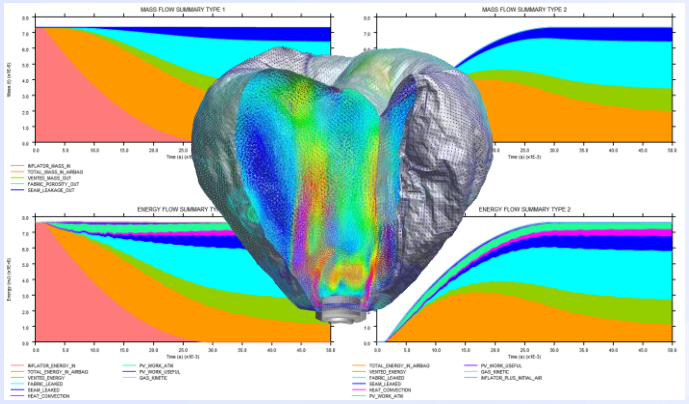
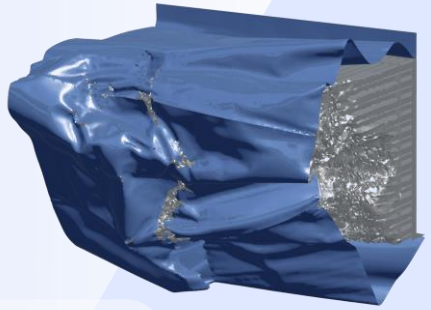
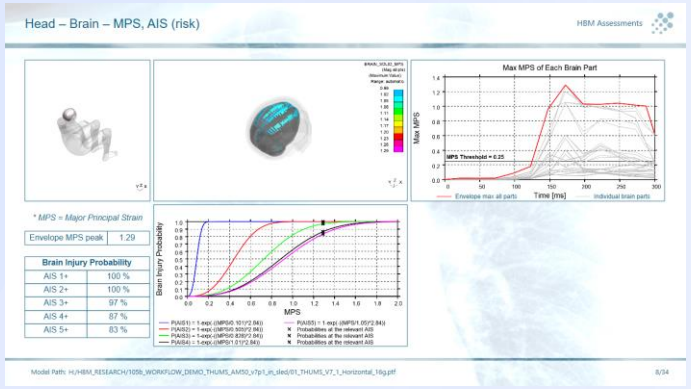
PRIMER 23.0

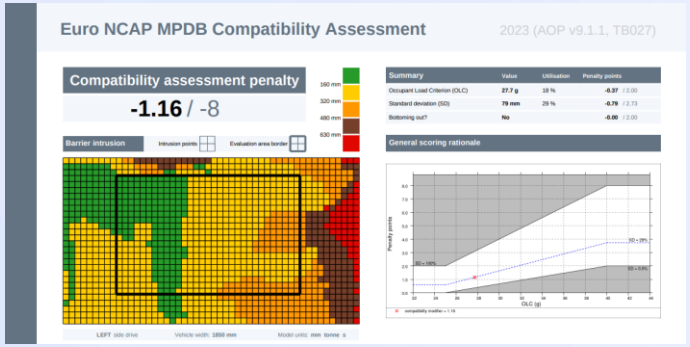
Oasys
LS-DYNA Environment

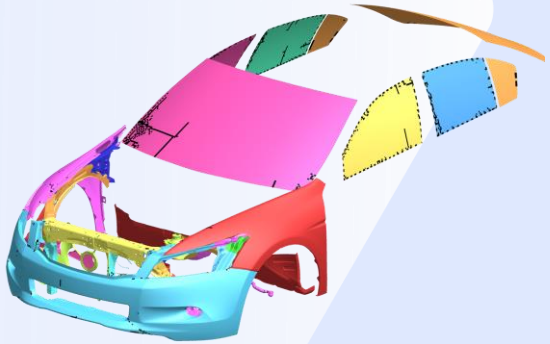
PRIMER 23.0 – Contents





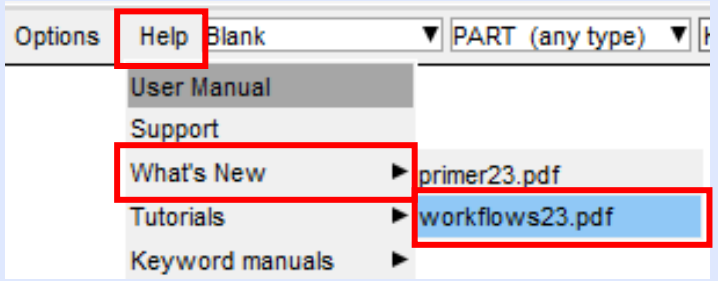






Workflows

- Workflows now has its own dedicated New Features document, which you can find in the Help menu of each program and on the Download pages of our website.
- Workflows 23 includes:
  - New Airbag Toolbox
  - New HBM Assessments
  - New Utilisation Workflows
  - Upgraded MPDB Compatibility Assessment
  - Expanded automotive protocol support
  - The latest Virtual Testing solutions

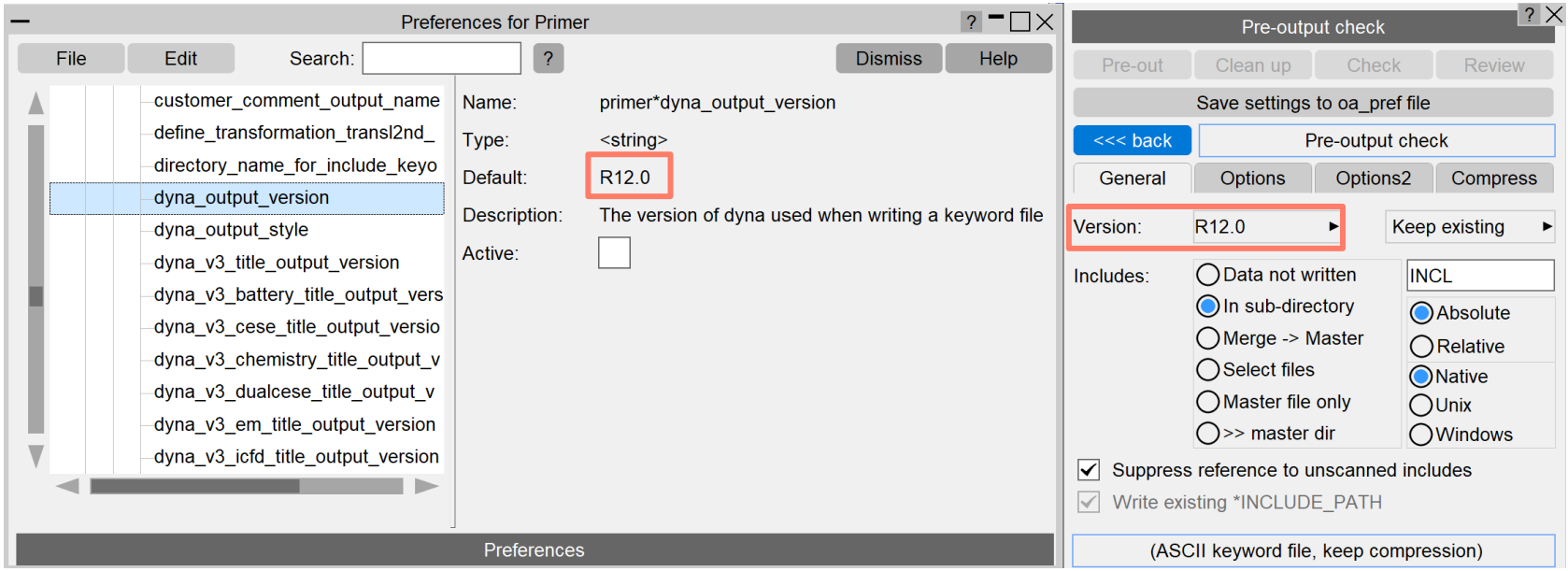



Complete LS-DYNA Support

Keyword support including *AIRBAG_CPG

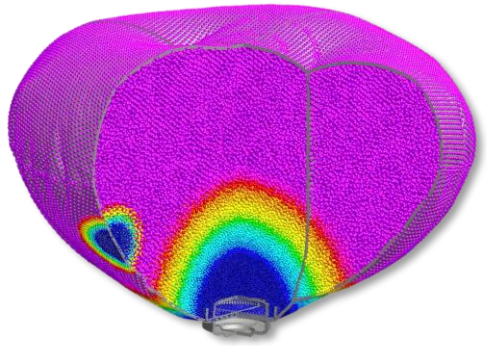
LS-DYNA Keyword Support

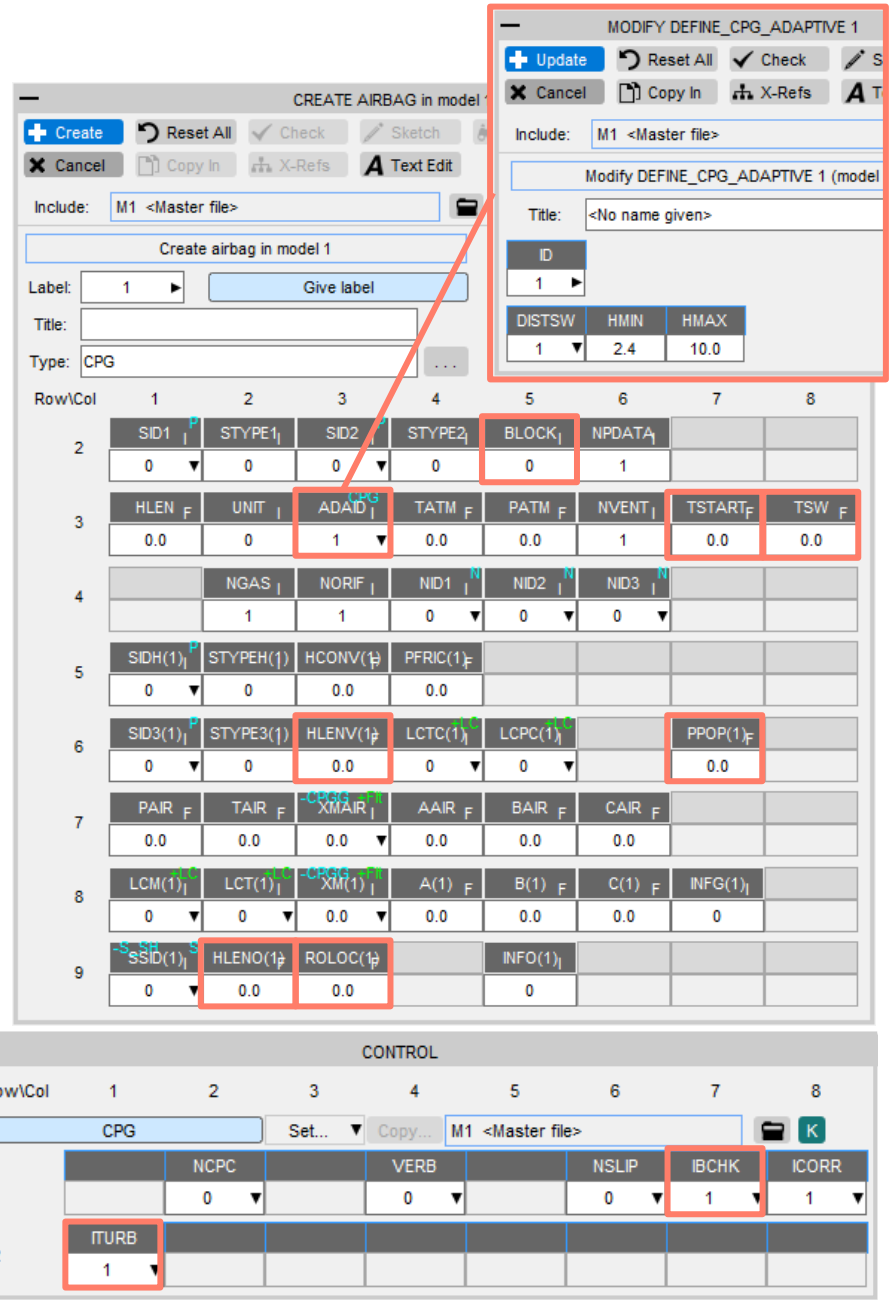
- LS-DYNA keywords up to and including R16.0 fully supported.
  - Includes all updates to isogeometric analysis keywords, ***IGA**, supporting increased industry adoption.
  - Includes previously unsupported incompressible smooth particle Galerkin keywords, ***ISPG**.
- Some LS-DYNA R17.0 additions and modifications supported.
- Default output version updated from R11.0 to R12.0.
  - Aligns with Ansys policy of extended support for even numbered versions.
  - Later versions including R17.0 can be selected.



Support for ***AIRBAG_CPG**

- Full support continues for the new CFD solver, Continuum Particle Gas (CPG), specialised for airbag gas dynamics.
- Support for the following fields has been added:
  - BLOCK: reduces venting and fabric porous leakage from contact
  - ADAID: references the new ***DEFINE_CPG_ADAPTIVE** keyword which transitions from a small particle distance at the wall to a larger distance at the centre of the airbag
  - TSTART: birth time for the CPG solver
  - TSW: time to switch to the CV method
  - HLENV: local particle distance around vents
  - PPOP: local pressure threshold before vent opens
  - HLENO: local particle distance around orifice
  - ROLOC: user-defined radius for local orifice refinement
- In ***CONTROL_CPG**:
  - IBCHK: activate mesh integrity check
  - ITURB: activate a standard $k-\varepsilon$ turbulence

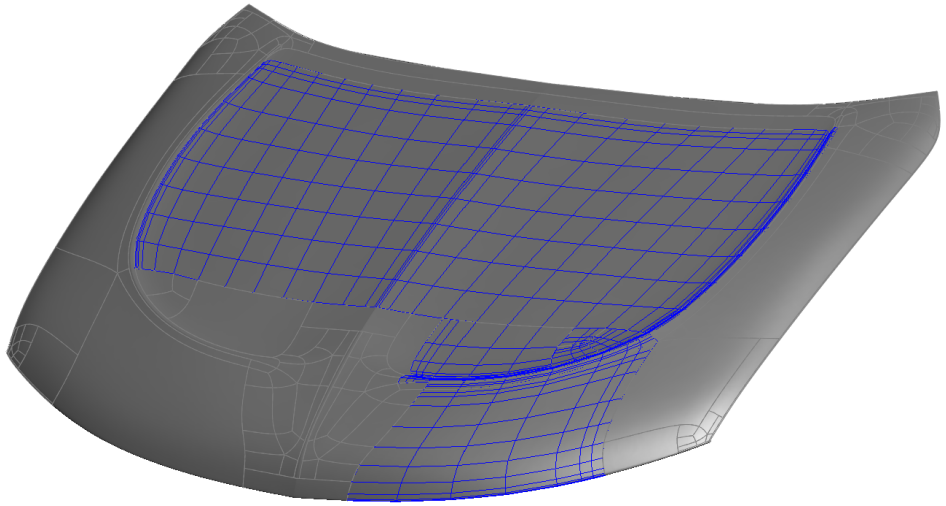




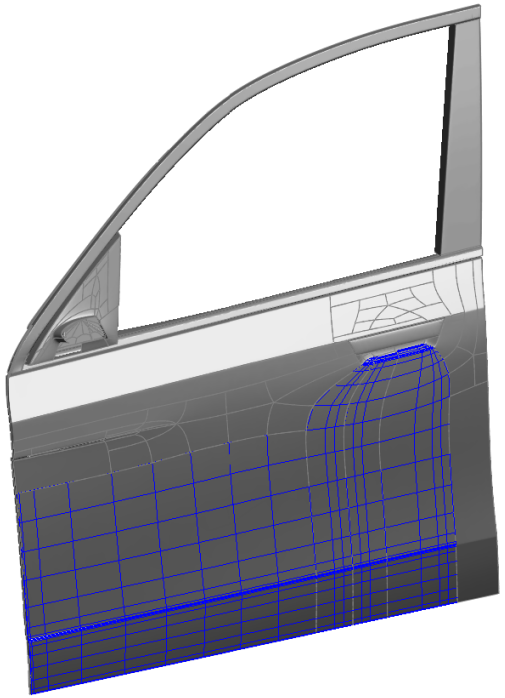
Isogeometric Analysis (IGA)

*IGA Improvements

- *IGA keywords act as a CAD type counterpart to traditional FE models.
  - No need for meshing CAD geometry.
  - Faster, more accurate results.



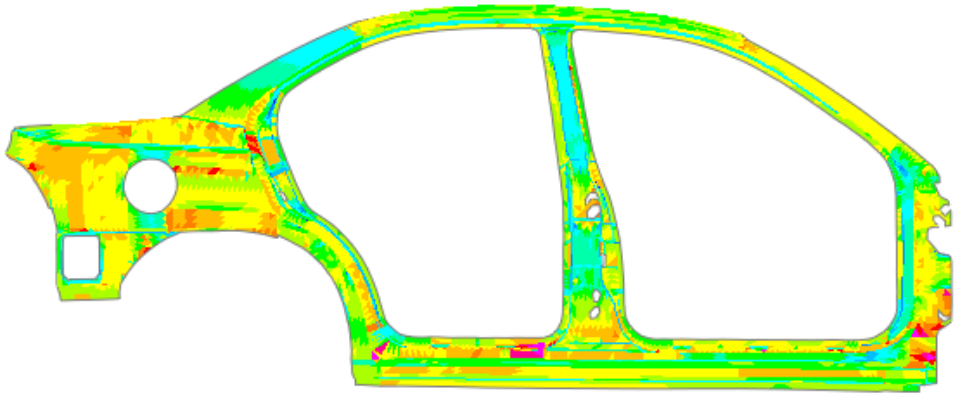
- IGA Improvements in PRIMER 23.0 include:
- Picking FACE_XYZs
  - Support for ***IGA_FACE_XYZ**s
  - Support for ***SET_IGA_FACE_XYZ**s
  - Makes load and boundary conditions setup easier
- Correct drawing of 1D_BREPs
  - Accurate visualization of ***IGA_1D_BREP**s
  - Better geometry interpretation during model setup



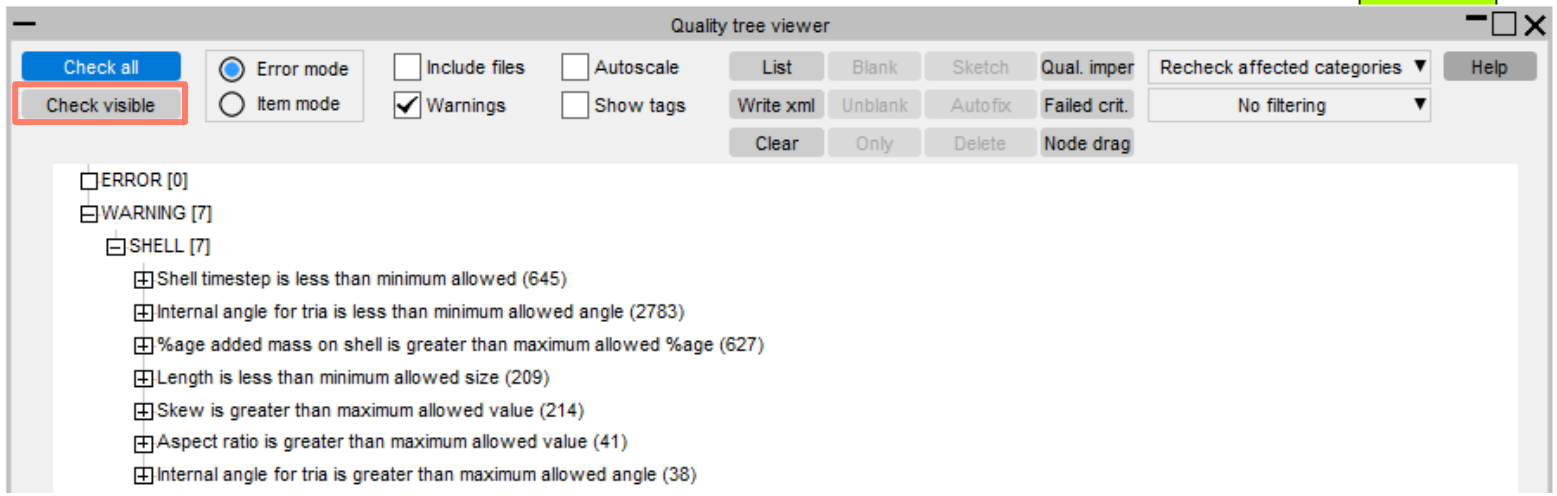
Checking

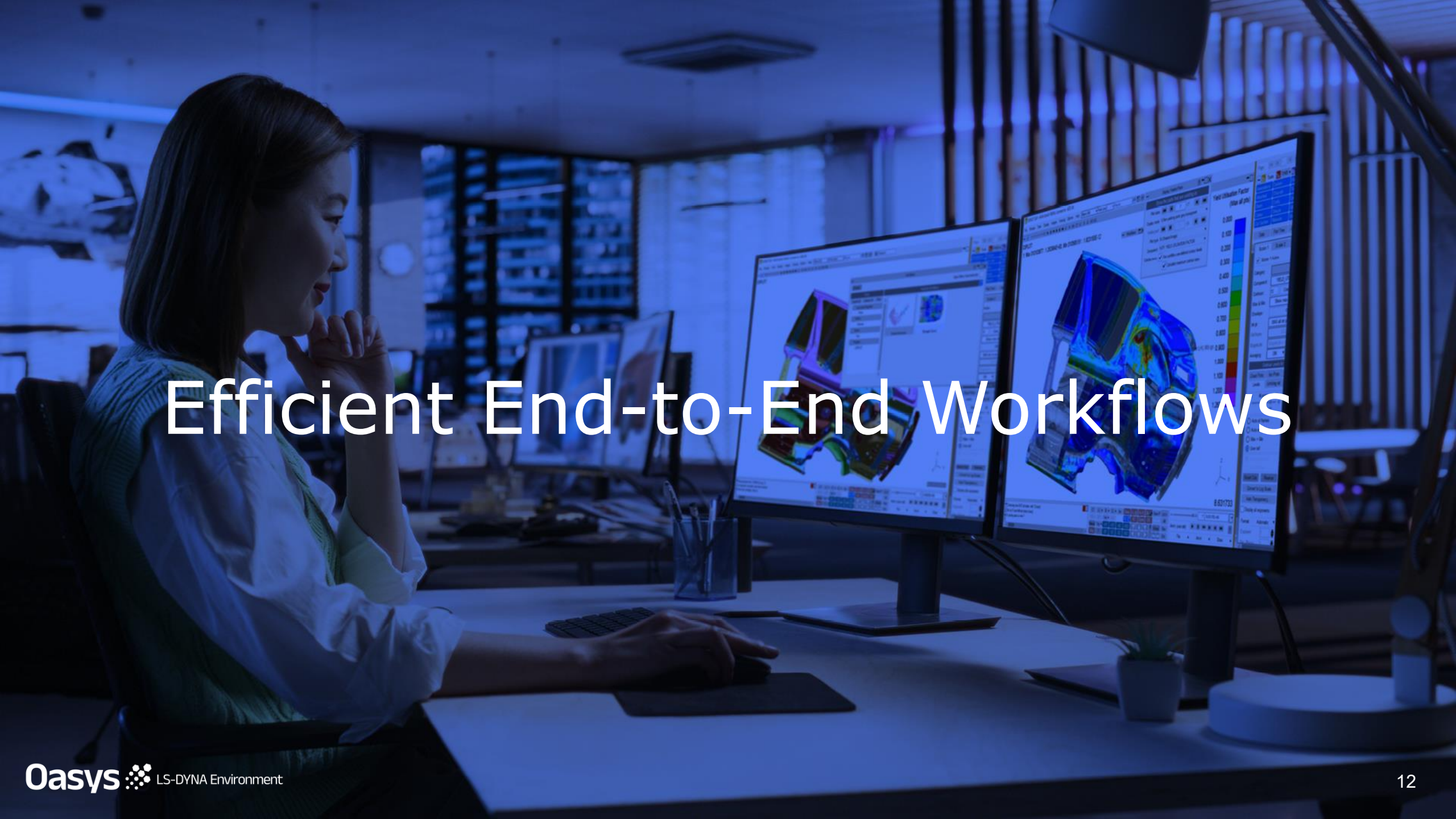
Element Quality Check - Visible only

- When performing an element quality check, it is now possible to check only the visible elements of the model:
  - Faster
  - Helps you focus on the specific area of the model you are interested in



- The top area of the check panel has been re-designed to be more user friendly.

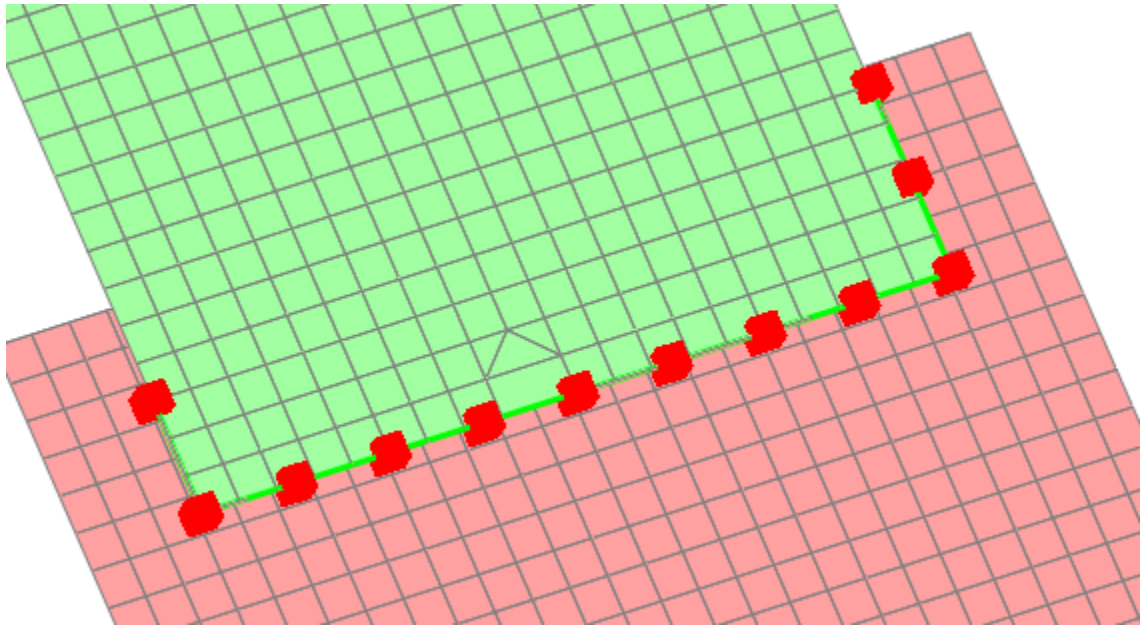


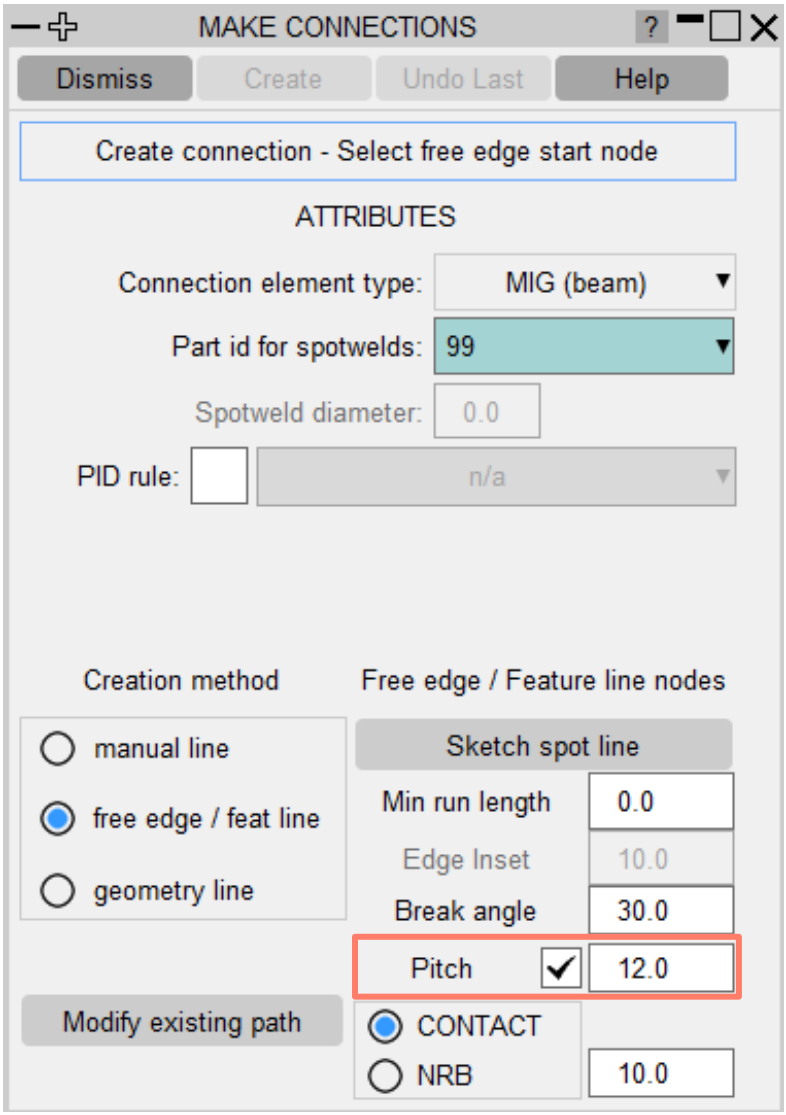

Efficient End-to-End Workflows

Connections Enhancements

MIG weld pitch control

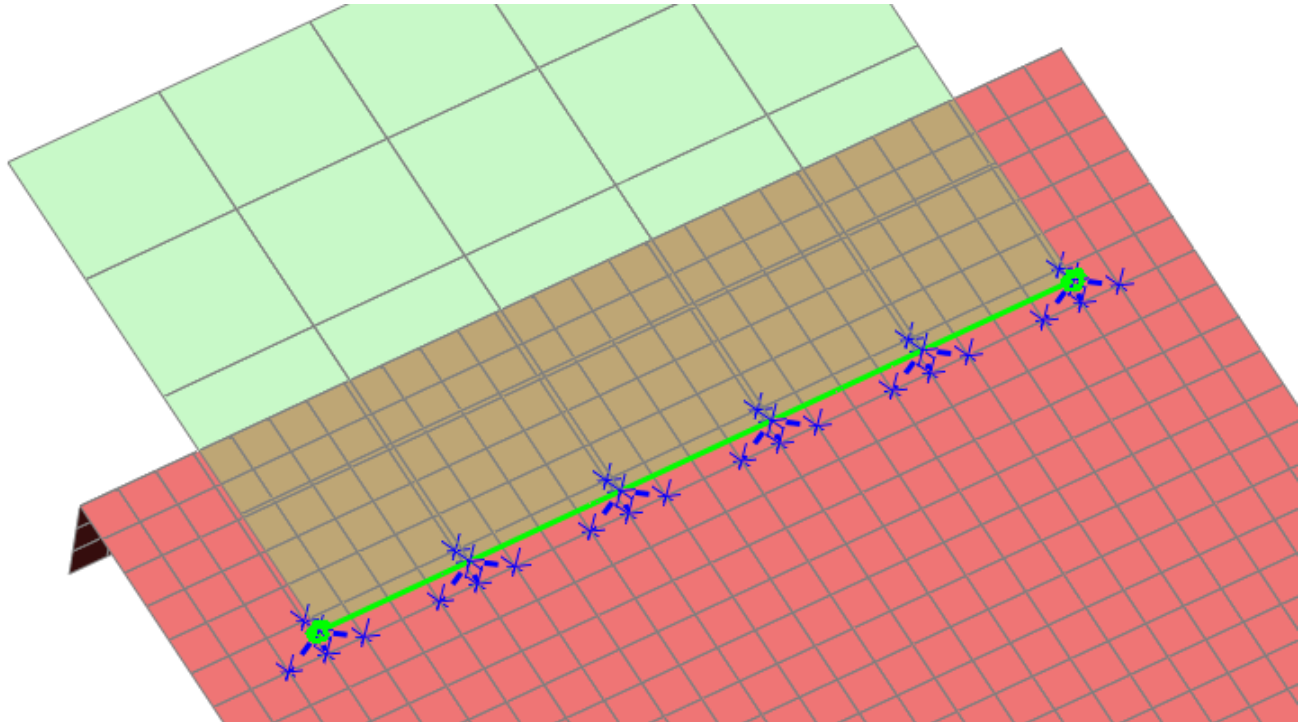
- Previously MIG weld beams meshed to nodes on the source side. Nodes on target side attached by tied contact.
- Now beams nodes on the source side can also be attached by a tied contact making MIG welds mesh independent.
- New option to set pitch.
- Pitch automatically adjusts to weld at corners.

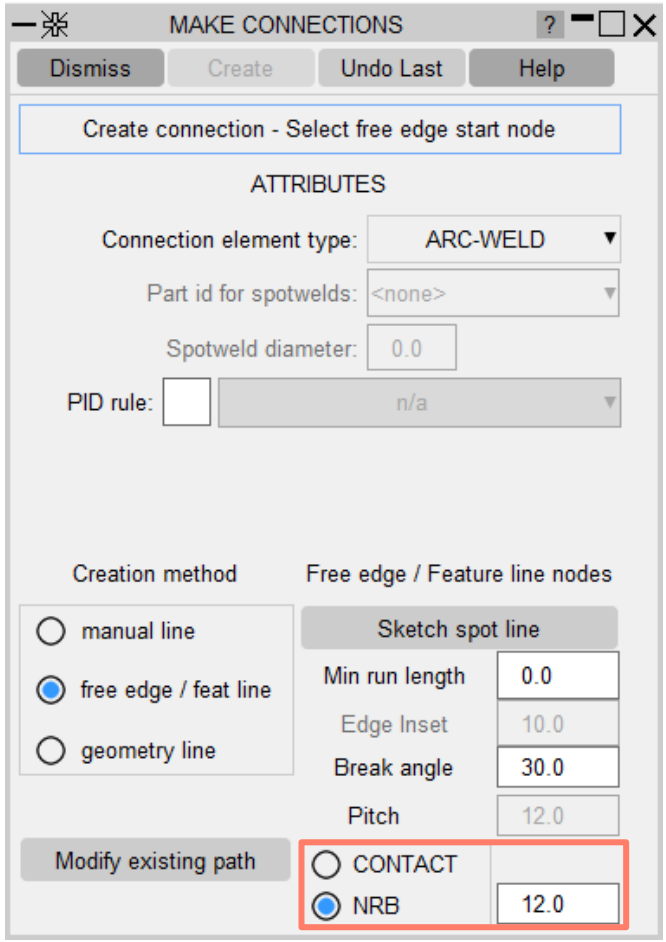


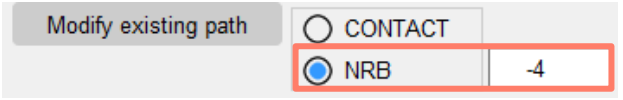


Contact/NRB method for ARC weld

- ARC weld can be made by Contact or NRB.
- For NRB target nodes can be controlled by:
  - Diam > 0 - search distance from source node
  - Diam < 0 - #closest nodes attached
    e.g. input -4 for four target nodes in the below example





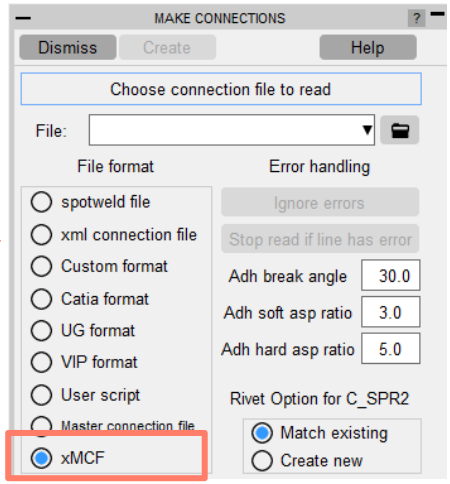


χMCF support

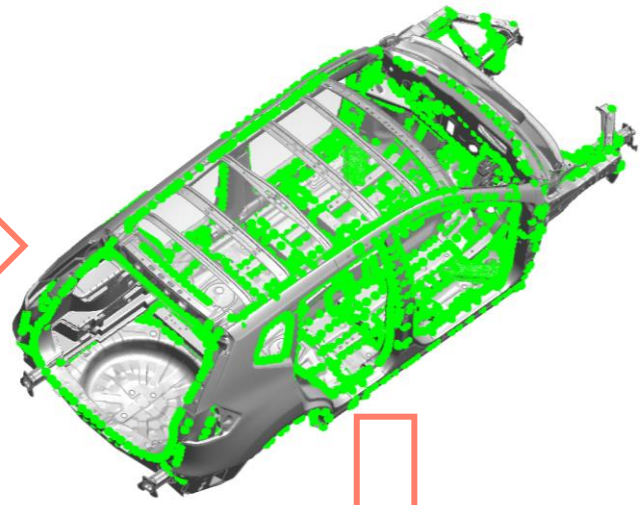
- χMCF (Extended Master Connection File) is a comprehensive standard aimed at describing the major attributes of a connection in a neutral way to allow a seamless data flow from CAD creation, through optimisation, and finally to manufacturing control.
- χMCF has grown into a cross-functional standard that can support the definition and automated virtual builds of full vehicle assemblies.
- Several OEMs and suppliers have adopted the χMCF format for connection data representation.
- PRIMER 23.0 introduces read and write functionality for this format thus improving client processes and ensuring more robust data transfer to and from other programs that support this format.

χMCF support - standalone χMCF connection files

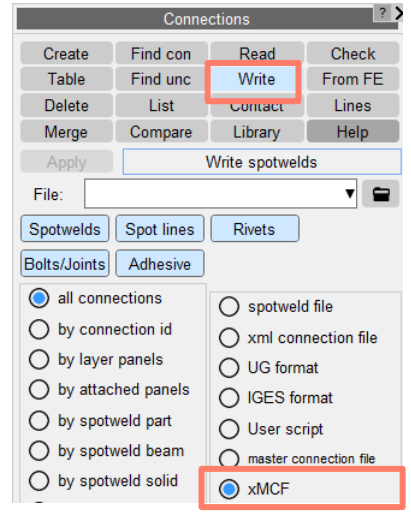
- Connection recipes can now be read into PRIMER from external χMCF files.



Input χMCF



- PRIMER connections can now also be written to stand-alone χMCF files.



Output χMCF

χMCF support - embedded χMCF connection data

- Some software can also embed connection information as post-*END data in the χMCF format.
- PRIMER 23.0 can read this information during model keyin and set up relevant connections automatically.
- In the case of embedded χMCF data, the relevant FE data is expected to be present in the model and PRIMER establishes the link between the connection and the extant FE entities.

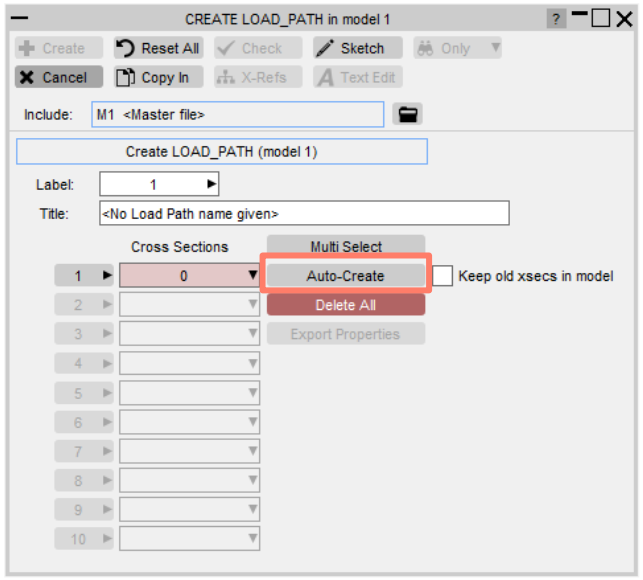
```
$$<xmcf xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
$$    <version>3.1.0</version>
$$    <date> 2025-06-10 </date>
$$    <connection_group id="1">
$$     <connected_to>
$$     </connected_to>
$$     <connection_list>
$$      <connection_0d>
$$       <bolt>

 ...

$$</xmcf>
```

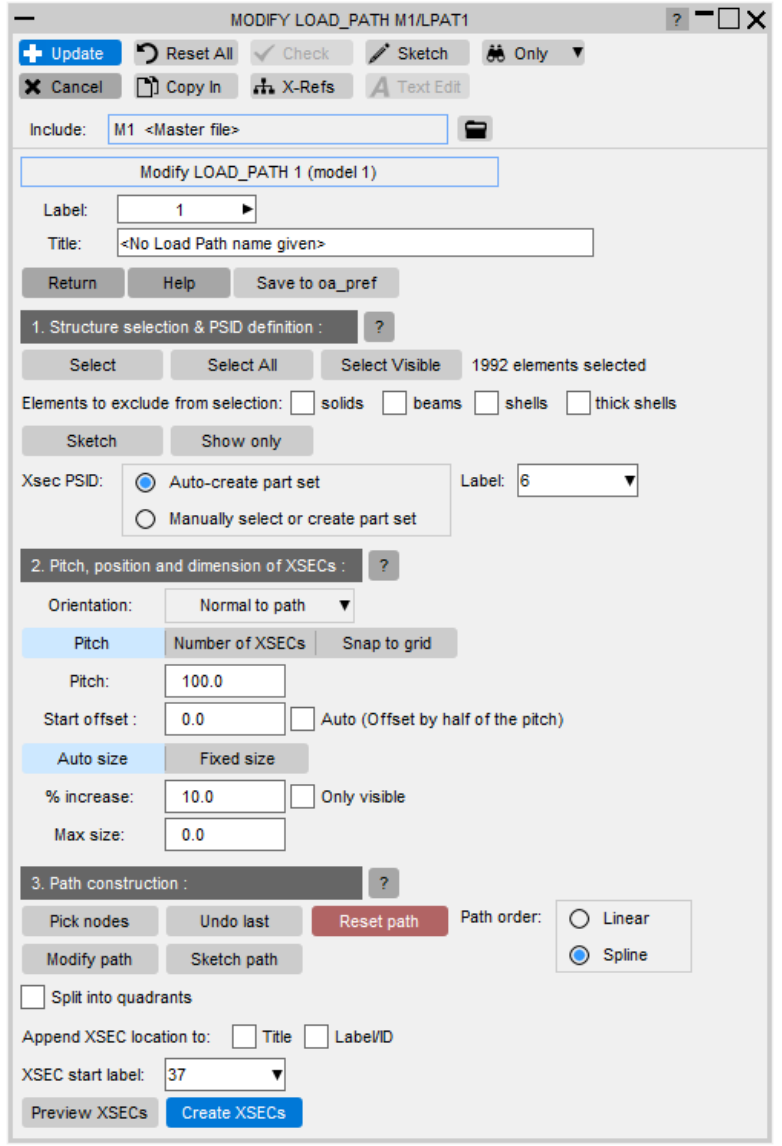
- The ability to read, interpret, preserve and write χMCF data improves interoperability between preprocessing software.

Load Path Tool Enhancements

Load path tool "Auto-create" feature

- The Load path "Auto-create" feature was introduced in PRIMER 22.0.
- It enables the automatic creation of multiple cross sections across a desired structure via:
  - Selecting the desired structure and the PSID to be referenced by the ***DATABASE_CROSS_SECTION**s
  - Defining the pitch, position and dimensions of the cross sections
  - Defining a path at the desired structure by picking nodes.

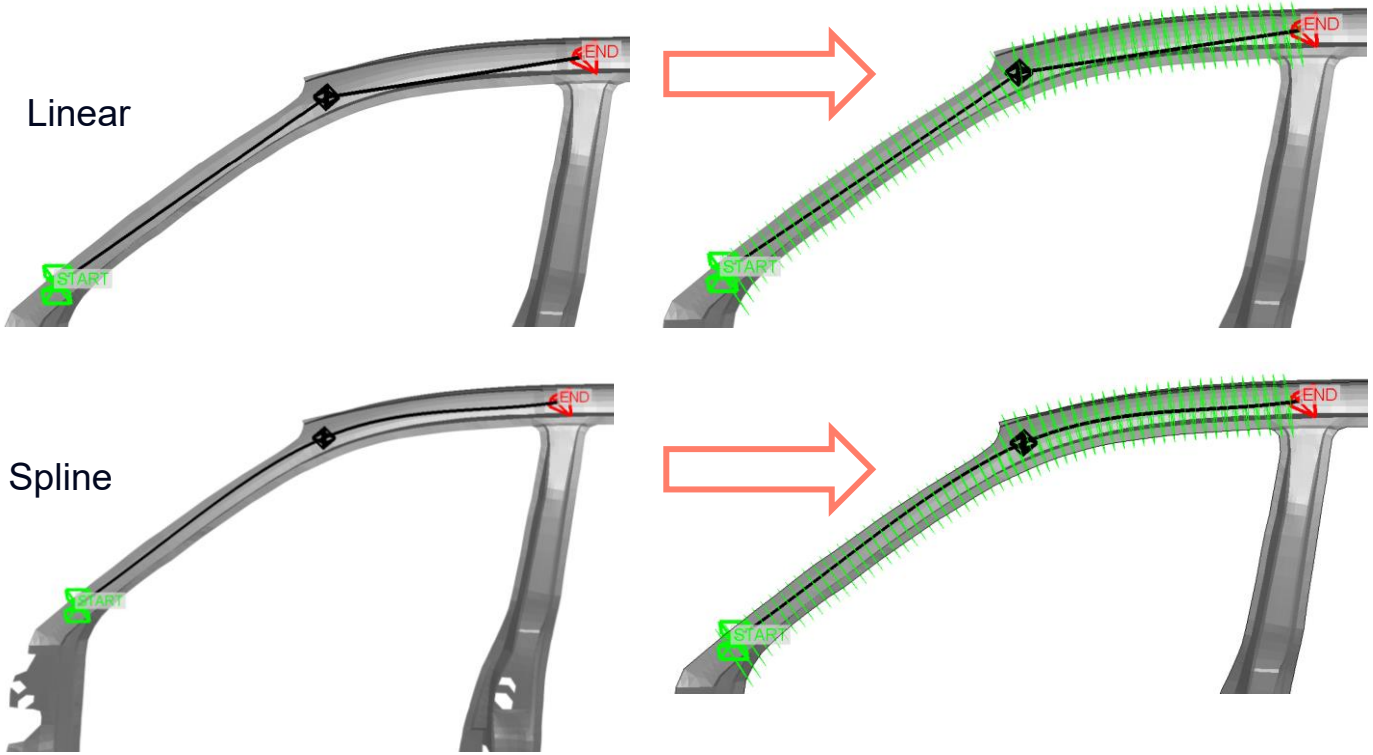


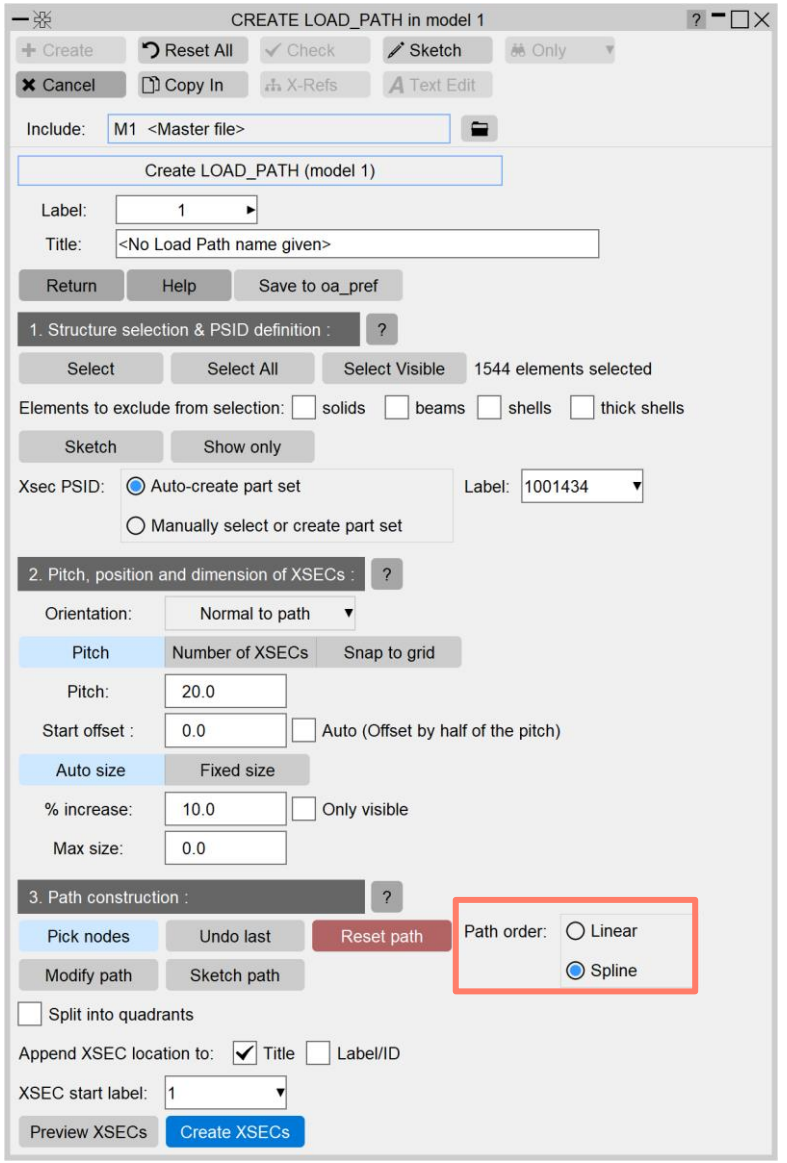


- It has been improved in PRIMER 23.0 to offer enhanced capabilities.

Path construction based on Spline order

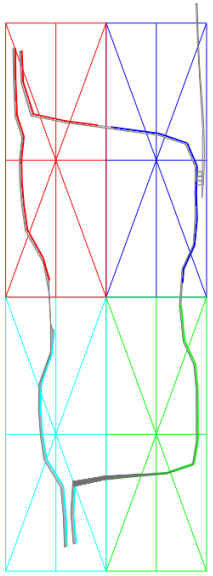
- PRIMER now supports generating cross-sections along spline-defined paths, rather than only along linear node-to-node segments.
- Cross-section placement and orientation are calculated based on arc length, allowing more accurate representation of curved load paths.

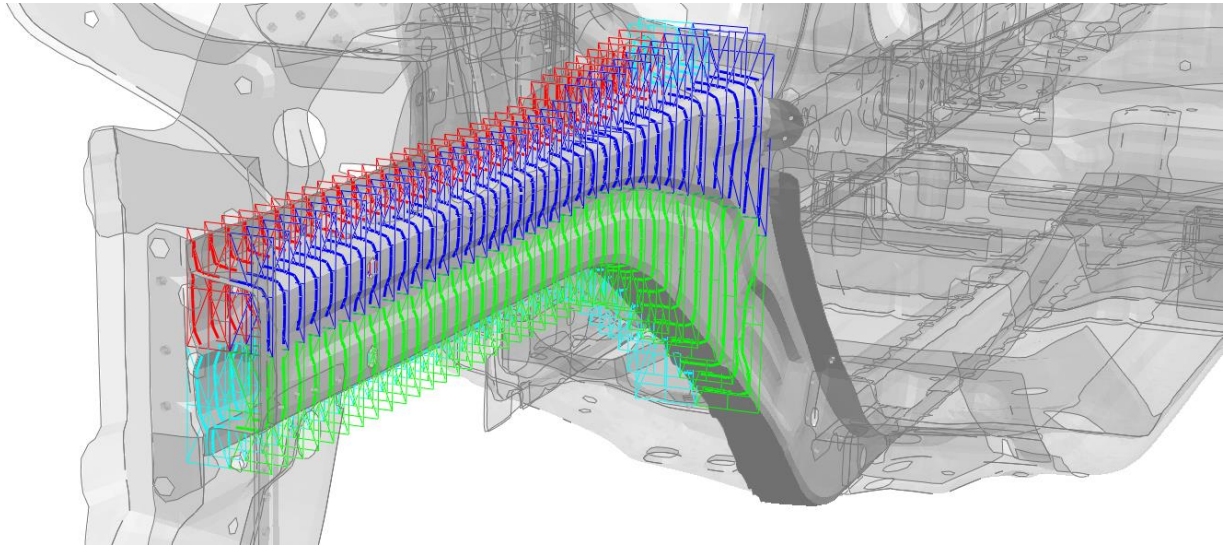


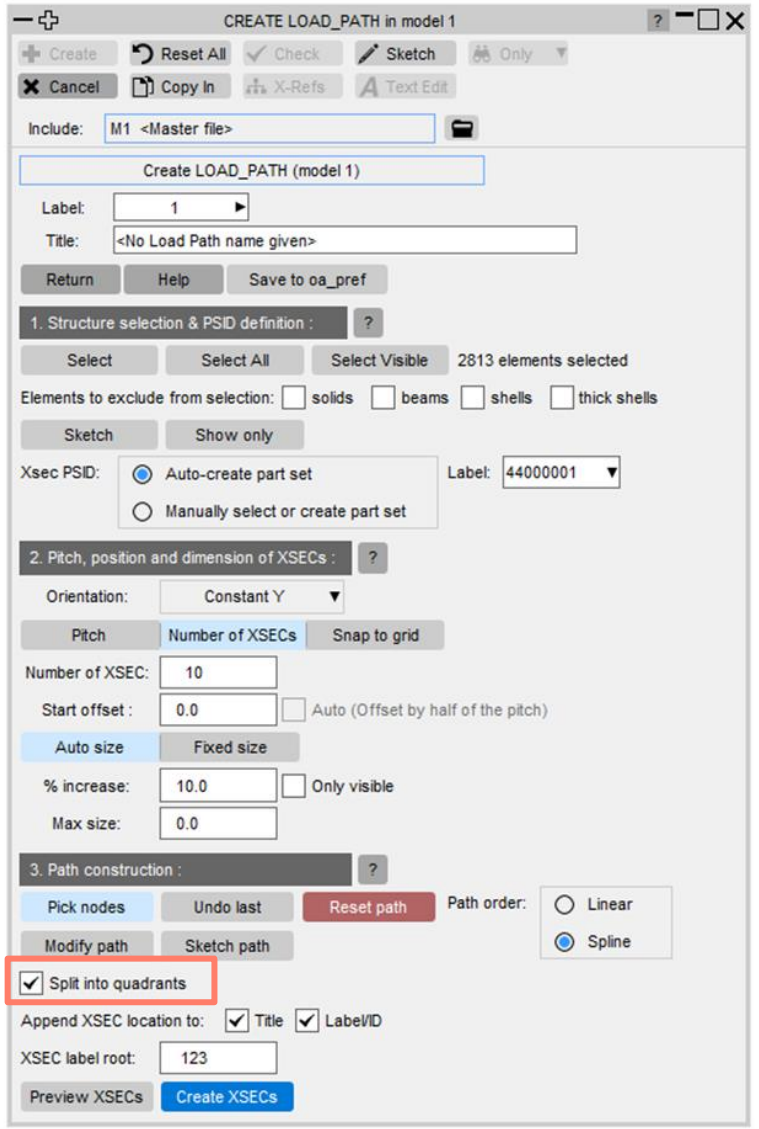


Split XSECs into quadrants

- When the 'Split into quadrants' option is enabled, PRIMER subdivides each generated cross-section plane into four quadrants, creating four independent ***DATABASE_CROSS_SECTION** entries per location, giving more insight into loads travelling through the structure.
- Quadrant definition is based on the plane geometry rather than the structural cut, with automatic updates to titles and IDs to reflect quadrant numbering, when applicable.

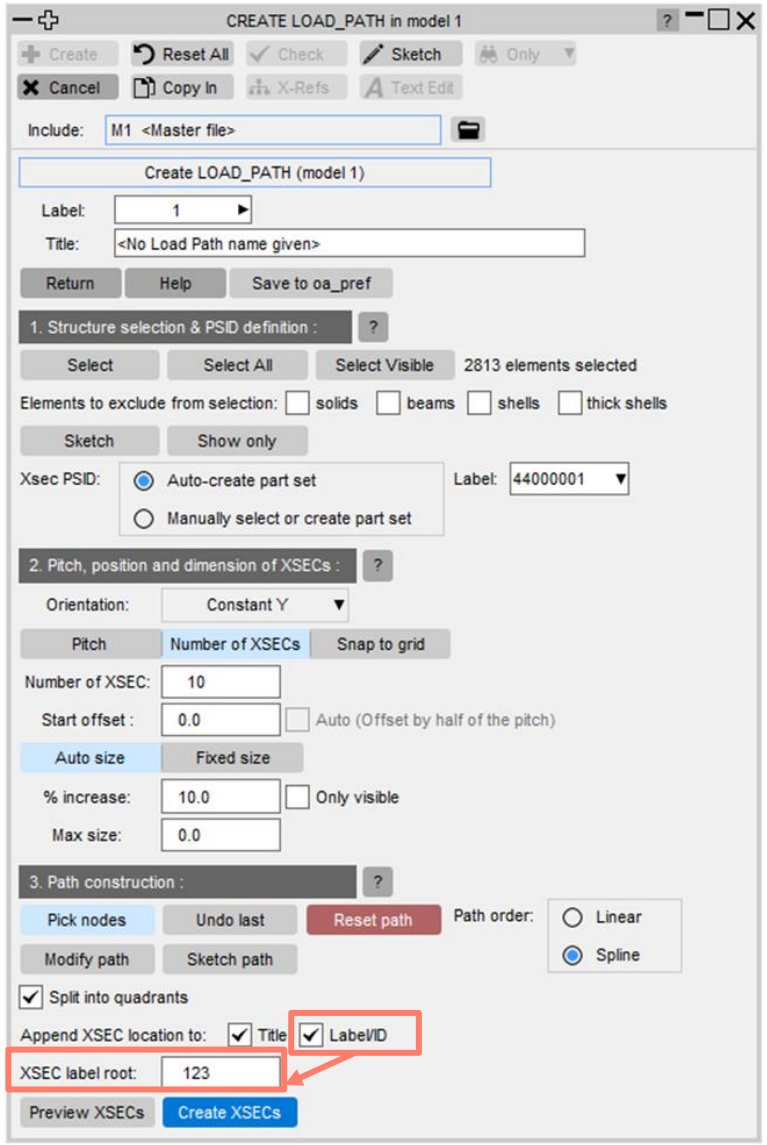






Append XSEC location to Label/ID option

- If this option is selected, PRIMER incorporates the location coordinates directly into the XSECs labels using the following format (with N being the maximum ID length based on the selected label format):
  - [XSEC label root (up-to N/2 digits)][Coordinate (N/2 – 1 digits)][Sign/Quadrant digit]
  - Root ID: User-defined prefix
  - Sign/Quadrant digit: Without quadrants: 0 for positive, 5 for negative coordinates. With quadrants: 1-4 for positive quadrants, 6-9 for negative quadrants
  - Coordinate: (N/2−1) digits from the thousands place down to the 10^(5−N/2) place of the coordinate magnitude value
- This label rule can help manage many 100s or 1000s of xsecs as part of an automated vehicle structural performance assessment tool.
- Examples for a XSEC label root of 1234:
  - If the XSEC centre is at x=21501.45 and 'Orientation' is set to 'Constant X', the XSEC ID will be 12341500 *(Small Format, N=8)* or 123415010 *(i10 Format, N=10)*
  - If the XSEC centre is at y=22.5 and 'Orientation' is set to 'Normal to path' with the normal vectors of the generated XSECs closely aligned with the Y axis, the XSEC ID will be 12340020 *(Small Format, N=8)* or 123400220 *(i10 Format, N=10)*
  - If the XSEC centre is at z=-406.5 and 'Orientation' is set to 'Constant Z', the XSEC ID will be 12340415 *(Small Format, N=8)* or 123404075 *(i10 Format, N=10)*

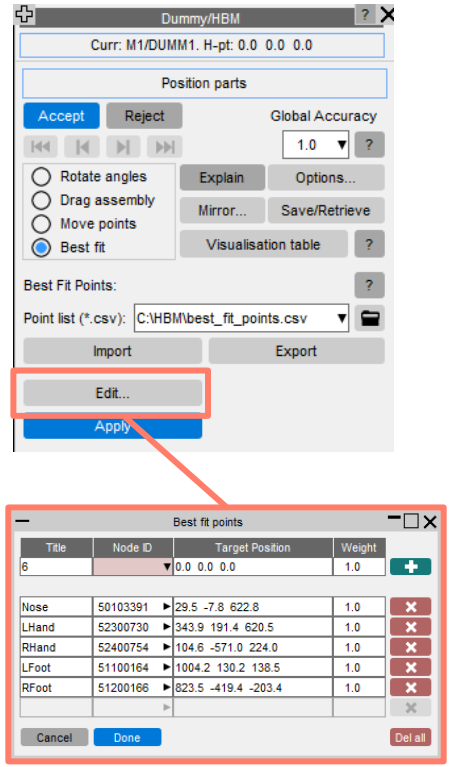


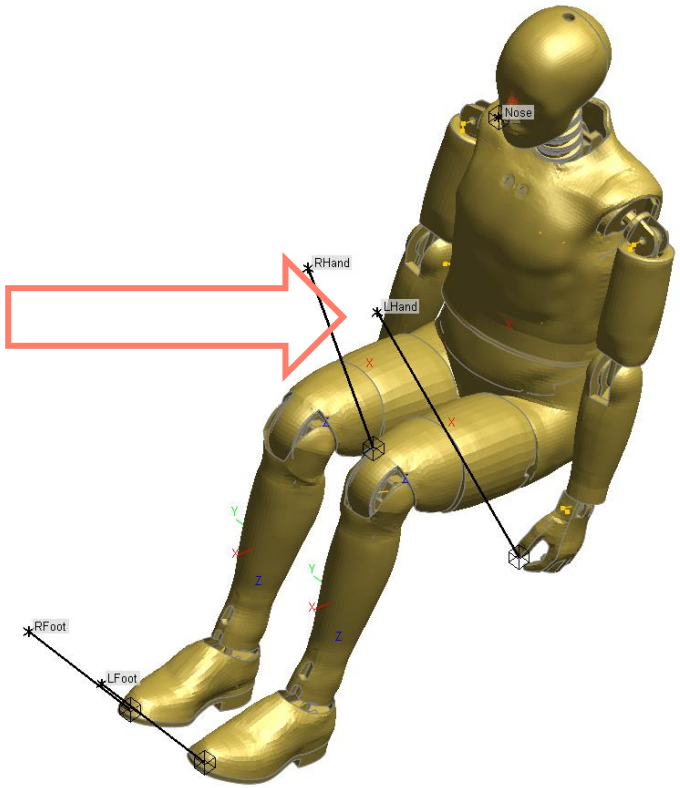

Human-Safe Design

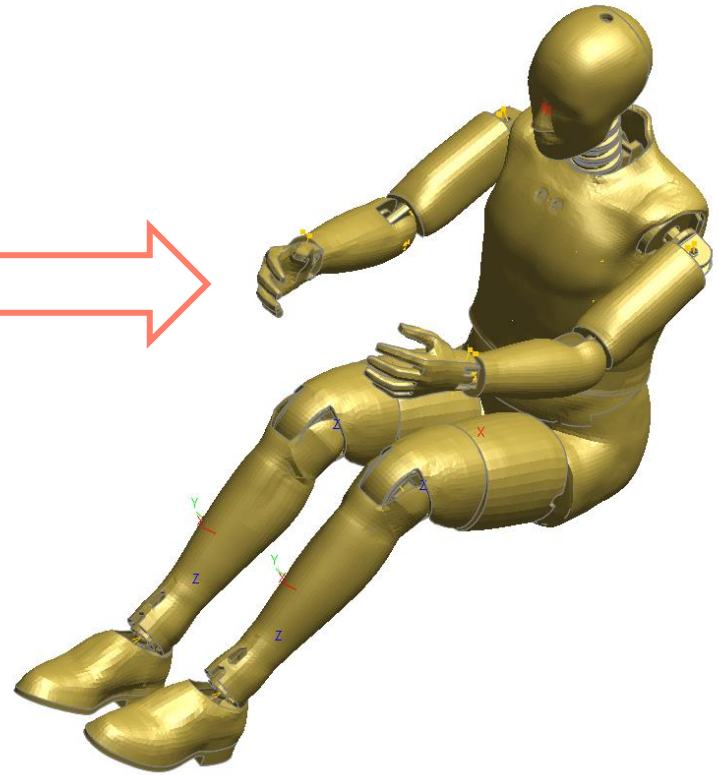
HBM/Dummy Positioning
Best Fit Points

Best fit points: Introduction

- A new dummy/HBM positioning tool is available under Safety → Dummies/HBM → Position → Move Parts.
- Best fit is a simple way to position a dummy/HBM by specifying a list of nodes on the model and their desired target points.
- The tool moves the dummy/HBM iteratively to bring the nodes closer to their target points. Iterations stop once the error is below a certain threshold, the position stops improving, or it reaches a maximum of 1000 iterations.

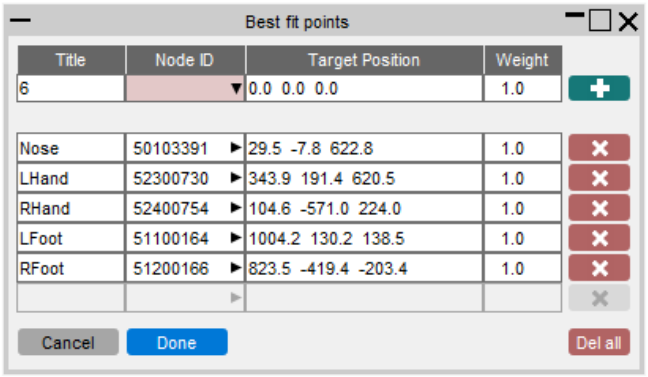




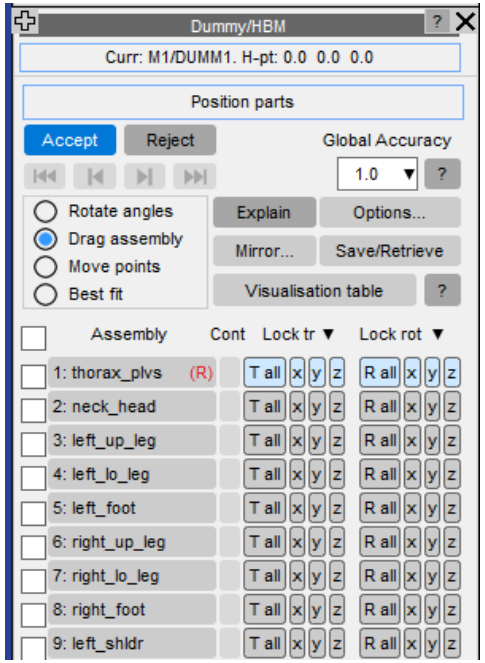


Best fit points: Input

- Input is designed to be as minimal as possible.
- Each row represents one best fit point including:
  - A title for user reference
  - Node ID of the dummy assembly node to position
  - Target position the node should reach
  - Weight used in objective function to prioritise points



- This list can be imported and exported as a CSV in the same format. Note that the first line is an optional header and will be ignored by PRIMER if detected.

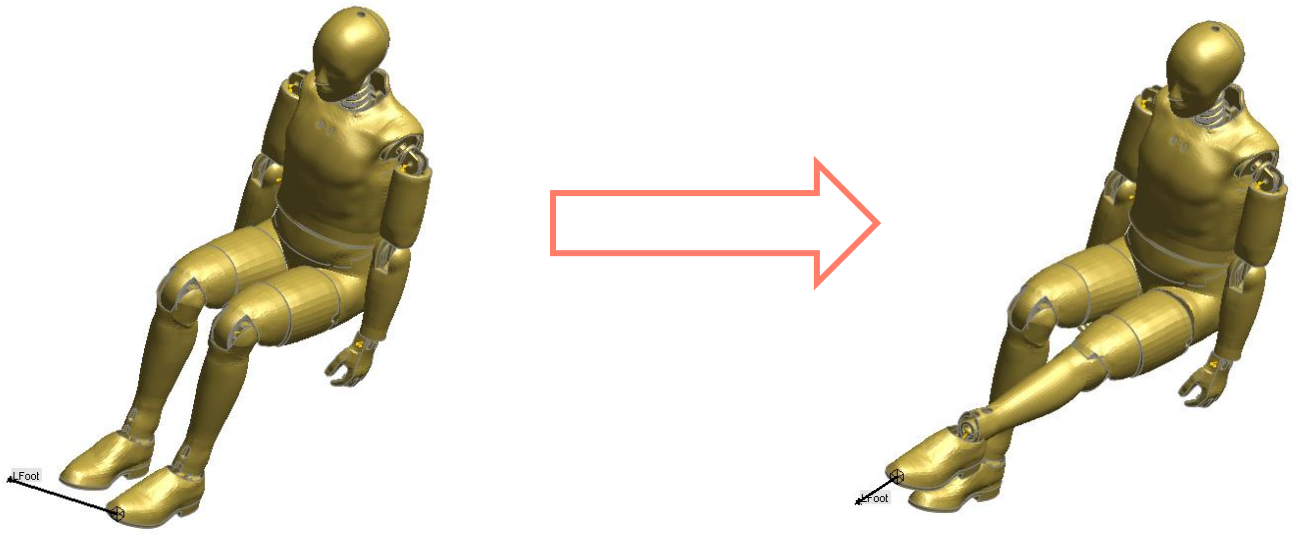


- Assembly locking information from “Drag assembly” is carried over.
- Obey soft stop angles also applies.

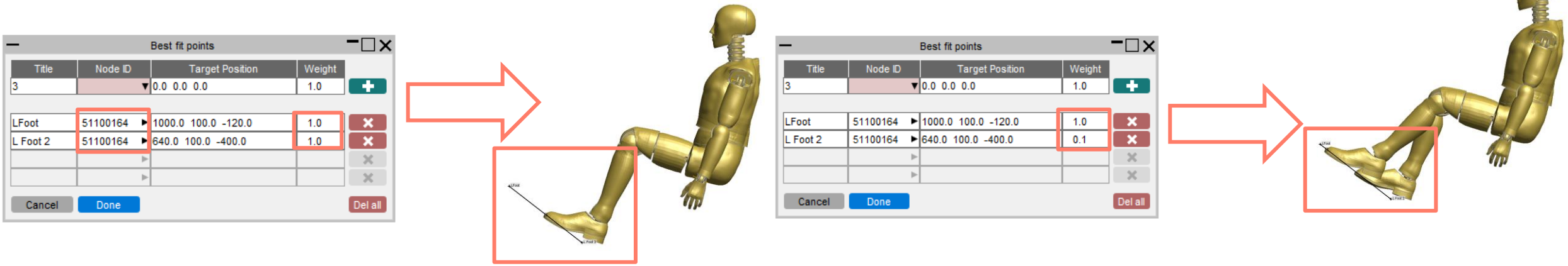
	A	B	C	D	E	F
1	Title	NodeID	X	Y	Z	Weight
2	Nose	50103391	29.5	-7.8	622.8	1
3	LHand	52300730	343.9	191.4	620.5	1
4	RHand	52400754	104.6	-571	224	1
5	LFoot	51100164	1004.2	130.2	138.5	1
6	RFoot	51200166	823.5	-419.4	-203.4	1

Best fit points: Examples

- The algorithm reduces the distance between points and their targets, but they are not always achievable/physically realistic.
- The iterative process moves the dummy/HBM as close to the point as possible.

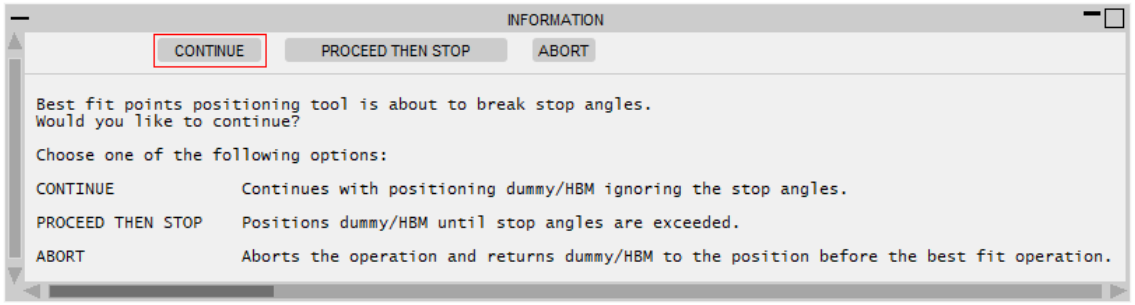


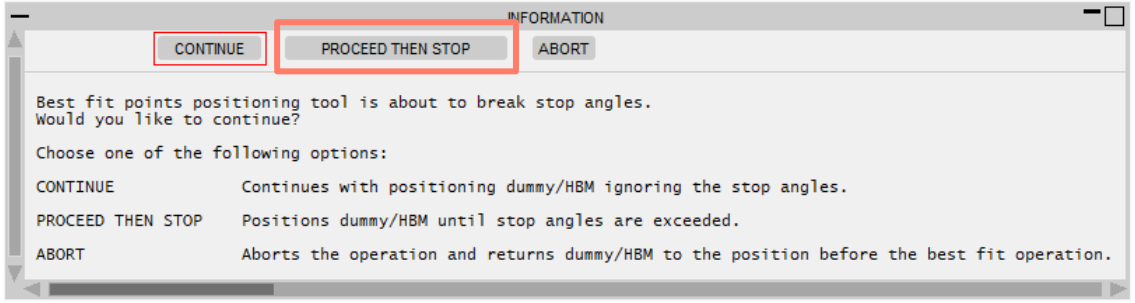
- Weights can be used to bias movement towards specific best fit points.

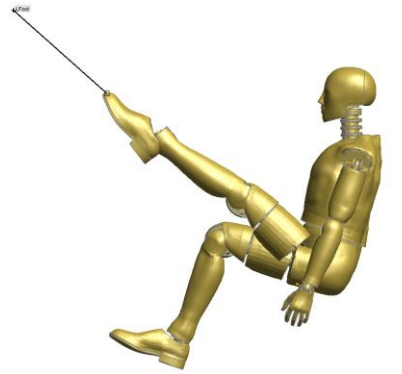


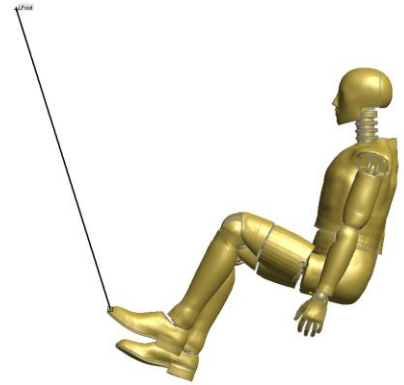
Best fit points: Examples

- Stop angles may need to be exceeded when positioning the dummy/HBM.
- There will be a warning when this occurs, giving the option to “CONTINUE” which will ignore all stop angles. This is not recommended and may cause issues with other positioning tools.
- “PROCEED THEN STOP” will stop positioning once a single stop angle is reached, even if other assemblies can still move.
- “ABORT” will cancel the operation and the dummy/HBM will not be moved.



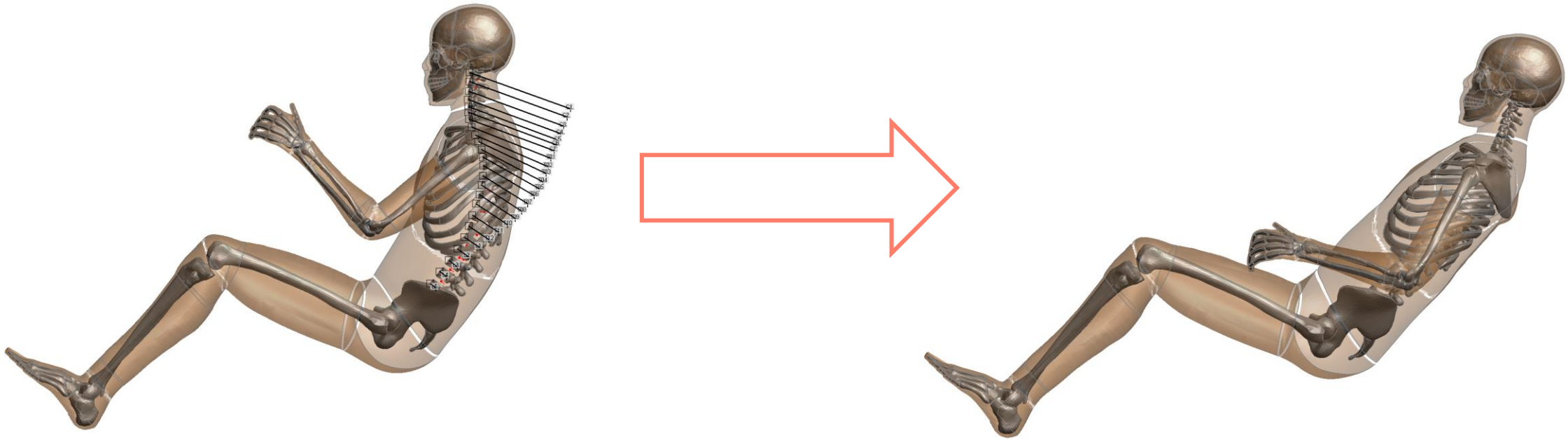






Best fit points: Examples

- The tool works with both dummies and HBMs.
- Spine positioning is possible but may require more care due to the smaller range of motion and greater complexity.
- Multiple points may need to be specified per assembly.

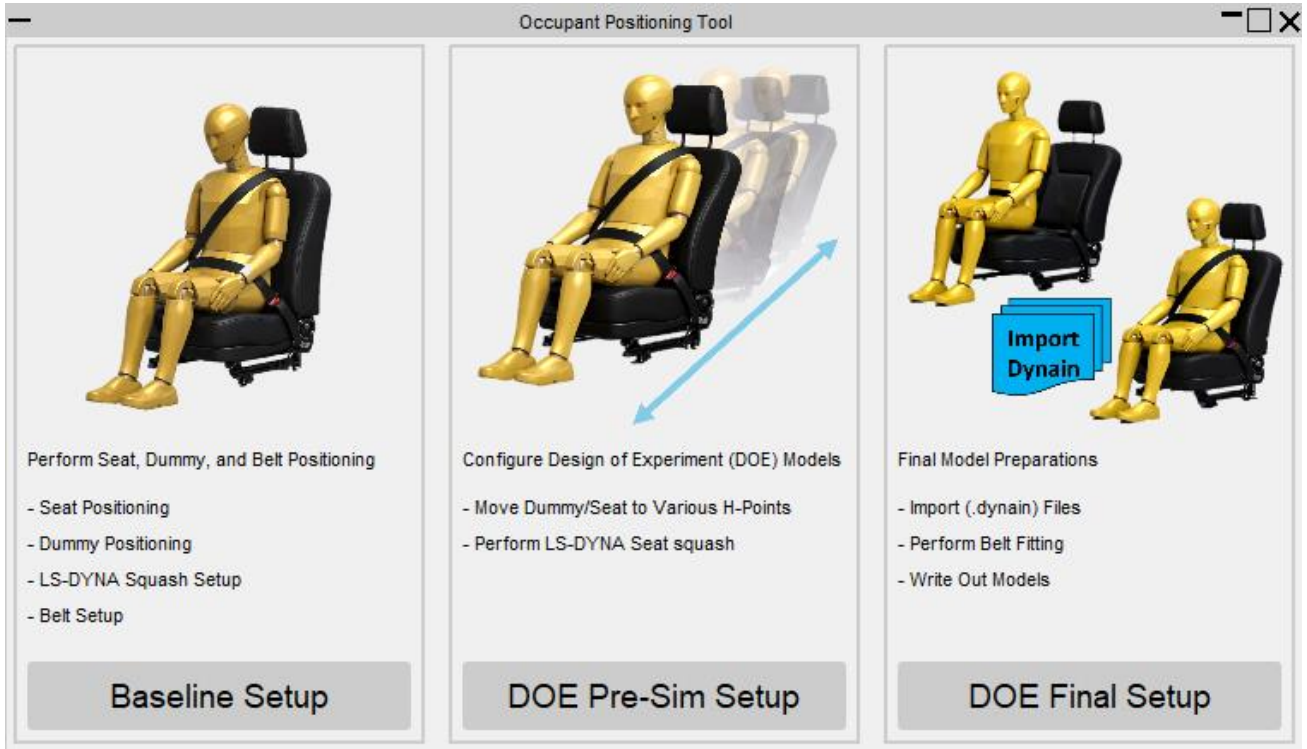


Acknowledgements: **THUMS | Toyota Motor Corporation**

Occupant and DoE Setup

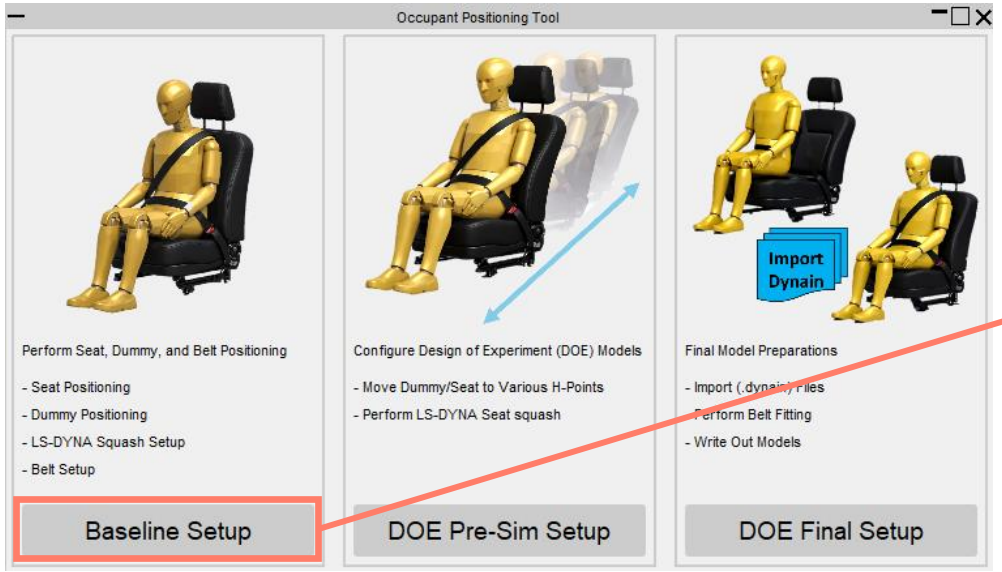
Workflow Overview

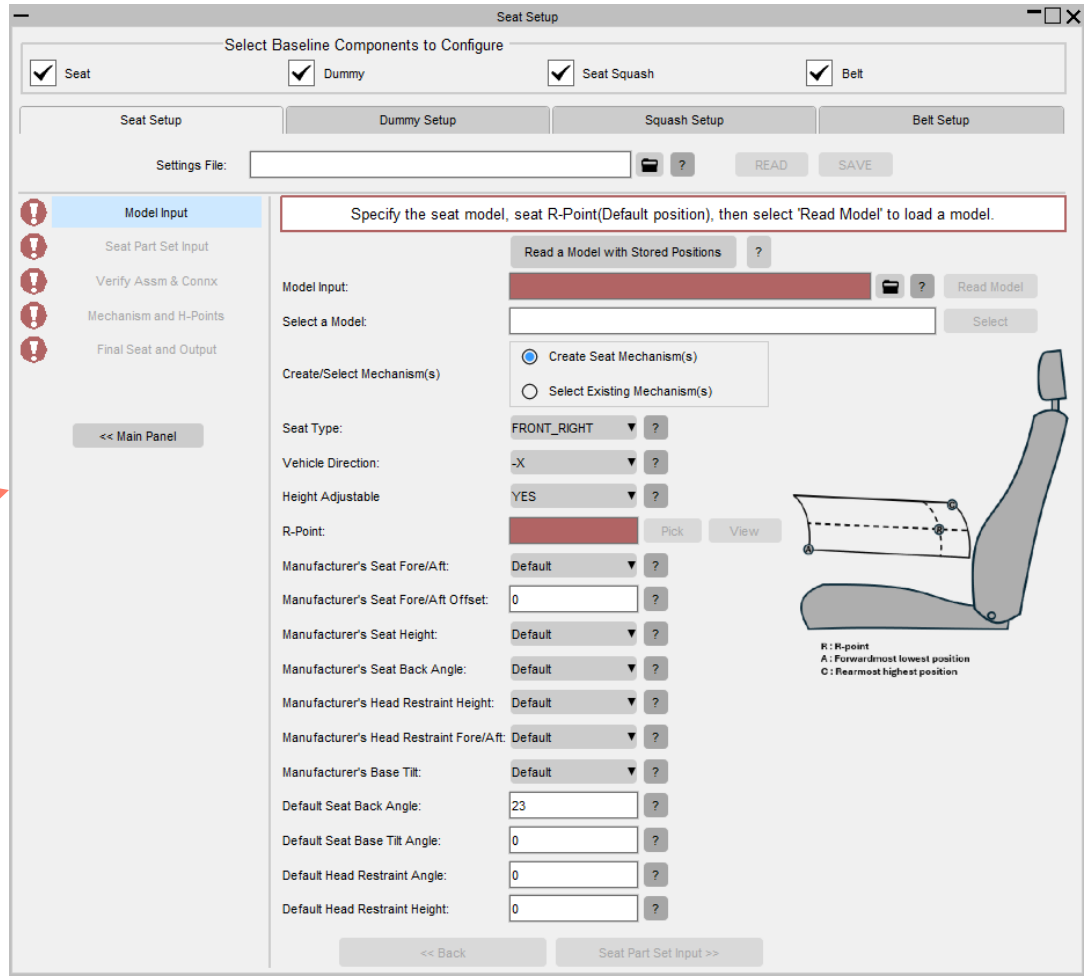
- This tool helps you to generate and manage multiple DOE simulation models efficiently from a baseline model by automatically applying parameter and configuration changes.
- Benefits include reduced manual setup effort, improved consistency across models, faster turnaround time, and minimized setup errors.
- Baseline Setup
  - Position the seat along a defined seat track curve.
  - Move the dummy's hands and feet to target points.
  - Set up LS-DYNA or PRIMER seat squash.
  - Fit the seat belt
- DOE Pre-Sim Setup
  - Configure a Design of Experiment (DOE) model from the baseline.
  - Automatically reposition the seat and dummy to specified H-Points.
  - Run LS-DYNA or PRIMER seat squash at each H-Point position.
- Final Model Preparations
  - Once simulation results are available, use DOE Final Setup to load the dynain file and complete final belt fitting.



1. Baseline Setup

- Baseline Setup works as a standalone tool or alongside DOE Setup. Use it to create a seat mechanism, position the seat along the track curve, move the dummy's hands and feet to target points, and fit the belt.
- After positioning, prepare an LS-DYNA squash setup or run a PRIMER seat squash.



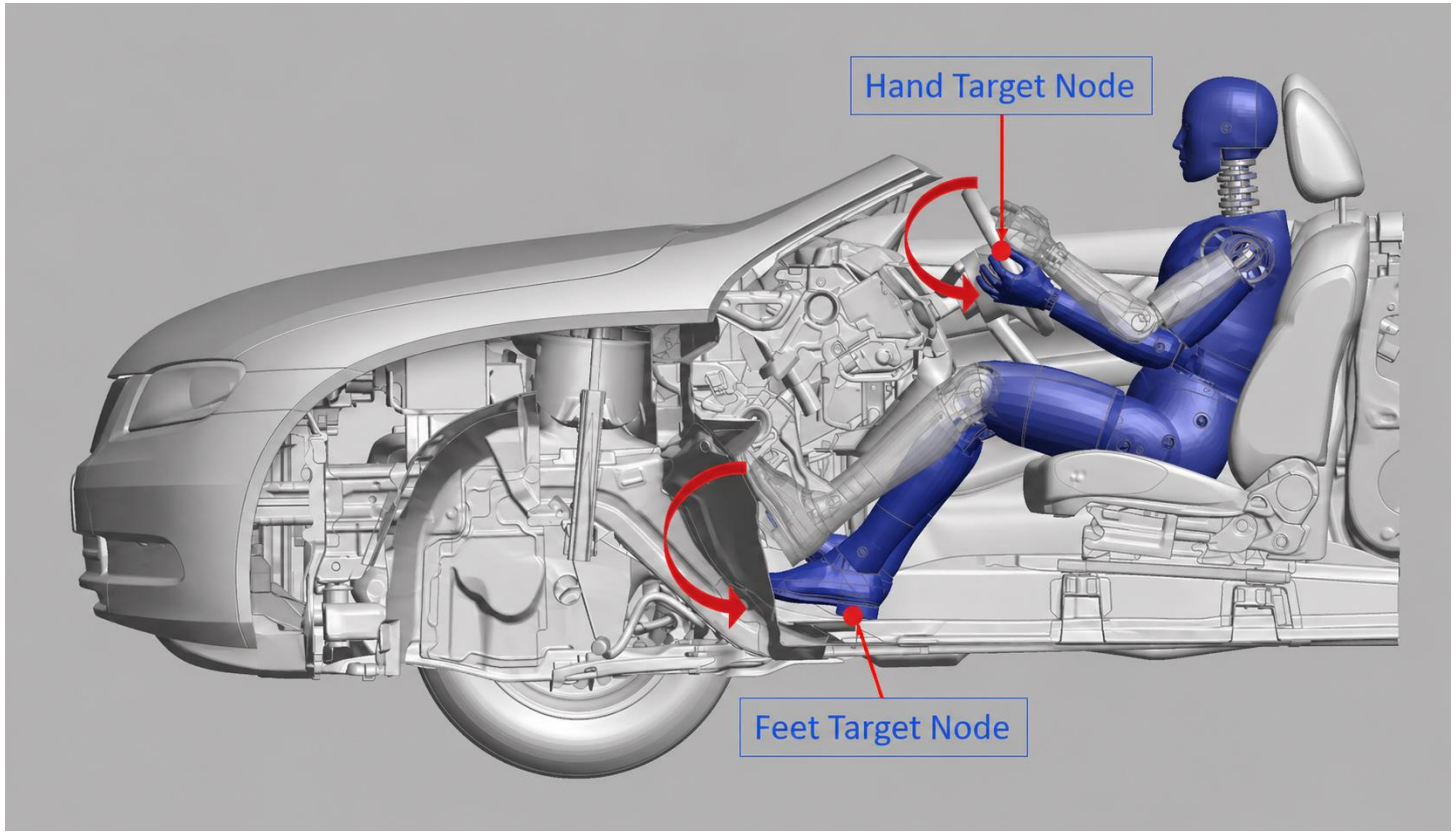


2. Seat Setup

- Move seats to different positions along the seat track to comply with testing protocols.
- Define a seat mechanism by specifying the required seat part sets.
- Provide seat track details via an IGES curve file, node selection, or CSV coordinate import.

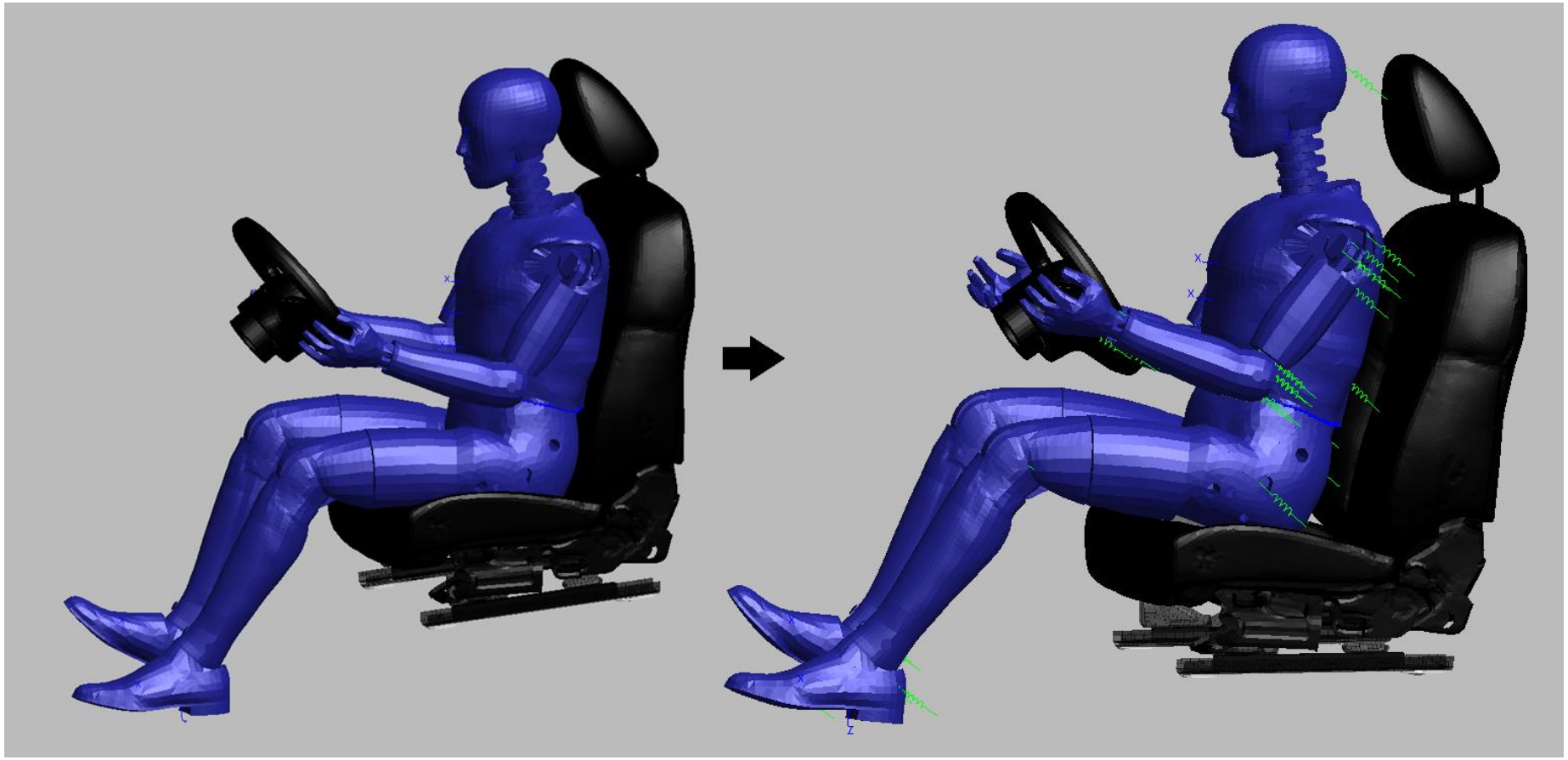
3. Dummy Setup

- Position the dummy’s hands and feet at target nodes — for example, placing the right foot on the accelerator and the left foot on the footrest or brake/clutch. Define a node at each desired target.
- For a rear passenger, specify the knee gap to tuck the feet under the front seat, aligned parallel to the carpet.



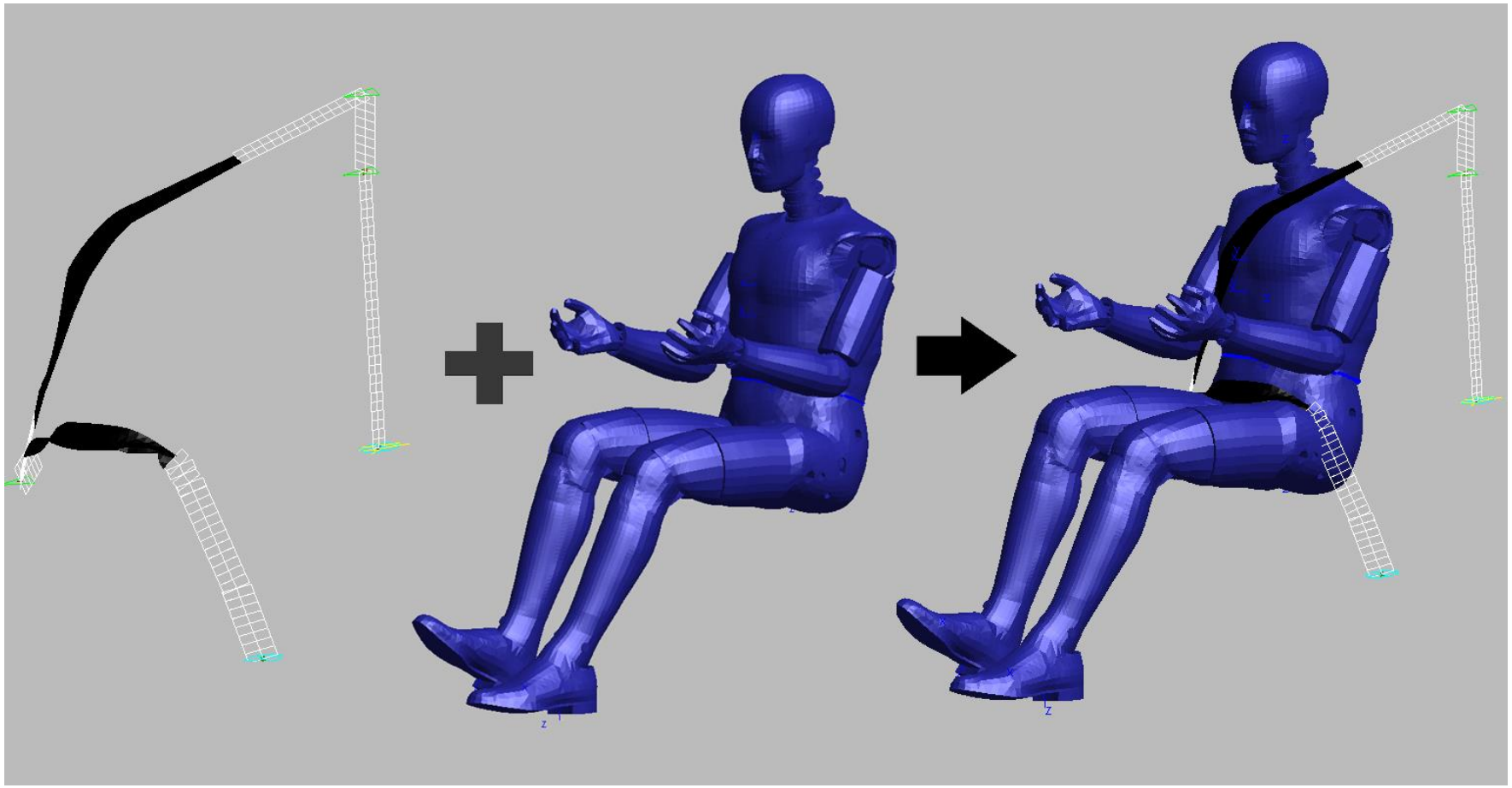
4. Squash Setup

- After positioning the seat and dummy, use this tool to prepare an LS-DYNA squash setup or run a PRIMER seat squash.



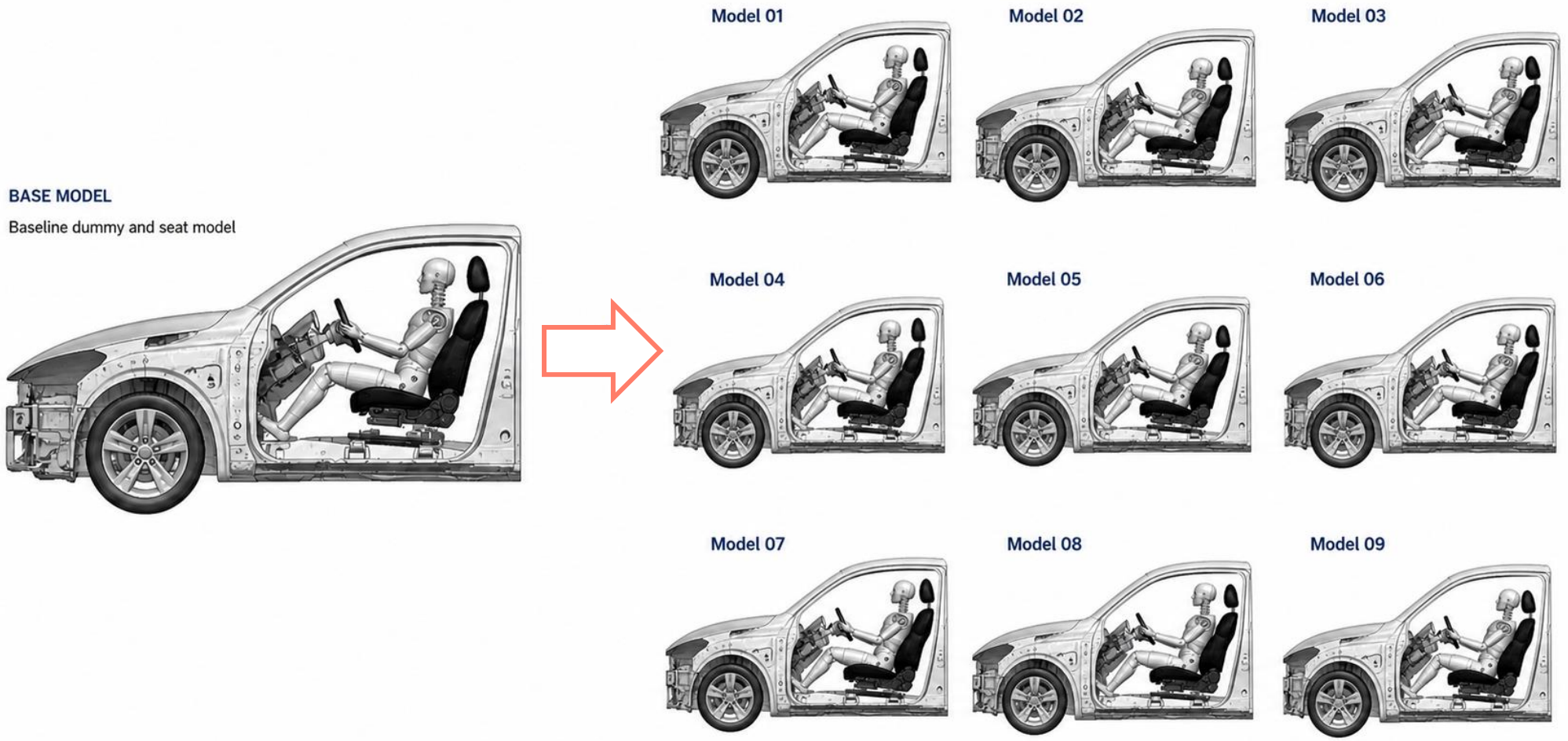
5. Belt Setup

- Create a new belt definition and perform belt fitting.
- You can define a new belt or refit an existing one.



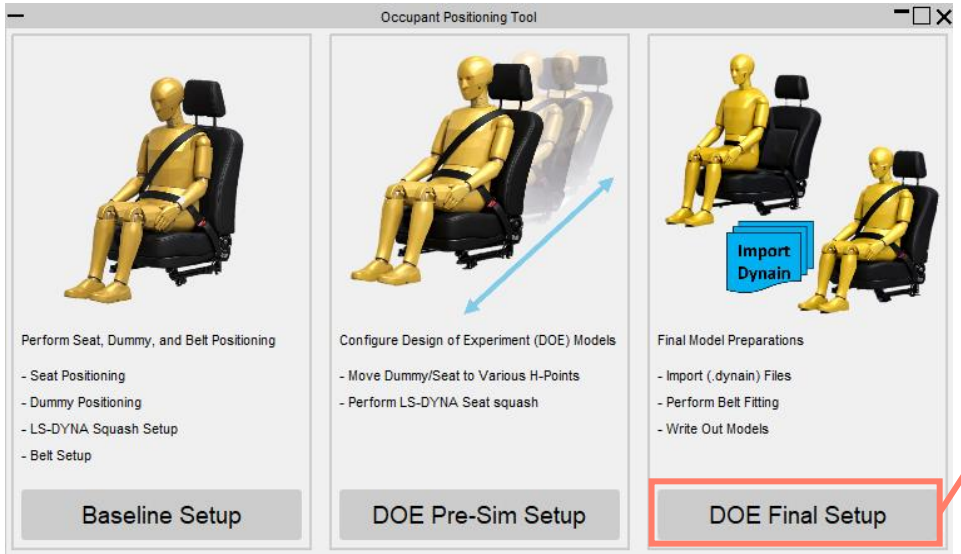
6. DOE Setup

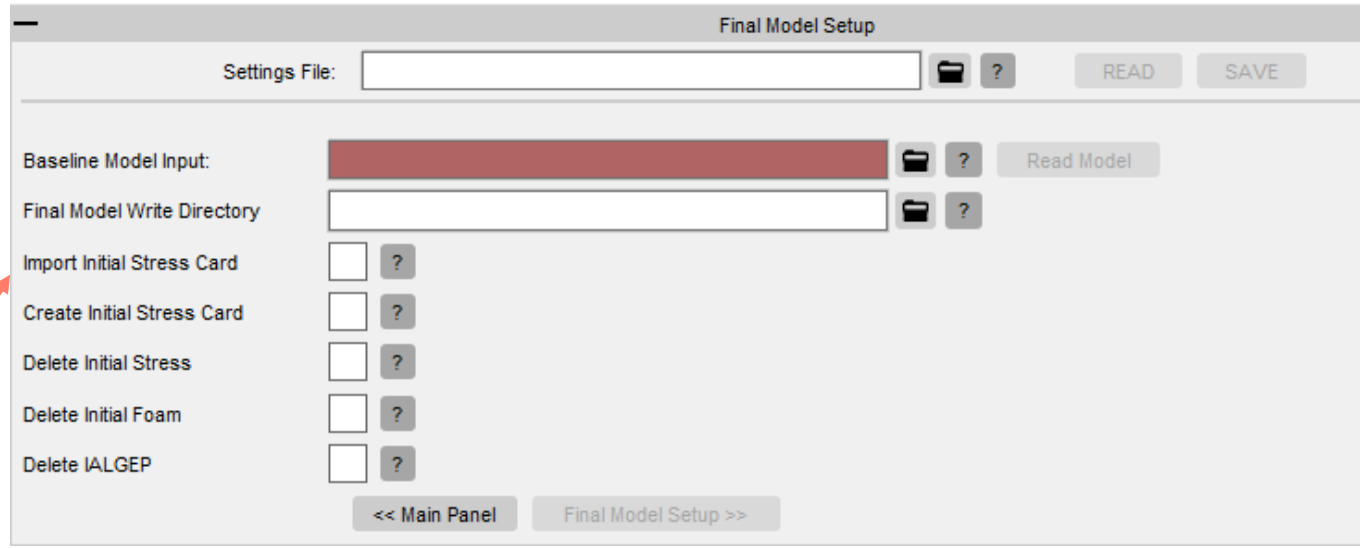
- DOE Setup automatically generates multiple model variants from a single baseline.
- It positions the seat and dummy based on inputs from a CSV file, H-Point matrix, or existing seat positions.



7. Final Model Setup

- Generate LS-DYNA results for the pre-sim models created in the previous step.
- Launch the tool and select “DOE Final Setup”.
- In the Final Model Setup panel, navigate to the pre-sim output folder and open “final_model_setup_settings.stg.” to load the final model setup inputs.

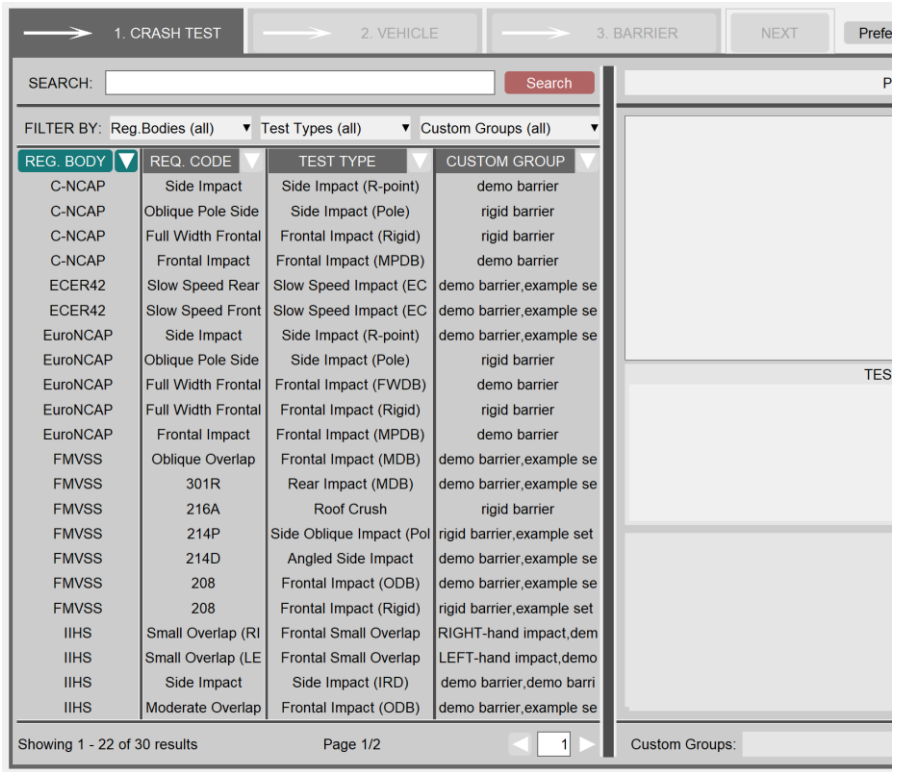


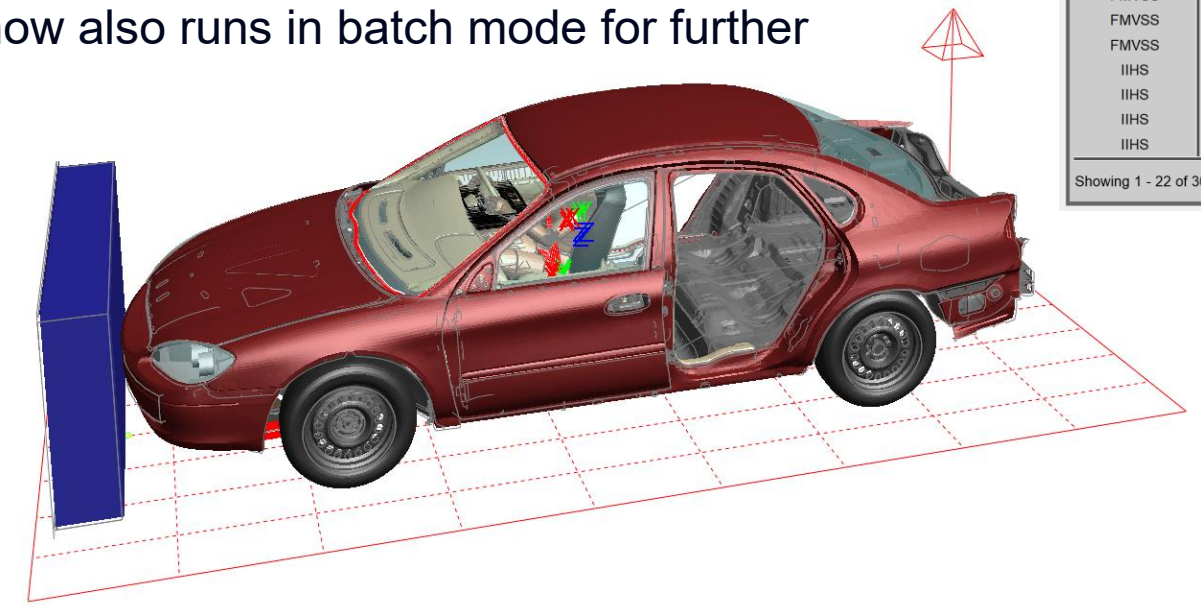


Loadcases

Crash Test Setup: Enhancements

- The Crash Test Setup tool automates the setup of regulated crash test models for faster and more consistent model preparation.
- For PRIMER 23.0 there is expanded protocol coverage:
  - C-NCAP Side MDB
  - C-NCAP Side Pole
  - C-NCAP Full Width Frontal Impact
  - C-NCAP MPDB
  - EuroNCAP FWDB
- The Non-UI script now also runs in batch mode for further automation.

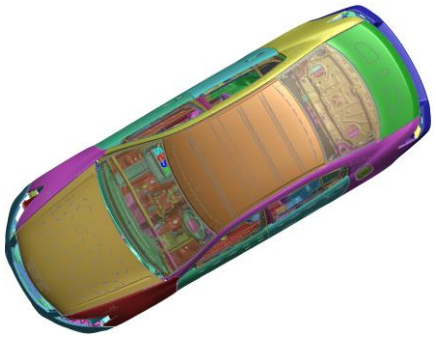


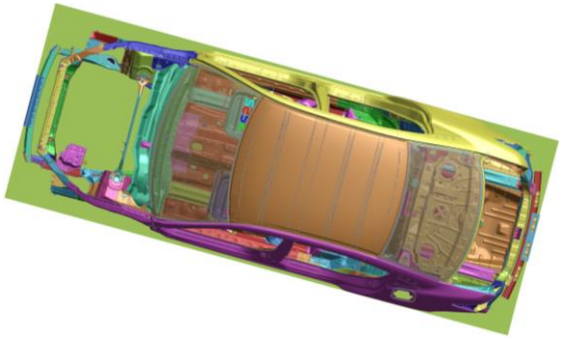


Sled Test Setup

- Sled test is tool that automates creating a sled-based setup and applies the prescribed acceleration pulse.
- Support has been extended to EuroNCAP Far Side testing:
  - Works with either the full vehicle model or a reduced Far Side model created from selected includes.
  - Uses the selected impact angle and side to calculate and apply vehicle rotation.
  - Supports two setup modes: vehicle only or both sled and vehicle.
- Benefits of Sled test in PRIMER 23.0:
  - Faster setup of Far Side sled cases.
  - Flexible model scope: run a full vehicle or a lighter reduced model.
  - Better control of the case definition through impact angle, impact side, and rotation mode.
  - More reliable plate placement because default rigid plates are created directly in their final position.

Full Model
Left side 60° impact
(no sled)

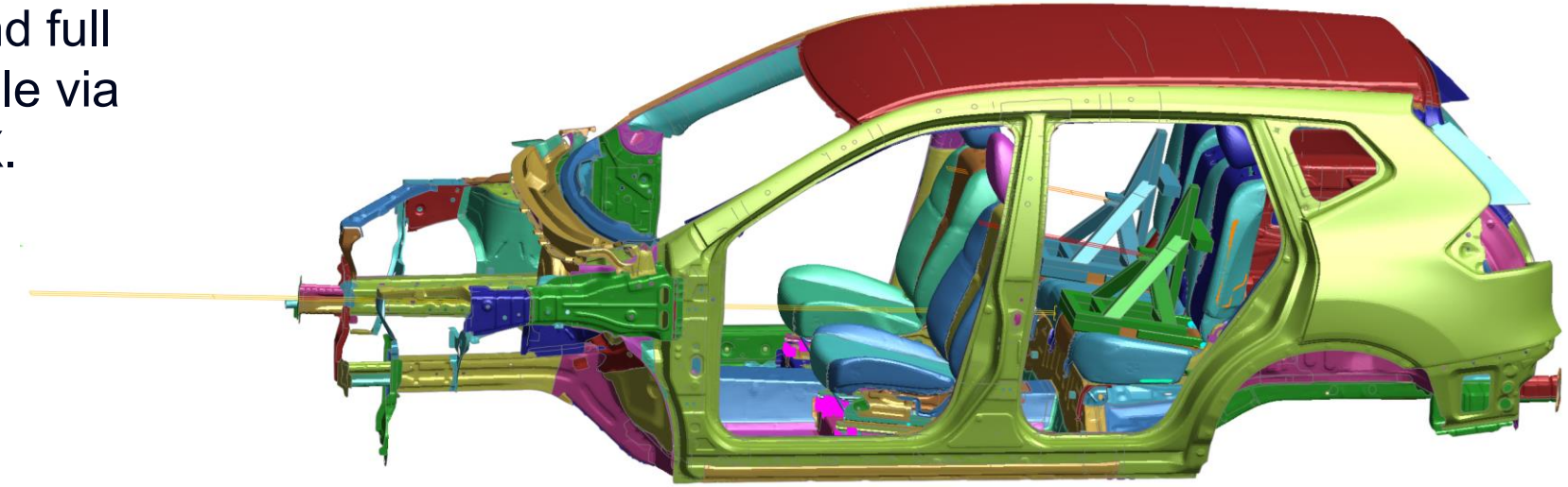




Reduced model
Right side 75° impact
(with Sled)

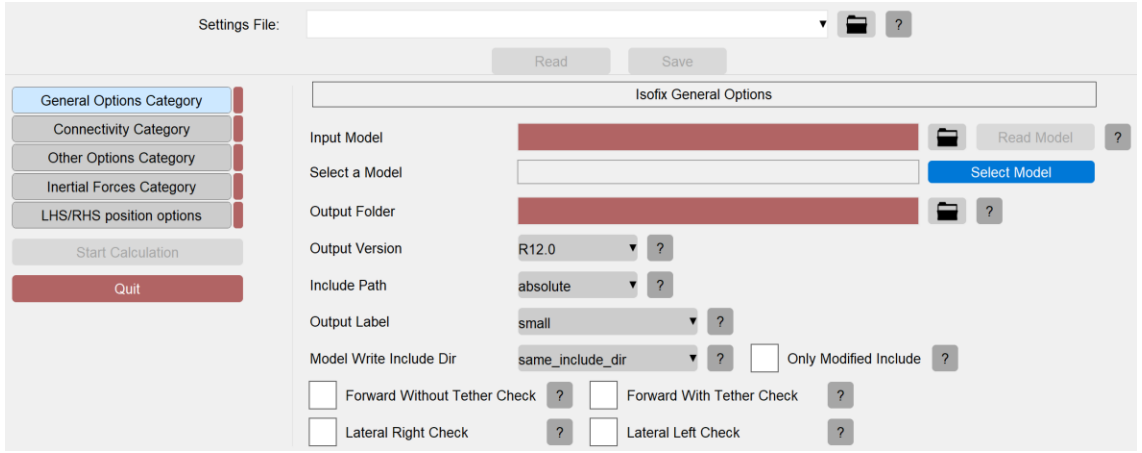
ISOFIX Tool

- The ISOFIX tool is a new automated tool for setting up ISOFIX loadcases in PRIMER according to the ECE R14 regulation.
- Accessed from **Tools** → **Safety** → **ISOFIX**.
- Supports four sub-loadcases:
  - Forward Without Tether, Forward With Tether, Lateral Right and Lateral Left.
- Uses supplied, validated SFAD device models for automated setup on left and right seat sides.
- Automates the pre-sim setup: positions and angles the SFAD, creates contacts and loading, performs seat squash, applies constraints, and fits the tether belt for the Forward With Tether case.
- An introduction to the tool and full step-by-step guide is available via **Help** → **Tutorials** → **ISOFIX**.



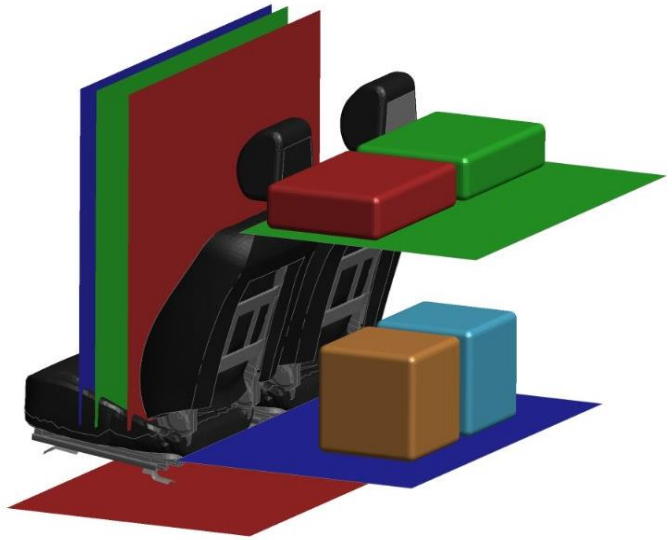
ISOFIX Tool

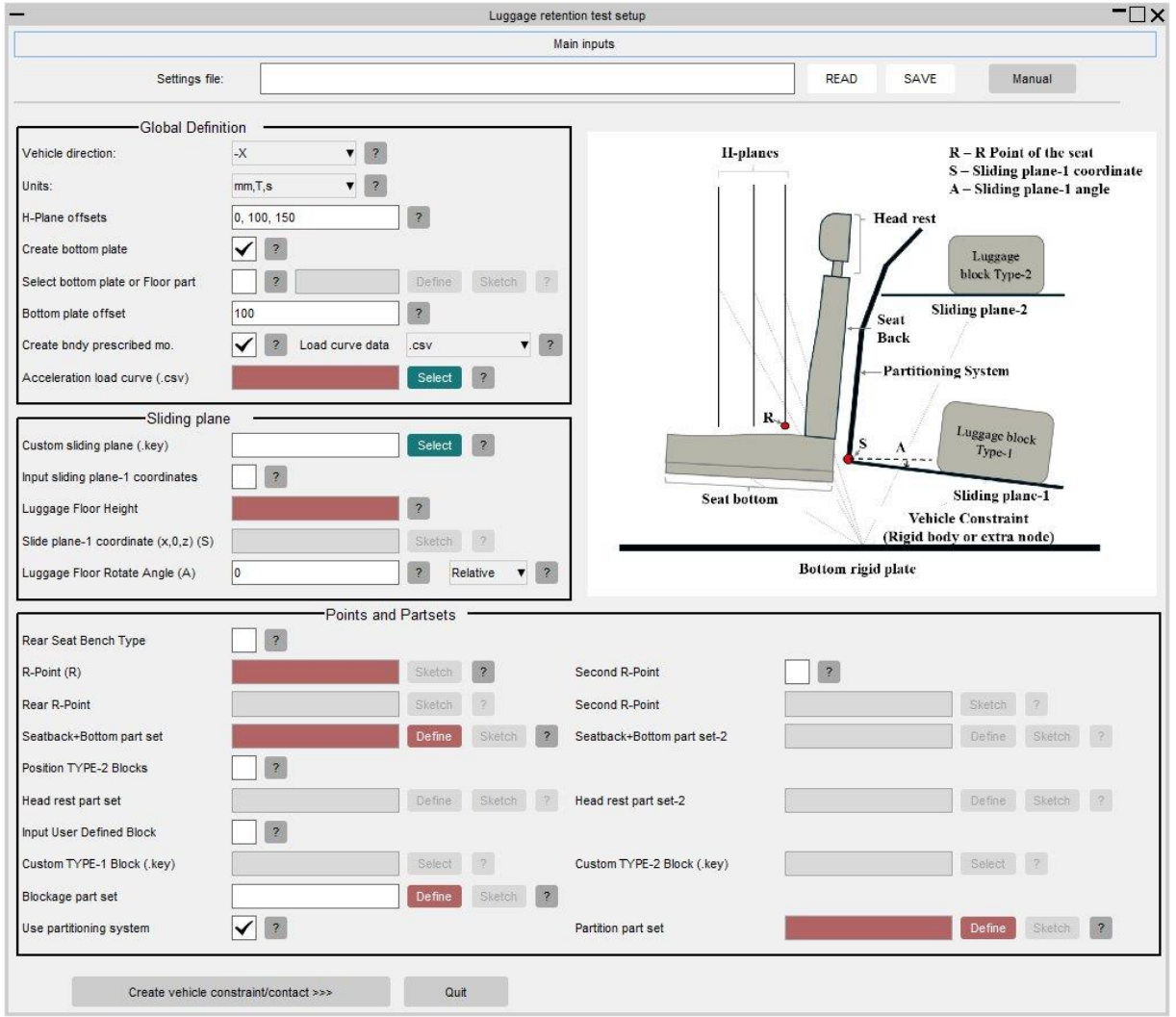
- Guided input panels group the setup into General Options, Connectivity, Other Options, Inertial Forces and LHS/RHS Position Options.
- Input model can be read from file or selected directly from an existing PRIMER model already in session.
- Output controls let you choose LS-DYNA version, include-path type, label format and include write strategy.
- Inertial Forces inputs adapt to the selected setup: Seat Frame enables CG-bar and optional X-point loading, while Vehicle Structure skips those fields.
- Rear Seat Type controls which seat-specific inputs are used: Bench enables rear-bench inputs, while Separate enables rear-left and rear-right inputs.
- Category status indicators and help buttons make setup, review, and validation easier.



Luggage Retention

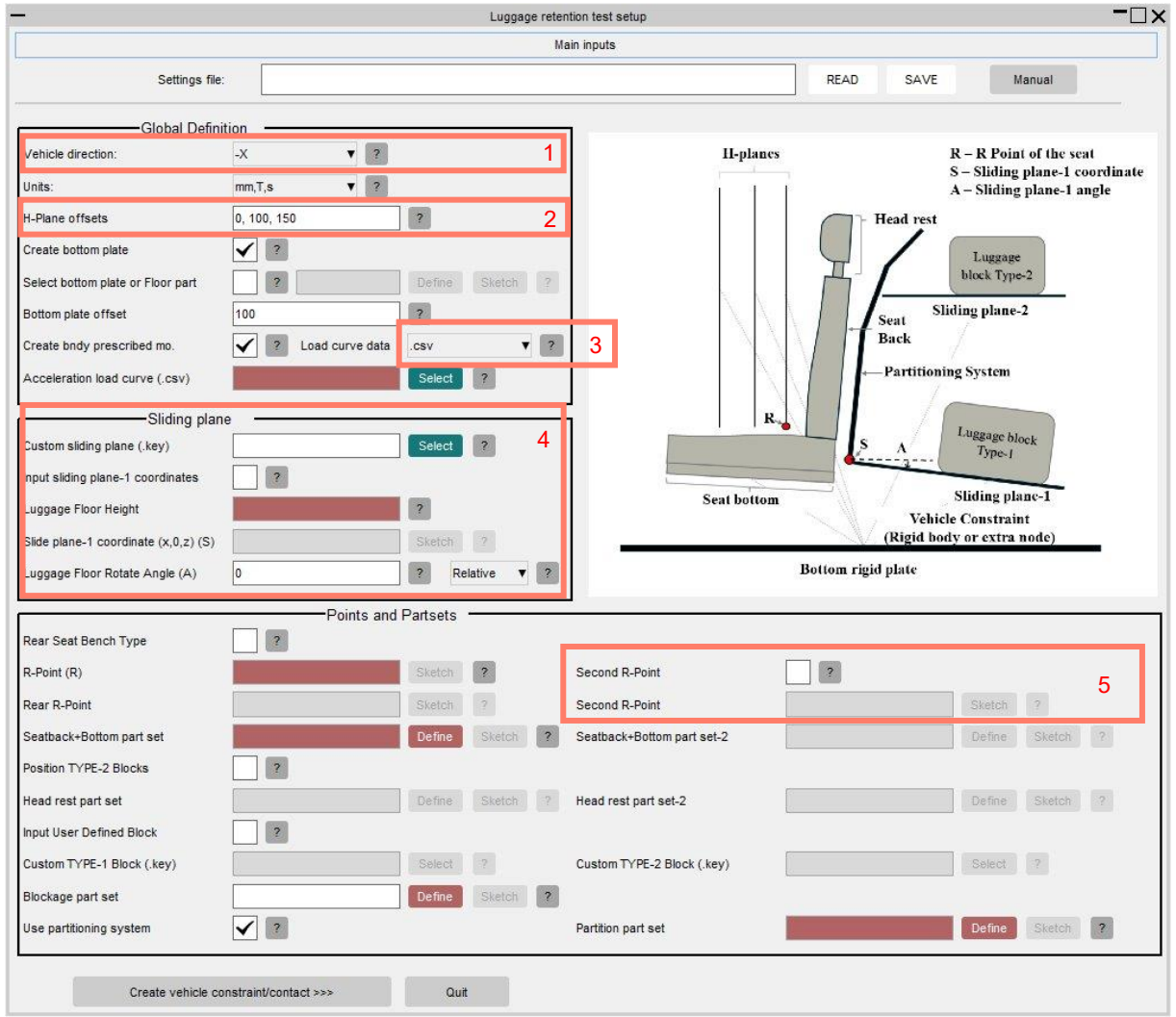
- The luggage retention tool enables you to position luggage blocks and set up analyses according to ECE R17.
- The tool is available in the Safety menu.
- The tool automatically sets up the planes and blocks as per regulations and inputs supplied.
- There is a comprehensive tutorial at:
  Help → Tutorials → Luggage Retention





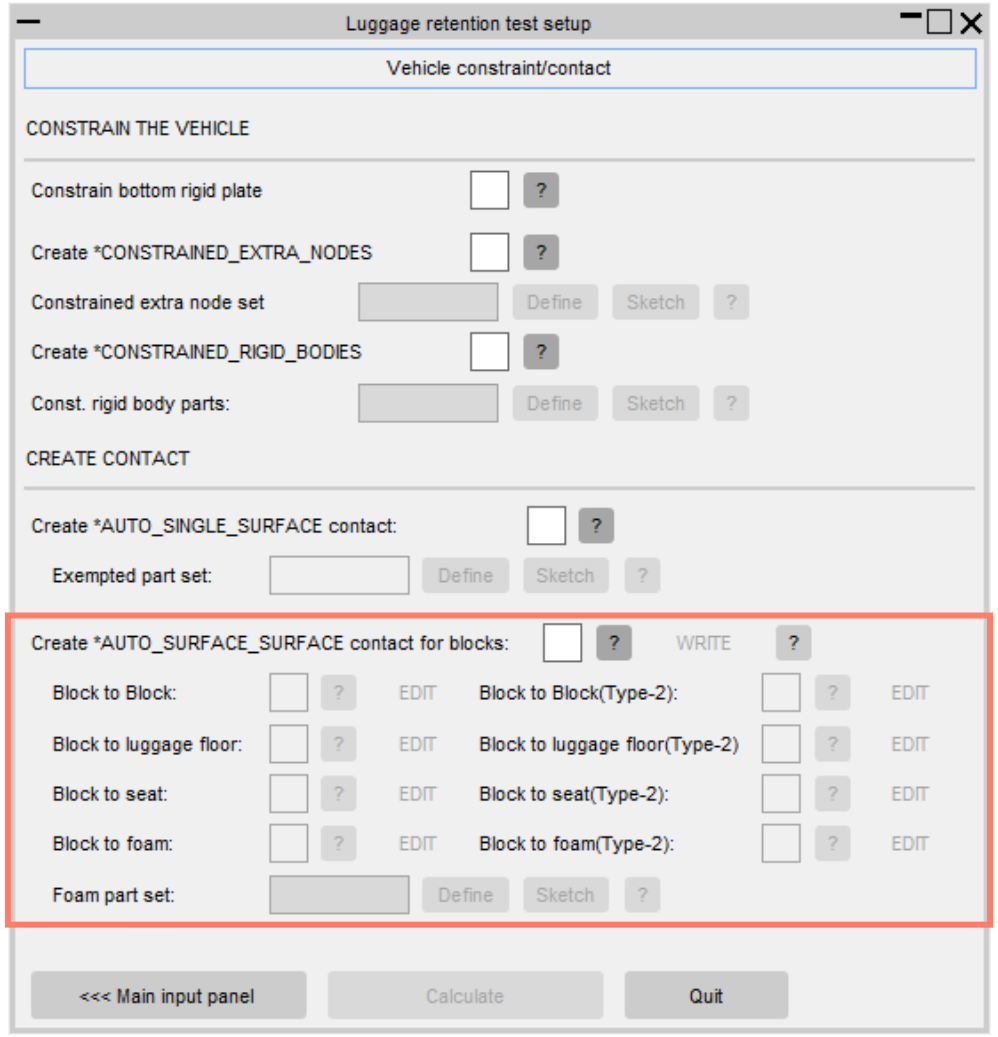
Luggage Retention – Additional input options

- Updates in PRIMER 23.0 include:
- Import custom Type-1, Type-2 blocks.
- Set vehicle direction in either direction along X-Axis (1).
- Set custom H-Plane offsets (2).
- Create boundary prescribed motion by importing load curve data in the following formats (3)
  - .csv file
  - .key file
  - Load Curve ID.
- Input custom sliding plane for luggage floor and position it using the given options (4).
- Additional R-point input for a pilot/copilot seat setup, allowing you to position luggage blocks and view planes for different type seats (5).



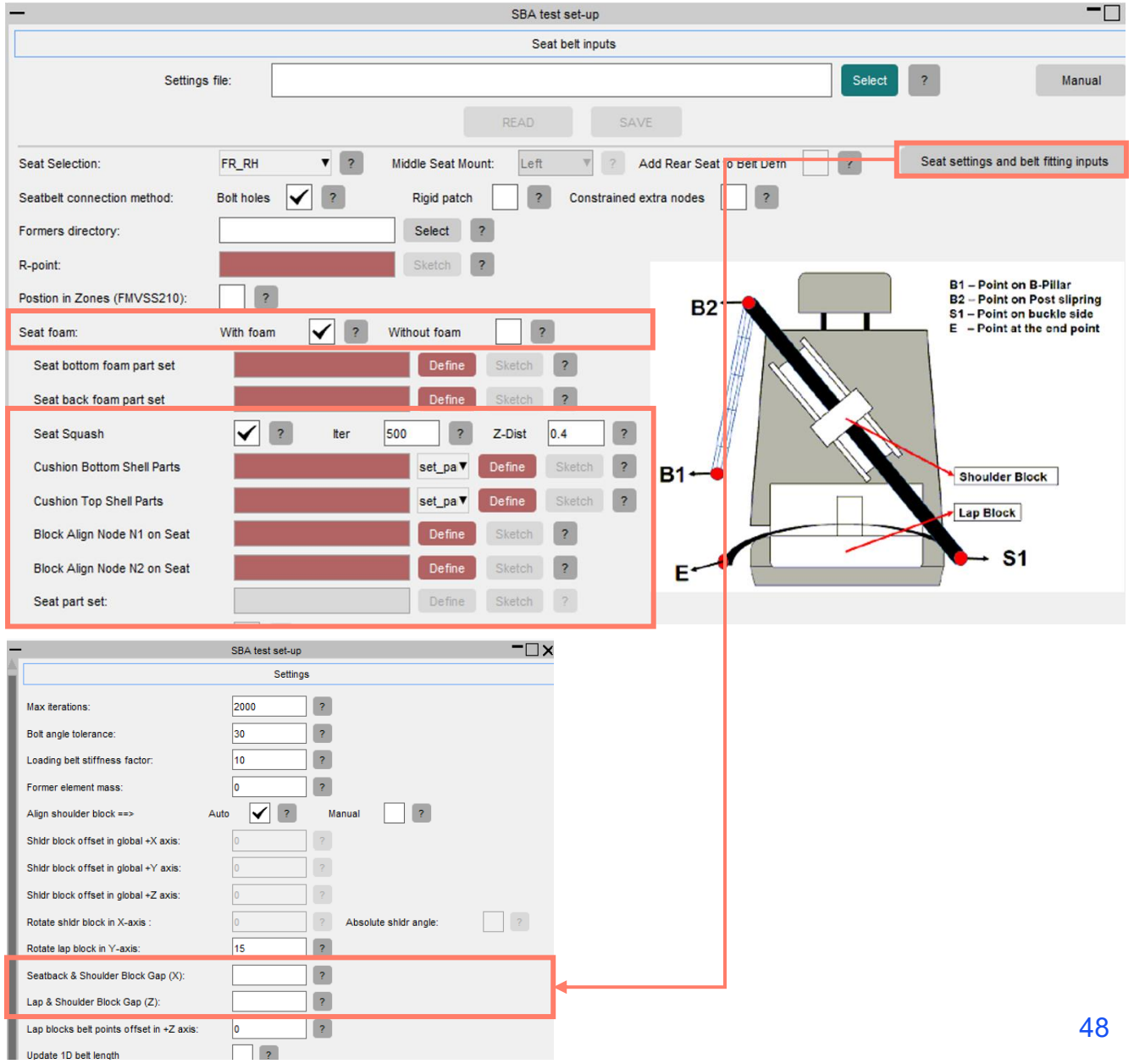
Luggage Retention – Creating and importing contacts

- ***AUTOMATIC_SURFACE_TO_SURFACE** contacts can be created between the block and different structures automatically when the tool is run.
- Contact data will be imported from the default_contacts.key file in the install directory, and new contact settings can be saved in the same area.
- These contact settings can be imported next time the tool is run.



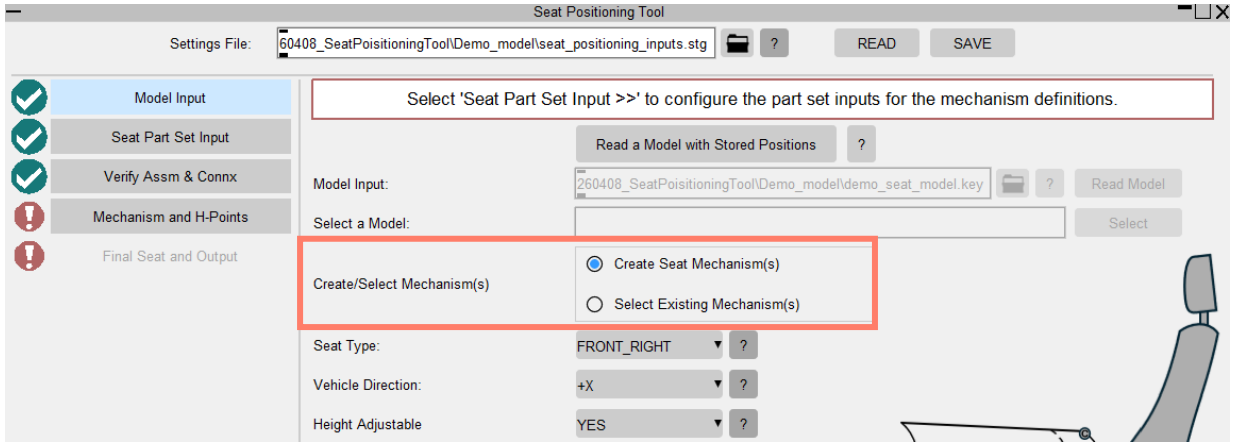
Seatbelt Anchorage (SBA) Tool – Enhancements

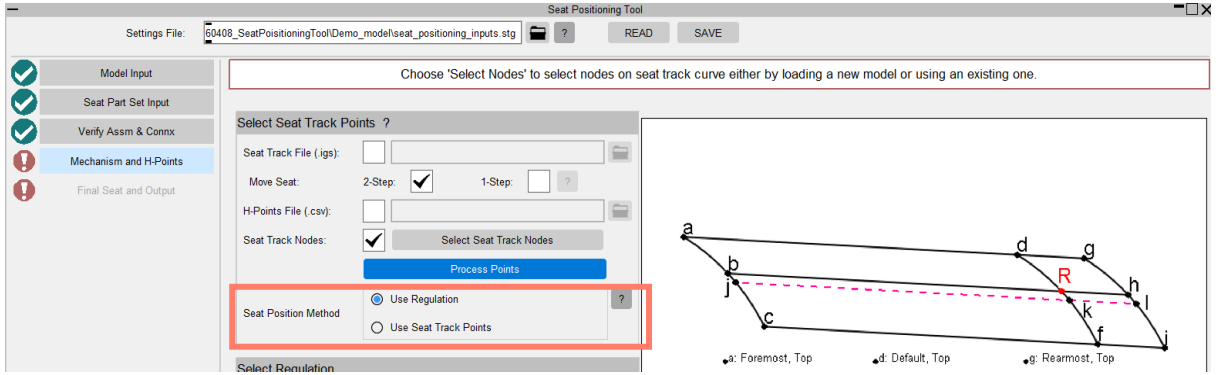
- Position the blocks as per FMVSS210
  - Enable this option to position the pelvis and torso blocks within the zones defined by FMVSS 210.
- Seat Squash (Primer Method)
  - Added option to perform squash between torso block and seat cushion using PRIMER method.
  - Specify nodes N1 and N2 to align the lap block along the N1 → N2 vector.
- Seatback and Shoulder Block Gap (in x)
  - Enter the distance to maintain between the seatback and shoulder block.
  - If left empty, the default gap obtained after running the tool will be maintained.
- Lap and Shoulder Block Gap (in z)
  - Enter the distance to maintain between the lap and shoulder blocks. The shoulder block will be moved along the belt direction (S1-B2) to maintain the specified gap in the z-axis.
  - If left empty, the default gap obtained after running the tool will be maintained.



Seat Positioning Tool – Enhancements

- The Seat Positioning Tool, introduced in the last release, enables you to quickly create seat mechanisms and position the seat at various predefined points in accordance with different testing protocols.
- The following updates in PRIMER 23.0 improve useability.
- Added an option to select an existing mechanism definition in the seat for seat positioning.
- An additional option "Use Seat Track Points" has been added to specify target points for seat positioning.
- When writing the model, the options configured in the PRIMER Model write panel will be used. Previously, the model was always written using absolute path.

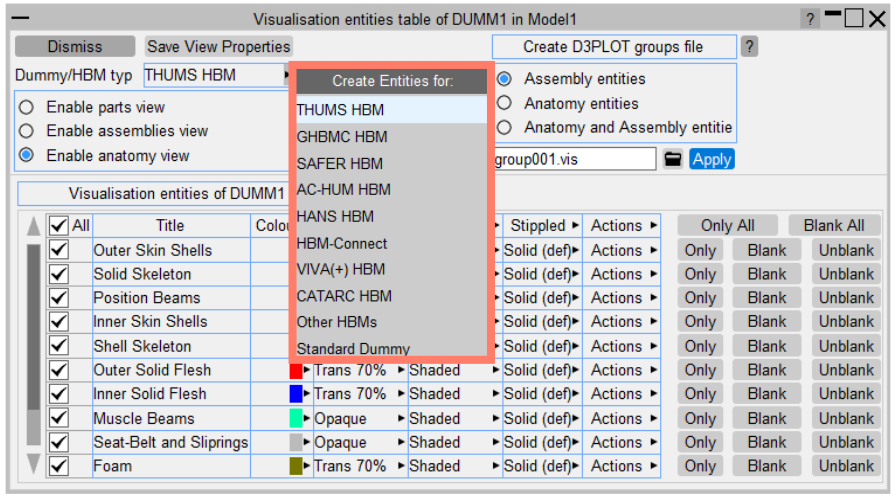




HBM Trees

Positioning trees for HBMs

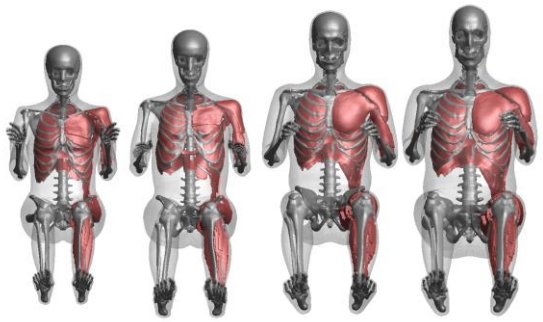
- PRIMER positioning tree files help position and prepare HBMs for Ansys LS-DYNA analysis.
- Tree files are free to PRIMER users and available from your local distributor.
- Positioning tree files are available for the following HBMs:
  - **GHBMC** (Elemance)
    - Detailed HBMs – occupant and pedestrian models;
    - Simplified HBMs – occupant and pedestrian models;
  - **THUMS** – occupant, pedestrian and TB-024 models;
  - **SAFER**;
  - **VIVA(+)** – seated and standing;
  - **AC-HUMs** (CAERI) – occupant and pedestrian;
  - **HBM-Connect** (Humanetics);
  - **HANS** (Ansys-Dynamore);
- PRIMER also supports visualisation of all the above HBMs via the **Visualisation Table** tool.
- The latest available in each family are listed on the following pages with new additions shown in green.



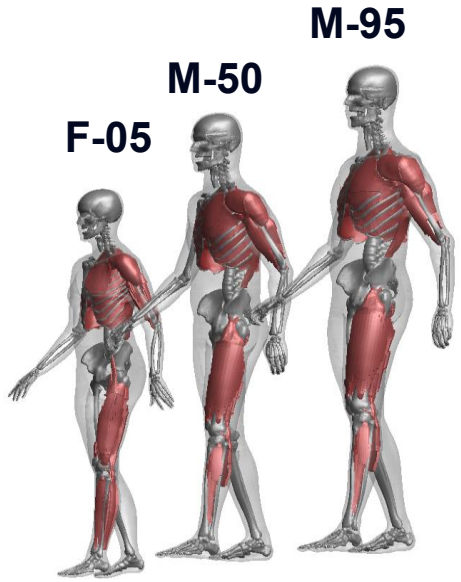
Acknowledgements: **THUMS | Toyota Motor Corporation**

Supported GHBMC models – detailed

- PRIMER supports the positioning for all the available versions of the GHBMC “Detailed” HBMs.
- PRIMER also supports the positioning for all the previously released versions of these HBMs.
- Tree files are free to PRIMER users and available from your local distributor.
- **Detailed occupants**
  - F50-O **v6.05**
  - F05-O **v6.0.1**
  - M50-O **v6.2.1**
  - M95-O **v6.2**
- **Detailed pedestrians**
  - F05-P v1.2/v5.3.4
  - M50-P v1.6/v5.3.1/v5.3.4
  - M95-P v1.2/v5.3.4



Detailed Occupants

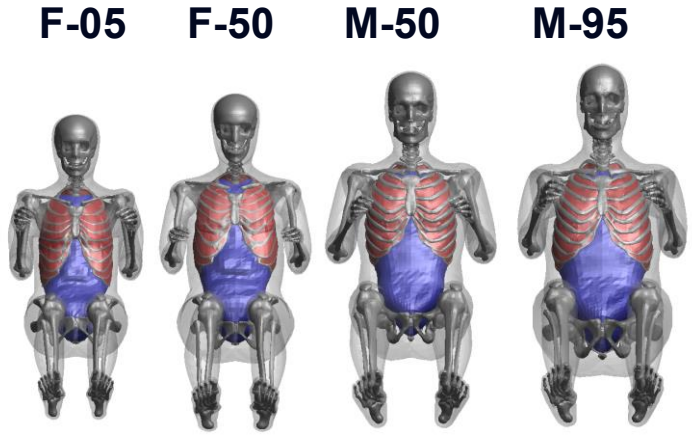


Detailed Pedestrians

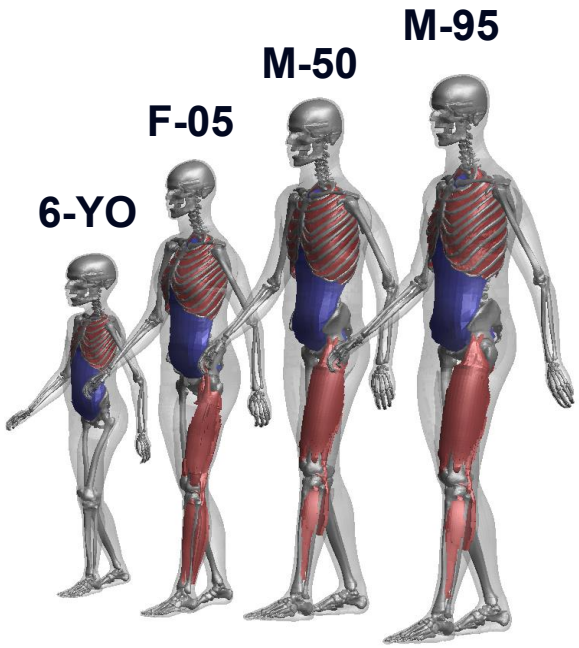
Acknowledgements: **Elemance, distributor of the GHBMC models**

Supported GHBMC models – simplified

- PRIMER supports the positioning for all the available versions of the GHBMC “Simplified” HBMs.
- PRIMER also supports the positioning for all the previously released versions of these HBMs.
- Tree files are free to PRIMER users and available from your local distributor.
- **Simplified occupants**
  - F50-OS v2.3.2
  - F05-OS v2.3
  - M50-OS **v2.4**
  - M95-OS v2.3
- **Simplified pedestrians**
  - F05-PS v1.8/v5.3.5
  - M50-PS v1.8/v5.3.5
  - M95-PS v1.8/v5.3.5
  - 3YO-PS v1.8
  - 6YO-PS v1.8/2.8.2
  - 10YO-PS v1.8



Simplified Occupants

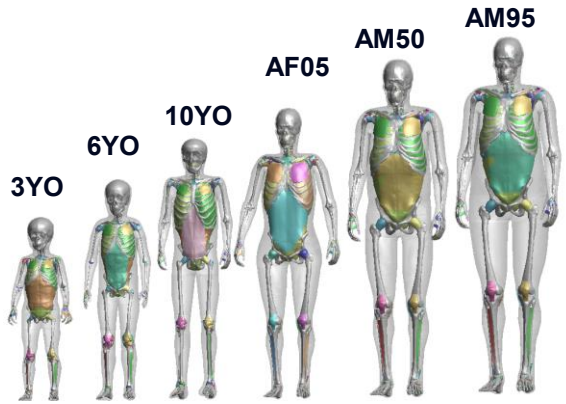


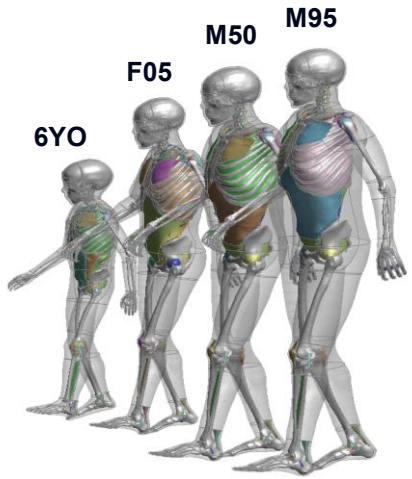
Simplified Pedestrians

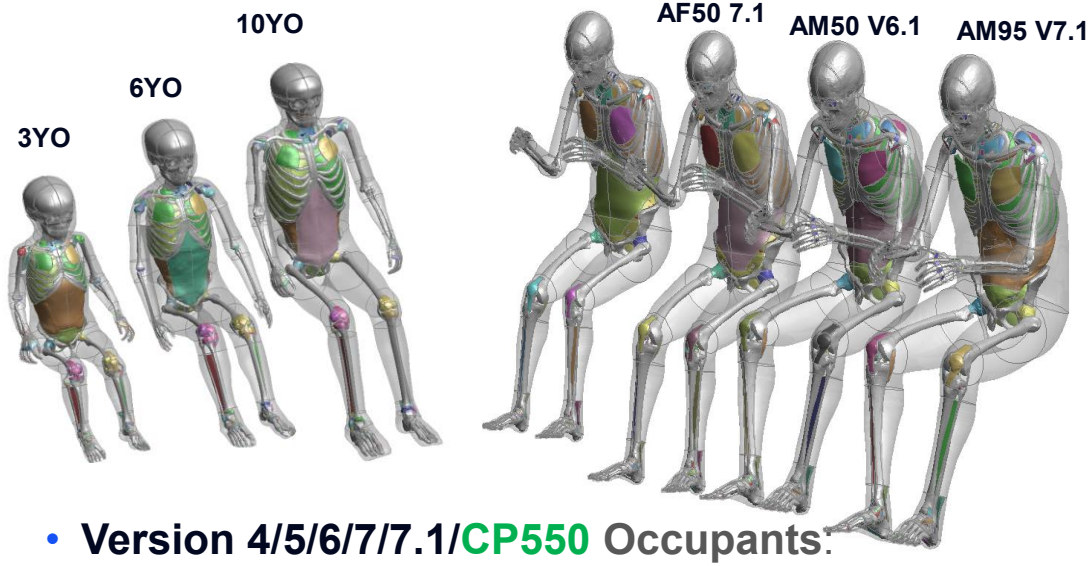
Acknowledgements: **Elemance, distributor of the GHBMC models**

Supported THUMS models

- PRIMER supports the positioning for all the available versions of the THUMS “Pedestrian” and “Occupant” HBMs.
- PRIMER also supports the positioning for all the EuroNCAP TB-024 and **AM50 V4.1/V7 CP550 compliant** HBMs.
- Tree files are free to PRIMER users and available from your local distributor.





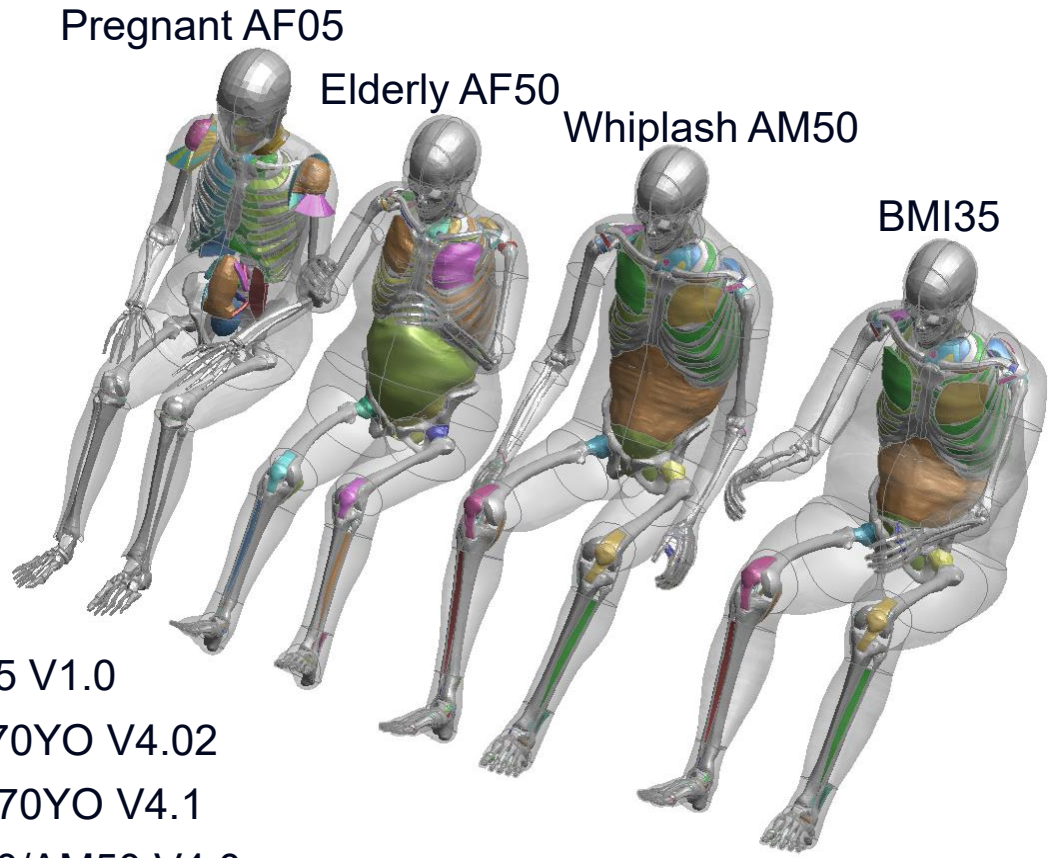


- **Version 4/4.1 Pedestrians**:
  - AF05-P v4.02/**v4.1**
  - AM50-P v4.02/**v4.1**
  - AM95-P v4.02/**v4.1**
  - 3YO/6YO/10YO v4.0
- **Version 4 TB-024**:
  - AF05-P v4.02
  - AM50-P v4.02
  - AM95-P v4.02
  - 6YO v4.0
- **Version 4/5/6/7/7.1/CP550 Occupants**:
  - AF05-O v4.1/v5.0.3/v6.1/v7/v7.1
  - AM50-O v4.1/v5.0.3/v6.1/ v7/ v7.1/**CP550**
  - AM95-O v4.1/v5.0.3/v6.1/ v7/ v7.1
  - 3YO/6YO/10YO v4.0

Acknowledgements: **THUMS | Toyota Motor Corporation**

Supported THUMS models – reclined and others

- PRIMER supports the positioning for all the available versions of the THUMS “Reclined” HBMs.
- PRIMER also supports the positioning for all the Other category HBMs, including the Pregnant HBM.
- Tree files are free to PRIMER users and available from your local distributor.



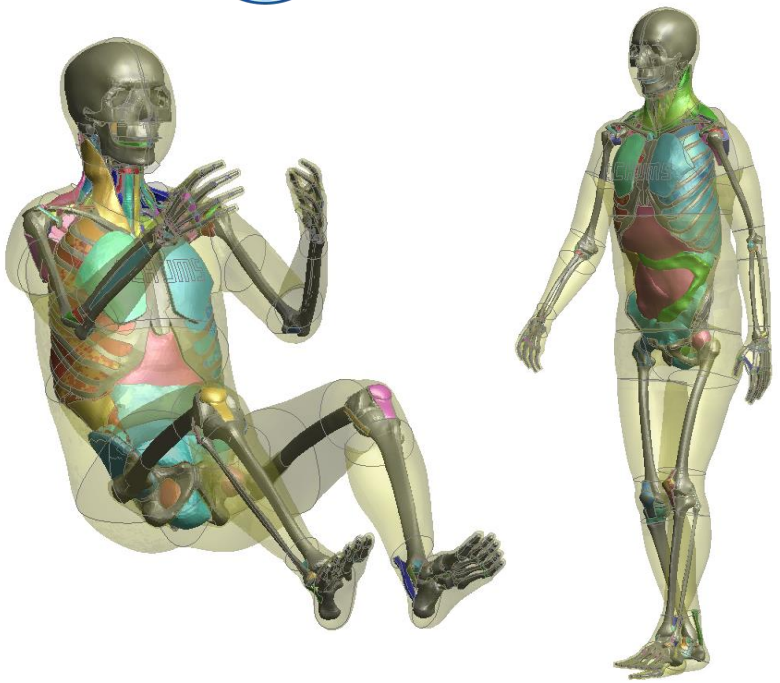
- **Seatback Reclined (25/35/45 Deg.)**:
  - AF05-O v7
  - AM50-O v7
  - AM95-O v7
- **Others:**
  - Pregnant AF05 V1.0
  - Elderly AF50 70YO V4.02
  - Elderly AM50 70YO V4.1
  - Whiplash AF50/AM50 V4.0
  - Obese BMI35 V4.0

Acknowledgements: **THUMS | Toyota Motor Corporation**

Supported AC-HUMs HBMs (CAERI)

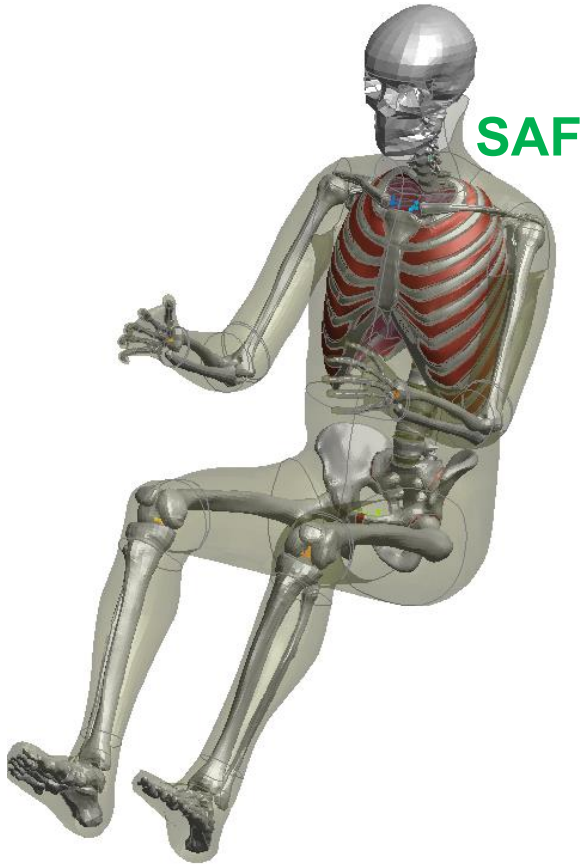
- PRIMER supports the positioning for all the available versions of the AC-HUMs HBMs from CAERI:
  - AM50 Occupant V1.0/V1.3/**V2.2**/**V2.3**/**V2.3.2**/**V2.4**
  - AM50 Pedestrian V1.0/V1.3/**V2.2**
  - AM95 Occupant V1.0/V1.3
  - AM95 Pedestrian V1.0/V1.3
  - **AF05 Occupant V1.1**
  - **AF05 Pedestrian V1.1**
- PRIMER supports the positioning for all these HBMs in both S2 and S3 unit versions.
- Tree files are free to PRIMER users and available from your local distributor.

中国汽研
CAERI

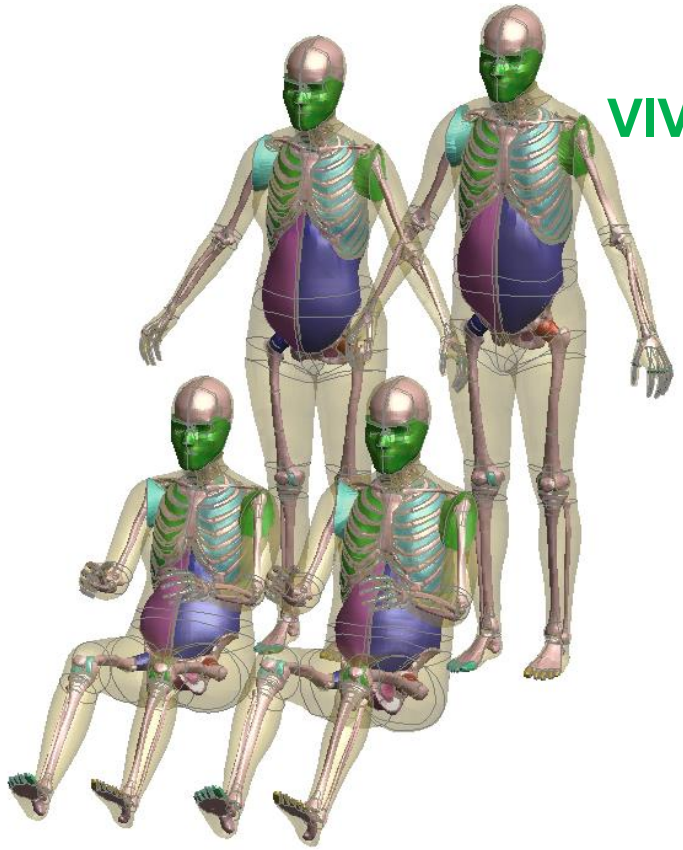


Supported SAFER/VIVA+ HBMs

- PRIMER supports the positioning for the **SAFER** Occupant HBM V11.1.0/**V12.0.0**
- PRIMER also supports positioning for the **VIVA+ 2.x** HBMs – both seated and standing postures.
- Tree files are free to PRIMER users and available from your local distributor.



SAFER V12.0.0



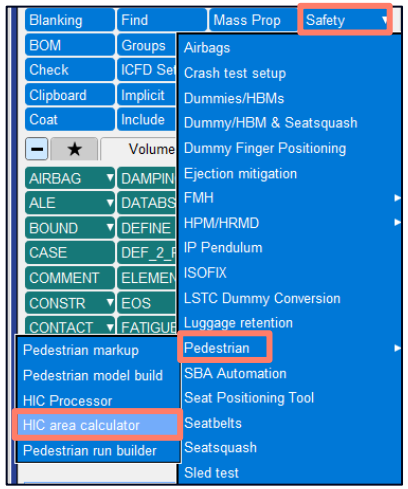
VIVA+ 2.0.0 F50/M50

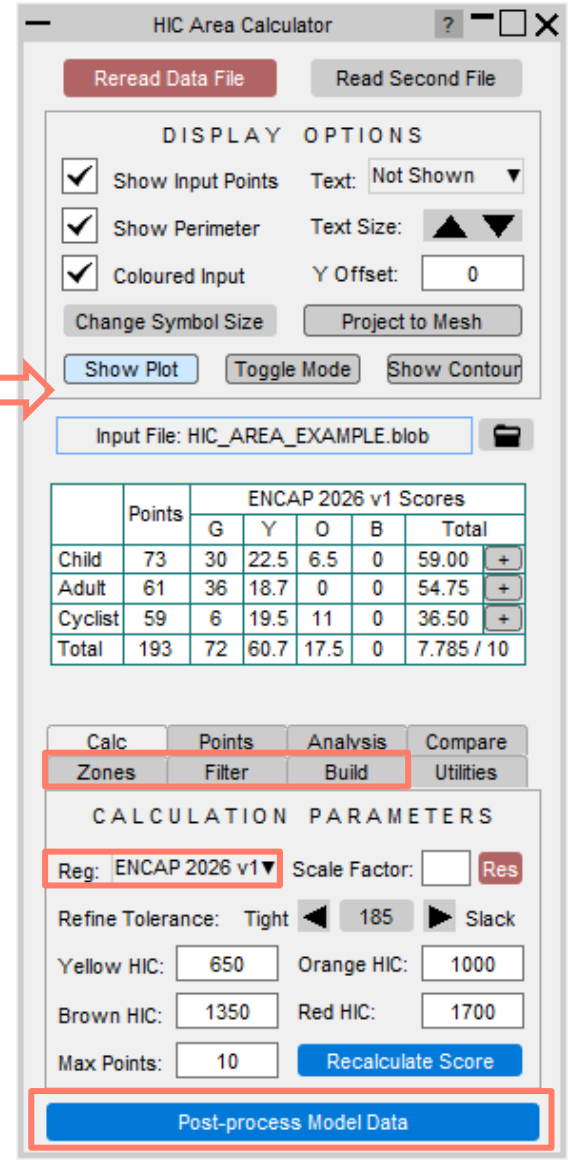
Acknowledgements: www.saferresearch.com
Acknowledgements: www.vivaplus.readthedocs.io

HIC Area Calculator and Processor

HIC Area Calculator

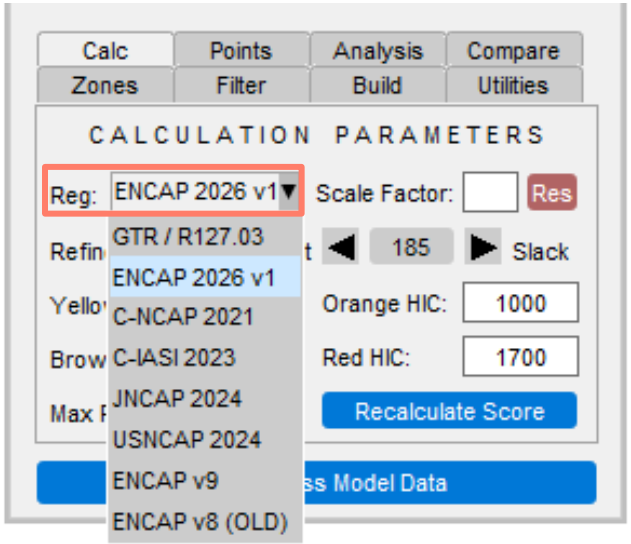
- The HIC Area Calculator is a powerful tool for pedestrian head impact analysis. For PRIMER 23.0 it has received a variety of enhancements:
  - New protocol support.
  - Filter options for HIC point display and labelling.
  - Ability to build new points from within the calculator.
  - Zone creation tools for high/low HIC zone curation.
  - Ability to read a .lst file as input and/or .blob files with impacts that have not been analysed/processed.
  - Seamless integration with new HIC Processor tool.
  - Improvements to area interpolation calculation.





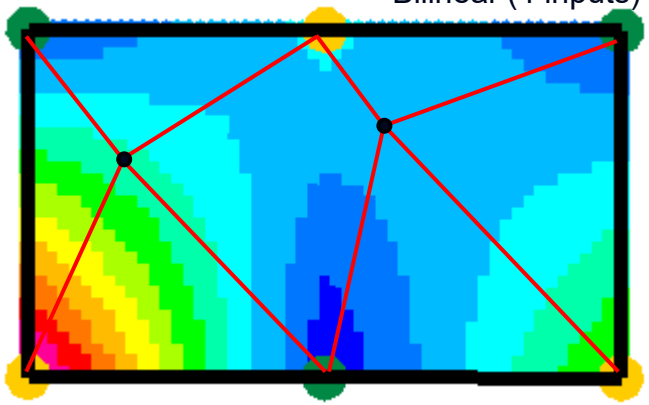
HIC Area Calculator – Scoring & Calculation

- New protocol support for:
  - EuroNCAP 2026
  - C-IASI 2023
  - JNCAP 2024
  - USNCAP 2024



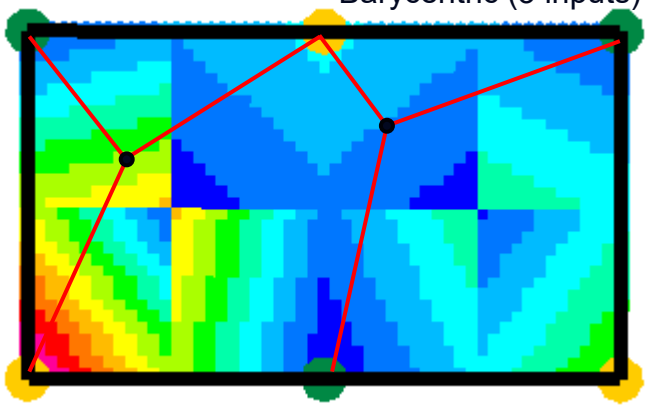
- Area calculation has been improved with updates to the criteria required to invoke bilinear interpolation (quadrilateral) instead of the default barycentric calculation (triangular).

PRIMER 23.0 Bilinear (4 inputs)



Smoother, uses more input data points.

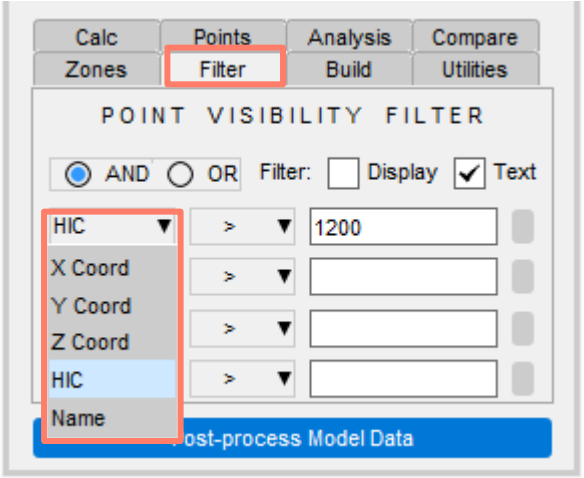
PRIMER 22.0 Barycentric (3 inputs)



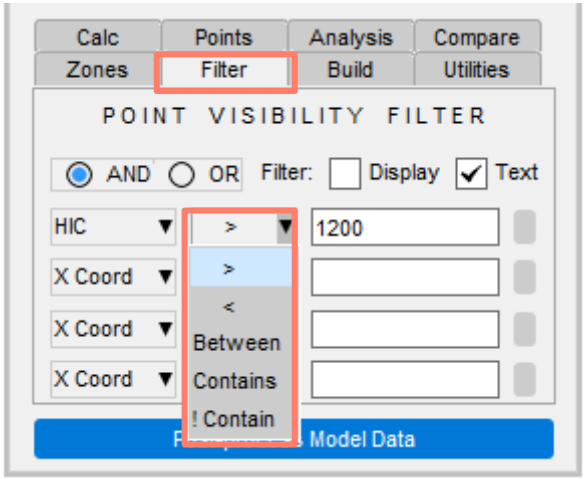
Checkerboarding possible under certain conditions.

HIC Area Calculator – Filter Tab

- The new filter tab makes it possible to show/hide blobs and/or blob labels based on their properties (including user defined properties).
- Properties can be numeric (e.g. HIC) or text based (e.g. Name).
- Numeric properties can be filtered by greater than, less than or between two values.
- Text properties can be filtered by whether they do or do not contain a substring.
- It's possible to supress the blob display entirely or just the label.
- Four individual filters are possible and can be combined using Boolean AND/OR logic.
- **Filters only apply to the display, they do not change any calculations.**



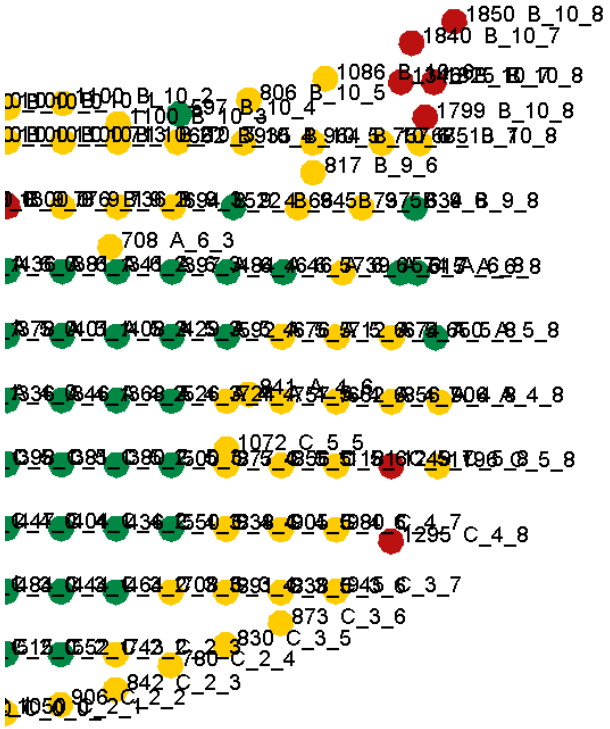
Point Properties



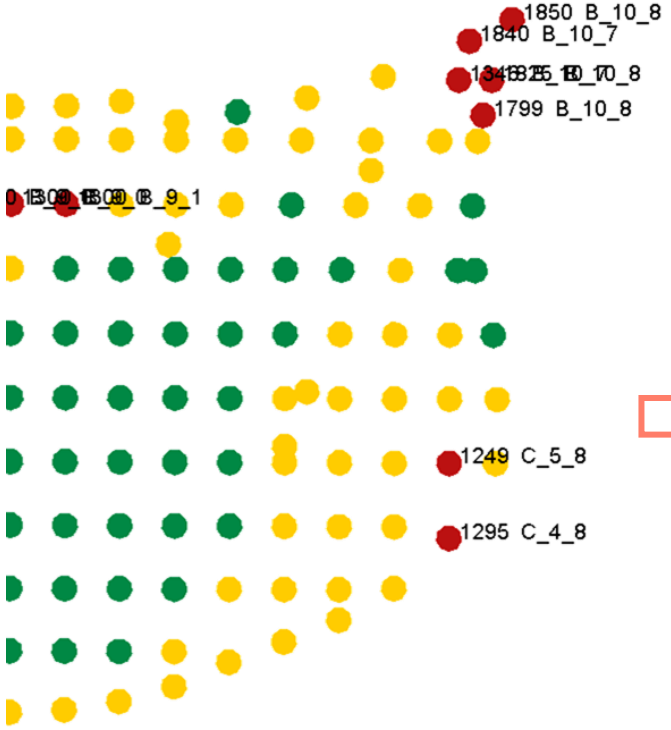
Filter Method

HIC Area Calculator – Filter Tab

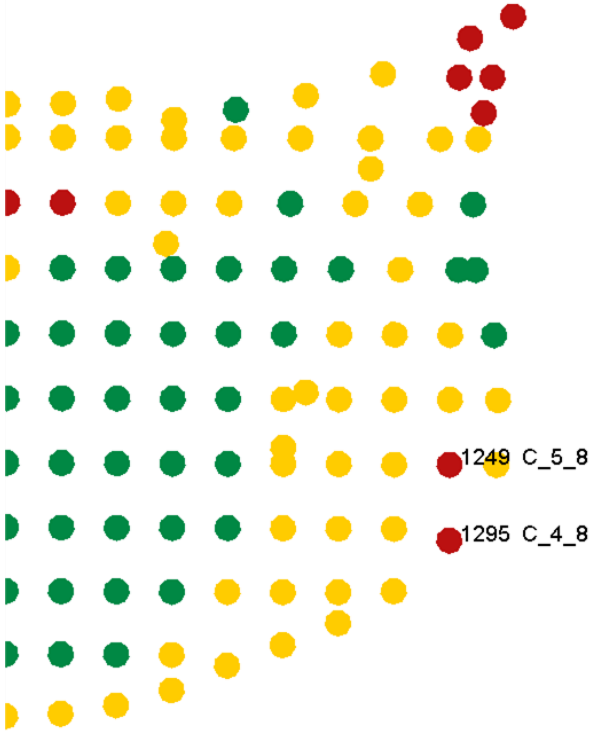
- An example of the filter being used to label only bonnet points exceeding HIC threshold:



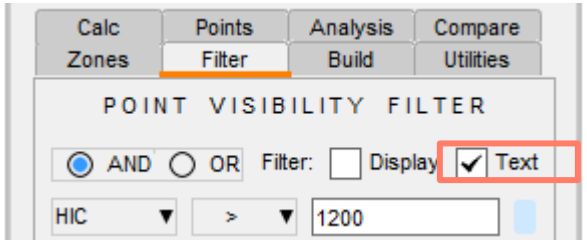
No Filter – impossible to read labels when zoomed out



Showing text for points with HIC > 1200 only

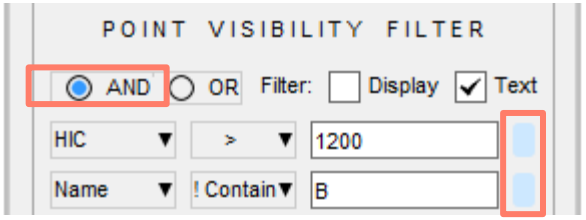


Showing text for points with HIC > 1200 only **AND** Names <u>not</u> containing 'B'



Text only

AND logic



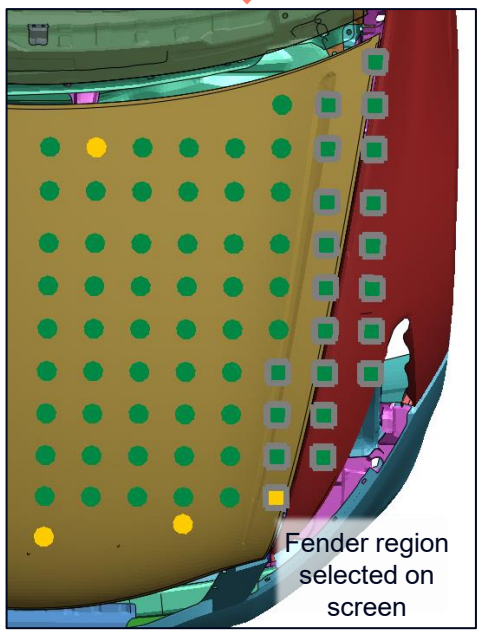
Filter on/off buttons

HIC Area Calculator – Build Tab

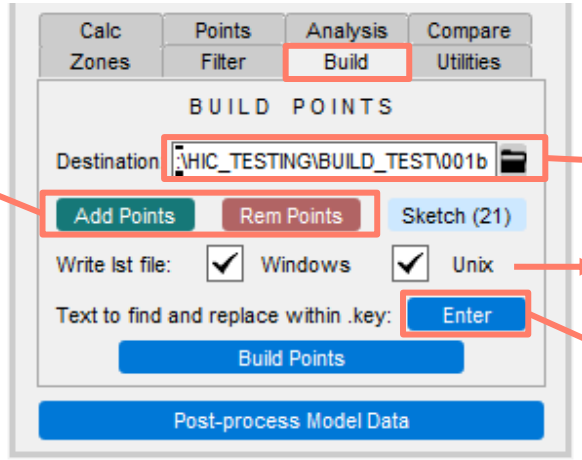
- The new build tab brings functionality found in the Pedestrian Run Builder tool (limited to .lst file input) to the HIC Area Calculator.

- It allows you to select points interactively, identify includes or parameters to change, and output .key files for the selected points with the new inputs.

- Quickly creating new input decks from previous iterations.



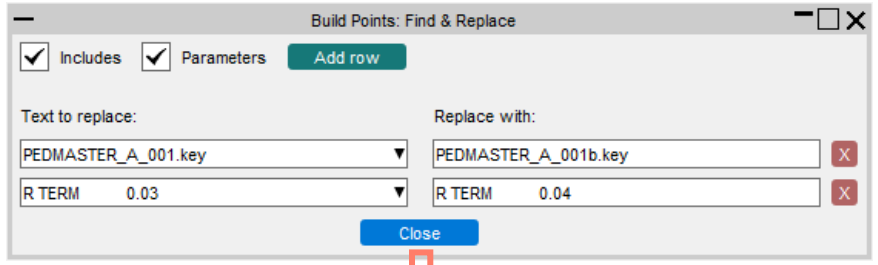
Add and remove points interactively

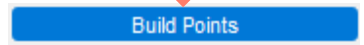


Output Location

.lst output (for HPC submission)

Find and replace inputs (*INCLUDE & *PARAMETER)





PEDMASTER_A_001.key string to be replaced by PEDMASTER_A_001b.key
&
Parameter setting termination time increased from 0.03 to 0.04.

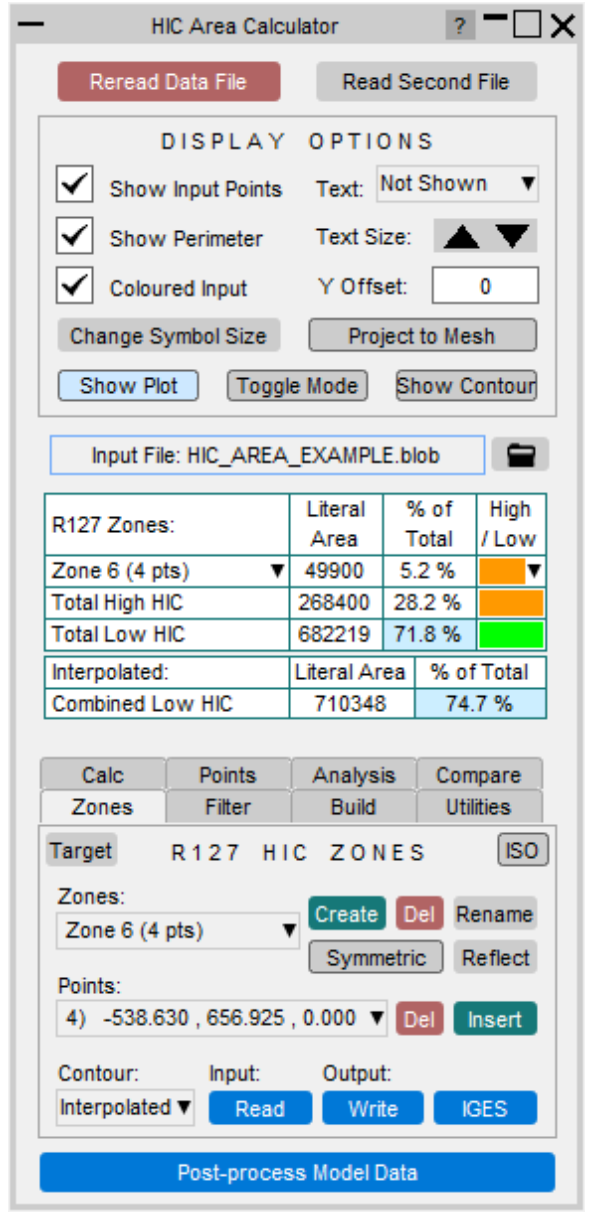
```
$
*PARAMETER
R VEL      -9722.22
R TERM          0.03
$
*INCLUDE
/data/veh/analysis/ped/master/ +
PEDMASTER_A_001.key
```

```
$
*PARAMETER
R VEL      -9722.22
R TERM          0.04
$
*INCLUDE
/data/veh/analysis/ped/master/ +
PEDMASTER_A_001b.key
```

HIC Area Calculator – Zones Tab

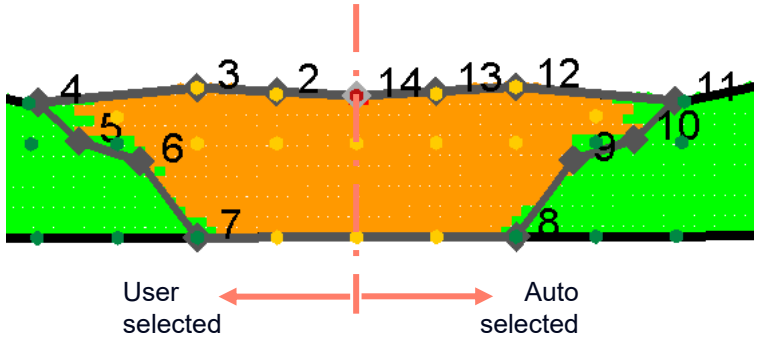
- The Zones tab is a response to feedback requesting the ability for users to create their own high/low HIC zones as part of vehicle homologation.

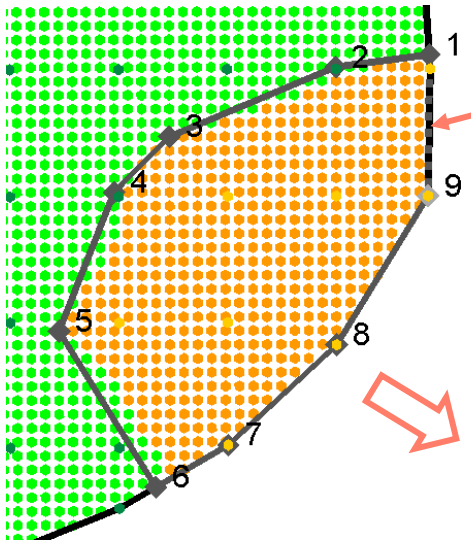
- The menu provides the ability to:
  - Target a given % HIC area (existing functionality).
  - Plot ISO points for a specific HIC value (existing functionality).
  - Create user defined high or low HIC zones.
  - Reflect and modify user-defined zones.
  - Calculate areas based on defined zone geometry (rather than interpolation).
  - Plot user defined zones in 2D or 3D.
  - Read/Write zones as text files.
  - Write IGES lines for sharing as CAD geometry.

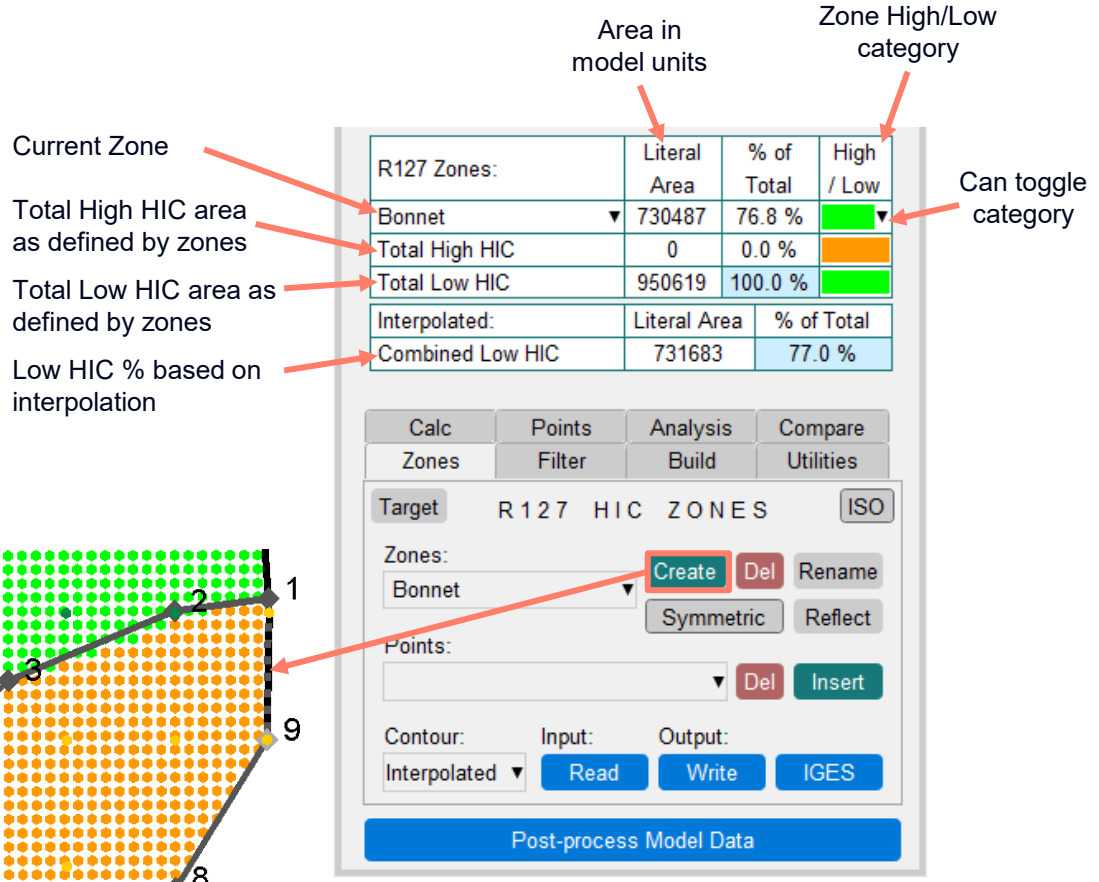


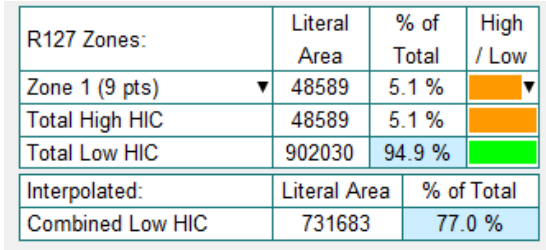
HIC Area Calculator – Zones Tab

- Initially no user zones are defined. Only the bonnet and windscreen are listed and assumed low HIC.
- Zones are built-up by selecting points on the screen and assigned to be high (default) or low.
- Points can be inserted or removed from existing zones.
- Zones can be named, deleted and reflected.
- A ‘Symmetric’ picking mode allows pairs of points to be selected across a line of symmetry.





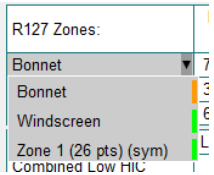


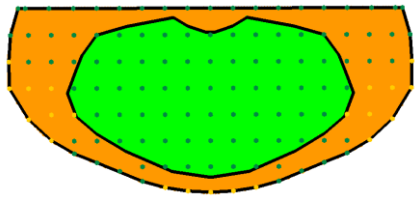


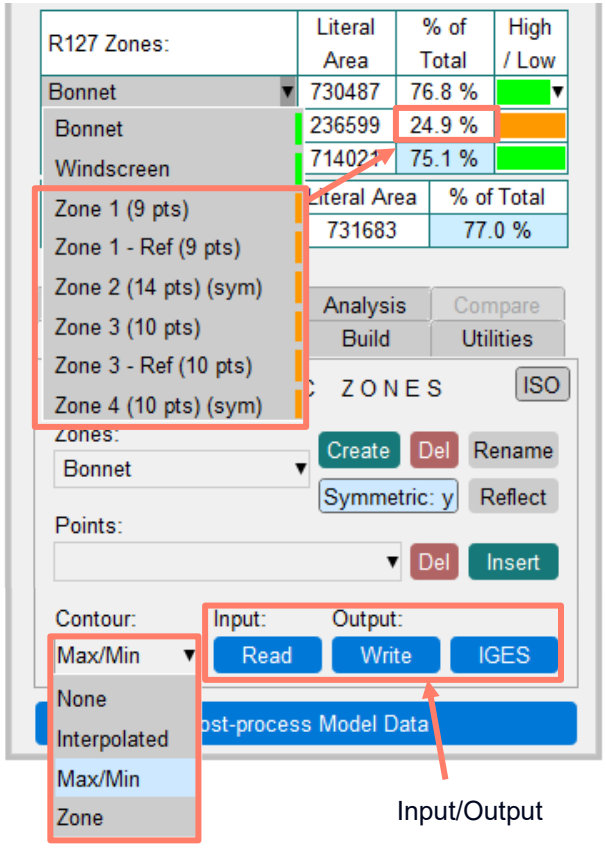
HIC Area Calculator – Zones Tab

- In this example the % low HIC area calculated by interpolation is 77%.
- However, the OEM wishes to declare 75%, to account for some boundary uncertainty.
- 6 high zones are created which sum to 24.9%.
- The zones can be saved as text or CAD.
- Additionally, the colouring of the interpolated points can be controlled by the dropdown.

- Tip: the default (bonnet/windscreen) assignment can be toggled to high HIC, and user zones to be low HIC, for cases where the outside of the zone forms a ring:

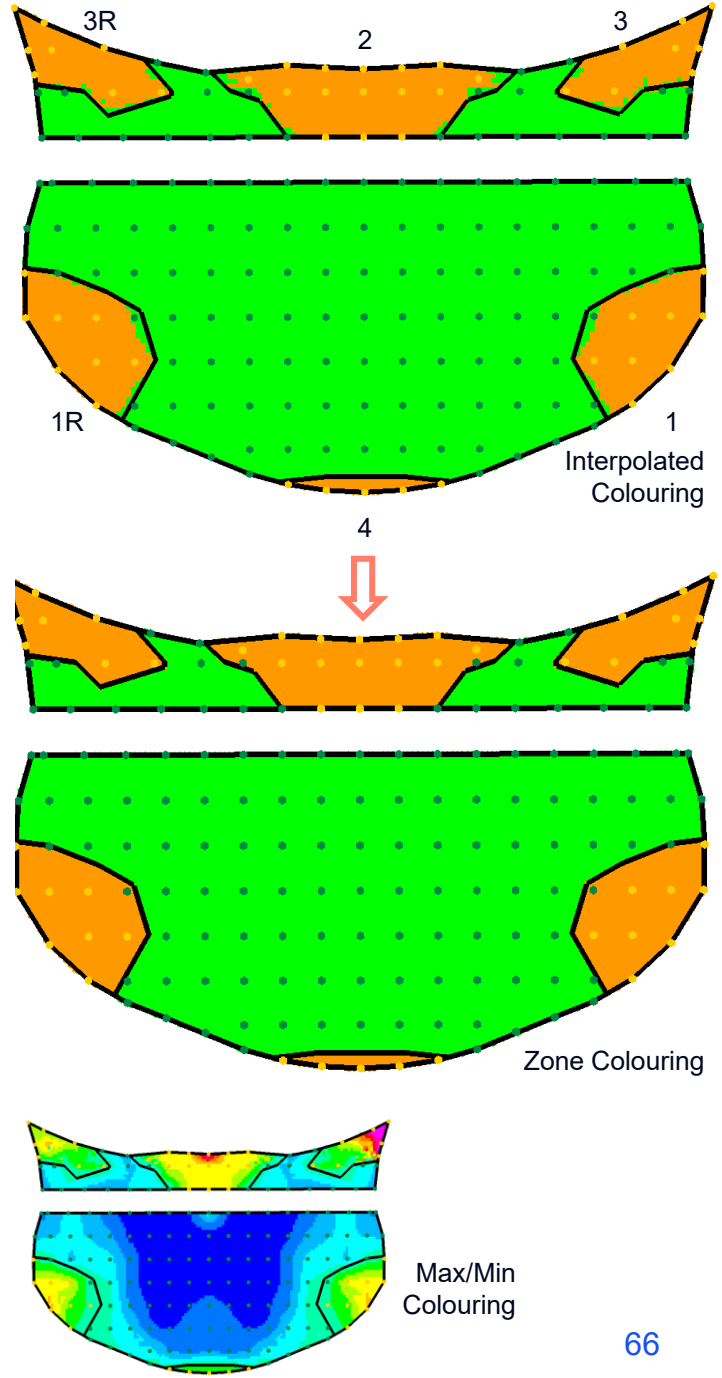






Contour colouring options

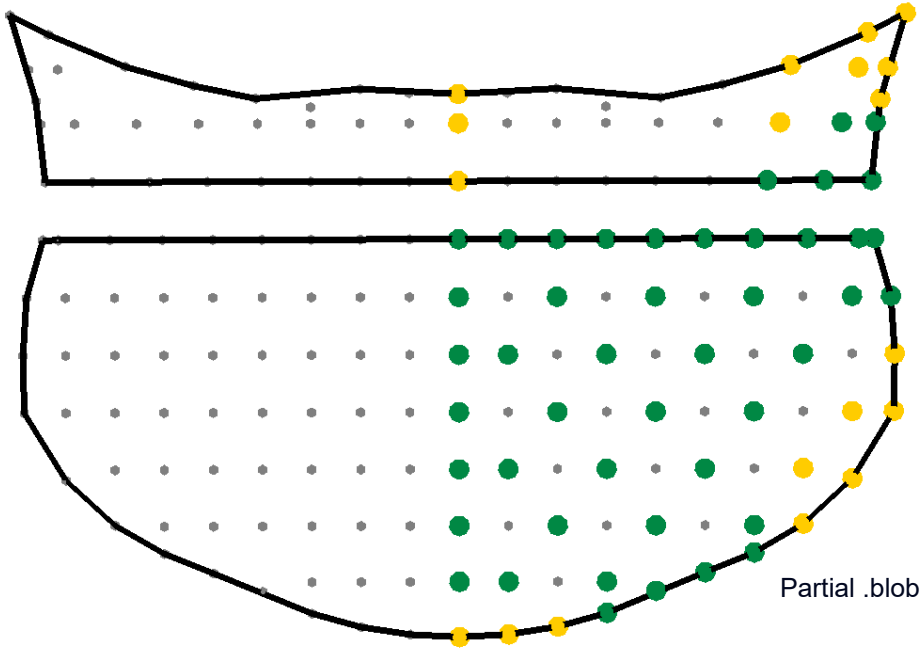
Input/Output



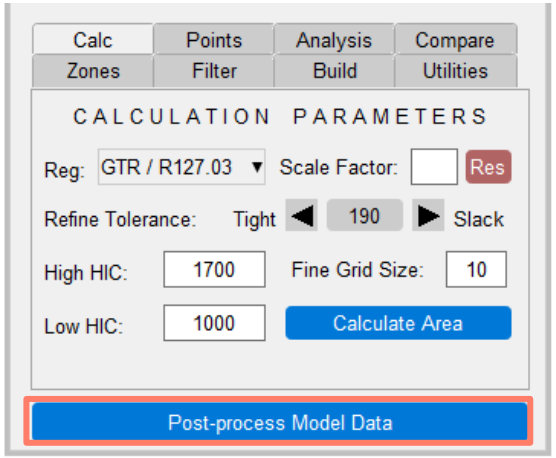
Max/Min Colouring

HIC Area Calculator – .lst File Input & 'Blank

- In addition to .blob files, the HIC Area Calculator can now read .lst files.
- .lst files are outputs from the model build process and are used as inputs to other processes (e.g. REPORTER).
- They contain relevant impact point data but not a HIC result.
- When a HIC value is not present, the impact **is ignored from any calculations**, but it is still displayed using grey colouring. HIC values can then be added via post-processing or by manual edits as part of 'what-if' experiments.
- In combination with the new HIC Processor tool, it enables you to take .lst files directly from model build and post-process the HIC results into a .blob file.
- An extension to this is that it's also now possible for .blob to be partially complete i.e. containing points without HIC values. Providing useful context for engineers working with subsets of results.



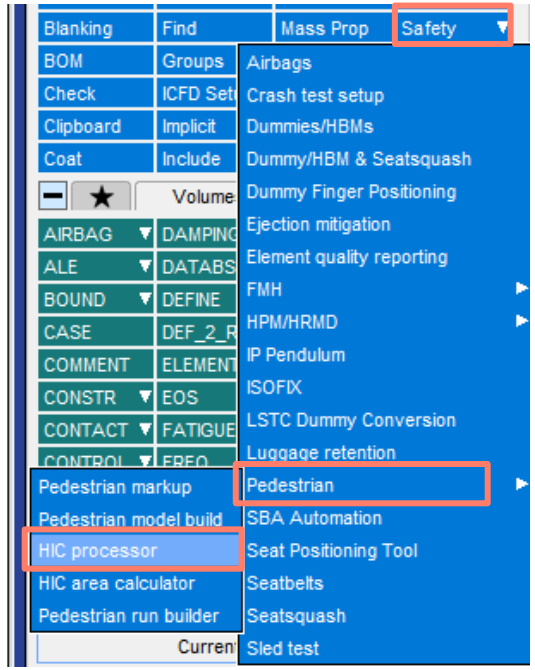
Partial .blob file.

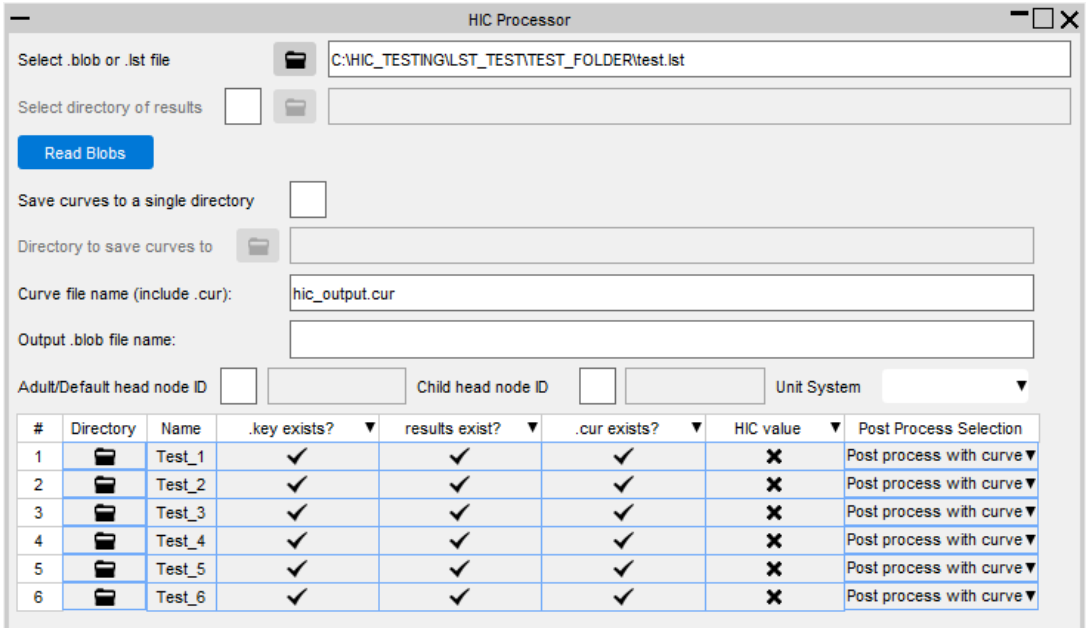


Post-process direct from HIC Area Calculator

HIC Processor

- The HIC Processor is a new tool in Oasys Suite 23.0.
- It can be accessed via a number of routes:
  1. PRIMER → Safety → Pedestrian → HIC Processor
  2. PRIMER → Direct from HIC Area Calculator
  3. T-HIS → Within the JavaScript menu
  4. T-HIS → As a batch process
- It enables quick processing of head impact analyses.
- It can process raw results data or extract HIC from existing output curve files.
- It produces acceleration time history curves and .blob files for use with the HIC Area Calculator or D3PLOT.

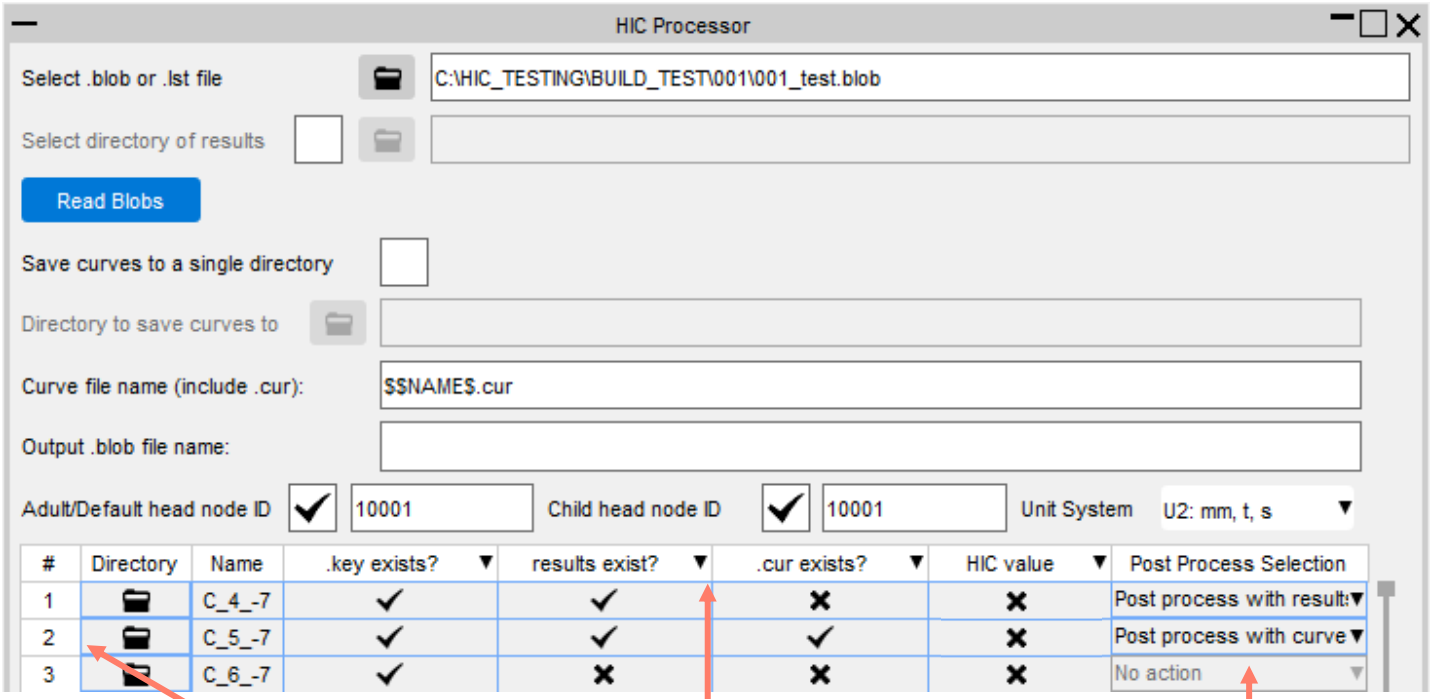




HIC Processor

- It works by following these steps:

1. Read a .blob or .lst file.
2. The tool will scan the individual result directories to determine:
   a) Does the input .key file exist?
   b) Are there results present?
   c) Have the results been processed, is there an existing results curve.
3. Choose to write all curves to a single directory or to write them within their respective results directories.
4. Define a filename for the output curves ($$NAME$ can be used for uniqueness).
5. Define a filename for the .blob file.
6. Input node ID's and unit system.



Columns can be filtered

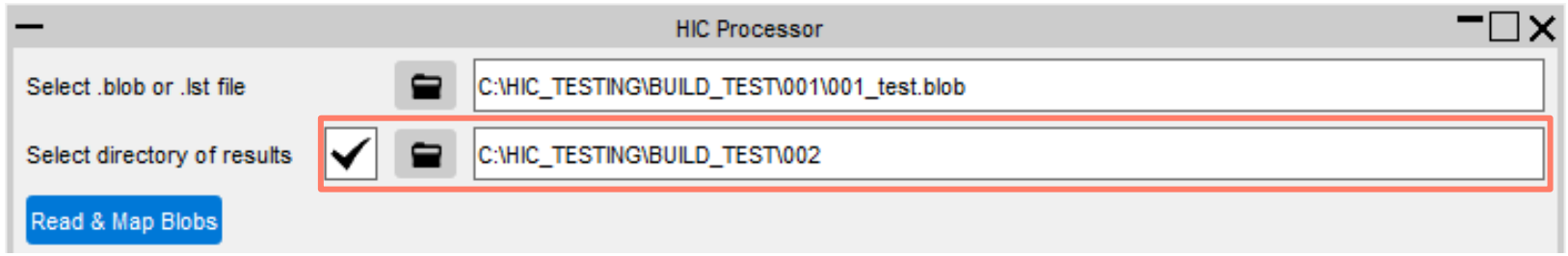
Multiple rows can be selected/edited using ctrl and shift selections

You can choose how to handle each result:

- Post-process with result will open the LS-DYNA output data and extract the time history curve, and HIC.
- Alternatively, if the curve is available the tool can open it and extract the HIC from the existing curve – useful for quickly generating .blob files from existing data/processes.
- Take no action. This may due to lack of data, or it could be that a partial .blob file is being processed, where some results are already known.

HIC Processor

- Additionally, there is an optional input to define a new results directory.
- When used, the directory is blended with the filepaths in the .blob (or .lst) to generate the new set of individual results directories.
- This allows you to post-process sets of new results without a necessary input file, an old file can be used and combined with the new results parent directory.



.blob:

`C:\HIC_TESTING\BUILD_TEST\001\CHILD\C_1_0` ← What's input

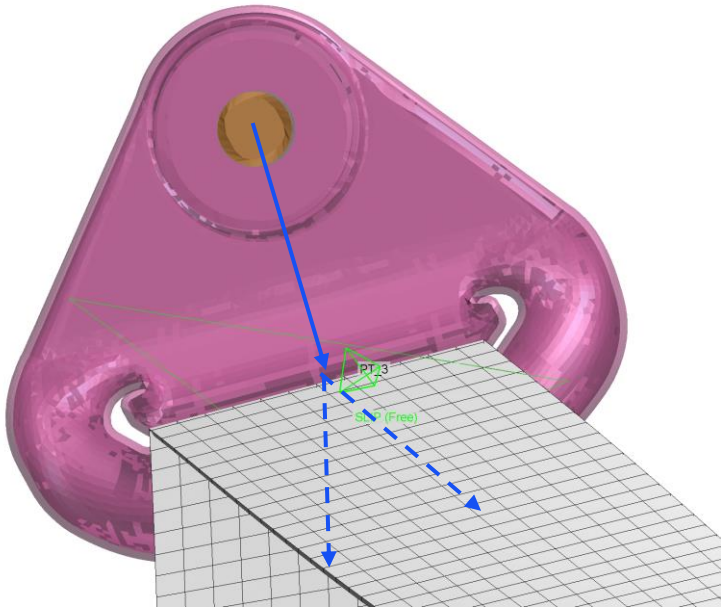
Combined with new directory:

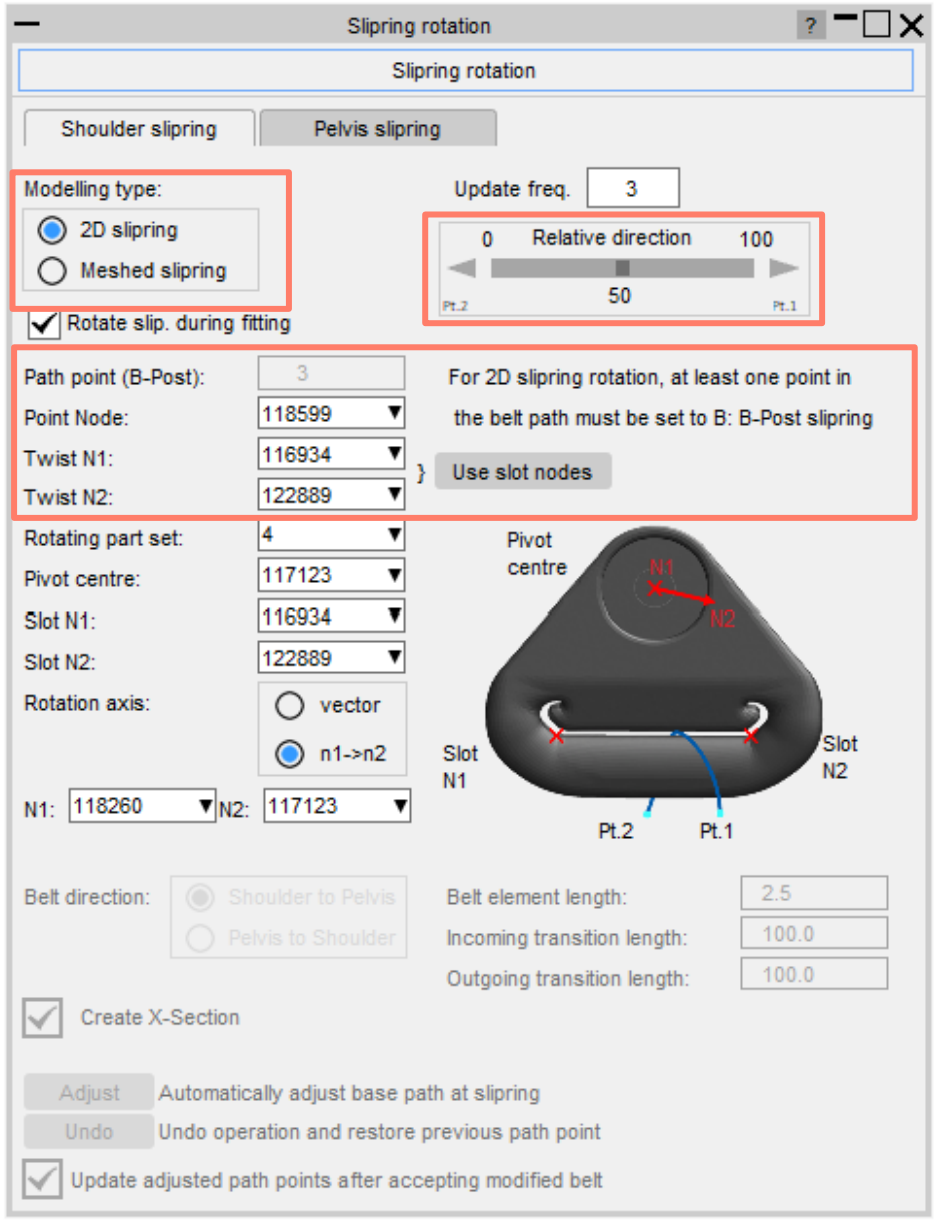
`C:\HIC_TESTING\BUILD_TEST\002\CHILD\C_1_0` ← What's processed

Seatbelt Enhancements

2D slipring rotation – Shoulder slipring

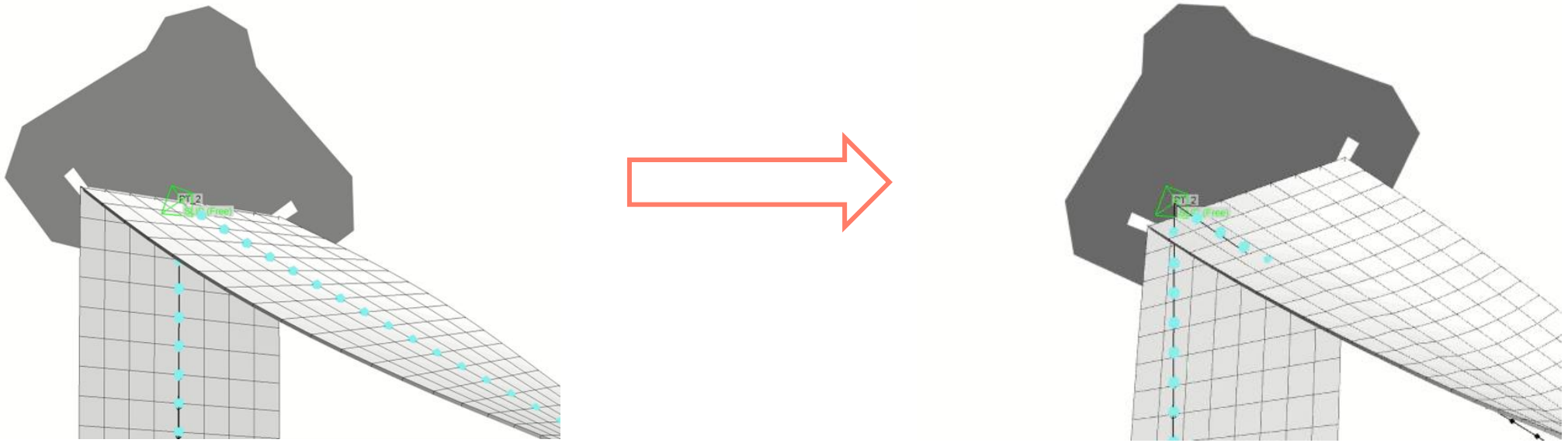
- The 'Slipring rotation' (formally 'Explicit slipring') panel has been updated to support the 2D slipring modelling type.
- If the modelling type is set to '2D slipring', the slipring will be automatically rotated so its radial vector aligns with the vector computed as a weighted interpolation between the belt's incoming and outgoing vectors projected onto the slipring plane. The alignment of the target vector can be controlled through the 'Relative direction' parameter.





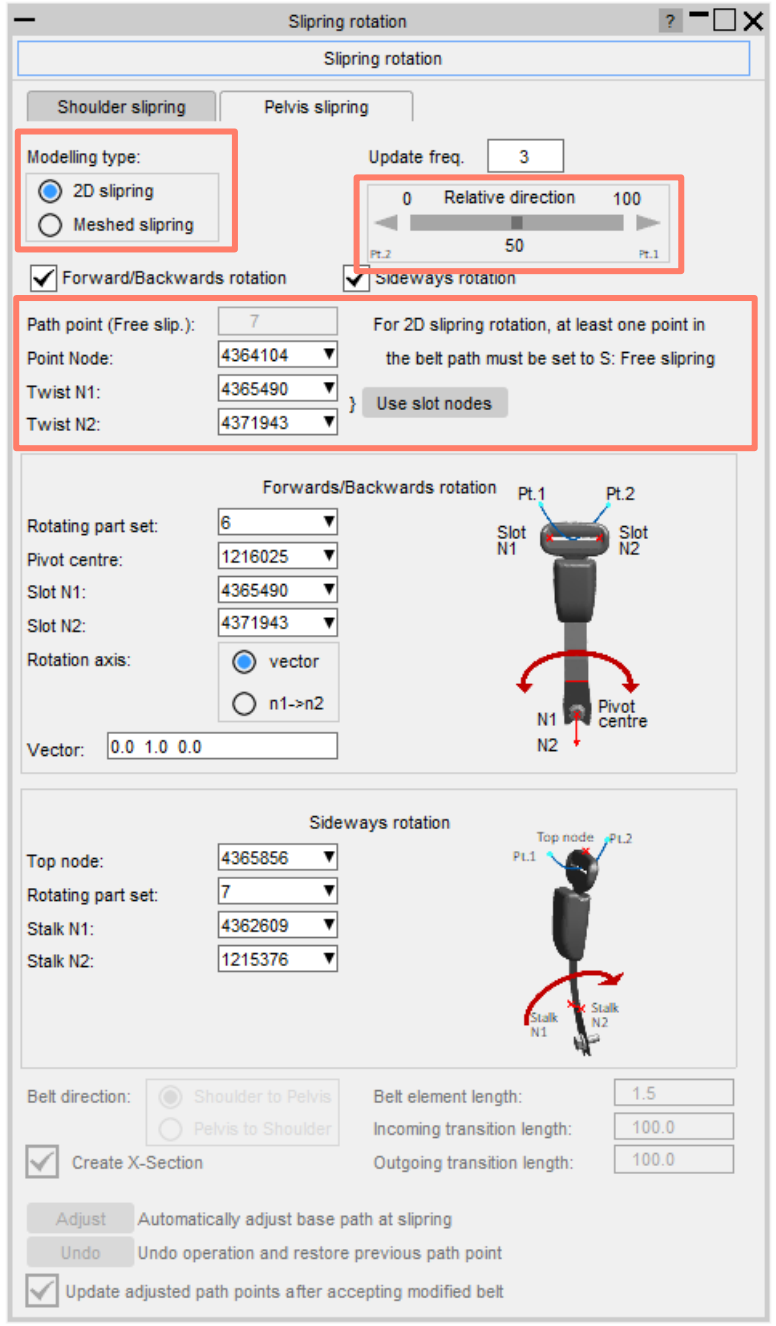
2D slipring rotation – Shoulder slipring

- The 2D slipring must be represented by a B-Post slipring path point during path definition and attached to a physical structure modelling the dynamics of the shoulder slipring.
- If the 2D slipring rotation feature is used, the meshed slipring structure will be rotated along with the B-Post slipring point and twist segment.



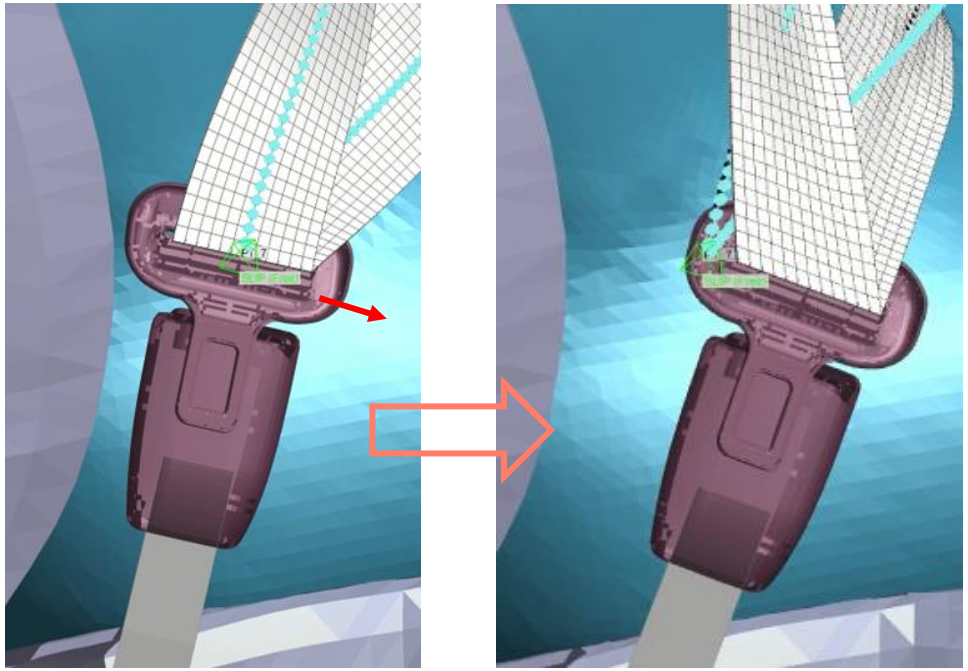
2D slipring rotation – Pelvis slipring

- The same logic applies for the pelvis slipring 2D slipring rotation, with the only difference being that the type of the path point representing the 2D slipring must be set to 'Slipring (free)' instead of 'B-Post Slipring'.

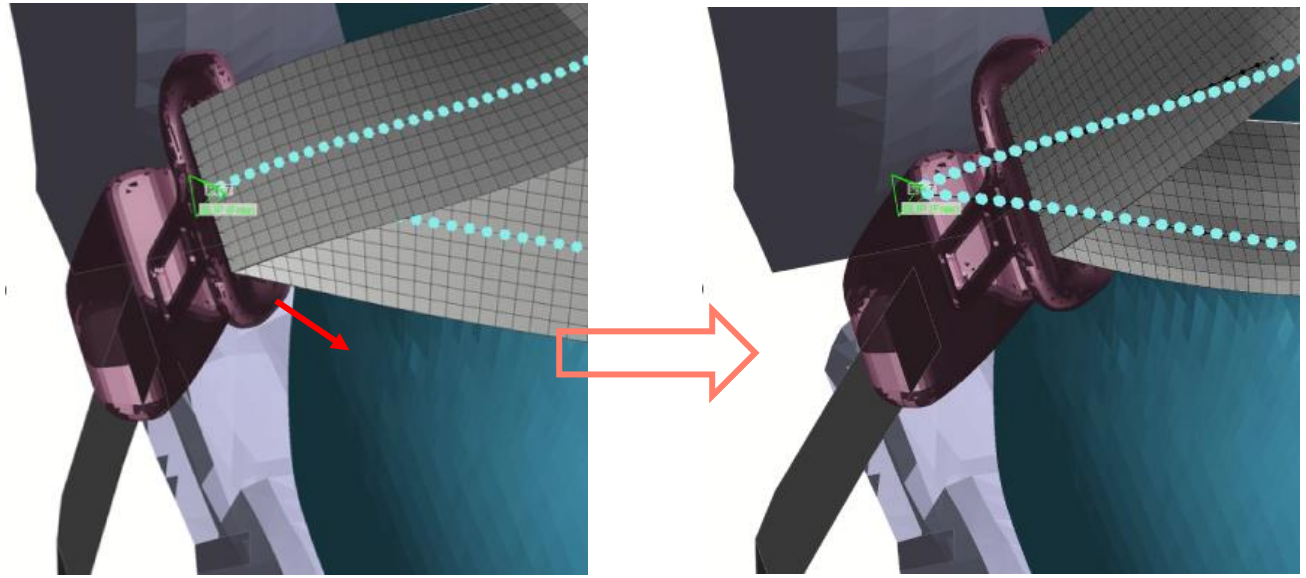


2D slipring rotation – Pelvis slipring

- Both 'Forward/Backward rotation' and 'Sideways rotation' can now be applied to the pelvis 2D sliprings.



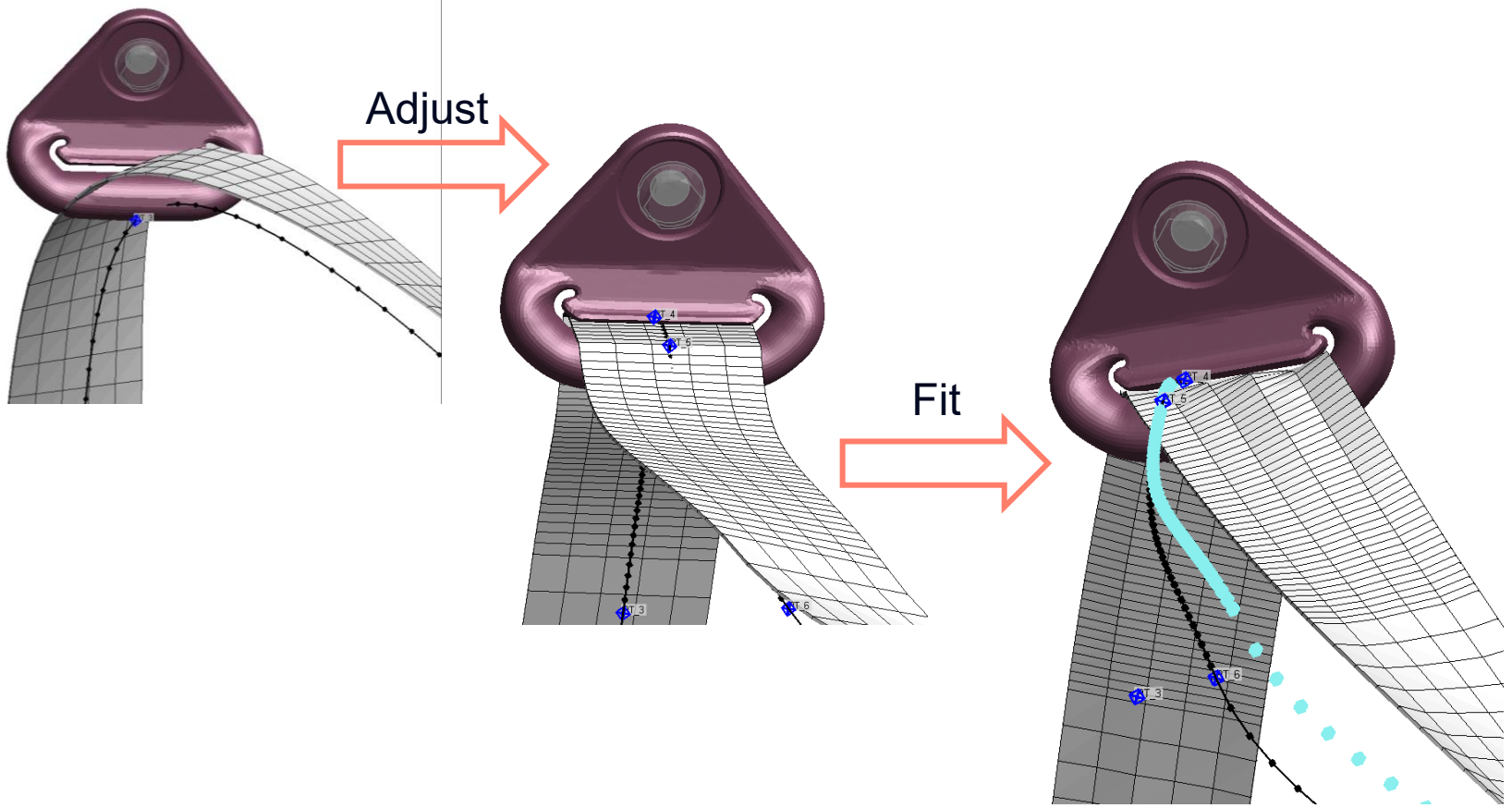
Forward/Backward rotation

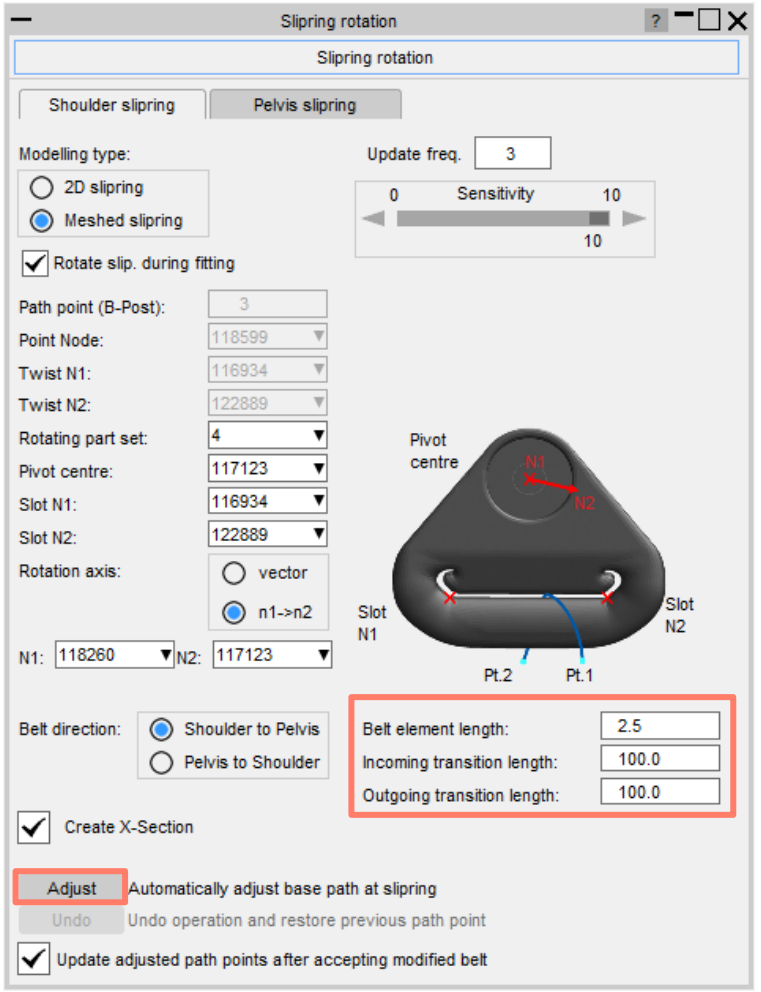


Sideways rotation

Finer belt mesh around sliprings

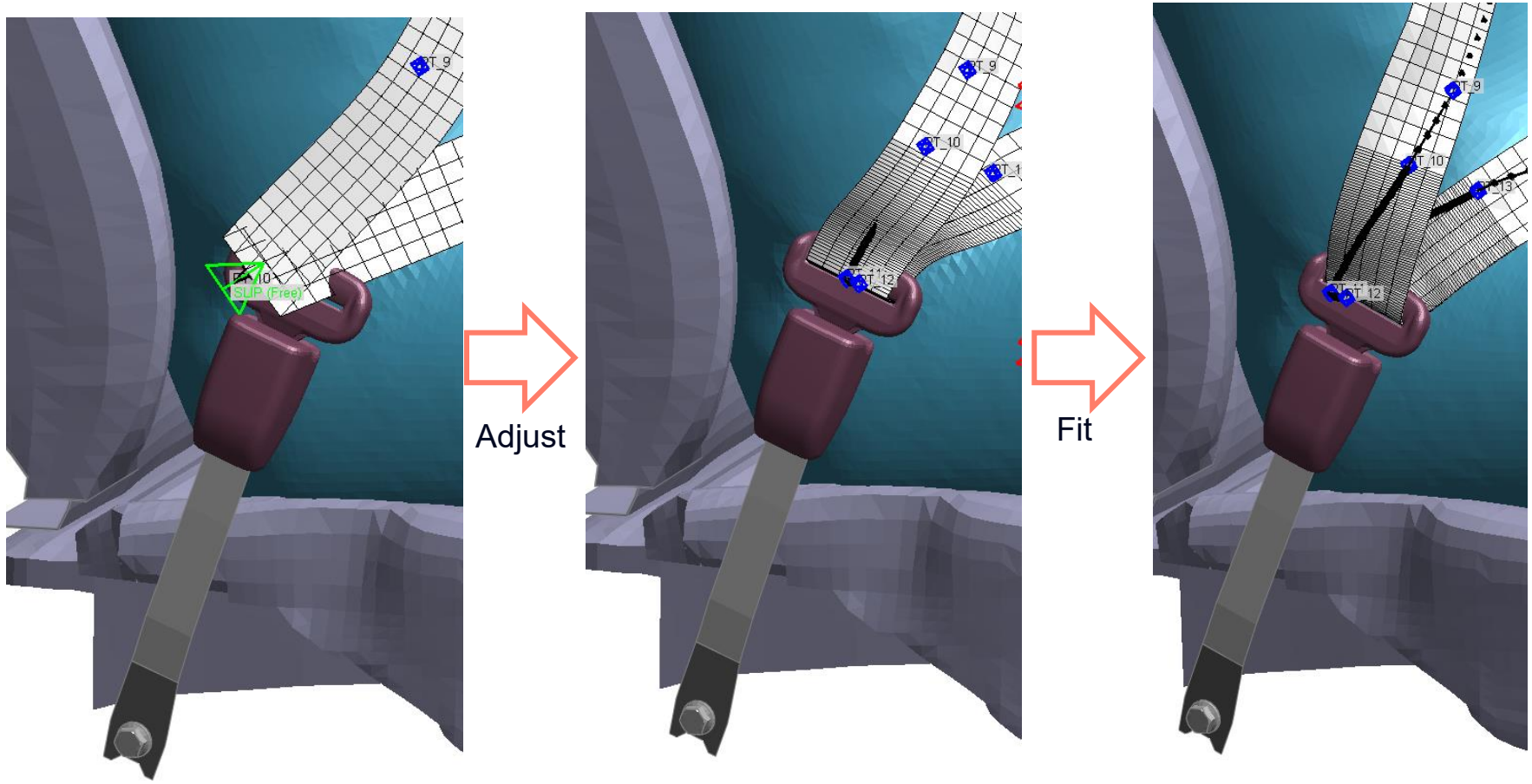
- Added the option to set a finer mesh for the belt region passing through an explicitly meshed slipring when the ‘Adjust’ feature from the ‘Slipring rotation’ panel is used for shoulder sliprings.

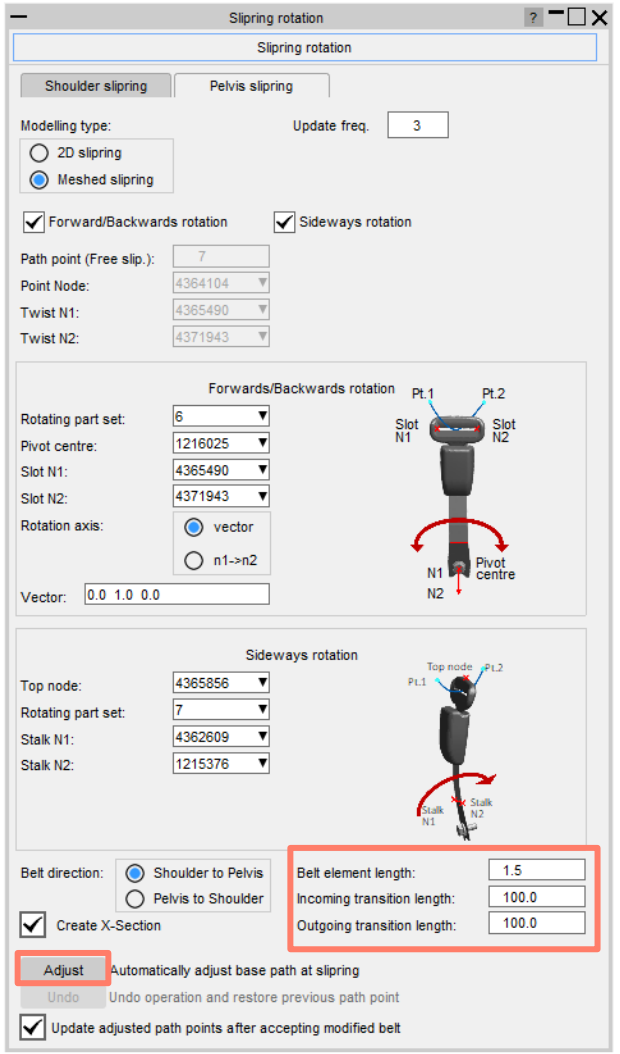




Finer belt mesh around sliprings

- The same option has been added for pelvis sliprings.

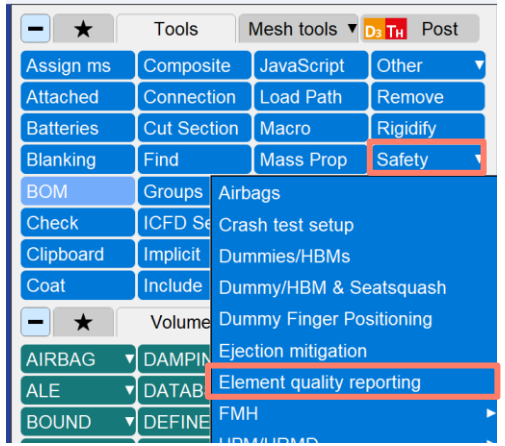


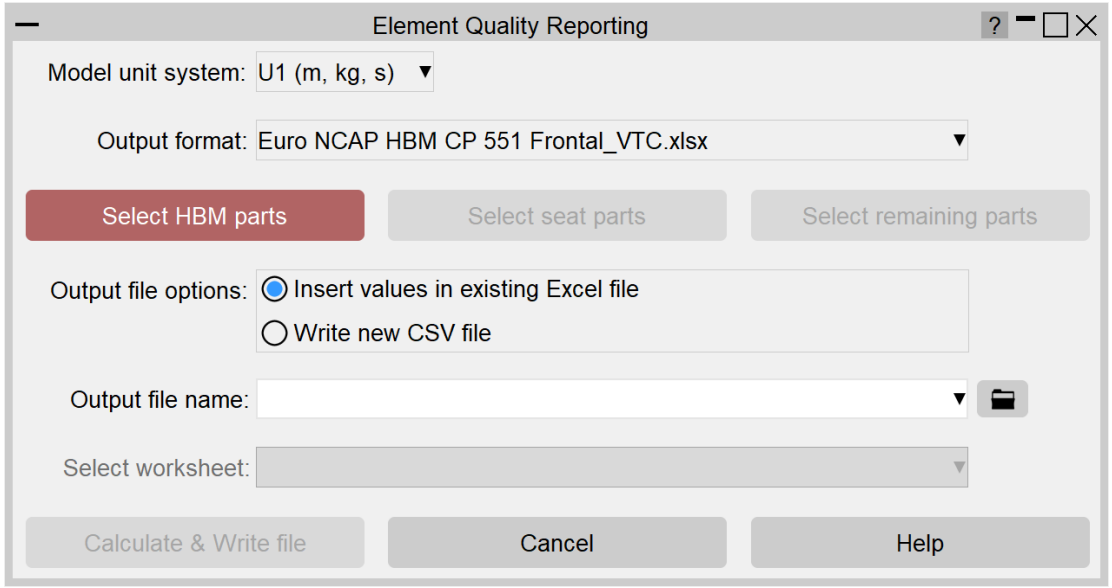


Element Quality Reporting

Element Quality Reporting

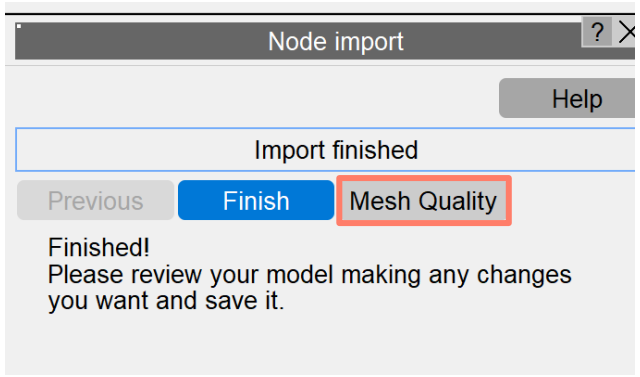
- A new element quality reporting tool is available under Safety → Element quality reporting.
- Data exported includes number of shell/solid elements, Jacobian, aspect ratio, warpage, timestep.
- The tool can be used to write an element quality report according to two formats:
  - Euro NCAP HBM CP 551 Frontal VTC
  - IIHS Rear Impact SIMULATION Data Submission
- There are two ways to generate the output file:
  - Inserting values into an existing Excel file
  - Write a new CSV file

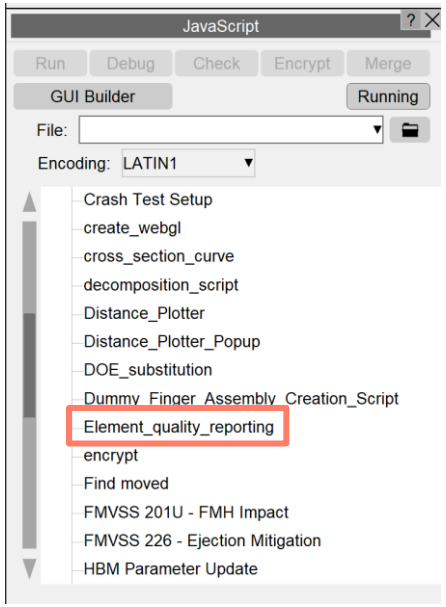




Element Quality Reporting

- You can specify the unit system of the model and the values will be output accordingly.
- For the Euro NCAP HBM Frontal VTC option, you are required to select the HBM parts to generate the report.
- For the IIHS Rear Impact option, you are required to select HBM parts, seat parts and remaining parts.
- If writing values to existing file, you can select the worksheet to which you want to export the values.
- This tool is also accessible at the end of the Node import process or through the standard JavaScript menu.





Element Quality Reporting

- Example output for Euro NCAP HBM CP 551 Frontal VTC

Quality criterion	measure	Original HBM
Number of shell elements	#	210439
Number of solid elements	#	186808
Jacobian - Shell	Min. value	0.427927405
	# of elements < 0.3	0
	# of elements < 0.5	6
	# of elements < 0.6	80
Jacobian - Solid	Min. value	0.383053243
	# of elements < 0.3	0
	# of elements < 0.5	126
	# of elements < 0.6	1062
Aspect Ratio - Shells	Max.	4.166687012
	# of elements >6	0
	# of elements >8	0
	# of elements >10	0
	Max.	4.560347557
	# of elements >6	0

- Example output for IIHS Rear Impact SIMULATION Data Submission

Quality criterion	measure	Dummy model (positioned)	Seat model (after dummy positioning)	All remaining model components
Number of shell elements	#	210439	210439	210439
Number of solid elements	#	186808	186808	186808
Jacobian - Shell	Min. value	0.427927405	0.427927405	0.427927405
	# of elements < 0.3	0	0	0
	# of elements < 0.5	6	6	6
	# of elements < 0.6	80	80	80
Jacobian - Solid	Min. value	0.383053243	0.383053243	0.383053243
	# of elements < 0.3	0	0	0
	# of elements < 0.5	126	126	126
	# of elements < 0.6	1062	1062	1062
Aspect Ratio - Shells	Max.	4.166687012	4.166687012	4.166687012
	# of elements >6	0	0	0
	# of elements >8	0	0	0
	# of elements >10	0	0	0
Aspect Ratio - Solids	Max.	4.560347557	4.560347557	4.560347557
	# of elements >6	0	0	0
	# of elements >8	0	0	0
	# of elements >10	0	0	0
Warpage - Shell	Max	45.48768234	45.48768234	45.48768234
	# of elements >5	10648	10648	10648
	# of elements >7.5	5667	5667	5667
	# of elements > 10	3122	3122	3122
	# of elements > 15	1026	1026	1026
	# of elements > 30	6	6	6

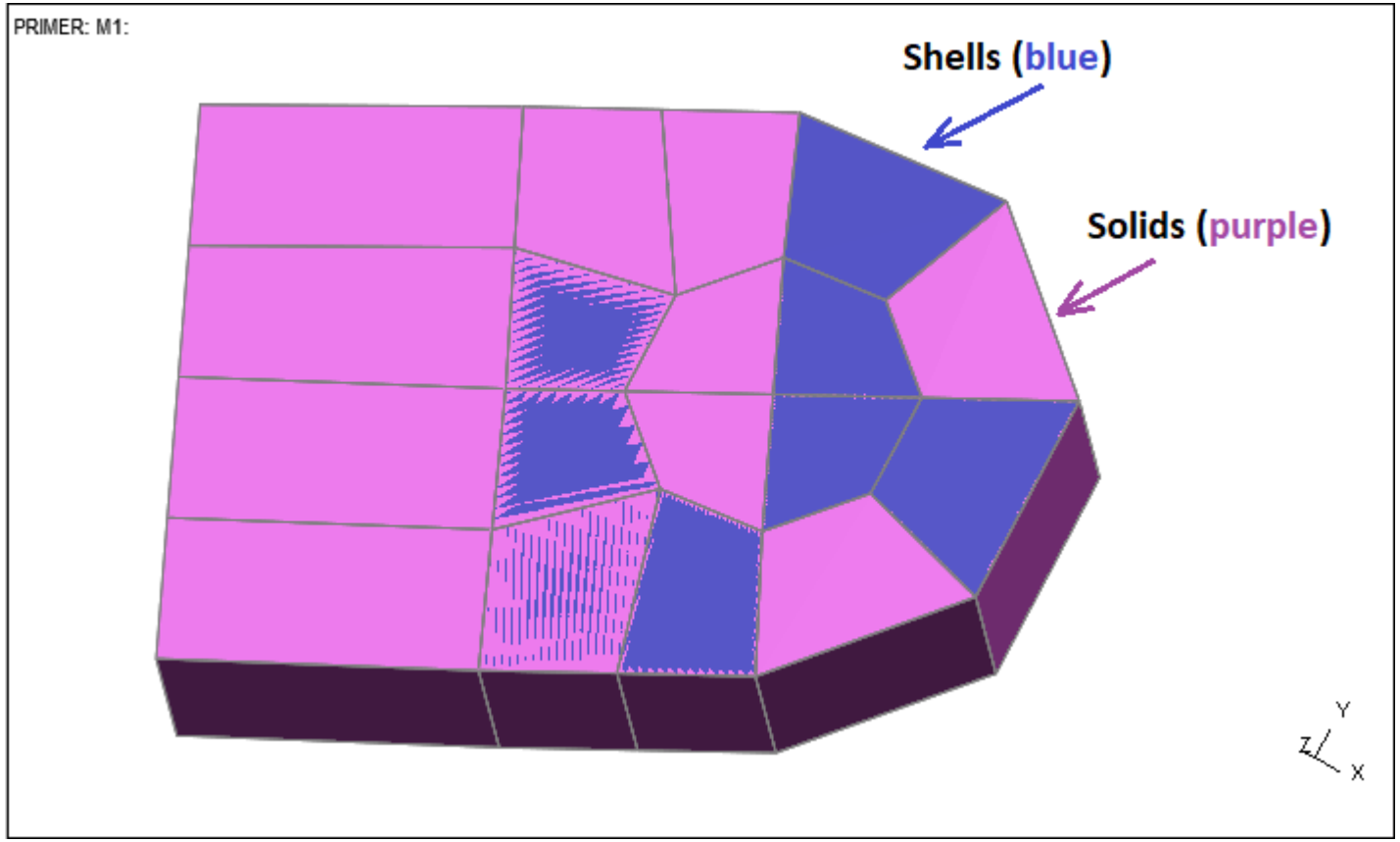

Speed and Performance

Sketching and Graphics

Improved graphics of coincident shells and solids #1

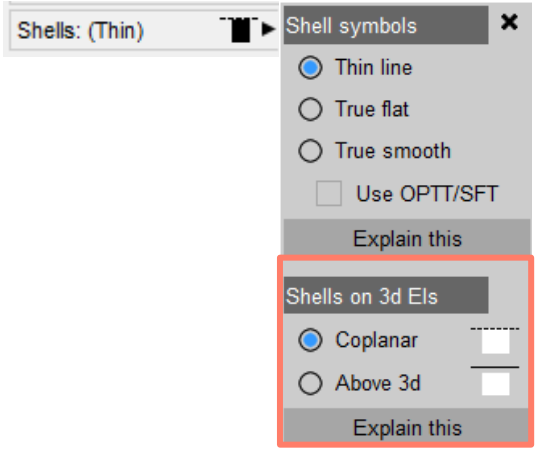
- When shells are meshed on solid faces, using the same topology, the default method of drawing them “thin on the neutral axis” means that graphics may show one or the other element type at random, and sometimes a mixture of the two as shown here.

- What is shown can change as the model is rotated.

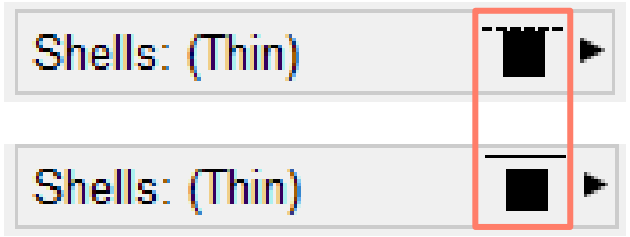


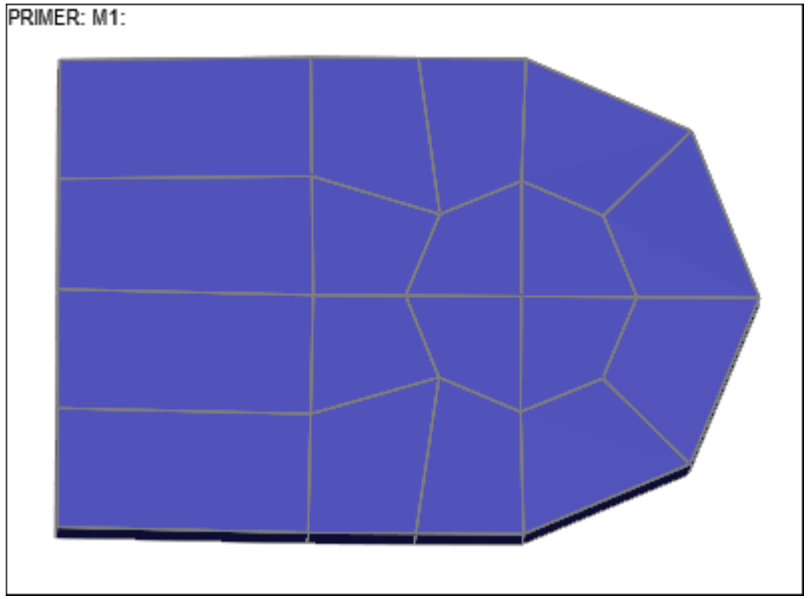
Improved graphics of coincident shells and solids #2

- A new “Shells on 3d elements” option has been added to the existing Shell display control popup menu in Display Options:
  - Coplanar, the existing “coincident with solid face” display method, remains the default for backwards compatibility.
  - Above 3d raises coincident shells above solid faces removing these graphics artefacts.



- The [Shell] button on the Display Options panel shows the currently selected mode:
  - Coplanar:
  - Above 3d:





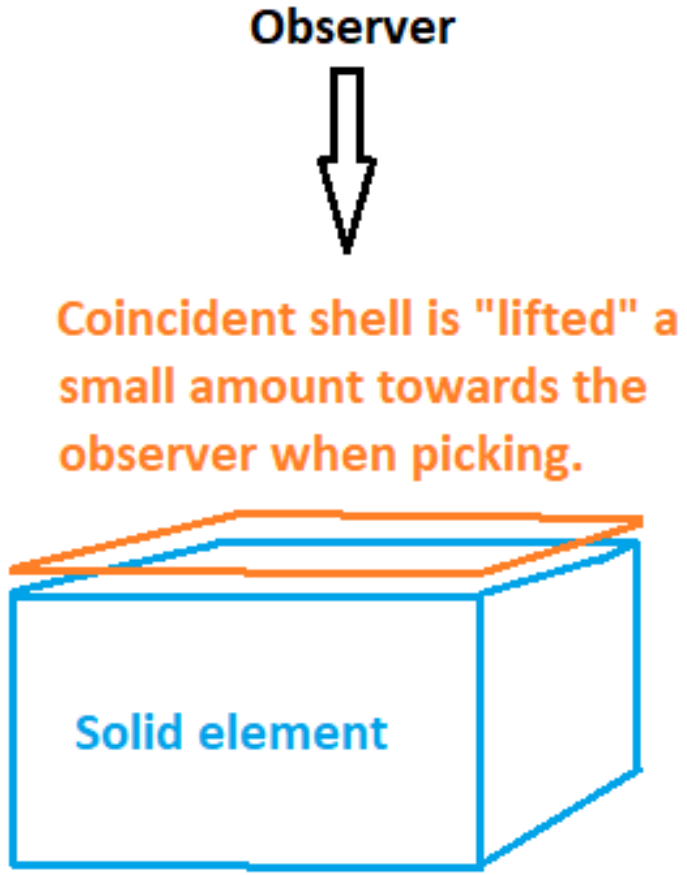
Screen-picking of coincident shells and solids

- Previously while screen-picking PRIMER had a slight bias in favour of shells when coincident with solids, but this was not consistent.

- This has been improved:

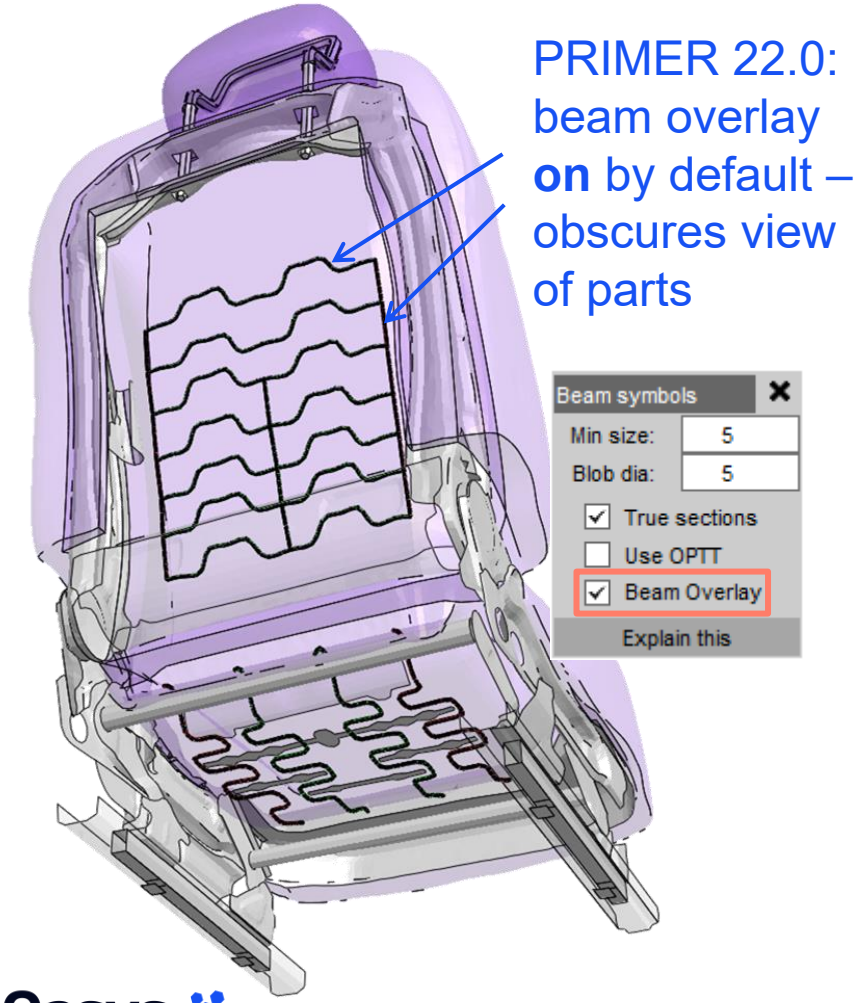
  - Where a shell is coincident with a solid element face and it would be legal to pick either element type, for example when picking parts, PRIMER will now always pick the shell.

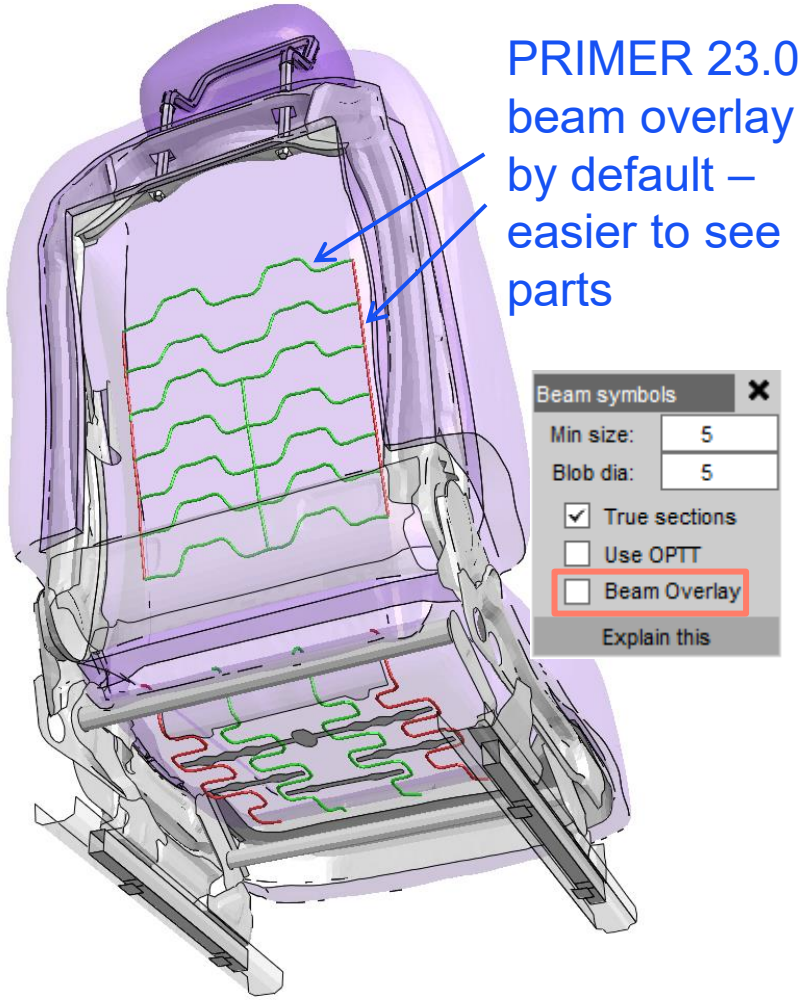
  - When only a single type, either shell or solid, is screen-picked in this situation it will be selectable “through” the other type, whether or not it is visible.

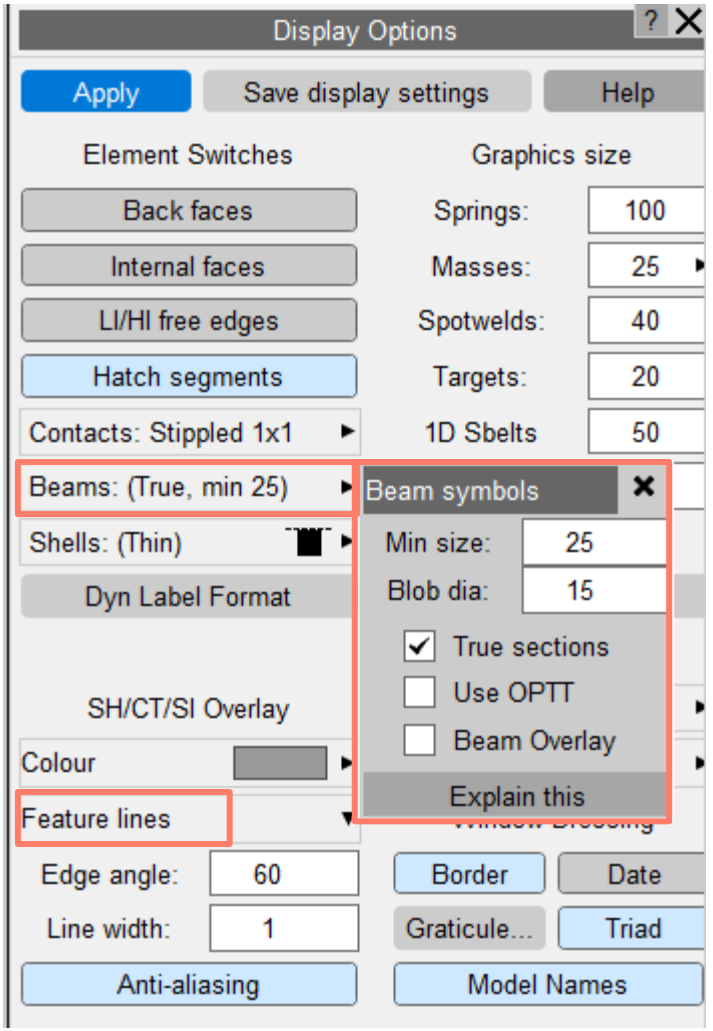


Control for overlay on true section beams

- In feature line/free edge modes, beam overlay is now off by default, but switchable.

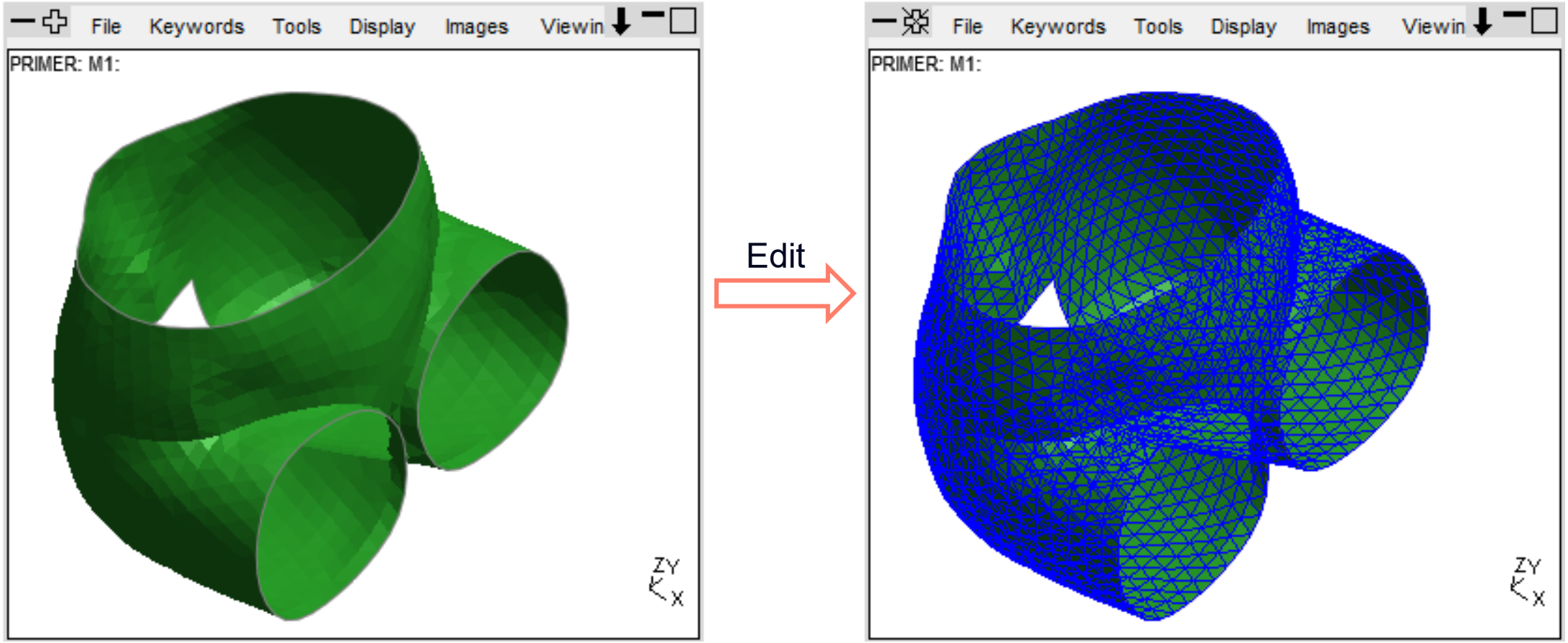






Control over post-edit sketching #1

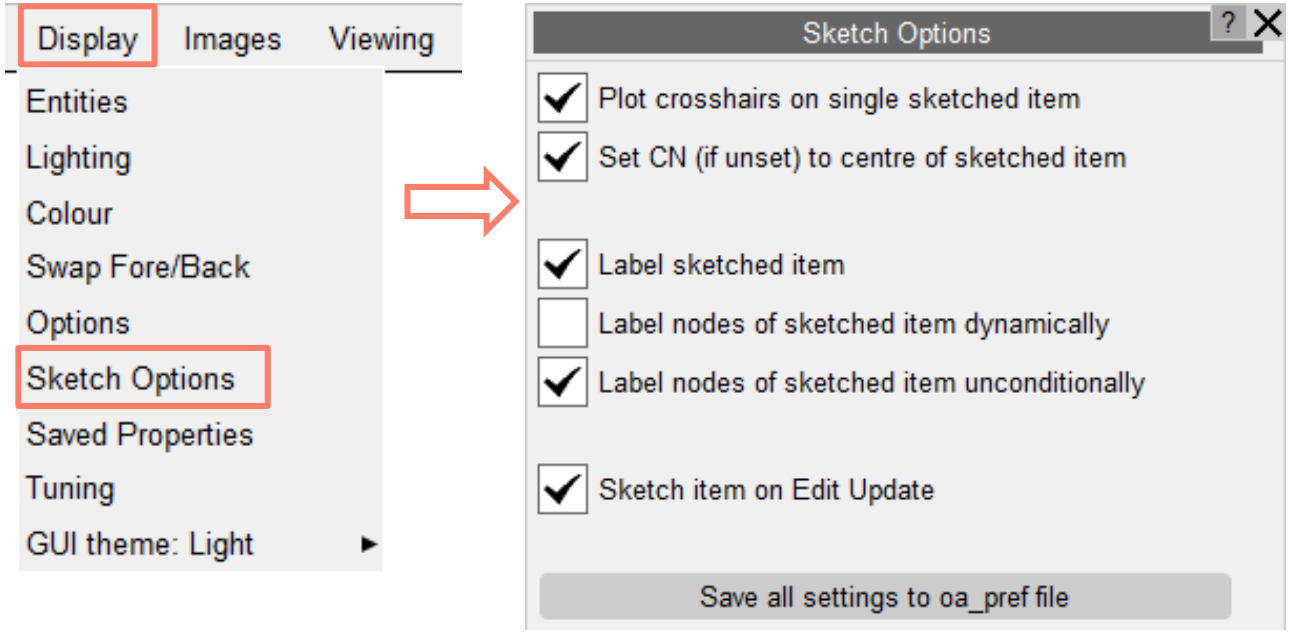
- Historically items have been sketched after editing, for example



- For large items, particularly sets with a lot of content, this can result in a long delay before the edit "completes" due to the time taken to update the sketched graphics.

Control over post-edit sketching #2

- This behaviour is now controllable via **[Display] Sketch Options**.



If "Sketch item on Edit Update" is unticked then items will no longer be sketched after an edit operation updates them.

This can be saved as the preference

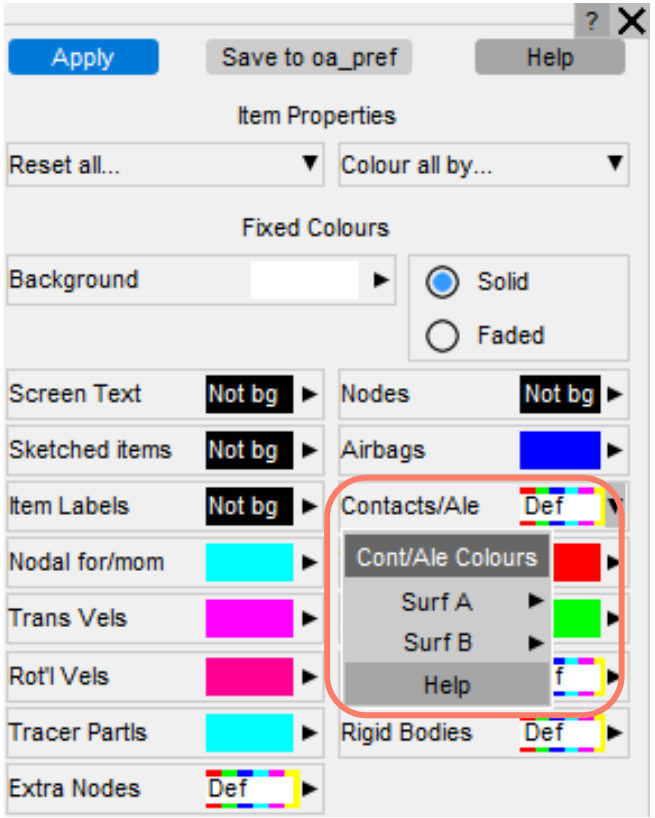
```
primer*post_edit_sketch: true | false
```

The default is **true** for backwards compatibility, but for speed turn this off.

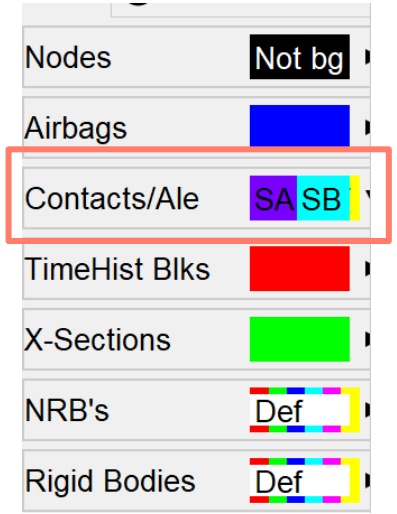
Save all settings to oa_pref file here will save the current status automatically.

ALE Keywords: Drawing and Sketching support

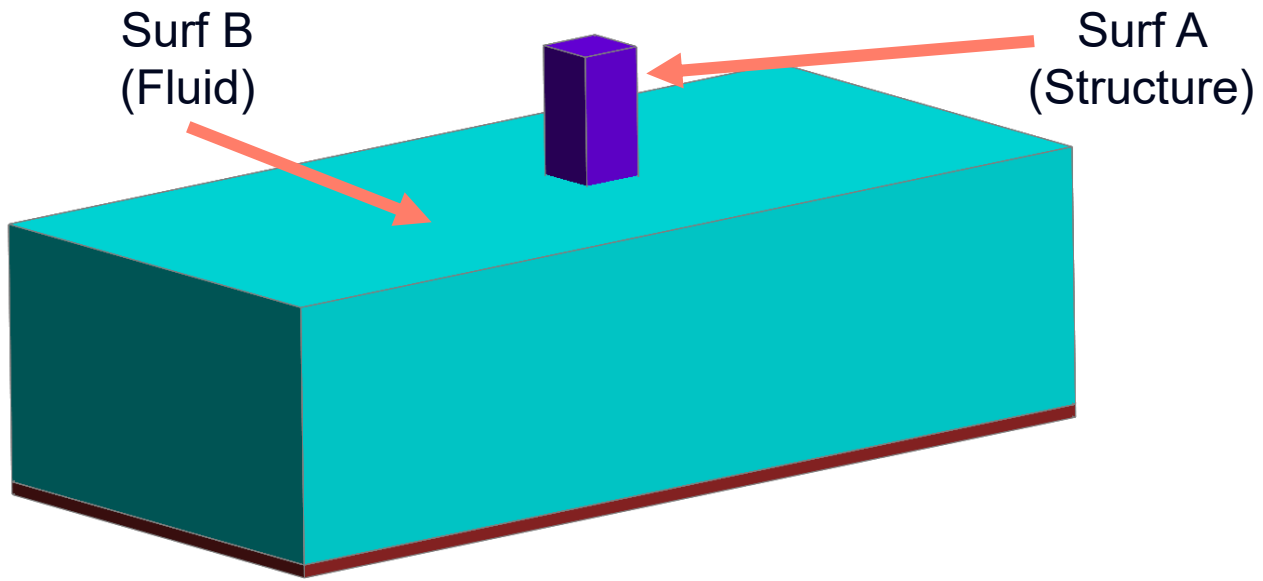
- Drawing and sketching is now supported for some important ***ALE** keywords.
- Applies to keywords involving two surfaces (Eulerian & Lagrangian).
  - ***ALE_COUPLING_NODAL_CONSTRAINT**
  - ***ALE_COUPLING_NODAL_DRAG**
  - ***ALE_COUPLING_NODAL_PENALTY**
  - ***ALE_STRUCTURED FSI**
- The existing Display → Colour → Contacts button has been modified to ‘Contacts/Ale’ and now supports both ***CONTACT** and ***ALE** keywords.



ALE Keywords: Drawing colours



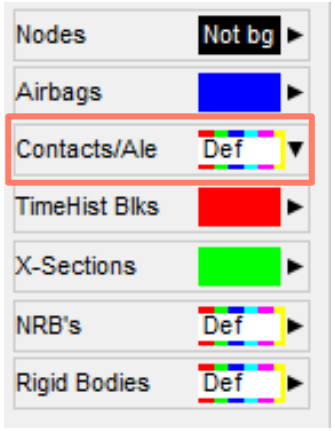
***ALE_STRUCTURED_FSI**

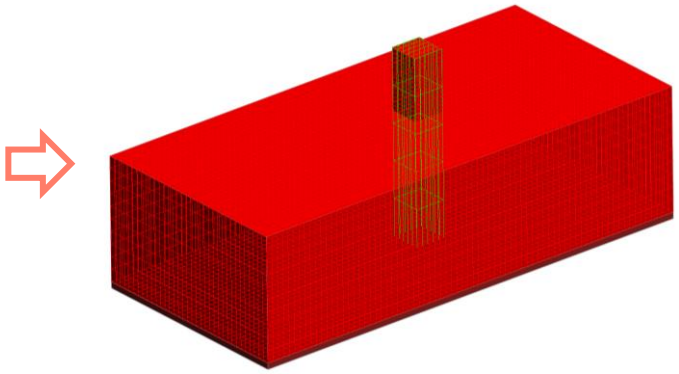


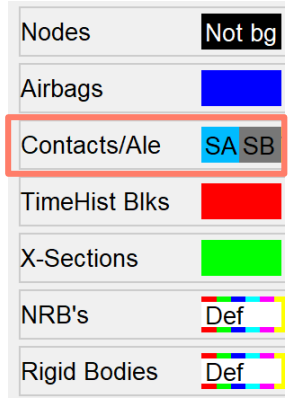
Fluid flow around a bar in a container

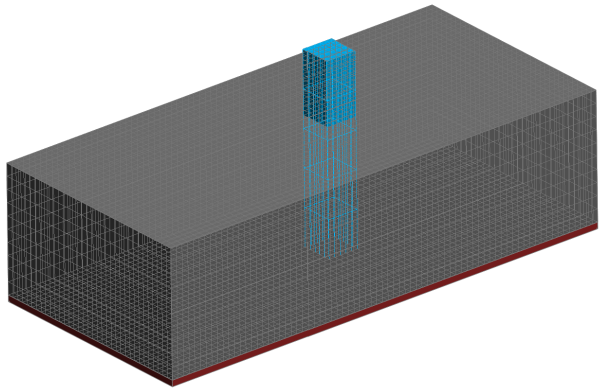
ALE keywords: Sketching colours

- Default sketching colours are Red/Green similar to Contacts.
- Can set custom colours for sketching with same ‘Contacts/Ale’ button.
- Default drawing colour is assigned based on label.





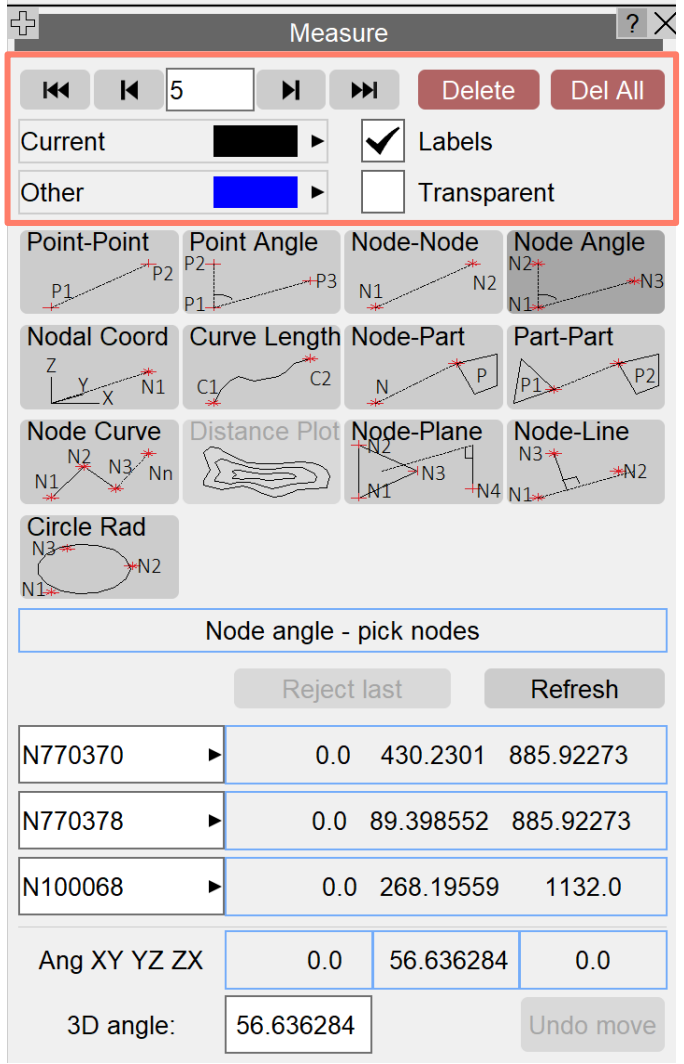


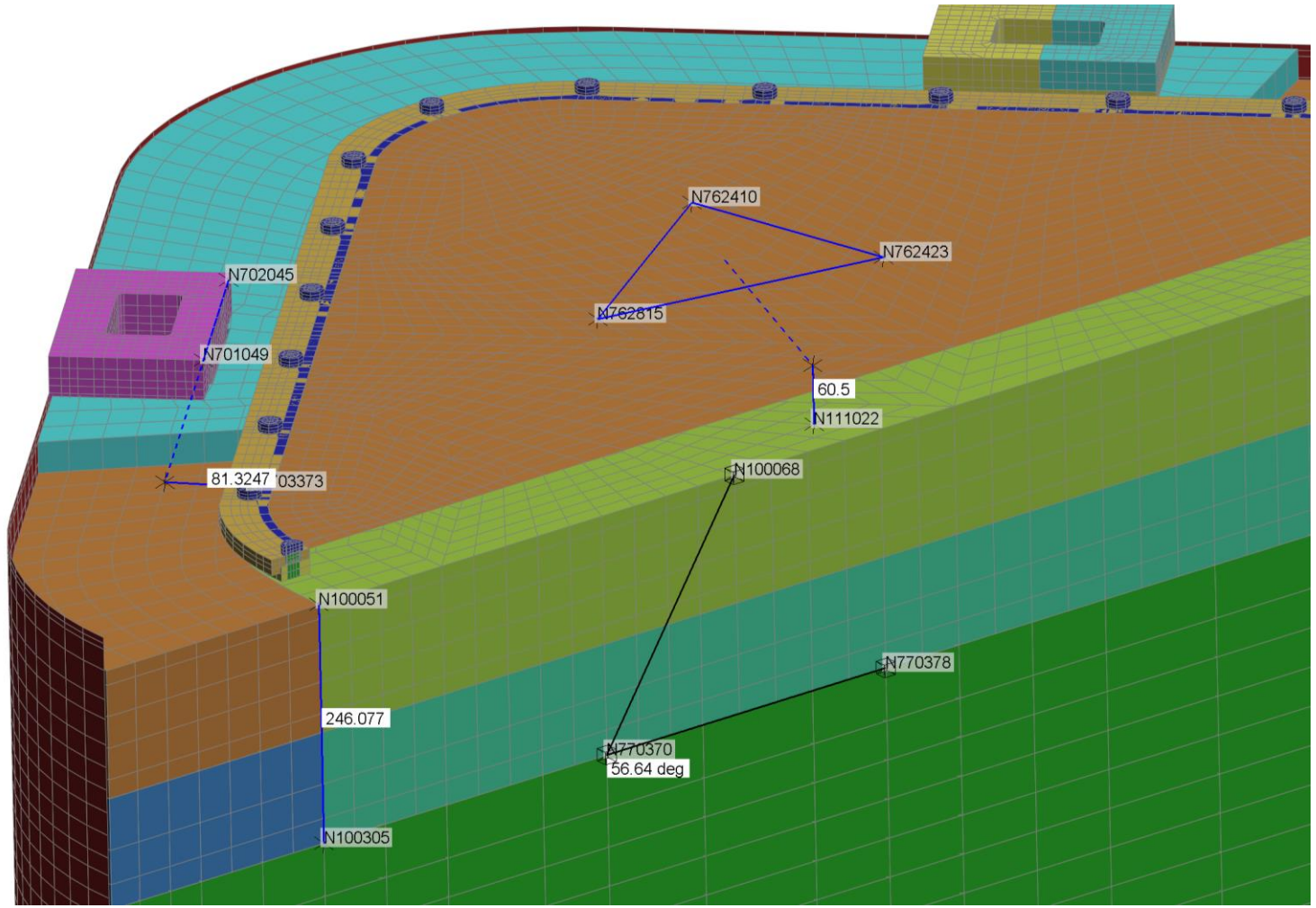


Measure Tool Enhancements

Multi Measure

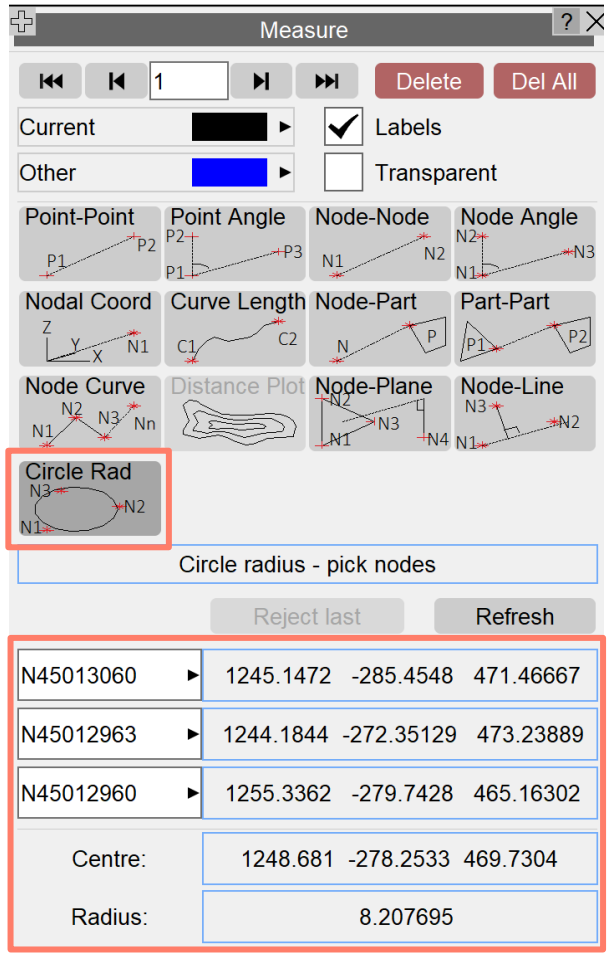
- PRIMER 23.0 can store multiple measurements as per D3PLOT, making models easier to prepare and check.

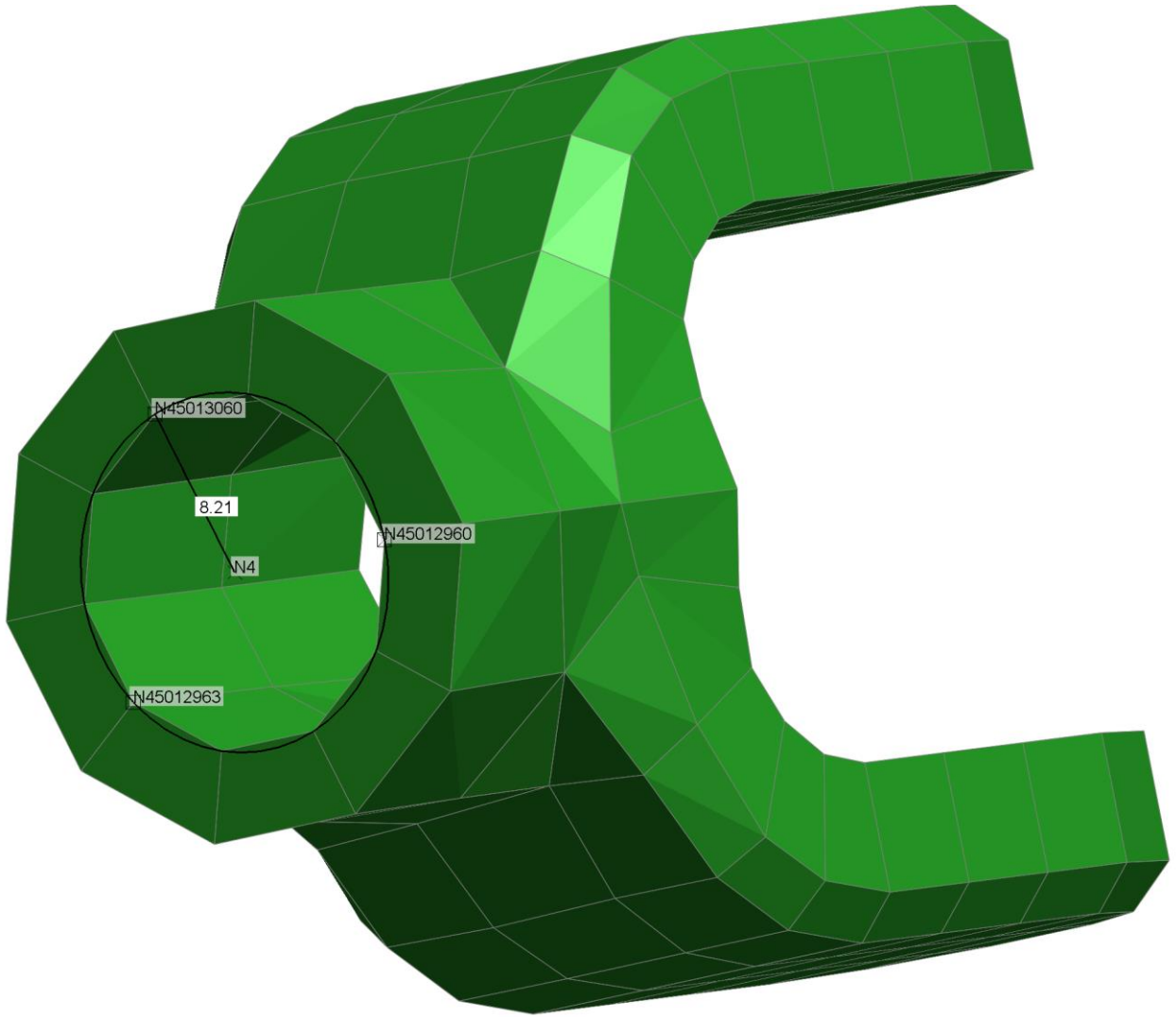




New Measure method: Circle Radius

- A new measurement type has been added to determine the radius of a circle formed by three nodes.



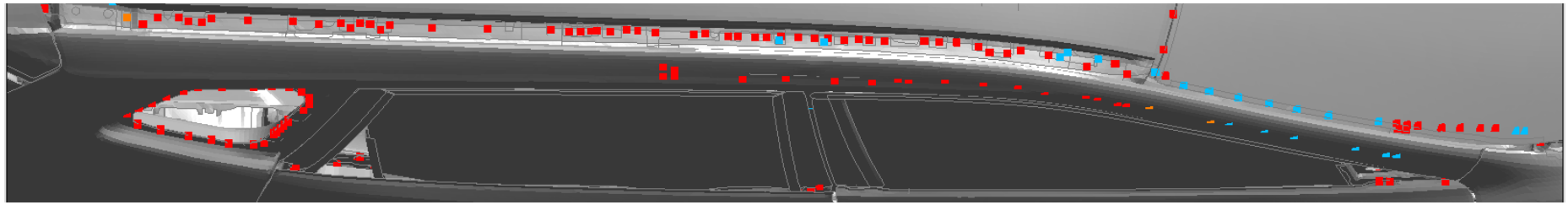


Speed and UI/UX Improvements

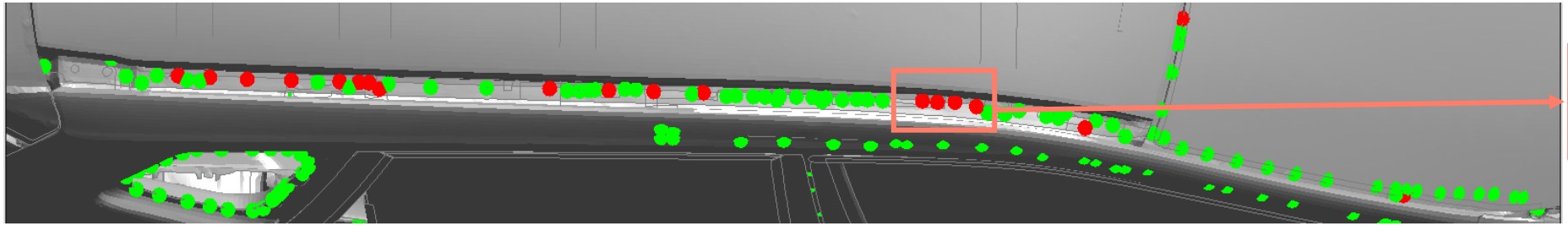
Spotweld remesh speed improvements

- Spotweld remeshing failures typically occur when welds are placed too close to feature lines or near warped edges. Previously, deleting these failed spotweld spotwelds was time consuming, significantly increasing the overall time required to remesh all the spotwelds in a full vehicle model.
- In PRIMER 23.0, we have improved the deletion process, substantially reducing the time required for remeshing. As a result, we have observed a speed up of 80-90% in remeshing for full vehicle models with a considerable number of spotweld failures.

Initial Beam Spotwelds



Hex Spotwelds after spot → Remesh



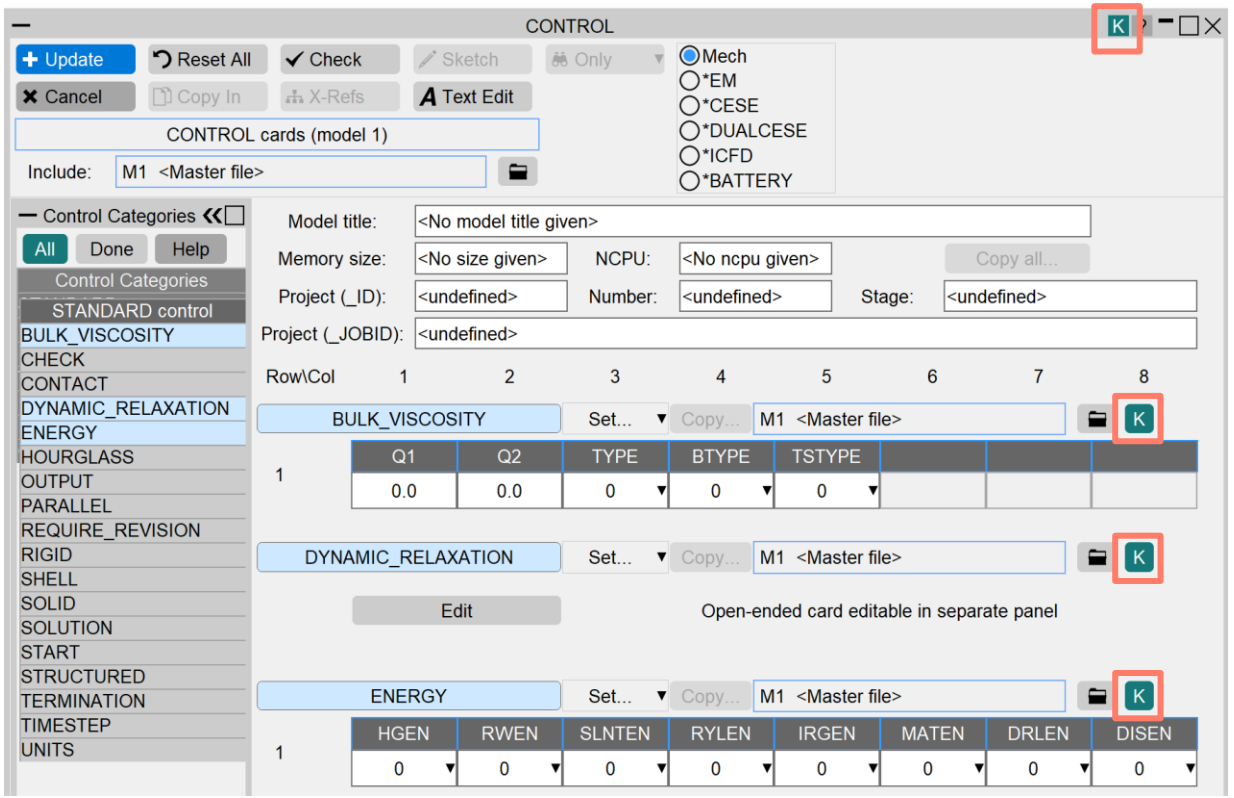
Key In: Go To Label and Go To String search

- Navigating long object menus has been made easier with new Go to Label and String options.
- Go To Label takes a label as input to display the nearest instance at the top of the menu.
- Go To String will search and manipulate the object menus to display the first instance of the input string at the top of the menu. Input values aren't restricted to label IDs.
- These are accessed through the Object Menu Key_In button.

Usability Improvements

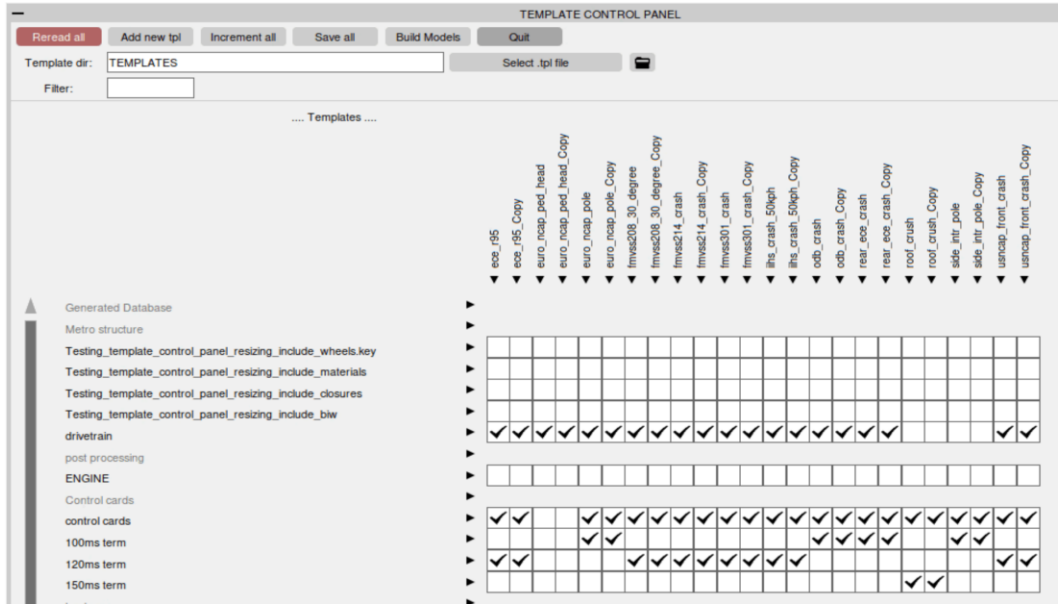
- A 'Ctrl+z' keyboard shortcut has been added for the global Undo button in PRIMER.

- The existing ‘K’ button at the top of the ***CONTROL** edit panel opens the keyword manual at the main ***CONTROL** page.
  In PRIMER 23.0, individual 'K' buttons have been added which open the keyword manual to the relevant ***CONTROL** keyword page, saving time.

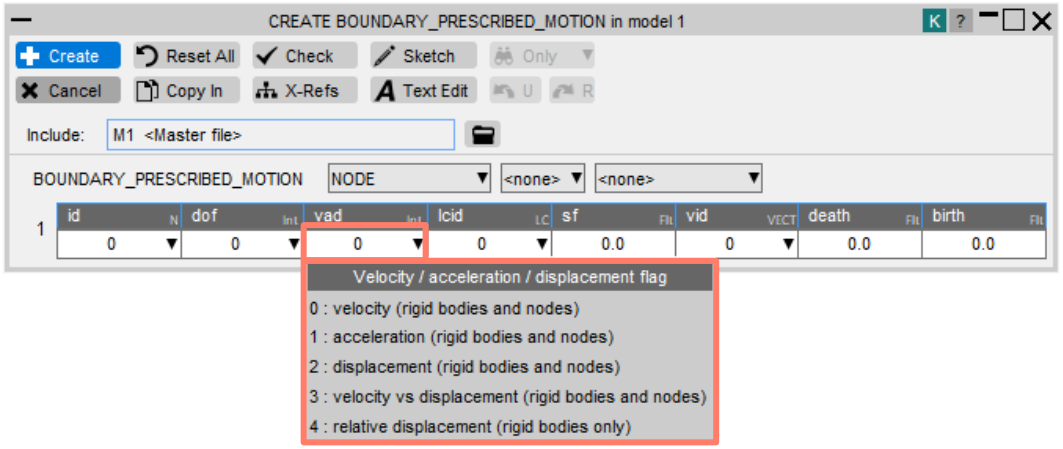


Usability Improvements

- The Template Control Panel can now be resized to expand the first column of that panel, making it possible to see the whole filename.

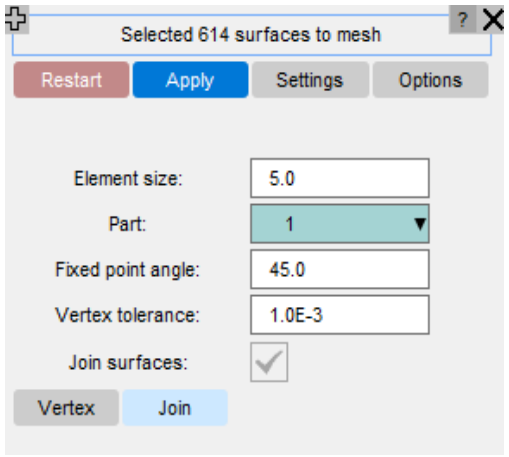


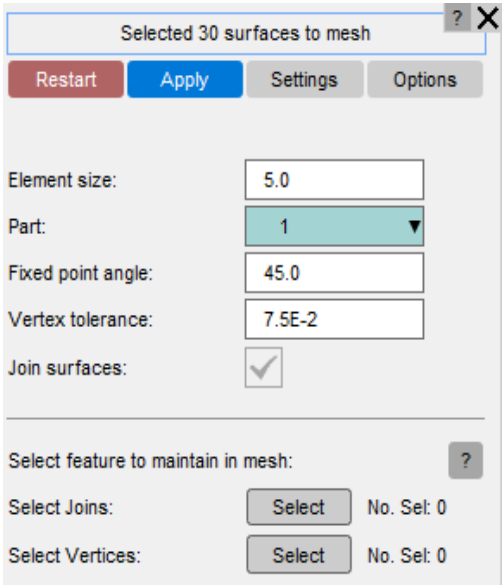
- More drop-down options have been added to fields within editors, enabling you to select predefined values.
  - This reduces the need to refer to the keyword manual and helps ensure correct input.
  - This feature is currently available in selected editors and will be expanded to additional editors in future updates.

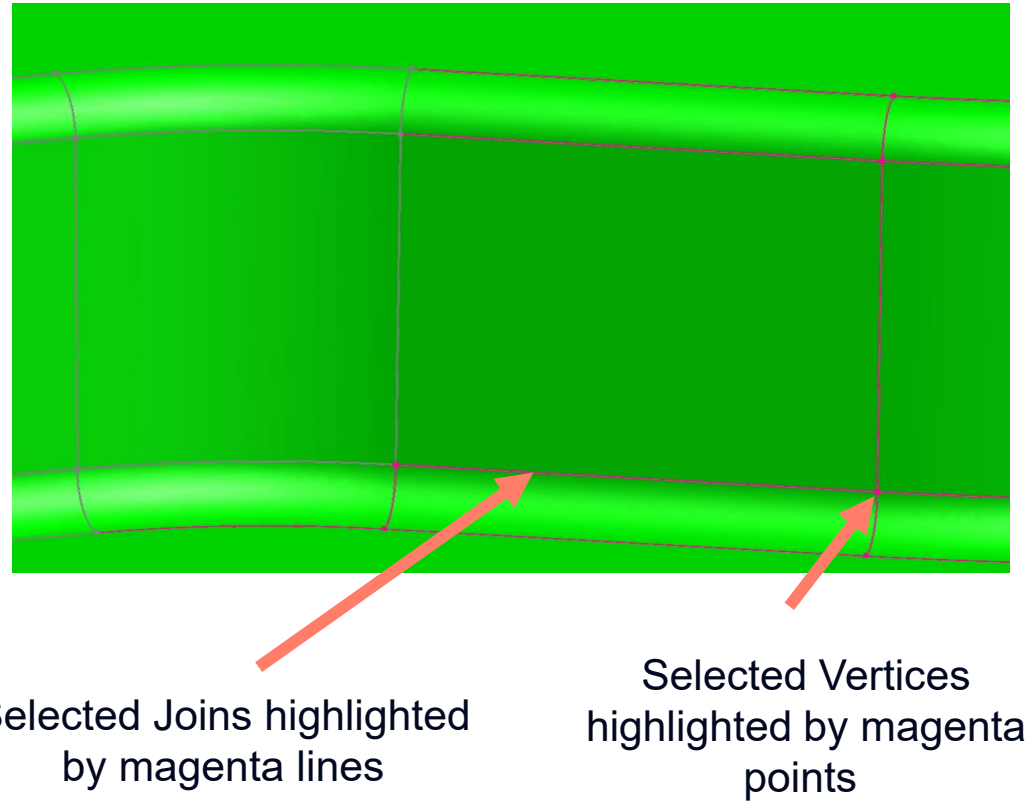


Improved Mesh Geometry UI/UX

- The Mesh Geometry tool allows you to select Joins and Vertices to be maintained during meshing.
- The user experience and layout of the associated buttons has been improved in PRIMER 23.0.



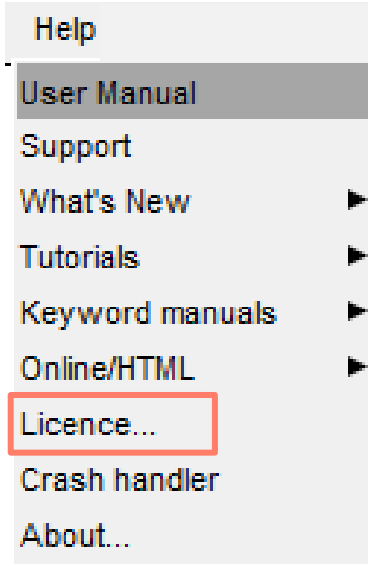


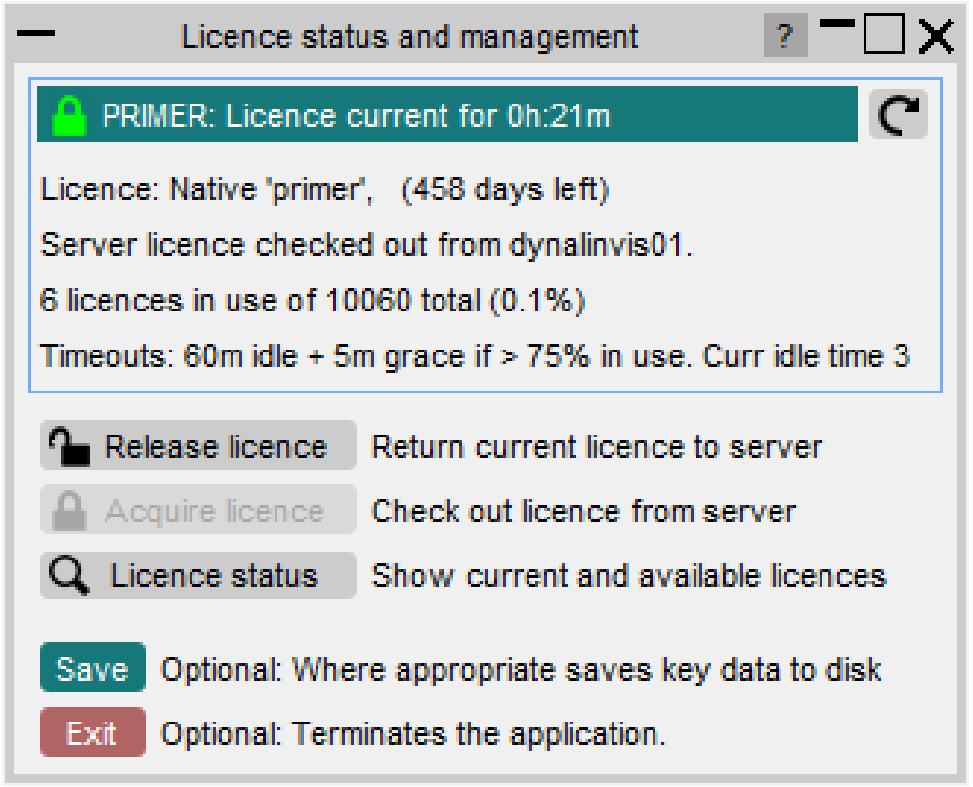


Licence Manager

Licence Manager menu

- Oasys Suite 23.0 introduces a new Licence Manager window to display and control licensing.
  - Invoked from **[Help] Licence**
  - Displays current licence status
  - Interrogates the licence server to obtain overall licence usage data
  - Allows the user to release a licence temporarily
  - Manages the licence situation following “timeout”
  - Manages the licence situation after loss of connection with the licence server.



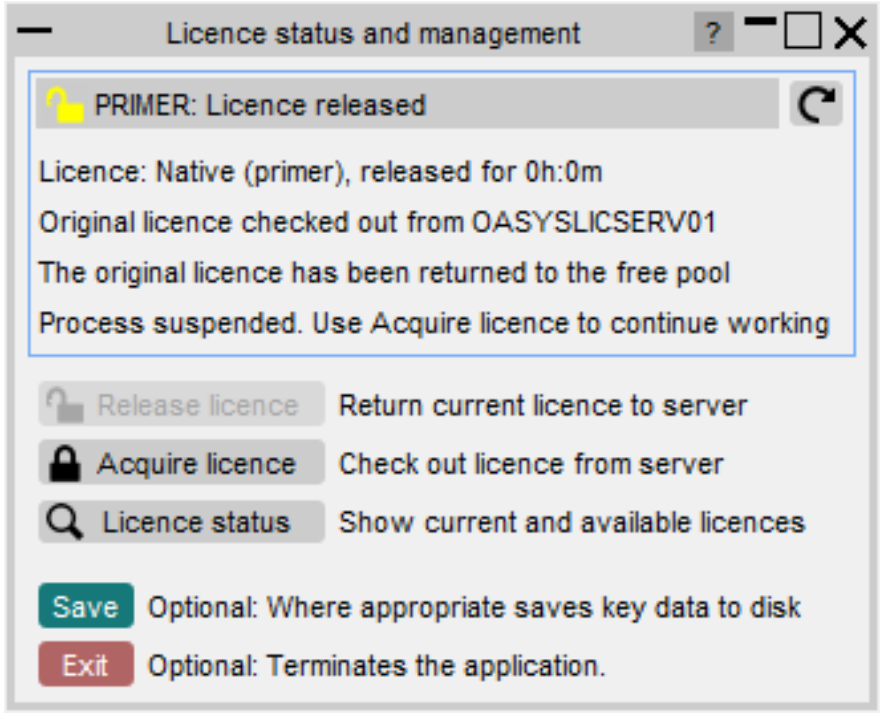


This shows the normal active licence status

Licence Manager menu

- Releasing a licence
  - **Release Licence** returns the current licence to the server's free pool.
  - The process is suspended, no data or work are lost.
  - The Licence Manager panel remains mapped in this state allowing to licence to be re-acquired at any time.

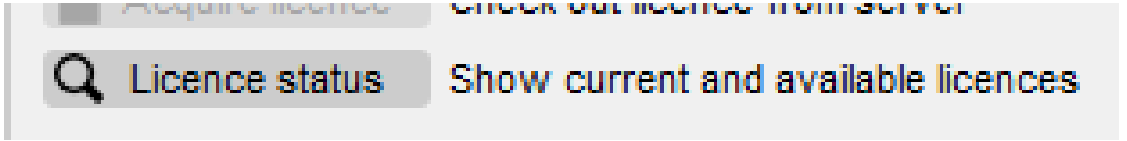
- Re-acquiring a licence
  - **Acquire licence** requests a new licence from the server. If successful, the process resumes.
  - If no licences are available the Licence manager retries at 30 second intervals until one becomes free, whereupon the process resumes. It remains suspended until this occurs.

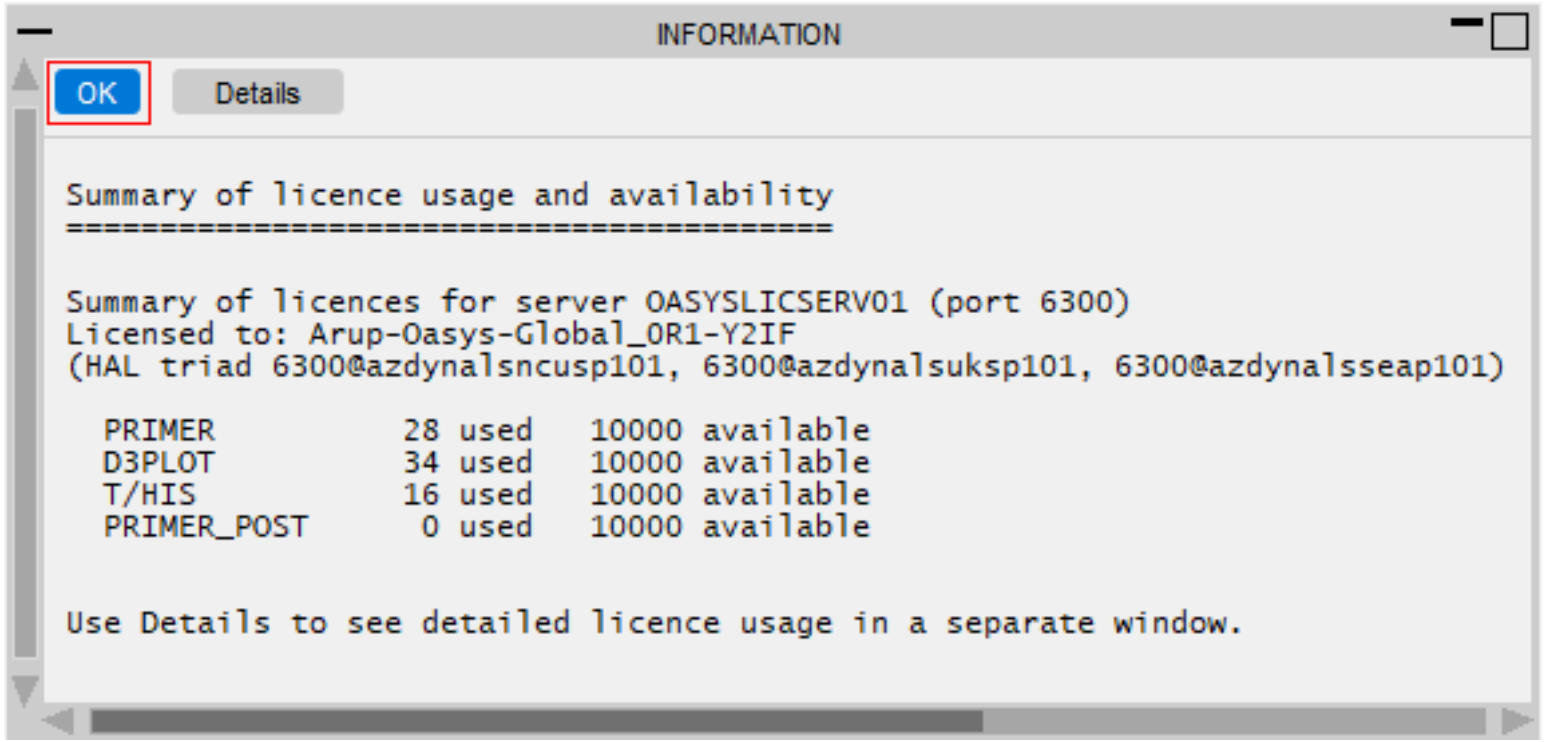


This shows the "licence released" state

Licence Manager menu

- Licence status
  - Obtains information about overall licence use.

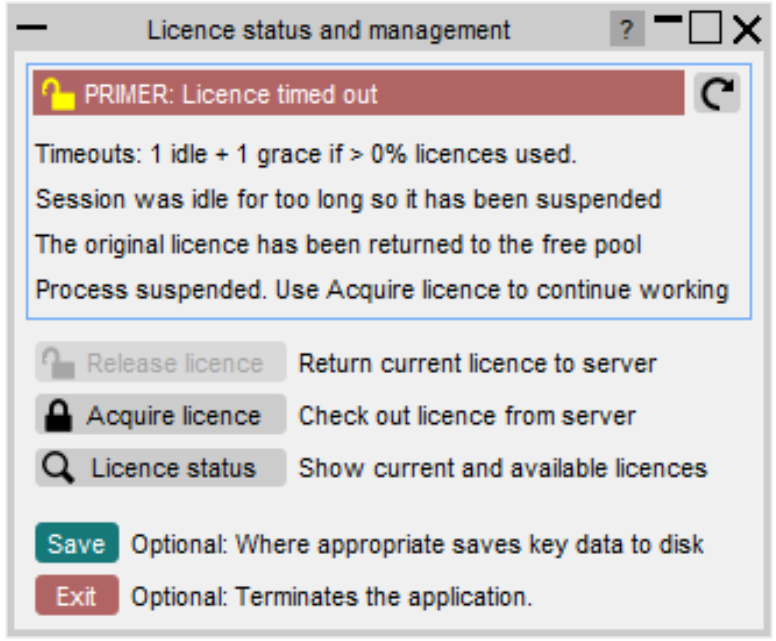




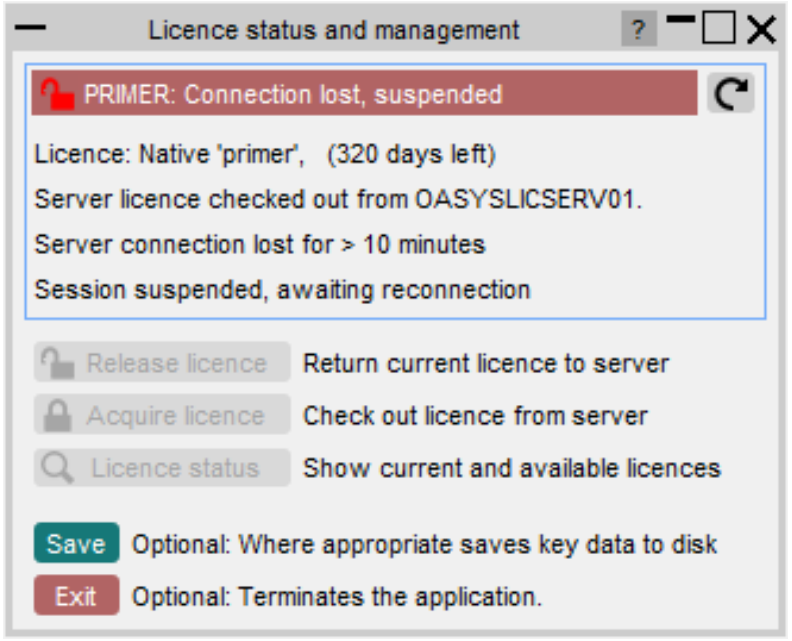
- **Details** interrogates the licence server using the lmxendutil utility to obtain detailed listings of all individual licence use.
- This information is written to a separate terminal window as it can be quite lengthy.

Licence Manager menu

- Managing the licence after “timeout” or loss of connection with the licence server.

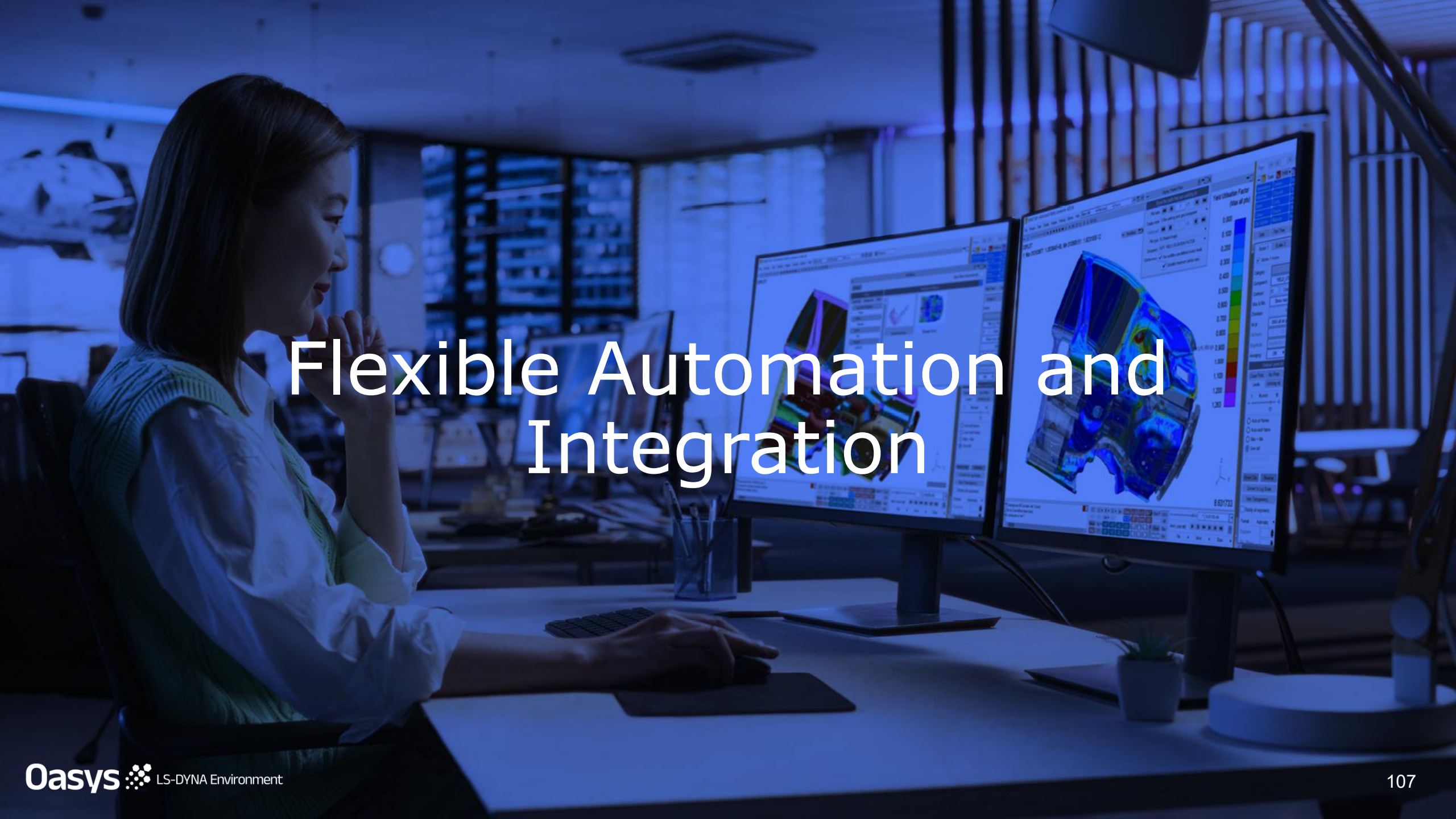


Process suspended by “timeout” following a sustained idle period.



Process suspended after >10 mins loss of server connection.

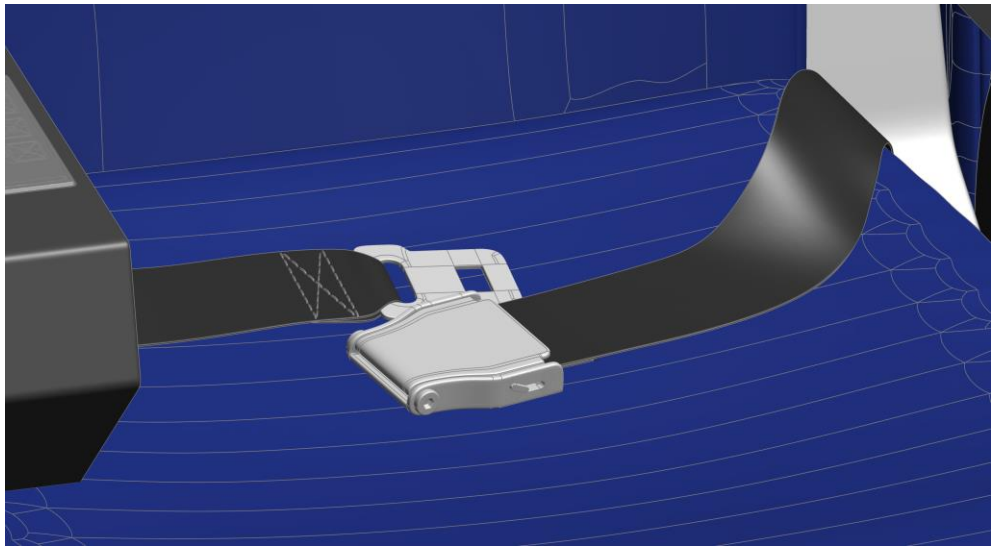
- In both these situations the Licence Manager displays the current status. On the left **Acquire Licence** will resume the session, on the right it will resume automatically once connection with the licence server has been restored.


Flexible Automation and Integration

CAD Reader

Expanded CAD compatibility

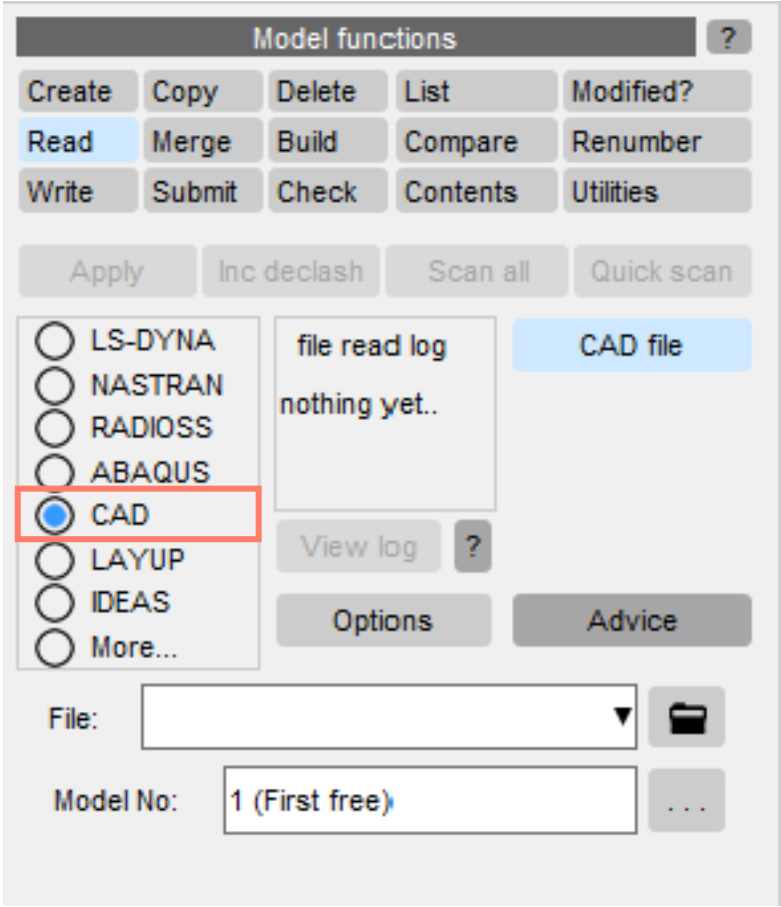
- CAD file support has been extended beyond the existing capability to read IGES, STEP, and JT files which itself has also been improved
- Importing CAD files is faster and the ability to read more filetypes enables more seamless workflows.



Expanded CAD compatibility

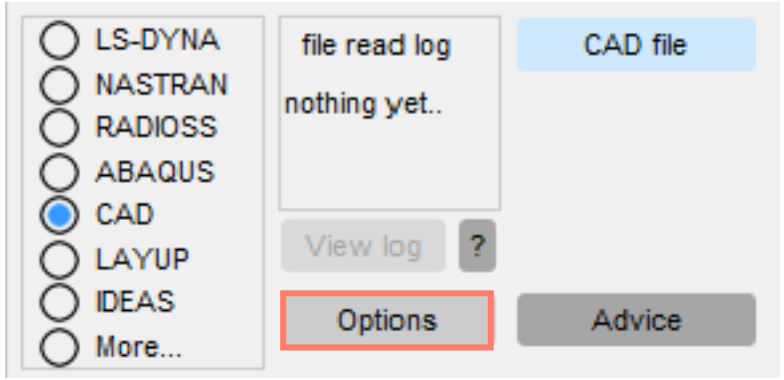
- Filetypes now supported:
  - ACIS
  - AutoCAD
  - Autodesk Inventor
  - CATIA V5
  - Creo - Pro/E
  - IGES (already supported)
  - JT (already supported – no longer requires an additional license)
  - NX
  - Parasolid
  - PRC
  - Rhino 3D
  - SolidWorks
  - STEP (already supported)
  - Stereo Lithography (STL)
  - U3D
  - Wavefront OBJ

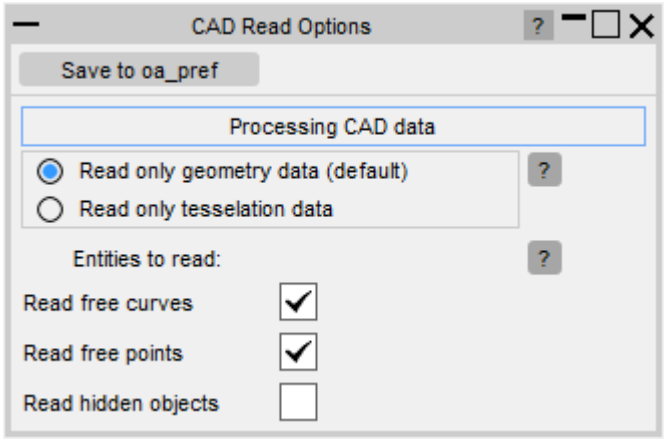
- Read access is available via the 'CAD' option in the Model Read panel, file drag/drop, Dialogue Input, the JS/Python API `Model.Read()` method, and when launching PRIMER using the command line



Expanded CAD compatibility

- To avoid loading unnecessary data and aid model read times, options have been added to control what data is read from CAD files:
  - Choose between reading Geometry or Tessellation data, depending on whether you want to perform operations on the CAD data or simply visualise the model.
  - Choose whether 'non-structural' points or curves are loaded into PRIMER.
  - Choose whether to load entities that have been marked as 'hidden' in the CAD file.



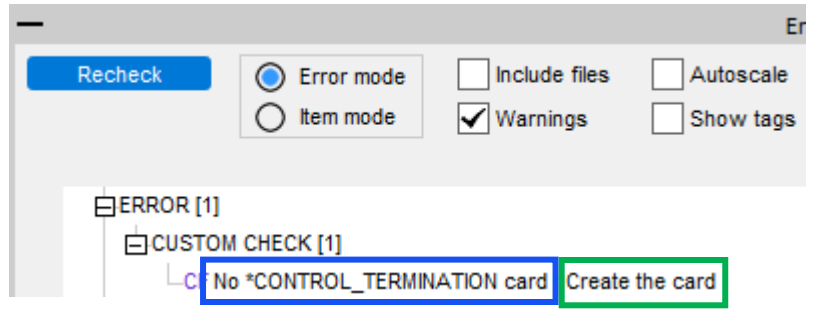


Autofixes for Custom Checks

Autofixes for custom checks

- It is now possible to perform autofixes for custom (JavaScript) checks.
- Allows you more control over checking and consistency by applying company or project specific fixes.
- Example: a custom check to ensure ***CONTROL_TERMINATION** is present can create the card as an autofix.

```
// arguments[0] is name of script
var m = arguments[1];    // arguments[1] is model

if (!m.control.termination.exists)
{
    Check.Error("No *CONTROL_TERMINATION card",
                { autofixMessage: "Create the card",
                  autofixFunction: create_ctrl_termination });
}
```

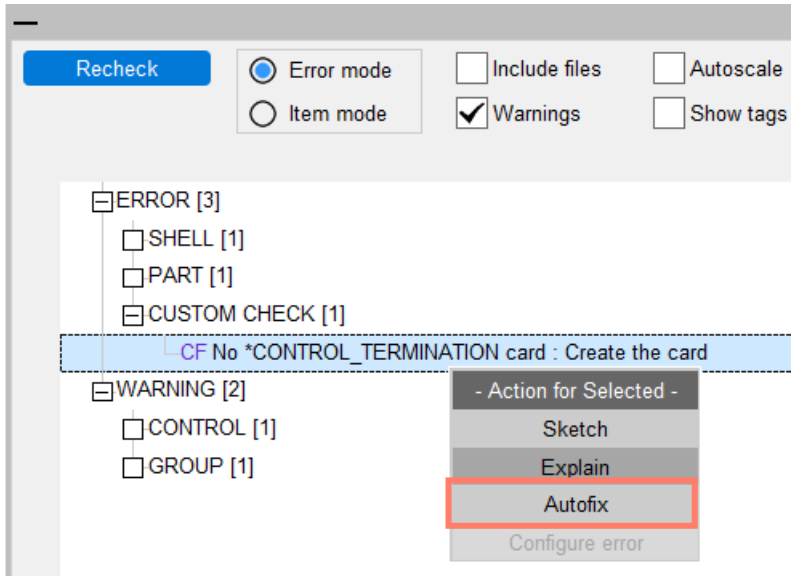



```
function create_ctrl_termination()
{
    var model = this;

    model.control.termination.exists = true;
    model.control.termination.endtim = 0.25;
    return `Created *CONTROL_TERMINATION card with end time ${model.control.termination.endtim}`;
}
```

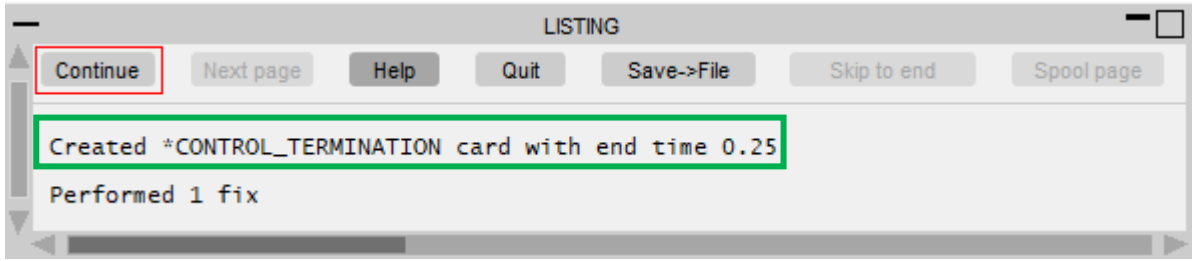
Autofixes for custom checks

- When the autofix is invoked, the function defined by `autofixFunction` is called.

```
// arguments[0] is name of script
var m = arguments[1];    // arguments[1] is model

if (!m.control.termination.exists)
{
    Check.Error("No *CONTROL_TERMINATION card",

                { autofixMessage: "Create the card",

                  autofixFunction: create_ctrl_termination });
}
```




```
function create_ctrl_termination()
{
    var model = this;

    model.control.termination.exists = true;
    model.control.termination.endtim = 0.25;
    return `Created *CONTROL_TERMINATION card with end time ${model.control.termination.endtim}`;
}
```



Updates to both JavaScript and Python APIs

JS-API and Python API

- New dynamic methods added to the Solid class:
  - `Solid.Faces()` - returns an `array` containing arrays of `Node` objects for each face of the `Solid`
  - `Solid.GetNodes()` - returns an `array` of the `Node` objects used by the `Solid`
  - `Solid.GetNodeIDs()` - same as `Solid.GetNodes()` but returns an array of Node IDs.
- `Model.CAD` option added for reading CAD models via `Model.Read()`.
- `IGARefineShell`, `IGARefineSolid` and `IGATiedEdge` classes added.
- Previously missing `Error` and `Warning` methods added to (Database) `History` class.
- The `radius` can now be passed to the (Database) `CrossSection` constructor in the settings object. If `radius` is negative `xct` and `xch` are Node ids.

JavaScript specific updates

JS-API

- There is a new Link class in the JS API to enable the programs in the Oasys suite to start and pass information to/from the other programs. It is the JavaScript equivalent of interactively pressing the 'Post' button in PRIMER to start D3PLOT or T/HIS, and then passing data between the programs. See the Link class in the JS API documentation for more details.
- Added `ToAbsolute` and `ToRelative` methods to `File` class to convert file paths to absolute and relative respectively.

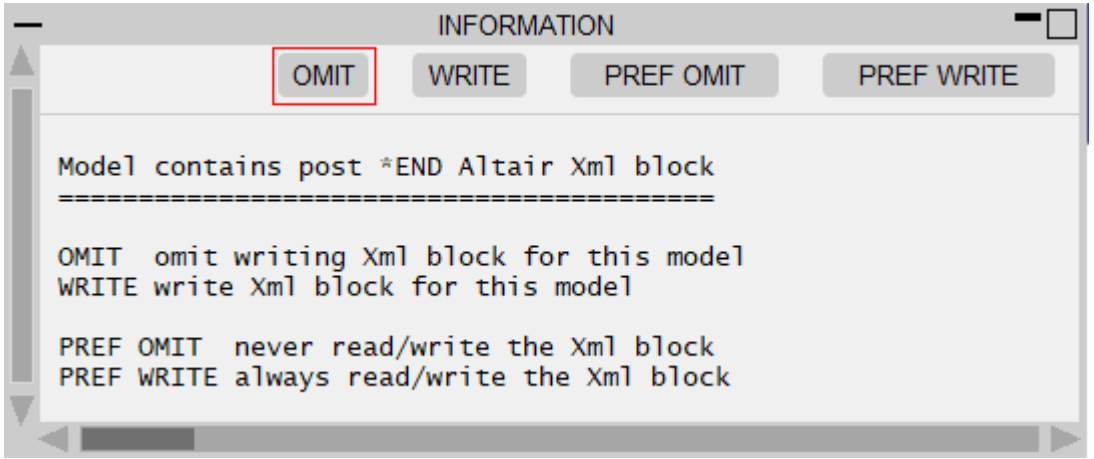
Other Developments and Preferences

Support for post-end Altair HyperMesh XML containing CAD info

- HyperMesh has options to write CAD information in post *END data of LS-DYNA .key files

```
*END
$$
$$<?xml version="1.0" encoding="utf-8"?>
$$<Altair_XML_Export>
$$<UDM xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"
 xmlns:SOAP-ENC="http://schemas.xmlsoap.org/soap/encoding/" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:udmcfg="http://schemas.altair.com/AltairUDMRuntimeConfig"
```

- Previously this data would be lost on passage through PRIMER.
- In PRIMER 23.0 these comments are now read and stored.
- If Part IDs are changed in PRIMER, the XML comment is updated automatically
- On keyout, there is option to write the comment.
- Maintaining this data is important for CAD traceability and helps preserve the integrity of your models.



Update of Part IDs in post-end Altair HyperMesh XML CAD info

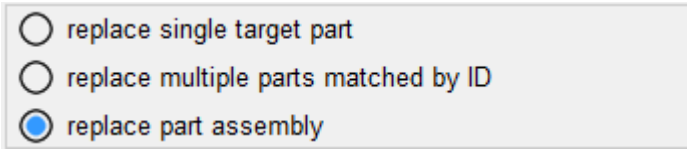
- Example:
  - In PRIMER Part ID 1 has been changed to 1001
  - This incurs several changes in xml. (Do not hand edit!)

```
9e6e38049a860f5f37e612885</udmxml:Attribute><udmxml:Attribute xsi:type="udmxml
="Components(1)" type="string" name="EntitySelectionExp">Components(1)</udmxml
te xsi:type="udmxml:AttributeCType" valueutf8="1" type="string" name="Selectio
<udmxml:Attribute xsi:type="udmxml:AttributeCType" valueutf8="59" type="string
urrenceColor">59</udmxml:Attribute><udmxml:Attribute xsi:type="udmxml:Attribut
```

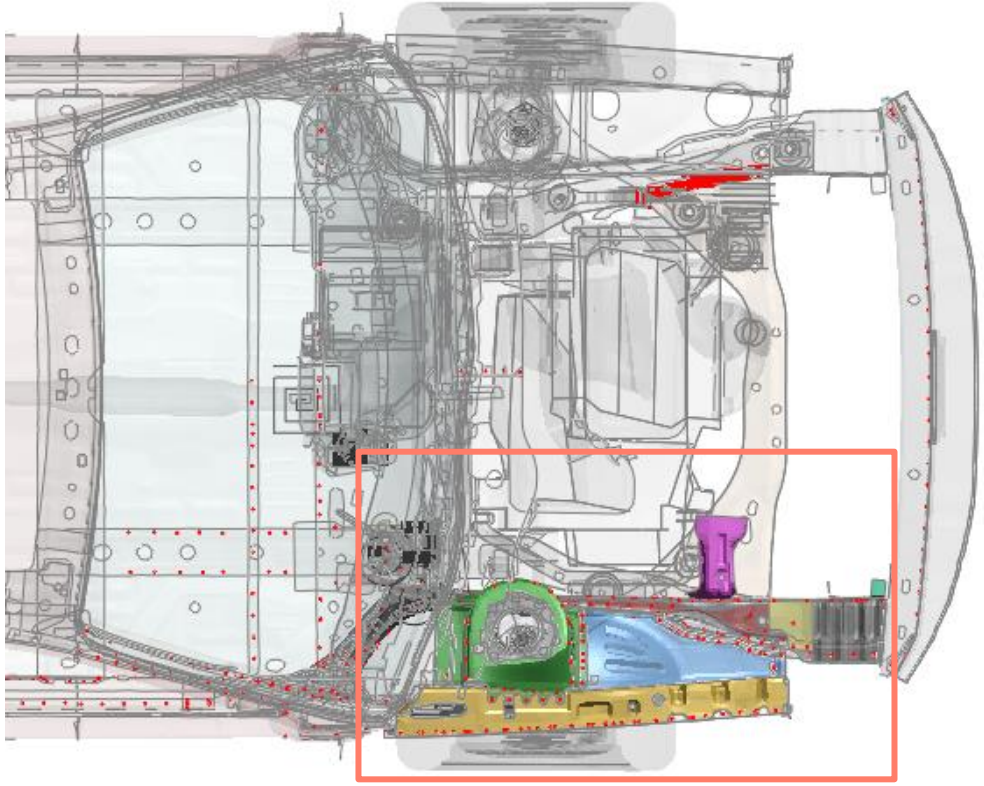
```
xsi:type="udmxml:AttributeCType" valueutf8="ebbd8855c5beae4e854a
type reference">ebbd8855c5beae4e854a5b26bbcb15a4</udmxml:Attribu
8="6ce625c9e6e38049a860f5f37e612885" type="string" name="protoin
e6e38049a860f5f37e612885</udmxml:Attribute><udmxml:Attribute xsi
e="string" name="EntitySelectionExp">Components(1001)</udmxml:At
ueutf8="1001" type="string" name="SelectionExp">1001</udmxml:Att
eutf8="59" type="string" name="UdmxmlString_HmOccurrenceColor">5
teCType" valueutf8="4" type="string" name="UdmxmlString_HmOccurr
```

Part/Assembly Replace improvements

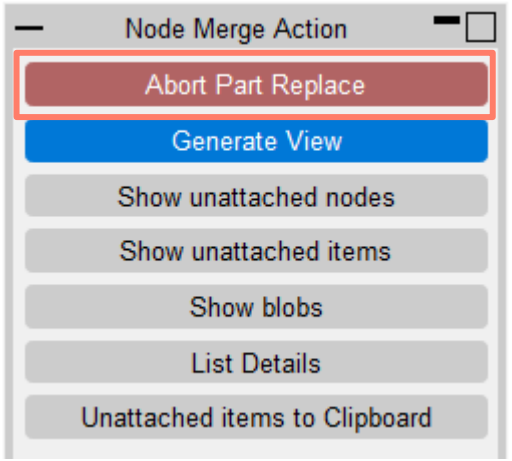
- Part replace can be used to easily replace one or more parts in a target model with those from a source model

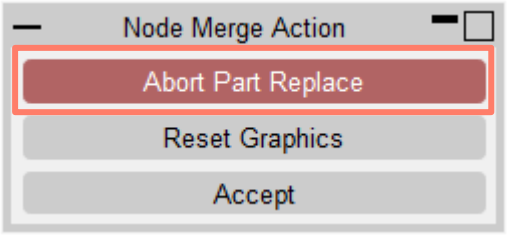


- In PRIMER 23.0 automatic transparency highlights replacement parts/assembly up front



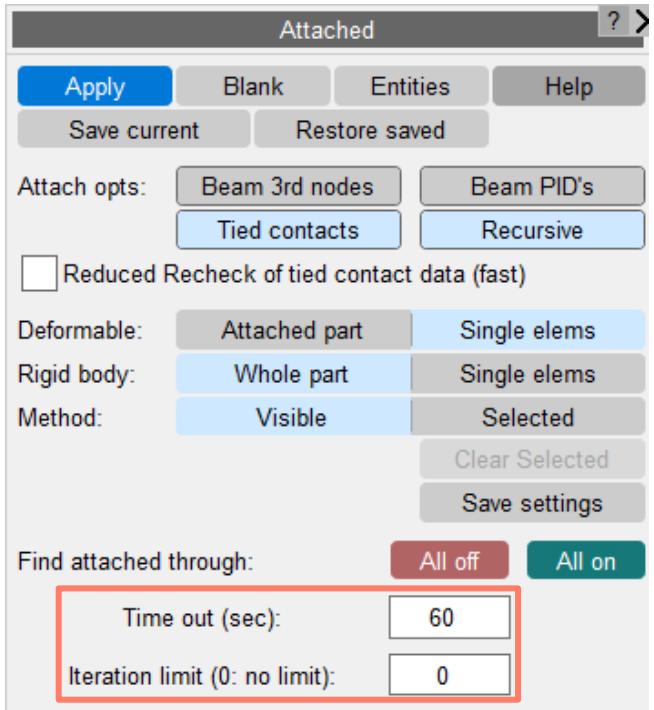
- There are new options to abort and restore model before and after node merge

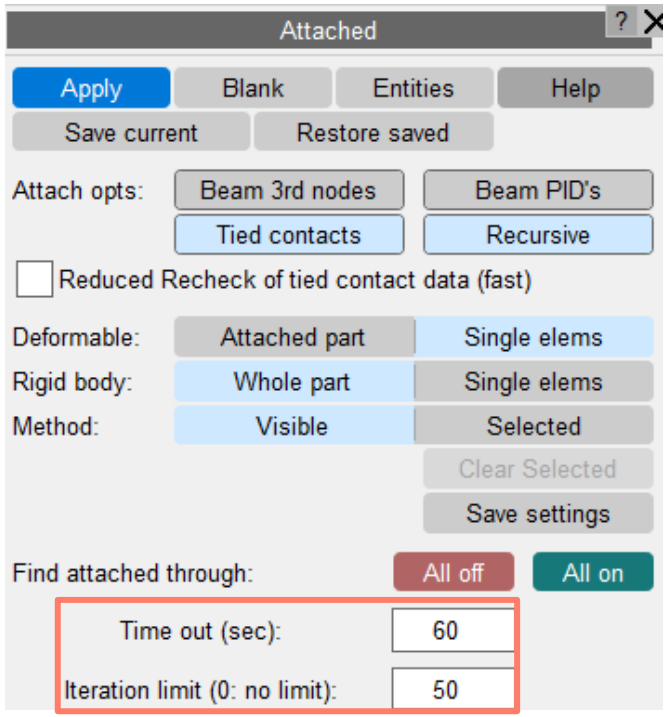


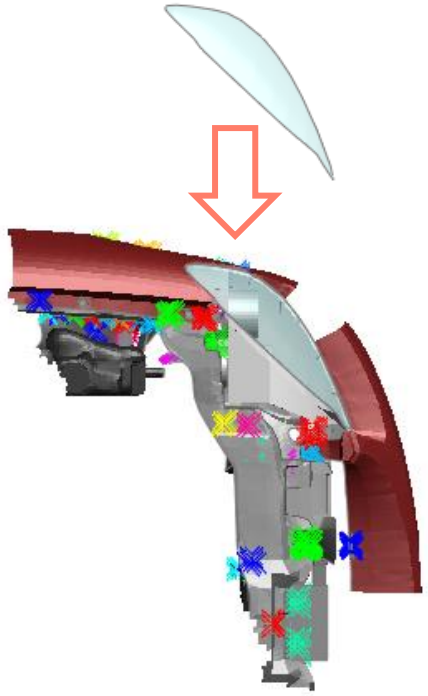


Find Attached: Iterative Recursive Attached

- The attached tool allowed you to find things that are ‘attached’ to what is currently drawn. It is accessed via the Attached Tools menu item or can be invoked using the keyboard shortcut ‘j’.
- In PRIMER 23.0 the default for recursive attached is unlimited iteration. This will find everything attached as quickly as possible. A new option allows the process to be ended by a user defined timeout.
- If an Iteration limit > 0 is specified, recursive attached will perform a fixed number of iterations.

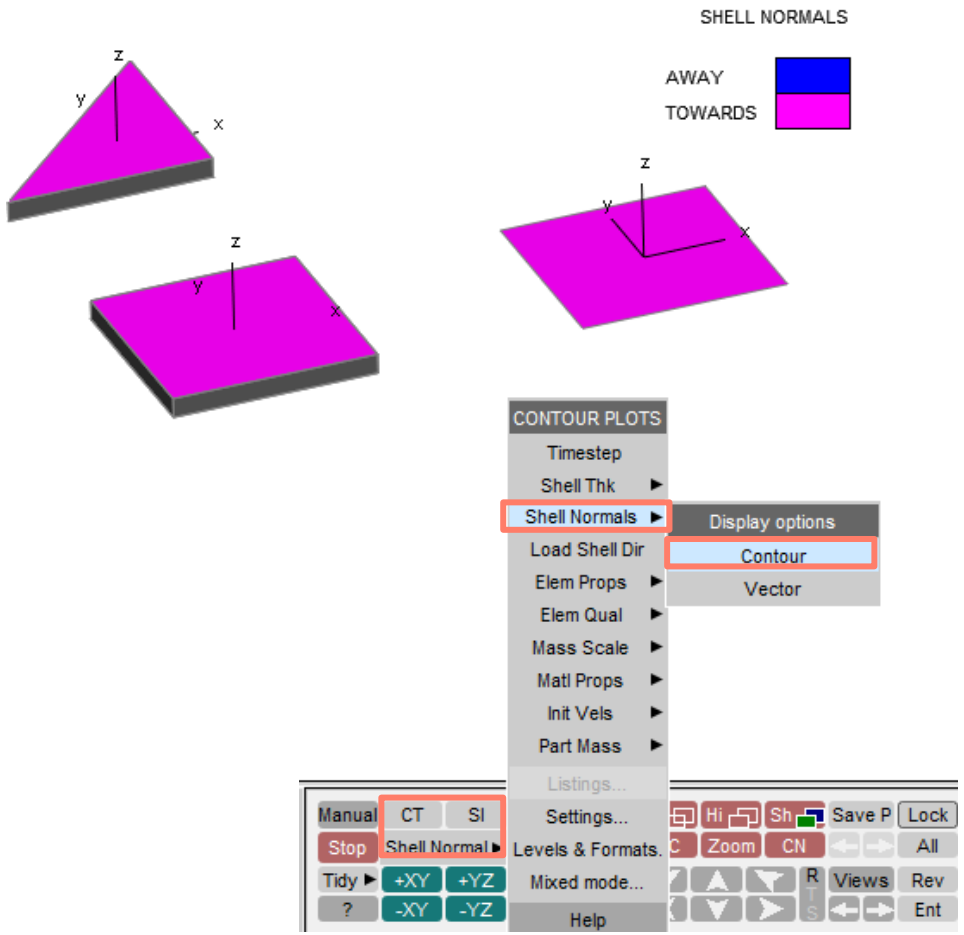


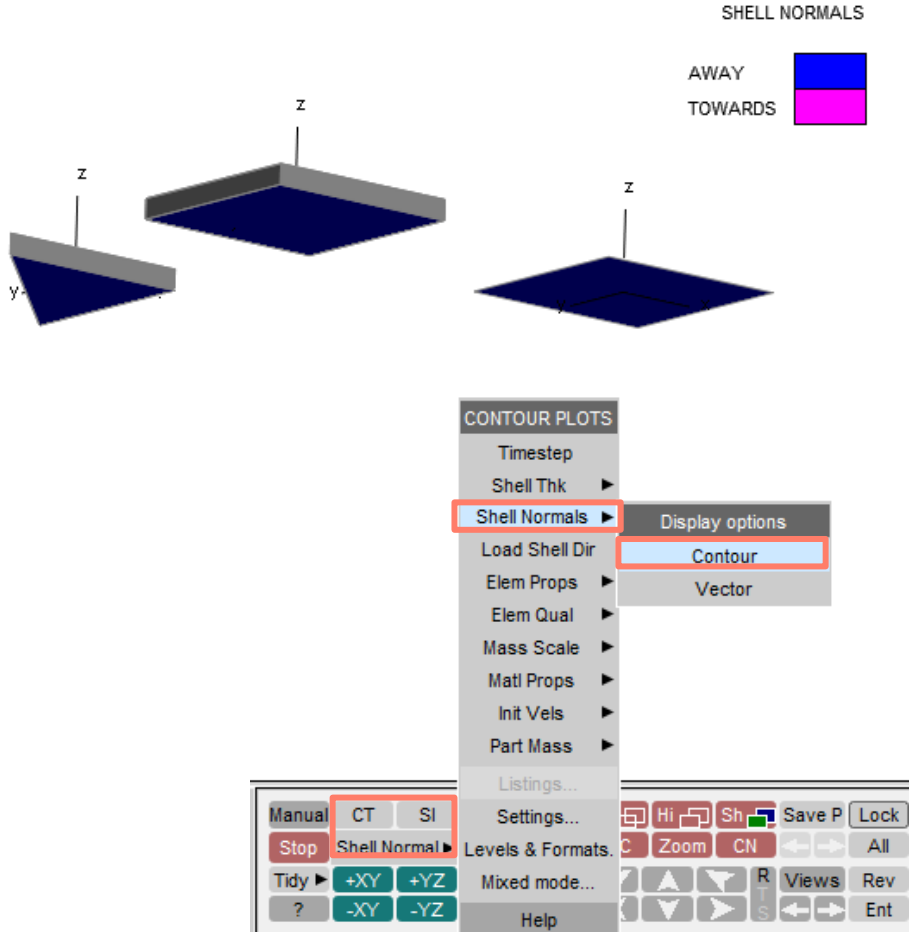




Contour TSHELLs by normal direction (towards/away from viewer)

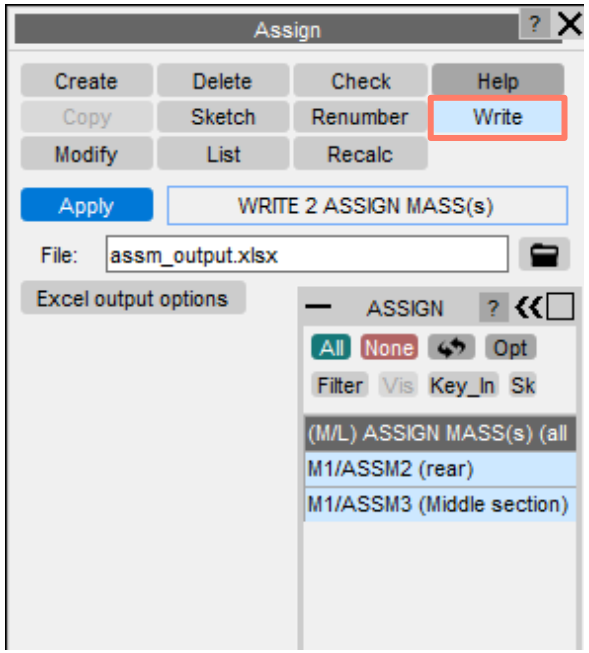
- Previously only **thin shells** could be contoured based on the normal direction.
- In PRIMER 23.0 this functionality has been extended to **thick shells**.

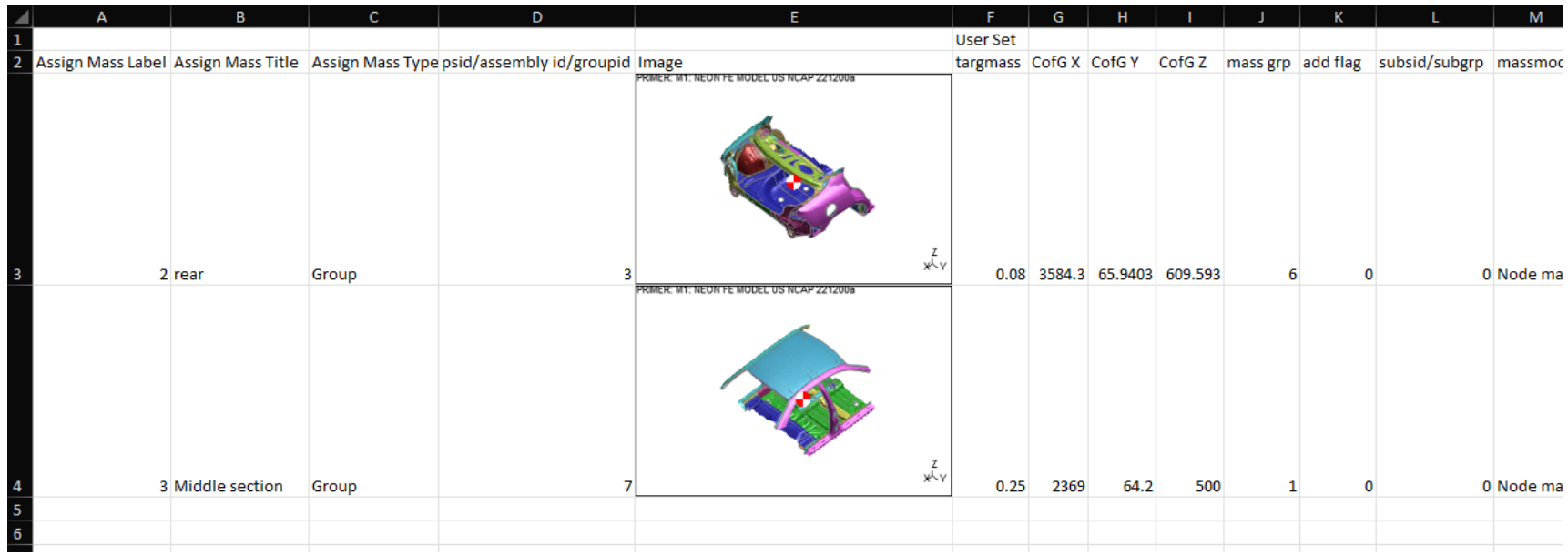




Assign Mass: Write to Excel

- You can now write out calculated assign mass values to Excel files via the docked panel.
- This will output files in the following format:

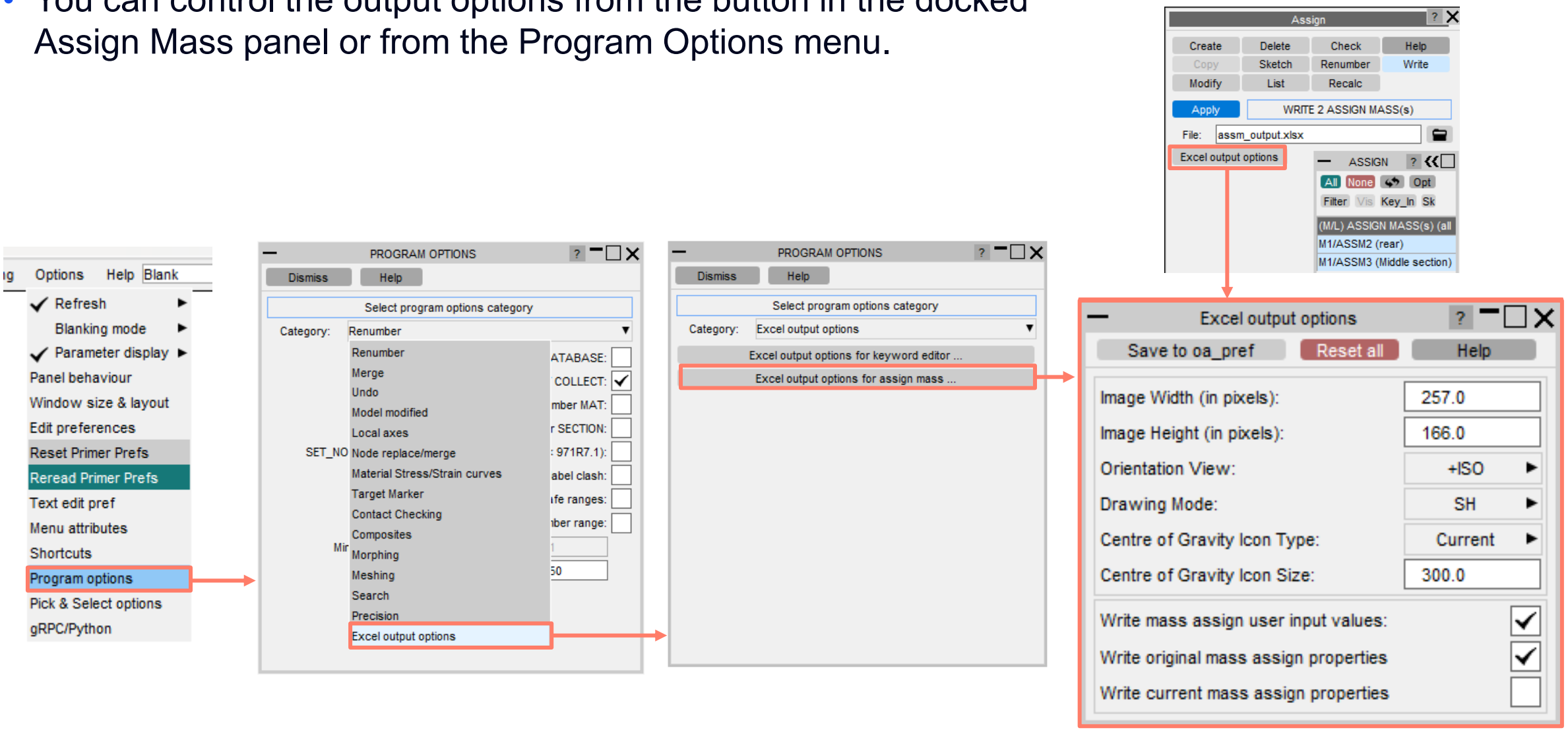




	A	B	C	D	E	F	G	H	I	J	K	L	M
1						User Set							
2	Assign Mass Label	Assign Mass Title	Assign Mass Type	psid/assembly id/groupid	Image	targmass	CofG X	CofG Y	CofG Z	mass grp	add flag	subsid/subgrp	massmoc
3	2	rear	Group	3		0.08	3584.3	65.9403	609.593	6	0	0	Node ma
4	3	Middle section	Group	7		0.25	2369	64.2	500	1	0	0	Node ma
5													
6													

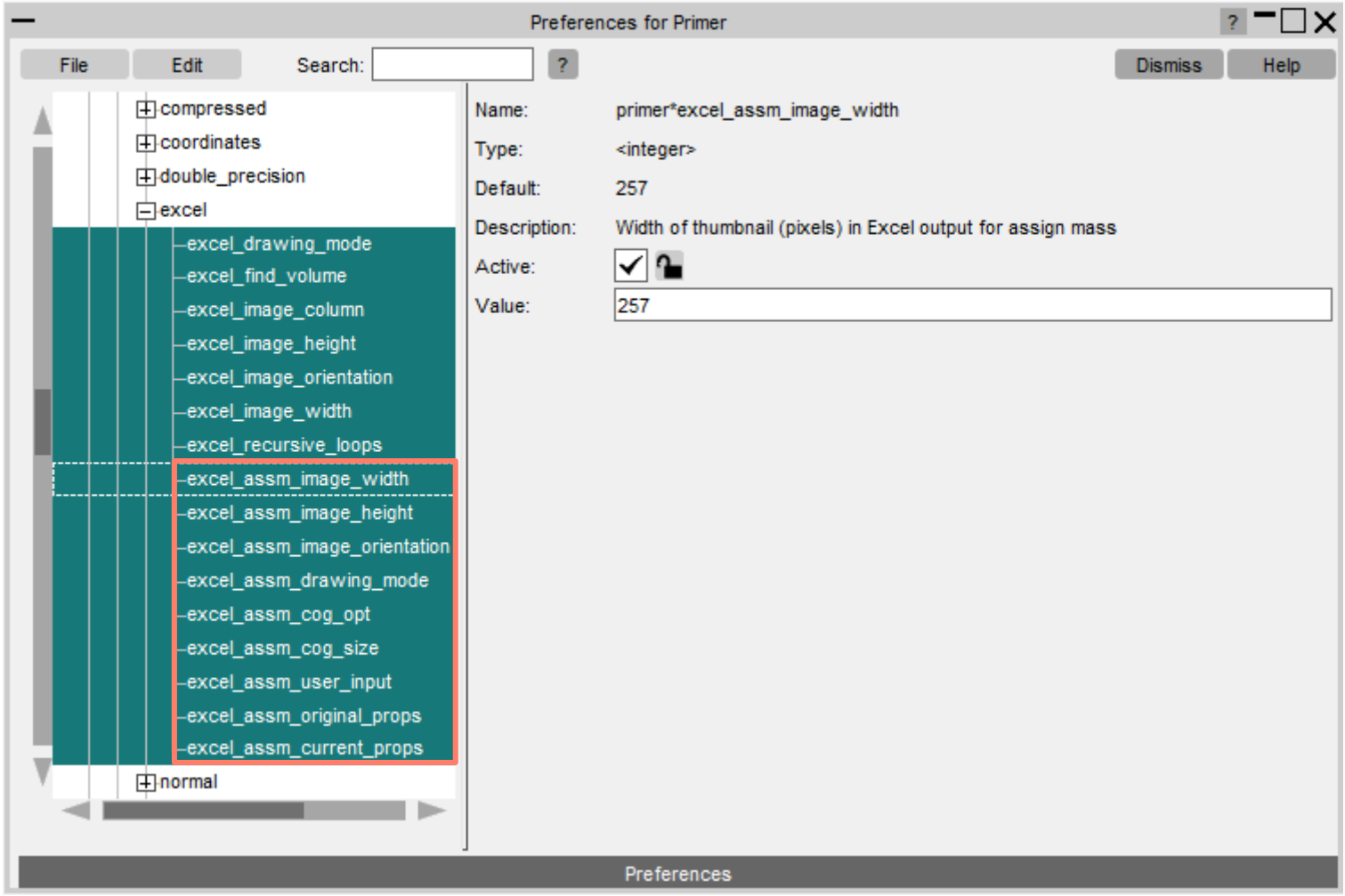
Assign Mass: Write to Excel

- You can control the output options from the button in the docked Assign Mass panel or from the Program Options menu.



Assign Mass: Write to Excel

- A new set of `primer*excel_assm_...` preferences have been added to save your preferred options:

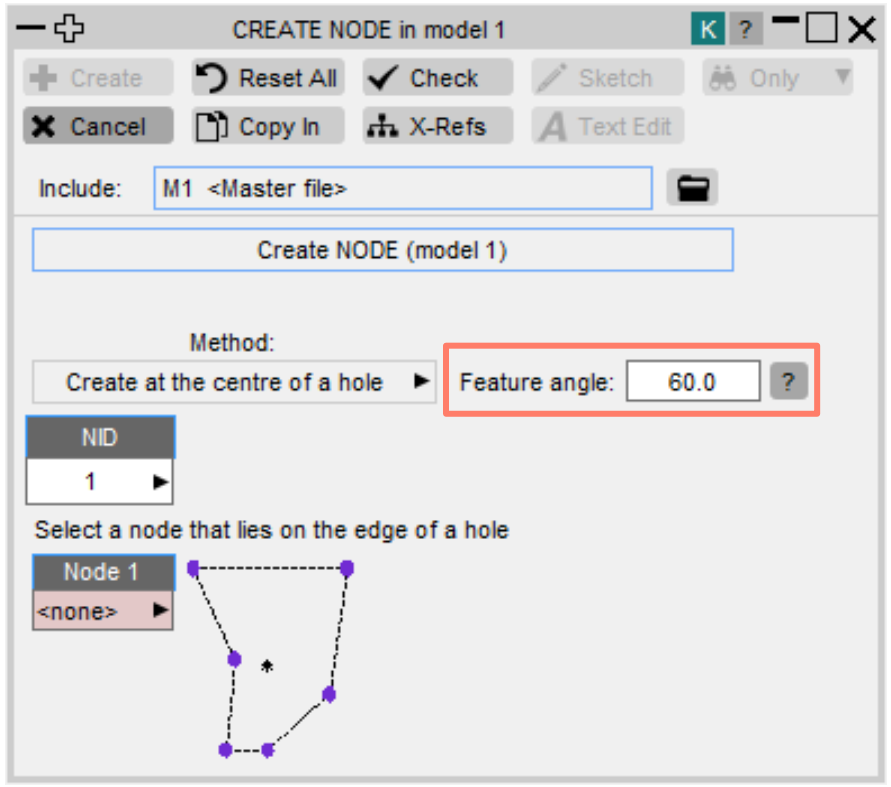


Propagate Model Properties Automation

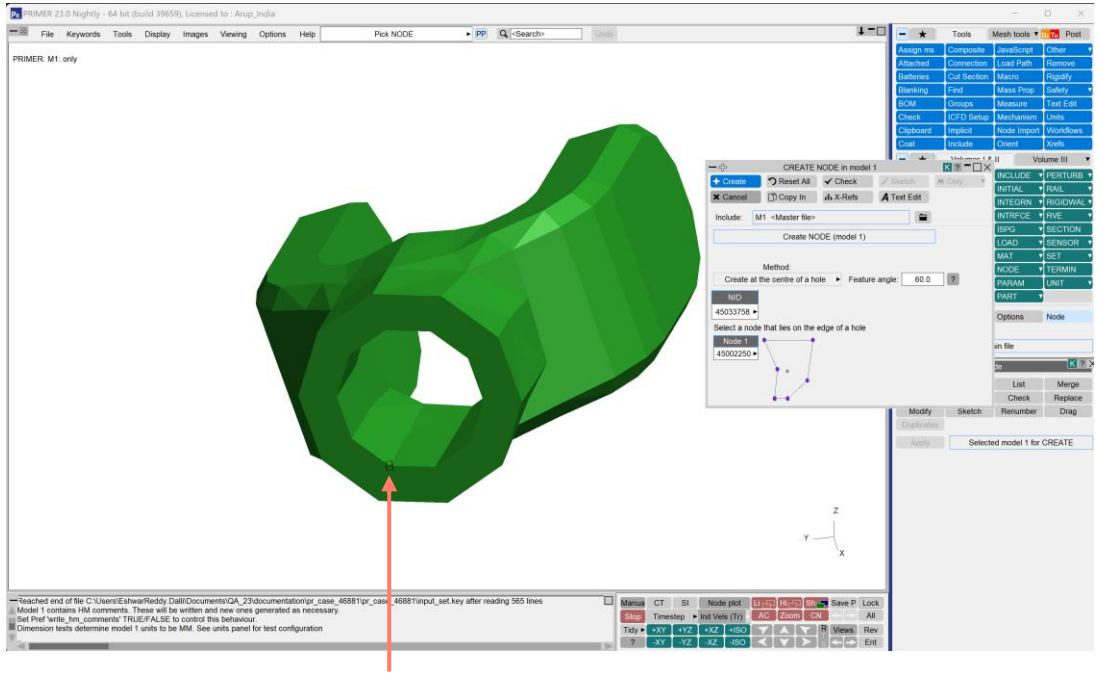
- The 'Propagate to model(s)' button within the Properties menu allows you to copy model attributes across to other models in the same session.
- Attributes for the model to propagate from are written out into a standard properties (.prp) file, and then read back into (and applied) to selected models.
- You can pick between propagating all of a model's states, or just the model's current state, along with what attributes to copy, and the models to copy the attributes into.

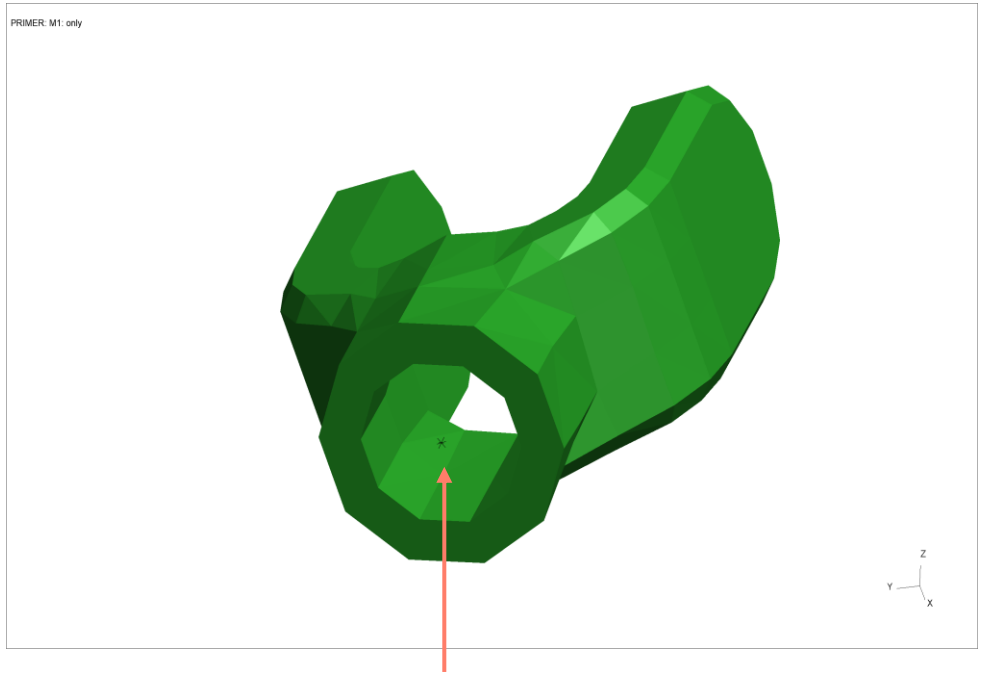
Centre node creation extended for 3D Holes

- Centre node creation for 3D holes defined by shell elements is now supported.
- Added feature angle input to detect hole boundaries based on geometric feature lines.



Centre node creation extended for 3D Holes

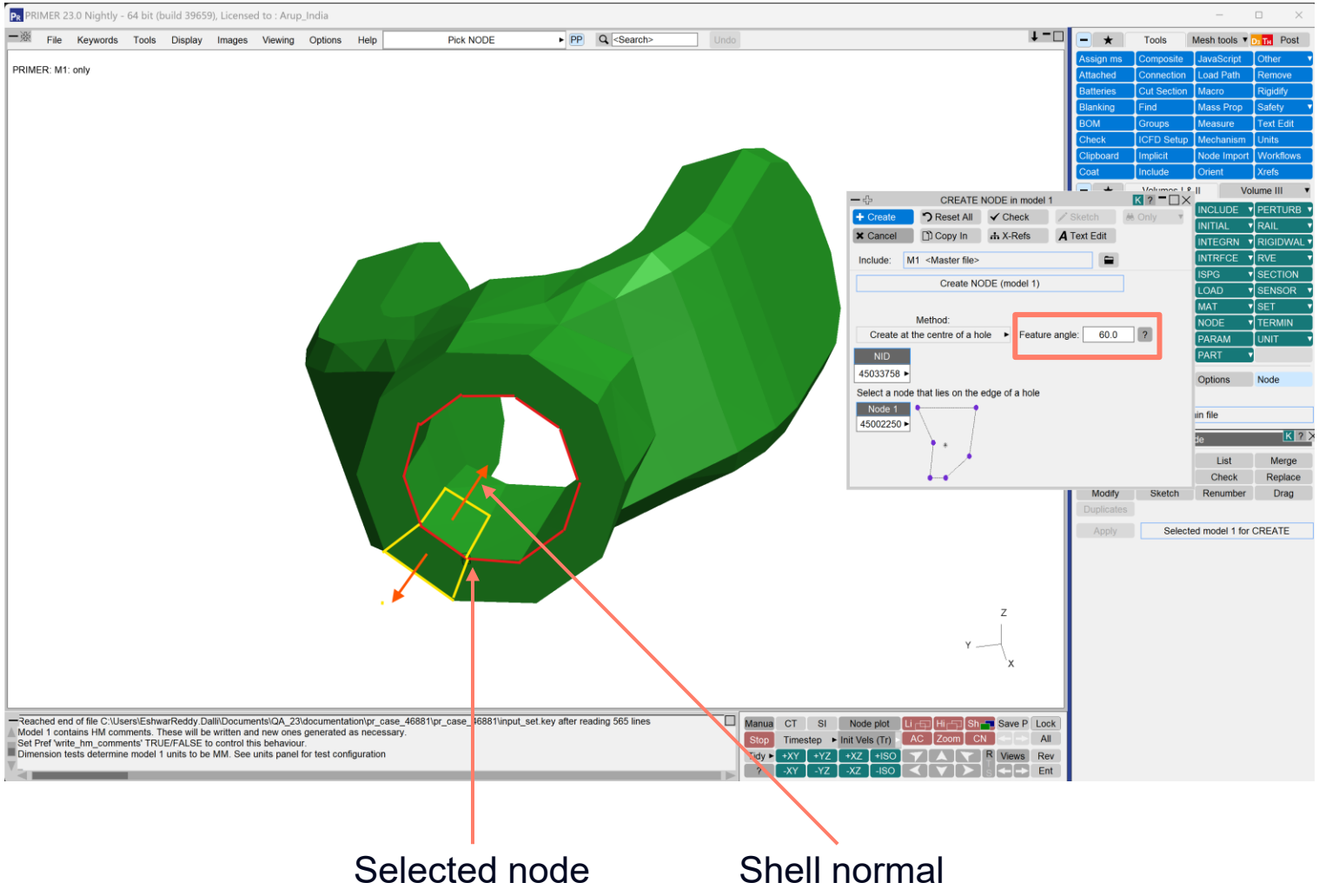




- To create the centre node (right image) for 3D holes, the selected node (left image) must lie on the boundary of the hole.

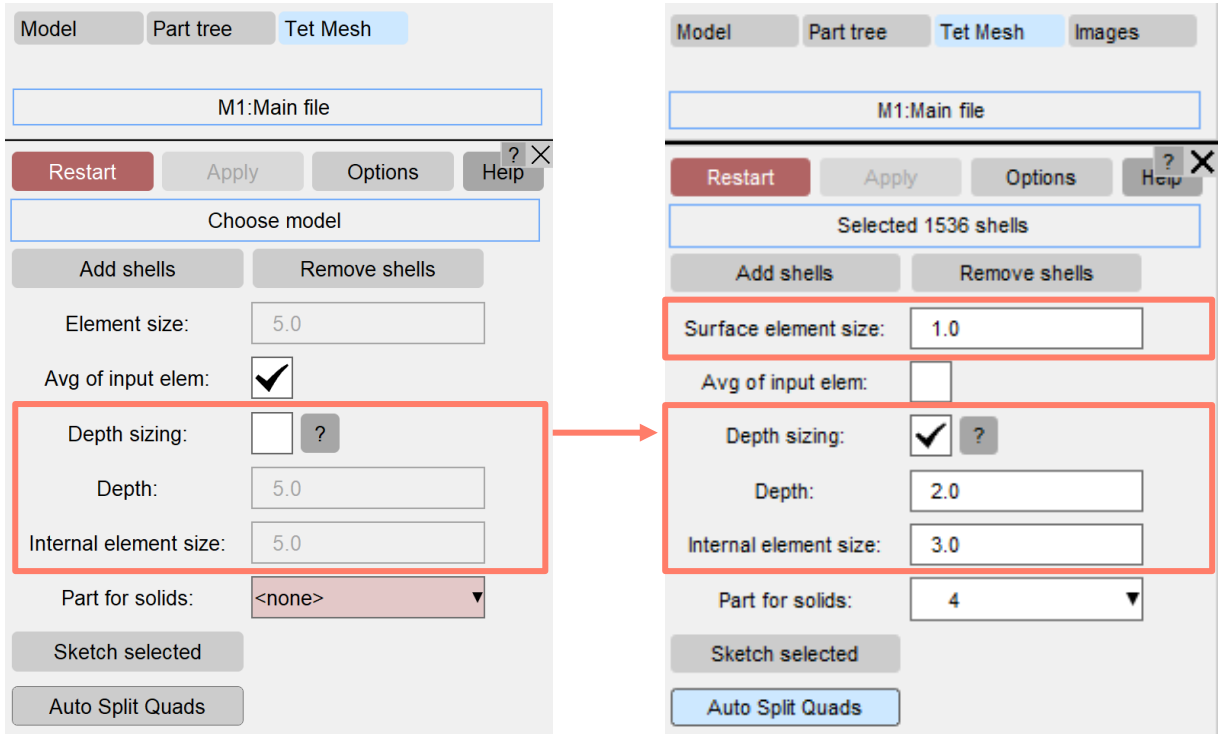
Centre node creation extended for 3D Holes

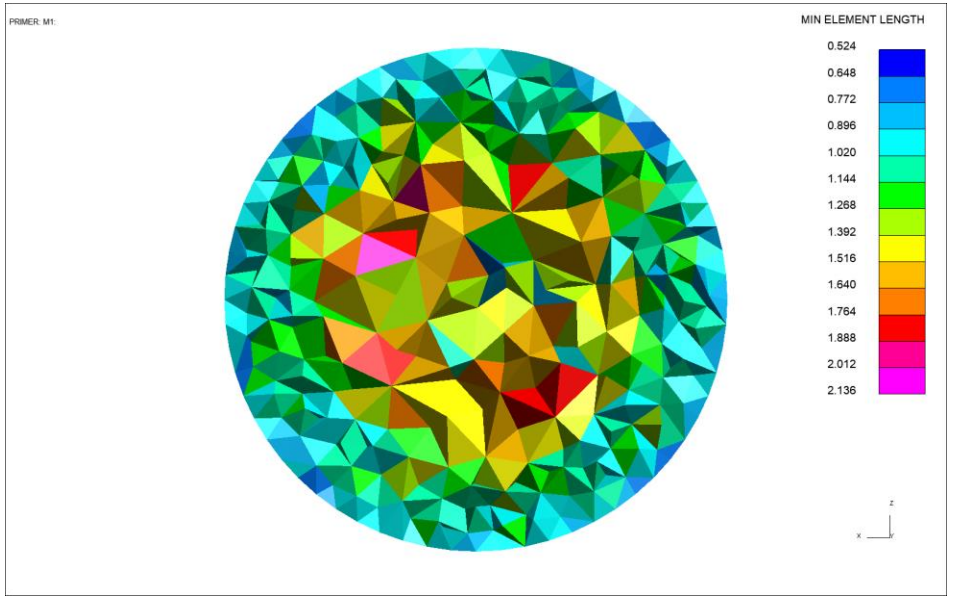
- PRIMER identifies the boundary of a 3D hole by checking if the selected node resides on a feature line forming a closed loop.
- An edge shared between two shells is a feature edge when the angle between the normals of those shells exceeds a specified threshold.
- This threshold is defined through the Feature angle input. By adjusting this angle, you can control which edges qualify as feature edges and thereby define the feature line used for centre node creation.



Added Depth sizing option for Tet Mesh

- Introduced a new **Depth Sizing** option in Tet Mesh panel to control element growth within a volume.
- When enabled, you can define a **Depth** up to which **Surface element size** is maintained.
- Beyond this depth, elements gradually grow up to the specified **Internal Element Size**.
- Helps save computation time in models where deformation occurs at surface, e.g. foam meshes.

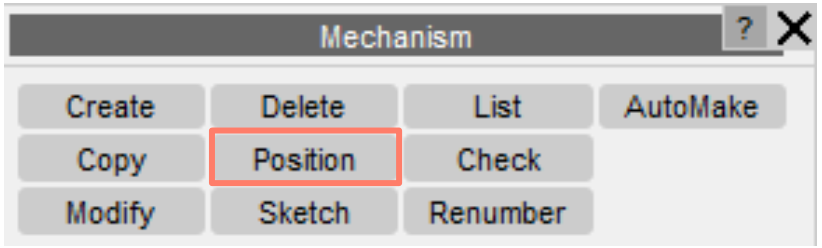


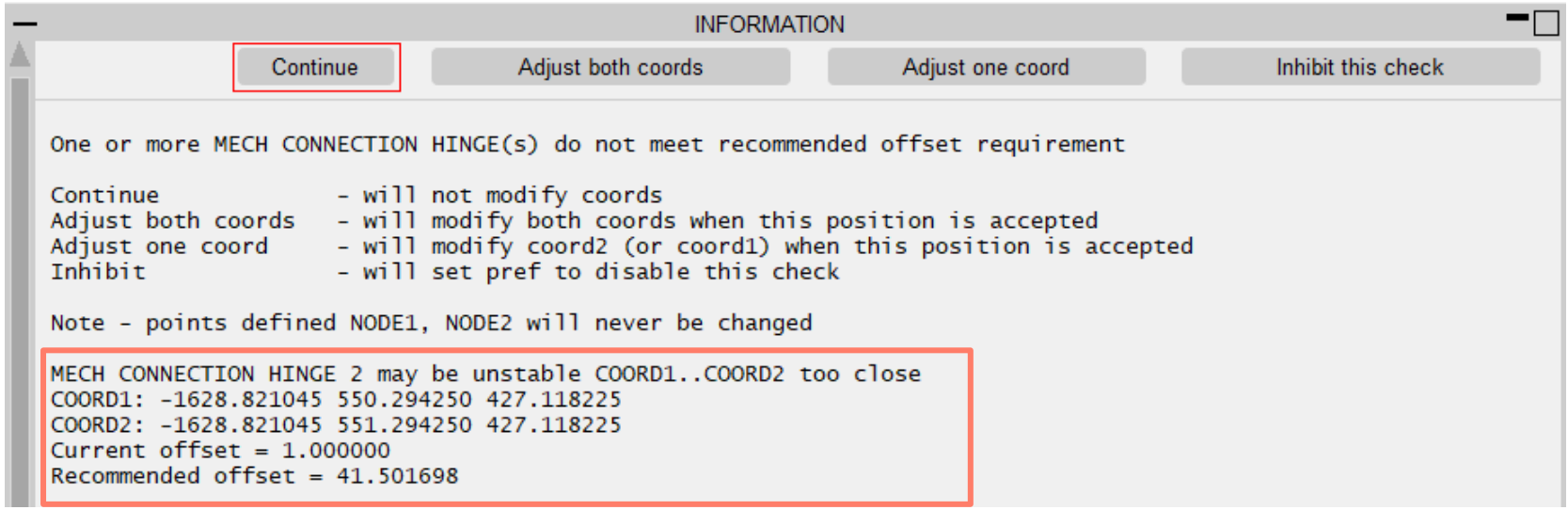


Cross sectional view of a Tet mesh on a sphere of radius 10mm, illustrating element size variation with depth based on the adjacent panel settings (smaller elements near surface, coarser inside)

Autofix for ill-conditioned hinge joints

- Mechanism hinge joints are required to be of 'reasonable' length with respect to assembly dimensions to maintain stability.
- On positioning, hinges violating this condition are now reported with an option to autofix them.
- This is another example of PRIMER helping you produce good quality models.





Timeout Control

- A configurable time limit determines when PRIMER, D3PLOT, T/HIS and REPORTER shut down automatically.
- The duration is controlled through the OASYS_TIMEOUT environment variable.
- Once this threshold is reached, the program exits in a safe manner.

New Preferences

Preference	Description
primer*back_faces	Whether the back faces of solids or thick shell elements are drawn
primer*internal_faces	Whether internal faces of solids and thick shell elements are drawn
primer*li_hi_free_edges	Controls how the edges of 2 and 3D elements are drawn in LIne and HIdden line plots
primer*use_triad_minimum	Whether to use a minimum element when drawing triads
primer*triad_minimum_factor	Minimum triad size. Min Triad Size = (factor/1000) * (model size)
primer*use_triad_scale	Whether to use a scale factor when drawing triads
primer*triad_scale_factor	Scale factor for the size of triads. Triad Size = scale factor * original size
primer*shells_use_optt_sft	Whether a part with optt or sft defined is plotted with that thickness

New Preferences

Preference	Description
primer*swap_nodal_coords_mode	Chooses which 'reference' nodes to use to swap the coordinate of 'normal' nodes
primer*swap_shell_topology_mode	Chooses which 'reference' shells to use to swap the coordinates of 'normal' shells
primer*display_model_name_option	Display model name options
primer*copy_orient_options_labels	Controls how boxes are oriented during rotation
primer*orient_general_label	The label increment for everything excluding Nodes and Elements
primer*orient_node_el_label	The label increment for Nodes and Elements
primer*excel_assm_image_width	Width of thumbnail (pixels) in Excel output for assign mass
primer*excel_assm_image_height	Height of thumbnail (pixels) in Excel output for assign mass
primer*excel_assm_image_orientation	Orientation view of model in Excel output for assign mass

New Preferences

Preference	Description
primer*excel_assm_drawing_mode	Drawing mode of model in Excel output for assign mass
primer*excel_assm_cog_size	Size of centre of gravity icon sketched in Excel output for assign mass
primer*excel_assm_user_input	Assign mass user input values Excel output flag.
primer*excel_assm_original_props	Assign mass original mass properties Excel output flag.
primer*excel_assm_current_props	Assign mass current mass properties Excel output flag.
primer*dummy_overwrite_position_name	Action when user provides existing position name.
primer*mechanism_overwrite_position_name	Action when user provides existing position name.
primer*connection_arcweld_diam	+ve search diameter for nrb nodes. -ve for fixed count of closest nodes
primer*connection_arcweld_method	Default method for connection arc-weld creation
primer*draw_beam_overlay	Draw overlay on true section beams in feature/free edge overlay mode

New Preferences

Preference	Description
primer*dynain_fix_material_lmin	Update LMIN on *MAT_SEATBELT after import if belt elements at sliprings have shortened.
primer*excel_assm_cog_opt	Type of centre of gravity icon sketched in Excel output for assign mass
primer*geom_read_free_curves	When TRUE, curves that do not trim any surfaces are loaded into PRIMER when reading a CAD model. When FALSE, these curves are not loaded
primer*geom_read_free_points	When TRUE, points that are not used to define curves or surfaces are loaded into PRIMER when reading a CAD model. When FALSE, these points are not loaded
primer*geom_read_hidden_objects	When TRUE, objects that are marked as hidden in a CAD file being read are loaded into PRIMER. When FALSE, these hidden objects are not loaded
primer*geom_tess_data	Determines what data is loaded into PRIMER when reading a CAD model

New Preferences

Preference	Description
primer*include_name_verbatim	Use verbatim (as read) include filenames when writing the master file only
primer*load_path_path_order	Default path order
primer*load_path_quadrants	Default status of the 'split into quadrants' option
primer*measure_entity_label	Set to 'TRUE' for PRIMER to show measure entity labels
primer*mechanism_hinge_offset_check	Check that hinge coordinate points are sufficiently offset to maintain stability
primer*mechanism_overwrite_position_name	Action when user provides existing position name
primer*model_build_lst_decimal_places	Number of decimal places for values in .lst file
primer*orient_general_label	The label increment for everything excluding Nodes and Elements
primer*orient_node_el_label	The label increment for Nodes and Elements
primer*pm_beam_length	User defined Beam length for markup lines

New Preferences

Preference	Description
primer*process_post_end_altair_xml	Process post *END Altair Xml block
primer*rename_duplicate_include	Rename duplicate include file names when reading keyword files
primer*shell_coincident_display	How shells that are coincident with solid element faces are displayed
primer*shells_use_optt_sft	Whether a part with optt or sft defined is plotted with that thickness
primer*sketch_crosshair_cn	Whether or not to set centre node (CN) at the crosshair location of a (single) sketched item
primer*sketch_crosshair_draw	Whether or not to draw crosshairs on a (single) sketched item
primer*sketch_crosshair_label	Whether or not to label a (single) sketched item with Mm/Ln

New Preferences

Preference	Description
primer*triad_scale_factor	Scale factor for the size of triads. Triad Size = scale factor * original size
primer*use_triad_minimum	Whether to use a minimum element when drawing triads
primer*use_triad_scale	Whether to use a scale factor when drawing triads
primer*write_parameter_comments	Write PRIMER comment tags for mutable parameters
primer*xmcf_unrealised_to_table	Map unrealised connections to Connections Table after reading in model with post-*END xMCF data
primer*keyin_temp_file_location	Directory where the temporary PGP data file is created while reading a model. CURRENT: Writes to master file's location. LOCAL: Writes to a local temporary directory. AUTOMATIC: Chooses CURRENT or LOCAL based on whether the master file is local or remote. DIRECTORY: User a user specified directory path.

New Preferences

Preference	Description
primer*legacy_iges_reader	Use the legacy IGES reader when reading IGES models
primer*legacy_jt_reader	Use the legacy JT reader when reading JT models
primer*legacy_step_reader	Use the legacy STEP reader when reading STEP models
primer*load_path_add_loc_to_label	Default status of the 'Append xsec location to xsec' option
primer*post_edit_sketch	Sketch edited items when Creating/Updating (only applies to bespoke editing panels)
primer*post_end_keyout_format	Output format of *BELT, *DUMMY, *MECHANISM and *LOAD_PATH keywords
primer*rename_duplicate_includes	Rename duplicate include file names when reading keyword files

New Preferences

Preference	Description
`primer*sketch_label_nodes`	Labelling of nodes on a (single) sketched item. DYNAMIC does this only if appropriate at the current scale.

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