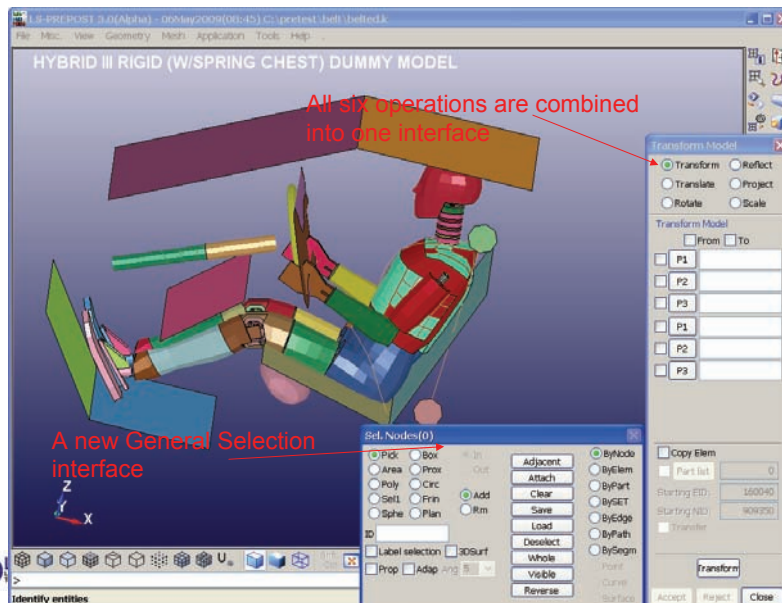
All six operations are combined into one interface

A new General Selection interface

14

All lsdyna data entity operation from old interface Page 5 are consolidated into one single tree

Each data entity will have its own interface in this area

Parameters that were set in the .lspostrc file now can be modified interactively in the configuration Setting interface
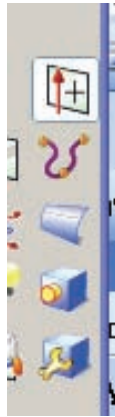
Keyword output order can be set here

Geometry Engine

- Online help for geometry operation
- Reference Geometry
- Curves
- Surfaces
- Solids
- Geometry tool

Geometry Engine – Online Help

Geometry Engine

- Reference Geometry Interfaces to create
  - Reference axis
  - Reference plane
  - Reference coordinate system
  - Reference points
- Reference geometry editing tools

Geometry Engine - Curve

- Curves Interfaces to create
  - Points, Lines
  - Circle, circular arc
  - Ellipse, elliptical arc
  - B-spline curve, helix, and composite curve
- Tools
  - Break curve, merge curve, bridge edges, and smooth curve

Geometry Engine - Surface

- Surface Interfaces to create
  - Plane, cylinder, cone, sphere, and torus
- Create surfaces
  - filling plane by edges, or by points
  - by extruding curve
  - by revolving curve
  - by sweeping curve along another curve

Geometry Engine - Surface

- Create surfaces
  - by lofting over multiple sections
  - by patching surface with 2 to n edges
  - by bridging two surfaces
  - by combining multiple surfaces
  - By fitting over points (xyz points) or finite element mesh

Geometry Engine - Surface
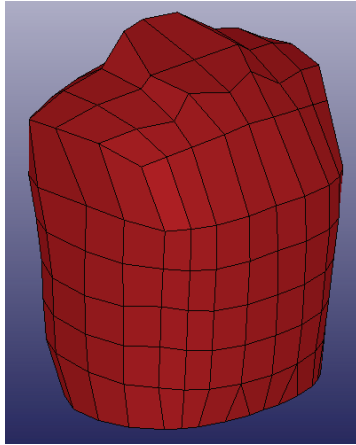
Finite Element Mesh
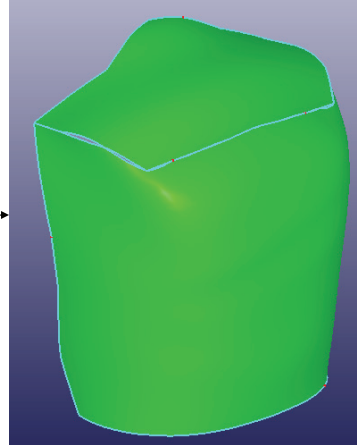
Geometry Surface

Geometry Engine - Solid

- Solid interface to create
  - Box, cylinder, cone, sphere, torus
- To create solid
  - By extruding faces
  - By revolving faces
  - By sweeping faces along a curve
  - By lofting over cross sections
  - By thickening shell surfaces

Geometry Engine - Solid

- To create solid
  - Solid edges can be fillet or chamfer
  - Solid block with wedge
  - Solid block Boolean operation
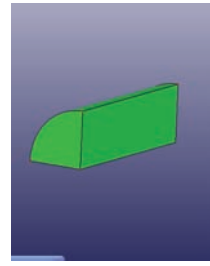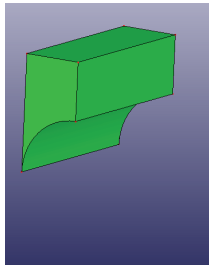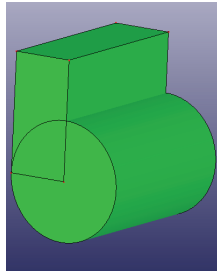
Geometry Engine – Geometry Tools

- Delete surface
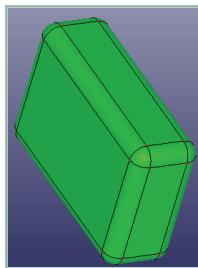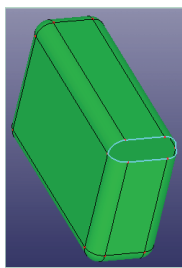
a. Solid box b. Delete
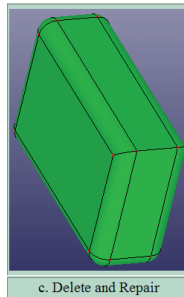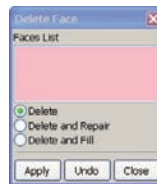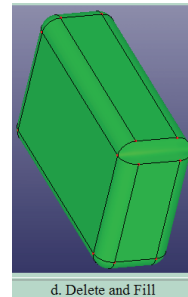
c. Delete and Repair d. Delete and Fill

Geometry Tools – extend curve

- Extend curve stop condition
  - Extends by distance
  - Extends to a specified surface
  - Extends up to vertex
- Extend curve extension type
  - Linear - extends curve tangent to the original curve along the vertices
  - Same curve – extends the curve along the geometry of the curve
  - Extend on face – extends the curve on the face if the curve locates on any face

27
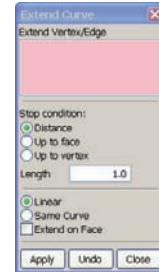
Geometry Engine – extend curve
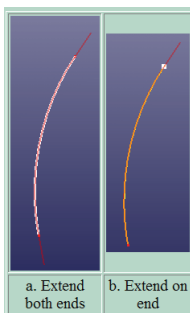
a. Extend both ends

b. Extend on end
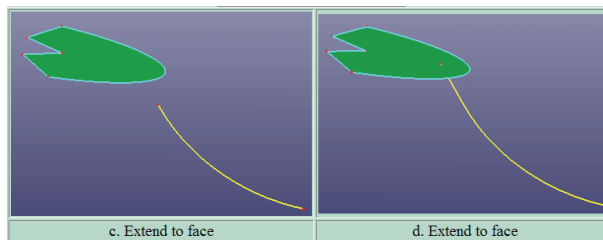
c. Extend to face

d. Extend to face
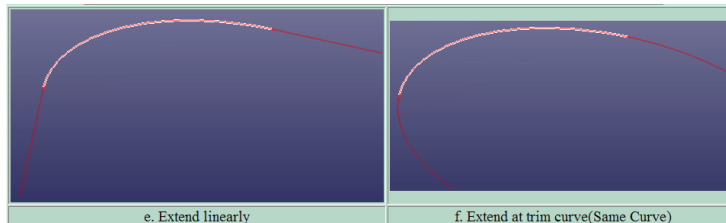
e. Extend linearly

f. Extend at trim curve(Same Curve)

28

Geometry Tools – extend face

- **Extend face stop condition**
  - Extends by distance
  - Extends to a specified face
  - Extends up to vertex
- **Extend face extension type**
  - Linear - extends face tangent to the original face along the edges
  - Same surface – extends the face along the geometry of the face

29
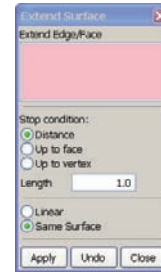
Geometry tool – extend face

a. Extend surface by selecting two edges

b. Extend surface by selecting face

c. Preview of extending surface to the selected vertex

f. Extend surface linearly

30
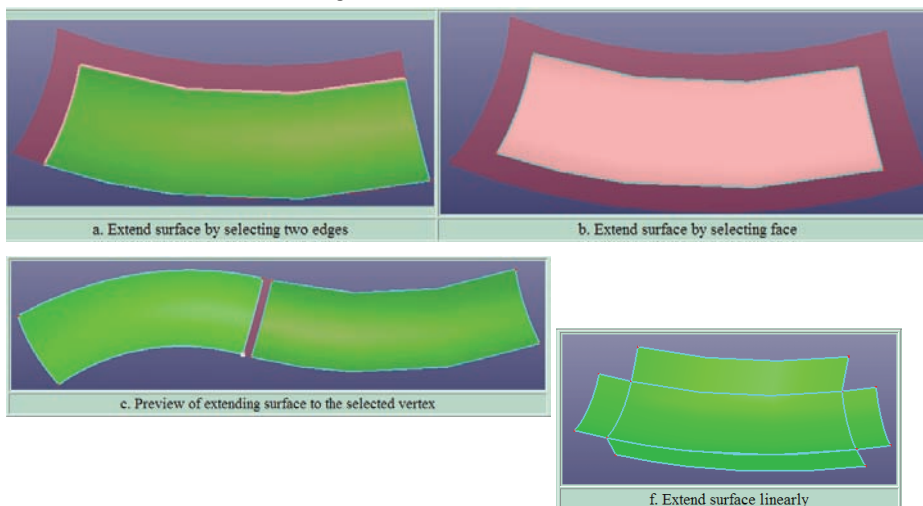
Geometry Tools - Intersection

- Intersection – select edge or face to calculate intersection of point or curve
  - Standard - Select edges, faces into group 1, select other edges, faces into group 2, and the shapes in groups 1 will intersect with the shapes in group 2
  - Mutual - Select edges, faces into the group, and the shapes intersect with each other in the group

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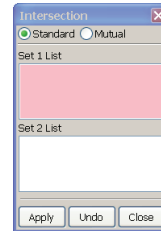
Geometry Tool - Intersection

| a. Preview of intersecting. | b. Intersecting results |
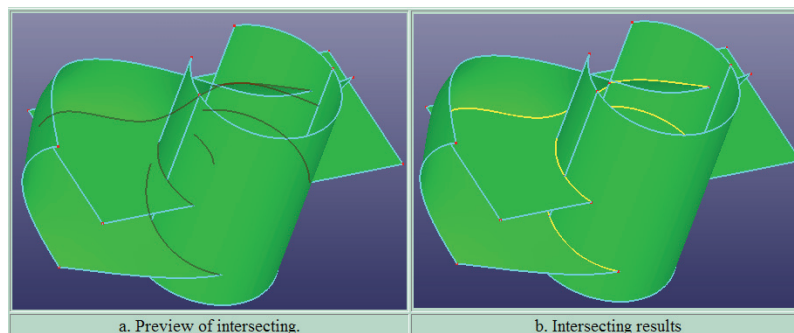
Geometry Tools - Offset

- Offset – offset a face/shell, a planar edge/wire or an edge on the face

b. Offset face to two directions (Face/Shell)

a. Offset using Plannar Edge/Wire

b. Offset using Edge on Face
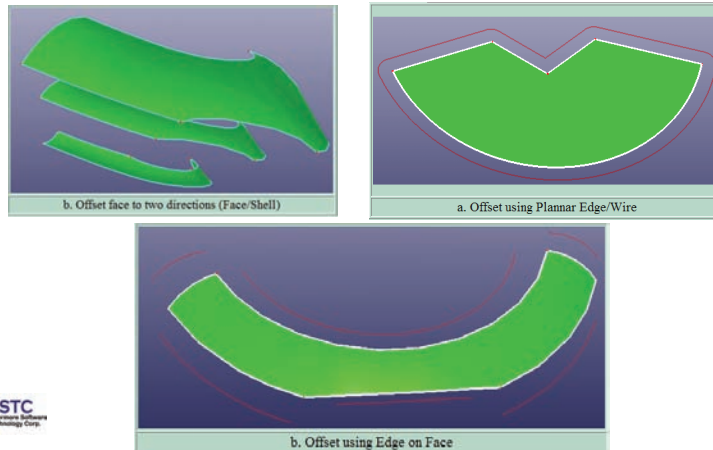
Geometry Tools - Project

- Project – Given a direction, you can project vertex, edge or wire to a destination face or shell

a. Preview of projecting top selected edge onto the plane

c. Projecting result
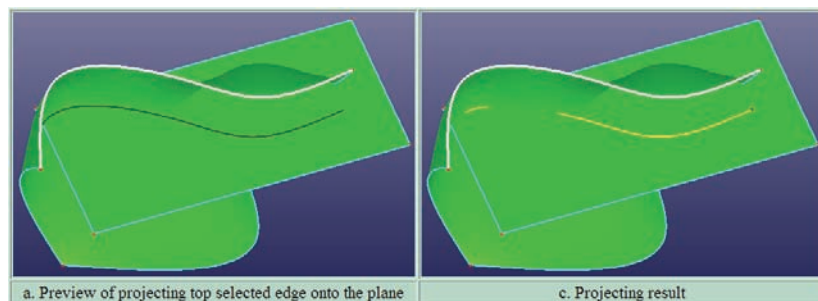
Geometry Tools – Replace Face

- Replace face – replace raw faces from a shell or solid by other new faces

| a. Raw shell | b. Replace middle several faces using a surface. |
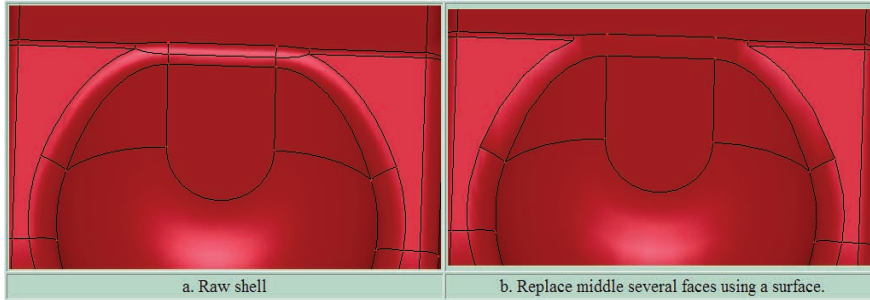
Geometry Tools – Stitch Faces

- Stitch faces – sew independent faces into a shell using Stitch Faces. If shell is closed with no open boundary, then it becomes a solid.

| a. Raw independent faces | b. Shell after stitching |
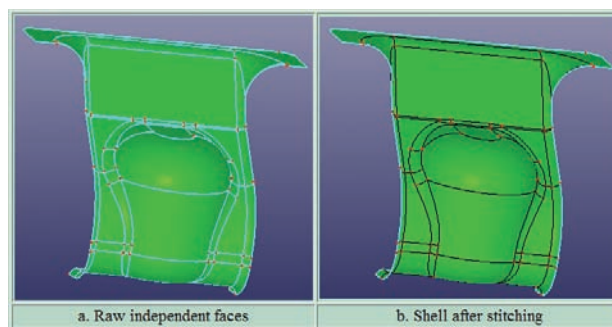
Geometry Tools – Trimming

- Trimming – trim edge or face by using other edge, wire, or face
- Trimming type
  - Standard – use standard entities to trim other entities
  - Mutual – Trim multiple faces using the faces themselves

| a. Using cylinder to trim the edge of the plane | b. The edge after trimming |

Geometry Tools - Trimming

| c. Using plane to trim the cylinder | d. The two sub cylinder faces after trimming |

| e. Four faces | f. Results after trim using "Mutual" method | g. Results after deleting the small faces |
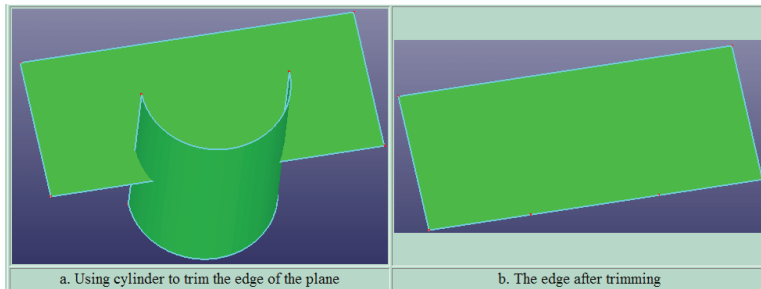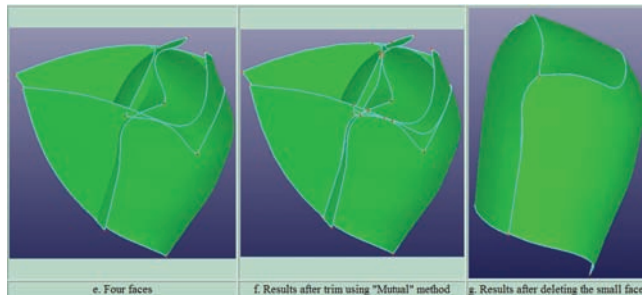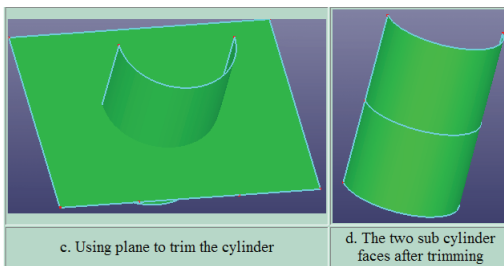
Geometry Tools – Transform and Copy

- Transform – Translate, rotate, mirror, or scale any shape or ref-geometry
  - Translate - Select an axis as direction of translation
  - Rotate – Select an axis as axis of rotation
  - Mirror – Select a point, axis or plane as the reference point or reflection
  - Scale – Select a point as the reference point of scaling
- Copy – Duplicate any geometry data

Geometry Tools - Management

- Geometry data management –
  - Blank/unblank
  - Delete
  - Export – Output geometry data in IGES or STEP file format
  - SplitShell – Split all shells and solids into independent faces
  - ClearModel – Remove all shapes or reference geometry from current model

Geometry Tools – Model Healing

- Heal model – Fix geometry errors such as duplicated faces, small faces/edges, abundant vertices and holes. Also to modify shape by replacing edge from face, add vertex to edge, etc.

- Topology simplification – untrim face, search and remove inner hole, search and fix fillet surface, search and remove fillet edge and reshape edge.

Geometry Tools – Measure

- Measure
  - Measure the distance between two points
  - Measure the radius and angle of the circular arc
  - Check the normal of the plane
  - Check if two circles are co-center
  - Check if two lines are parallel
  - Show or hide the ID of any geometry entities

LS-PrePost 3.0 Applications
Roller Hemming Job Setup
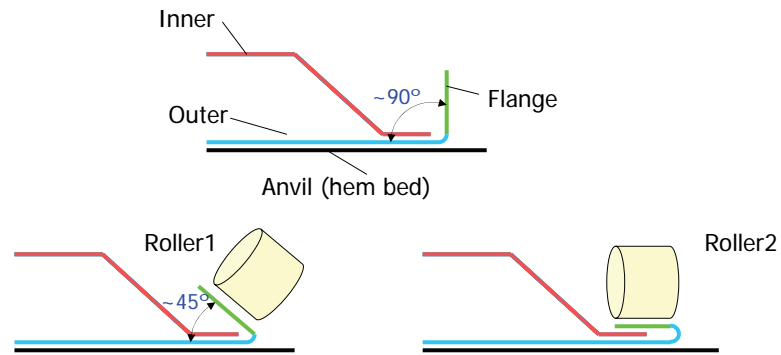
- Flange bending use robotic hemming roller
- Support multi-roller definition
- Roller motion curves generated automatically
- Easy simulation job setup
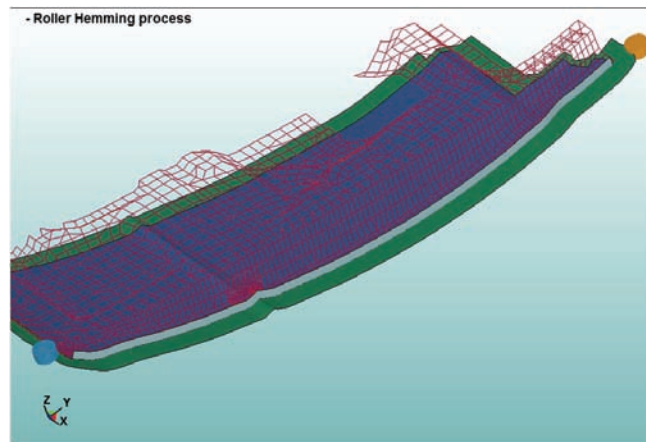- Use LS-DYNA explicit solver
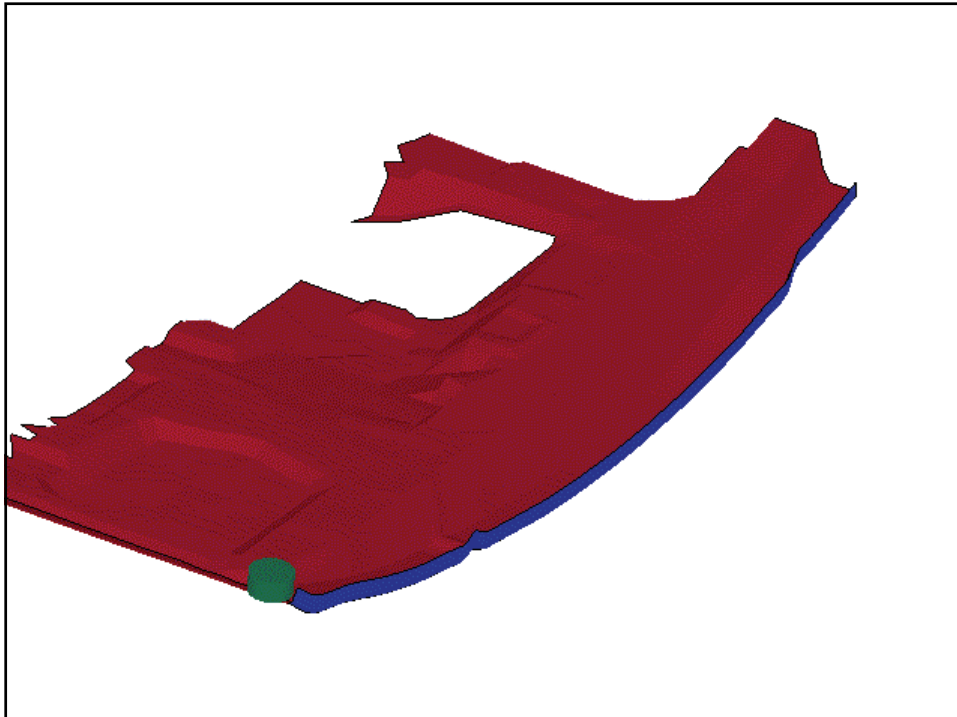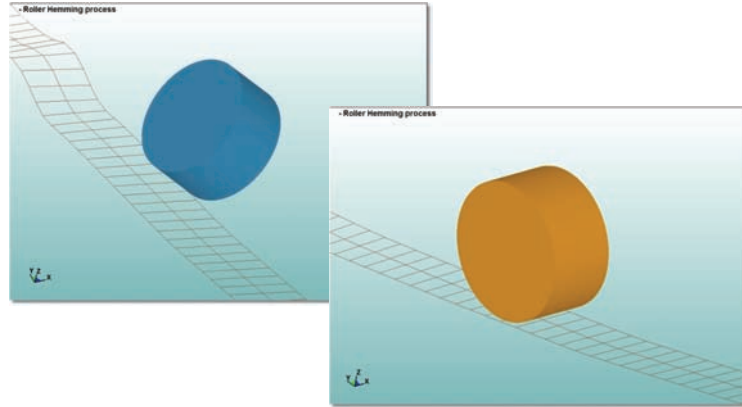

Roller Hemming interface

Roller Hemming example

Inner

~90°

Flange

Outer

Anvil (hem bed)

Roller1

~45°
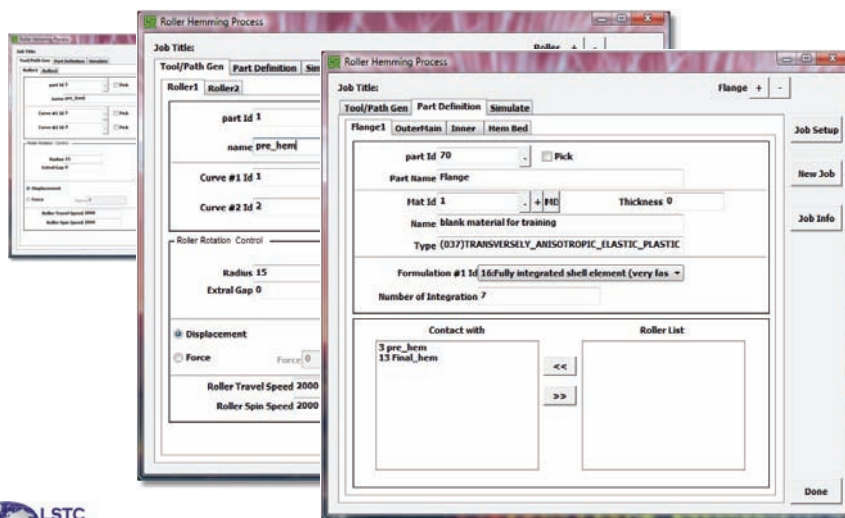
Roller2

Roller Hemming example

- Roller Hemming process

Roller Hemming example

47

LSPrepost3.0 ALE module

- Designed to greatly facilitate the ALE/FSI model buildup process.
- Guides users through different aspects of ALE/FSI model setup
- Embedded checking to eliminate input file errors.
- Interactive tool to generate the initial volume fractions for immediate onscreen display.
- It is a powerful preprocessing tool to build LS-DYNA ALE/FSI applications

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1. Outline of ALE application

- Input
  model with mesh
  (Material, Eos and Hourglass Optional)
- Output (LS-DYNA ALE input deck)
  Model mesh file
  Model volume fraction file (if with volume filling)
  ALE input deck main file which includes mesh file and volume fraction file
- Define
  Group/Mat
  Simulation Control
  Volume
  Initial Condition and Boundary Condition
  Mesh Motion
  FSI (Fluid-structure interaction)
- Interactive tools
  Select parts, elements, nodes, and segments, from id list or from graphics
  Input keyword data by forms
  Define and view volume geometry
  Create volume fractions and preview fluid parts on screen after volume geometry is defined
  Automatic data checking such as group/mat, ALE mesh parts and all defined data

2. Simple ALE model

We start with the following setup as shown in the figure below. There are three parts with each part modeling an ALE material, respectively.

2.1 Model description

ALE Multi-Material Group	Material Properties specified	Mesh
AMMG 1: Water	Part 10 (NULL+GRUNEISEN)	Part 10
AMMG 2: HE	Part 11 (HE_BURN+JWL)	Part 11
AMMG 3: Air	Part 12 (NULL+LIN_POL)	Part 12
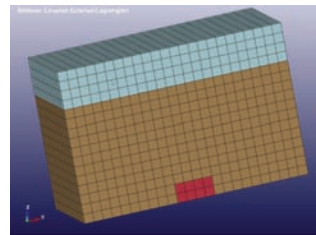
2. Simple ALE model

2.2 Define Group, Mat
Water, High Explosive, Air
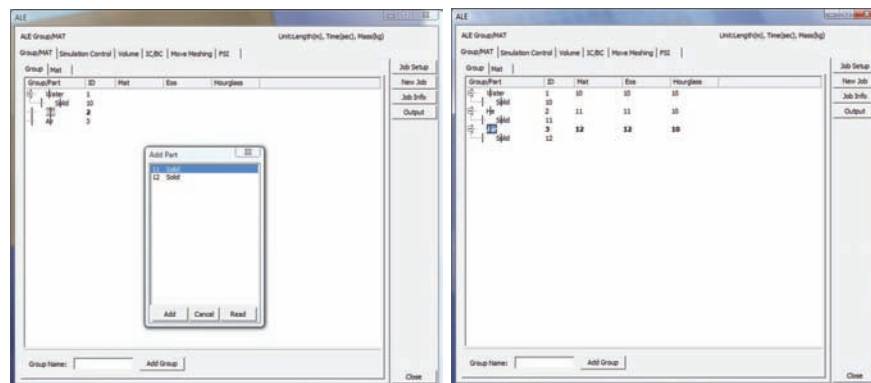
2. Simple ALE model

2.3 Simulation Control
termination time, number of states output

2. Simple ALE model

2.4 Define Initial Condition and Boundary Condition
Initial Detonation
all ALE mesh parts for detonation
Boundary SPC

2. Simple ALE model

2.5 Output DYNA input deck files
Model mesh file
ALE input deck main file which includes mesh file

ALE Output

Model File:	ls_ale_model
Volume Fraction File:	ls_ale_vfr.k
ALE File:	ls_ale.k
Dyna Version:	V971
CPU Number:	1
Master Folder:	E:\test\ale\test1	Browse
Sub-Folder:	ls_ale

Output Dyna   Cancel

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3. Initial Volume Filling

Instead of specifying each ALE material a mesh part, we define one mesh part for the whole ALE domain. And then by using the initial volume filling technique, we fill in the ALE materials.
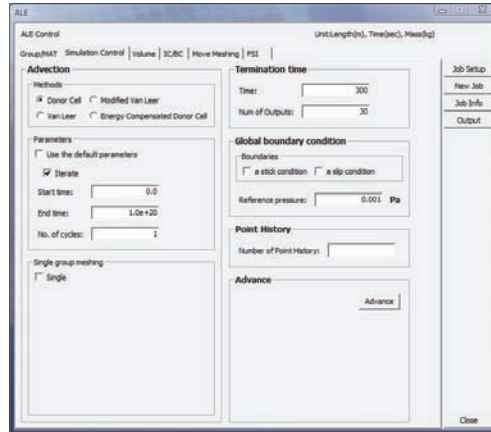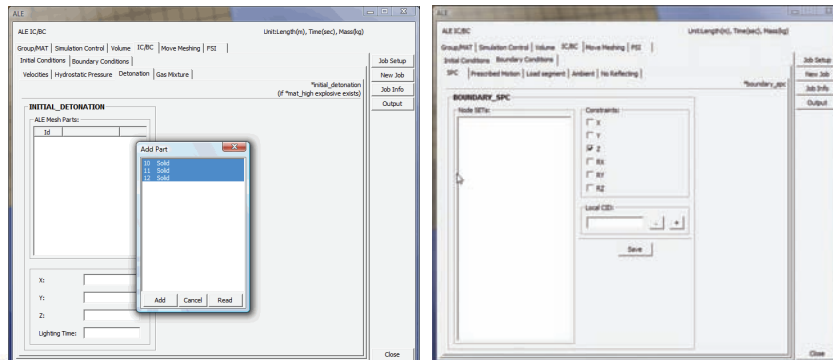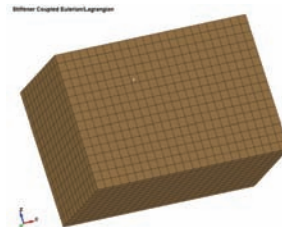
3.1 Model description

ALE Multi-Material Group	Material Properties specified	Mesh
AMMG 1: Water	Part 10 (NULL+GRUNEISEN)	Part 10
AMMG 2: HE	Part 11 (HE_BURN+JWL)	
AMMG 3: Air	Part 12 (NULL+LIN_POL)	

3.2 Group, Mat
Simulation Control and IC/BC
Initial Detonation
Boundary SPC
3.3 Define Volume
Volume Geometry
Sphere fill in the HE
Change the water (AMMG 1) to He (AMMG 2)
Plane fill in the air
Change the water (AMMG 1) to Air (AMMG 3)
Create volume fraction and Preview fluid parts
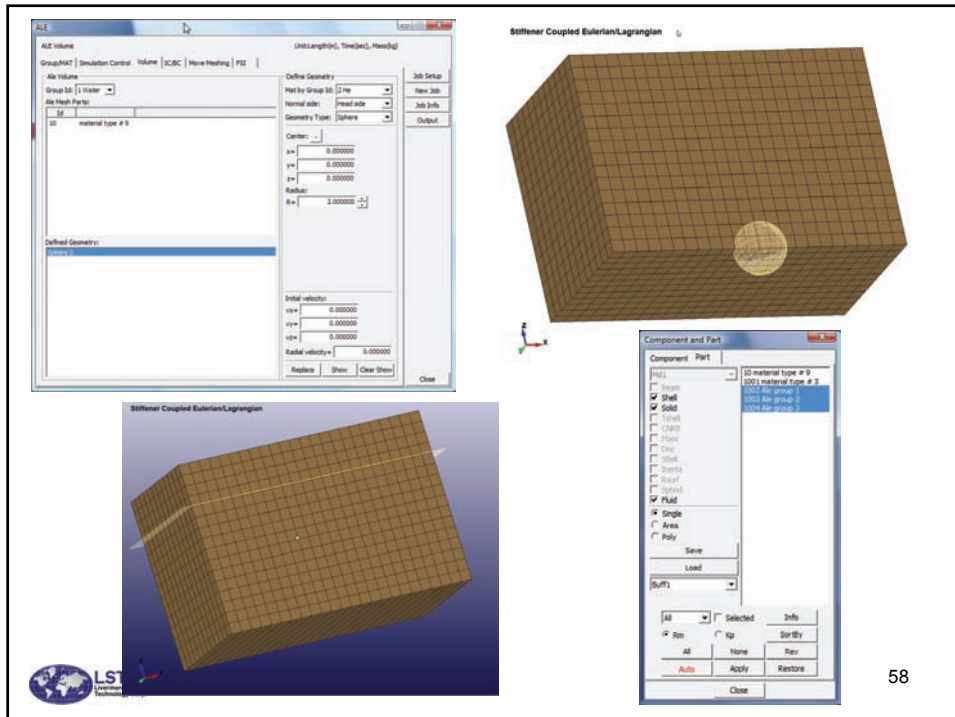
3.4 Output DYNA input deck files

Model mesh file
Model volume fraction file
ALE input deck main file which includes mesh file and volume
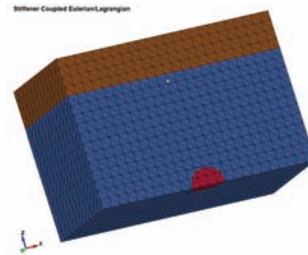fraction file

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4. ALE/FSI Model

In this model setup, we are going to add mesh motion
and Fluid Structure Interaction (FSI)

4.1 Model description

Material Definitions	*MAT	*EOS
Air	*MAT_NULL	*EOS_LINEAR_POLYNOMIAL
Water	*MAT_NULL	*EOS_GRUNEISEN
HE	*MAT_HIGH_EXPLOSIVE_BURN	*EOS_JWL
Steel	*MAT_PLASTIC_KINEMATIC	

4.4 Define Mesh Motion
a delayed mesh motion with a scale factor of 0.05 to make the mesh motion follow the shock wave as much as possible
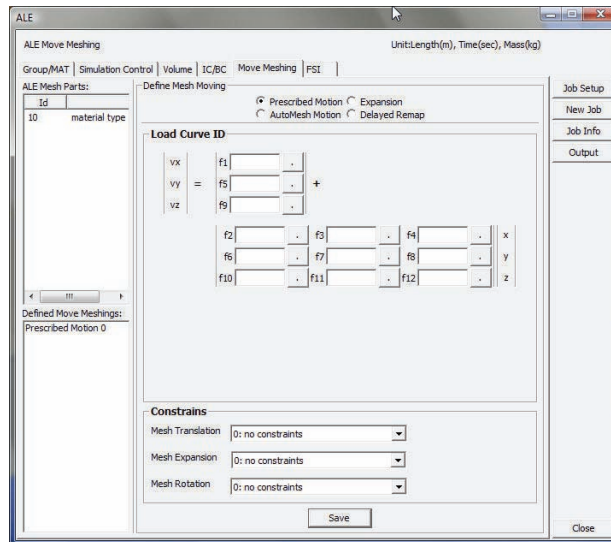
61

Outlook

- LS-PrePost 3.0 establishes a foundation with new graphical user interface that gives a modern look and feel
- Geometry engine will help building model and gives better mashing capability
- New applications can be easily added in the future
- Only Windows and Linux platforms will be supported

62