T/HIS 20.1

T/HIS 20.1 – Contents

Filtering and Correlation

CORA and ISO 18571

CORA and ISO 18571

T/HIS 20.0 comes with a new correlation tool that implements calculations according to CORA[1] and ISO 18571[2] methods.

You can use the T/HIS CORA tool to compare your LS-DYNA simulation results against other simulations, or against physical test data.

Select **Tools → Automotive → CORA** to access the tool.

The CORA and ISO 18571 correlations can also be automated via the T/HIS JavaScript API.

For more information about the tool, read Appendix F.1 of the T/HIS manual and follow the new tutorial (**Help → Tutorials → CORA and ISO-18571**).

[1]   An implementation of the methodology used by the Partnership for Dummy Technology and Biomechanics (PDB) software CORA (**COR**relation and **A**nalysis)

[2]   BSI Standards publication, Road vehicles - Objective rating metric for non-ambiguous signals, PD ISO/TS 18571:2014.

Filtering and Correlation

MADM Correlation Tool

MADM Correlation Tool

The minimum area discrepancy method (MADM) is ideal for correlation between LS-DYNA simulations and physical tests when **force** versus **deflection** is the relationship of interest, and offers benefits over other correlation methods that focus on parameters versus time.

The MADM Correlation Tool was developed in collaboration with the University of Coventry [1][2].
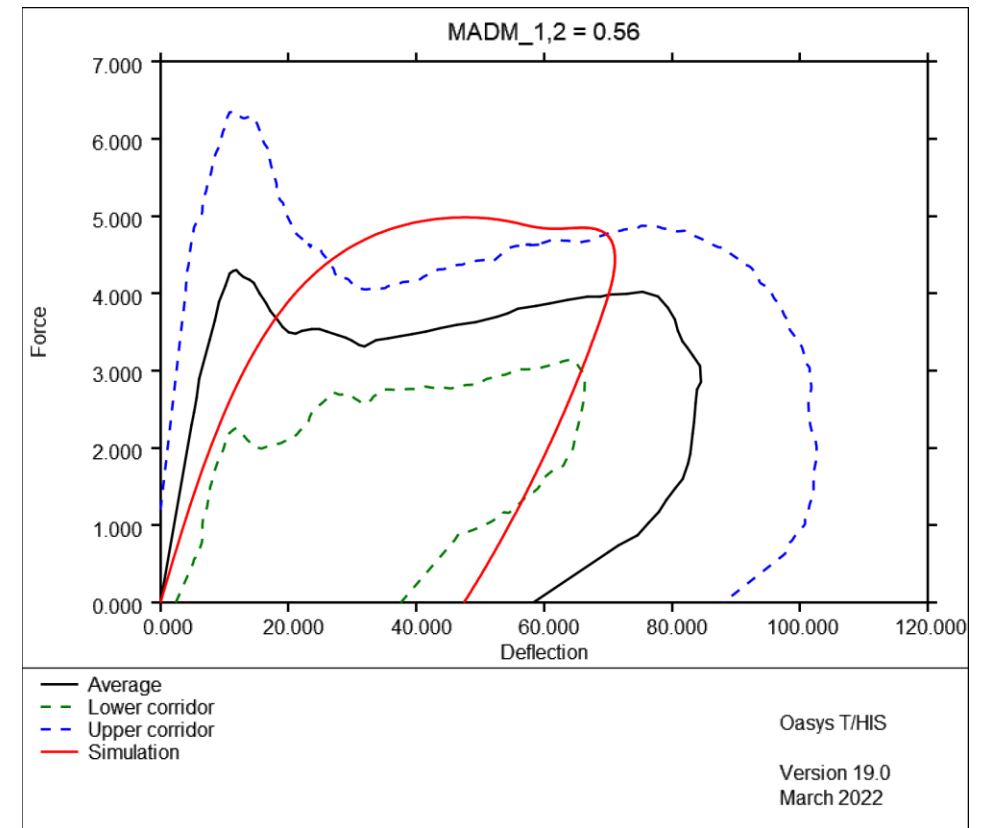
[1]   Bastien, C., Diederich, A., Christensen, J., & Ghaleb, S. (2021). Improving Correlation Accuracy of Crashworthiness Applications by Combining the CORA and MADM Methods. Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering. https://journals.sagepub.com/doi/10.1177/09544070211069666

[2]   Peres, J, Bastien, C, Christensen, J & Asgharpour, Z 2019, 'A Minimum Area Discrepancy Method (MADM) for Force Displacement Response Correlation', Computer Methods in Biomechanics and Biomedical Engineering, vol. 22, no. 11, GCMB-2018-045, pp. 981-996. https://doi.org/10.1080/10255842.2019.1610745

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MADM Correlation Tool

In T/HIS 20.0, select **Tools** → **Automotive** → **MADM** to access the MADM Tool. Further help and academic references can be found in the MADM window.

Workflows

Workflows

Previous versions of the Oasys Suite contained powerful tools and capabilities that could be used to interrogate and debug your analysis results. However...

1. The tools were not always customised for specific loadcases or tasks

2. You may have needed to manually perform a number of steps to process your results, which could be time-consuming and prone to error

3. The JavaScript API could be used to create tools to automate your post-processing workflow, but this requires time, resource and knowledge, which is not always available

To address this issue, a new **Workflows** feature has been added that provides tools customised for specific loadcases and tasks, and built upon the existing capabilities in the Oasys Suite, to make it easier to interrogate and post-process results.

Workflows

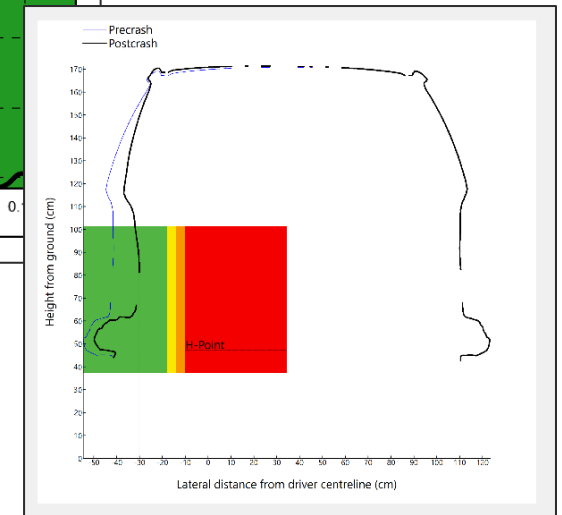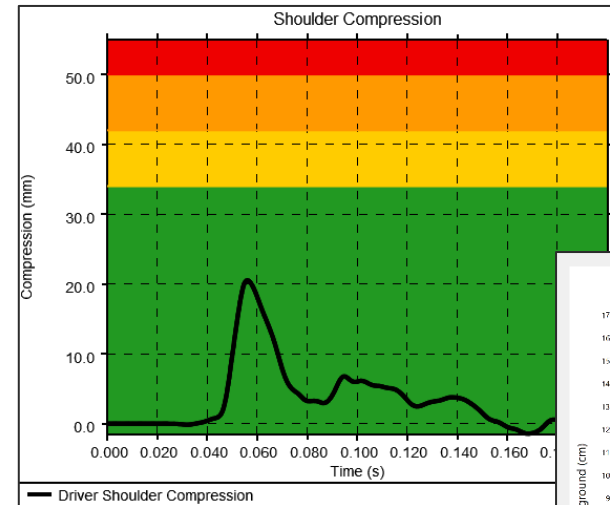**Workflows** allow you to tag your model in PRIMER with meta data, e.g.

The post-processing software reads this data and provides tools that are relevant to your analysis
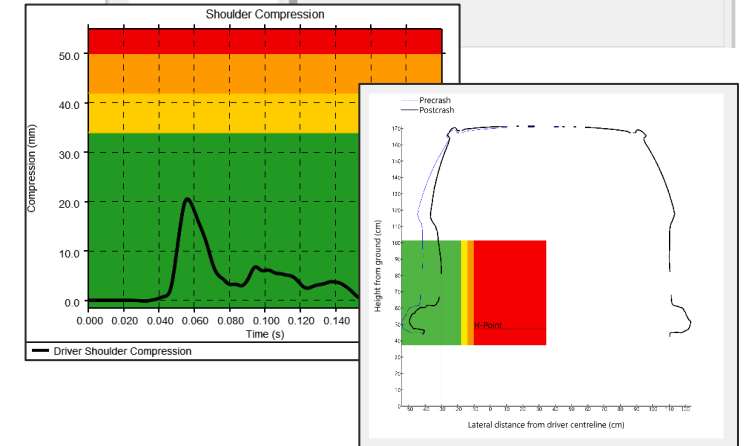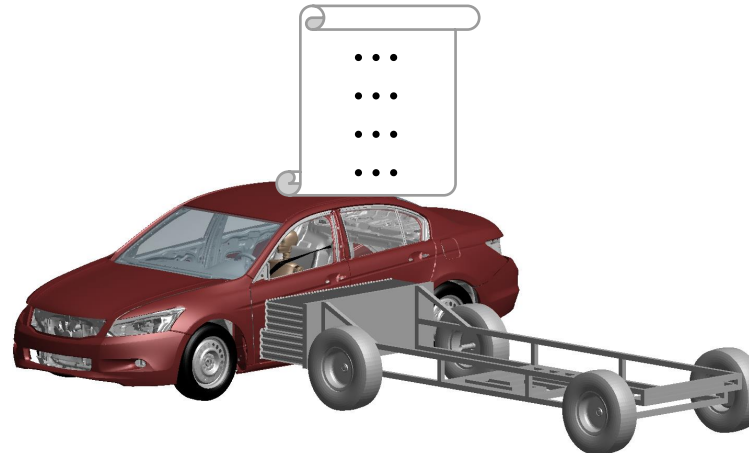
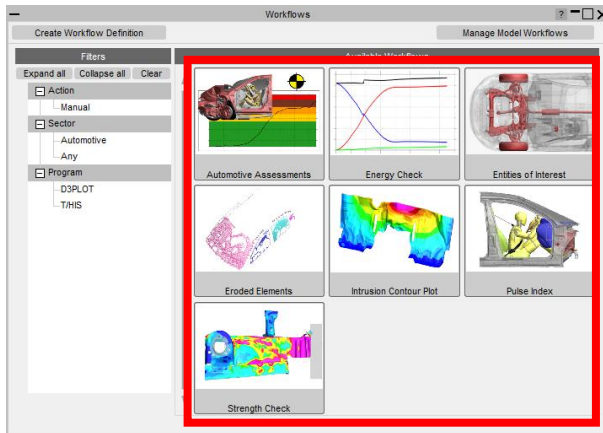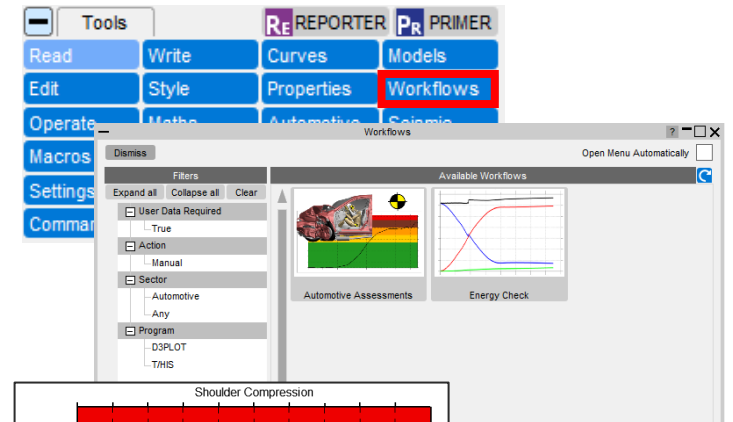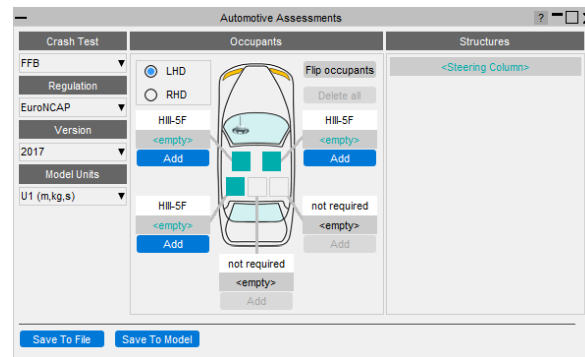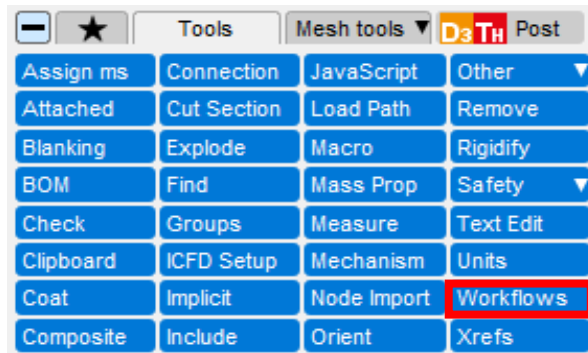# Workflows

To use a Workflow:

1. Select in PRIMER ⇨ 2. Tag the model ⇨ 3. Use in D3PLOT or T/HIS

Workflows

This release contains a collection of Workflows (described in more detail in further slides):

We plan to update these tools in future releases, as well as adding new tools.

If you have any ideas for additional features you would like to see in the existing tools or any ideas for new tools, please contact us.

| Workflow	Description
Automotive Assessments	Process crash and occupant safety simulations according to legal regulations and consumer safety NCAP protocols
Energy Check	Plot total, kinetic, internal and hourglass energy
Entities of Interest	Show and highlight groups of parts and export them to GLB files to view in D3PLOT Viewer
Eroded Elements	Visualise deleted elements at different states
Intrusion Contour Plot	An intrusion contour plot of selected parts (e.g. vehicle cockpit intrusion)
Pulse Index	Performs a vehicle pulse index calculation
Strength Check	Visualise yielding parts

Workflows: Automotive Assessments

The **Automotive Assessments** workflow tool is used to post-process analyses according to various crash test regulations.

1. **In PRIMER**, you select the crash test type, regulation, and the occupants and structures you wish to assess

2. **D3PLOT and T/HIS** can then plot results for the different assessments required by the regulation
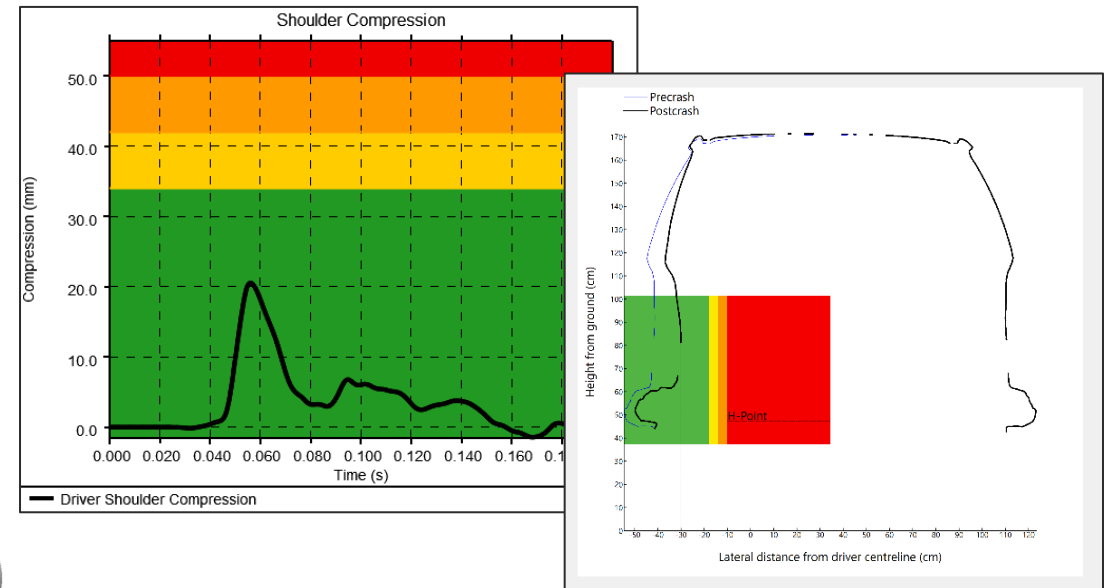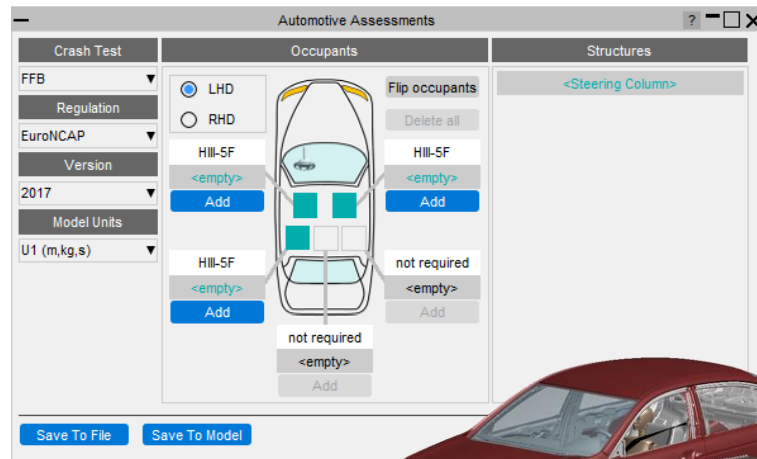
Workflows: Automotive Assessments

When the Automotive Assessments tool is launched in PRIMER you are presented with a menu that lets you specify the crash test type and the occupants and structures you wish to assess:

Set the crash test type, regulation, version and model units

Define the structures in the model

Define the occupants in the model

Workflows: Automotive Assessments

The Occupants section is used to select which occupants are in the vehicle, their positions in the vehicle, and the IDs of the entities from which data can be read.

This section updates automatically to show the required occupants in each position for the selected crash test type and regulation.

The first thing to do is select whether the vehicle is left hand or right hand drive (LHD or RHD).

The vehicle image will update to show the steering wheel on the correct side and the occupant positions will also update.
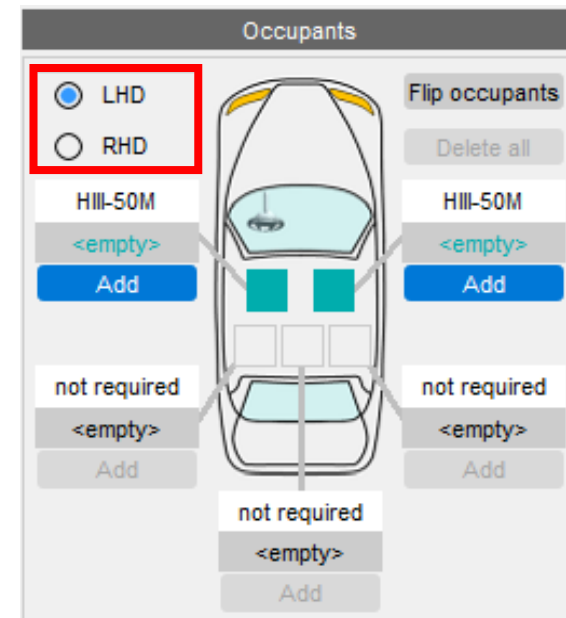
Workflows: Automotive Assessments

1. For each occupant, click **Add**
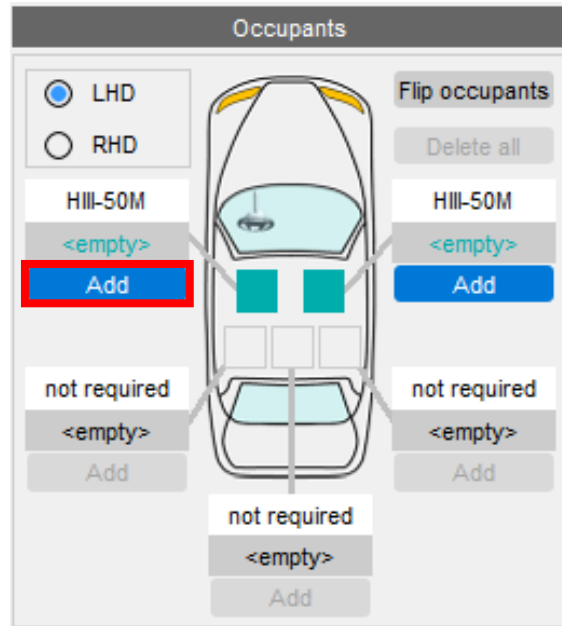
2. This will open a window where you can select the occupant type. Input entity IDs are filled automatically from a list of popular suppliers.

Note that if your model does not have an occupant (or you don't want to carry out an assessment on it) you can leave it empty. T/HIS and D3PLOT will only attempt to process results for occupants that have been added.

Workflows: Automotive Assessments

- The Structures section is used to select the IDs of the entities from which data can be read from structures in the vehicle.

- This section updates automatically to show the required structures for the selected crash test type and regulation.
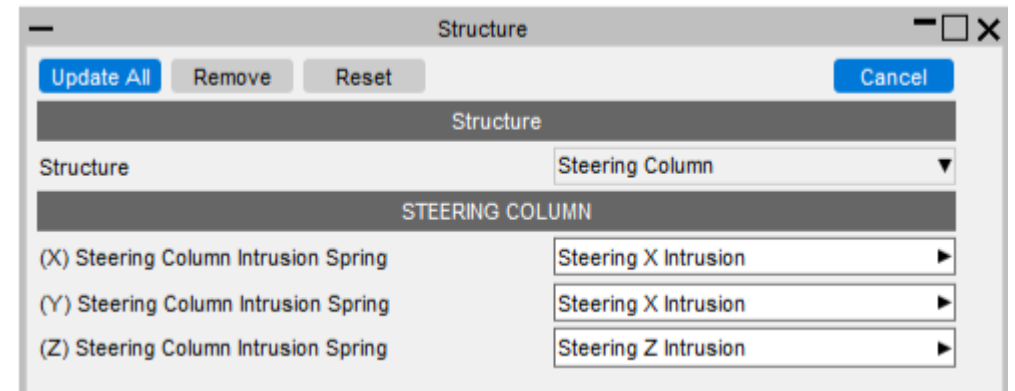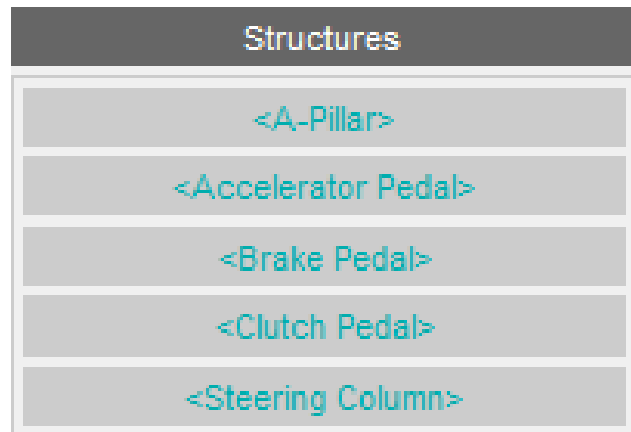
Workflows: Automotive Assessments

When launched in T/HIS, a menu appears, allowing you to select which occupant injuries and which structural checks you wish to perform:

Select which occupant injury assessments to plot.

The list of available occupants will depend on what was selected in PRIMER

Options to control how graphs are created and displayed

Select structural assessments.

The list of available structures will depend on what was selected in PRIMER

Workflows: Automotive Assessments

T/HIS will extract the data required, process it according to the rules set out in the regulation and plot the results on a graph with datums showing allowable limits:
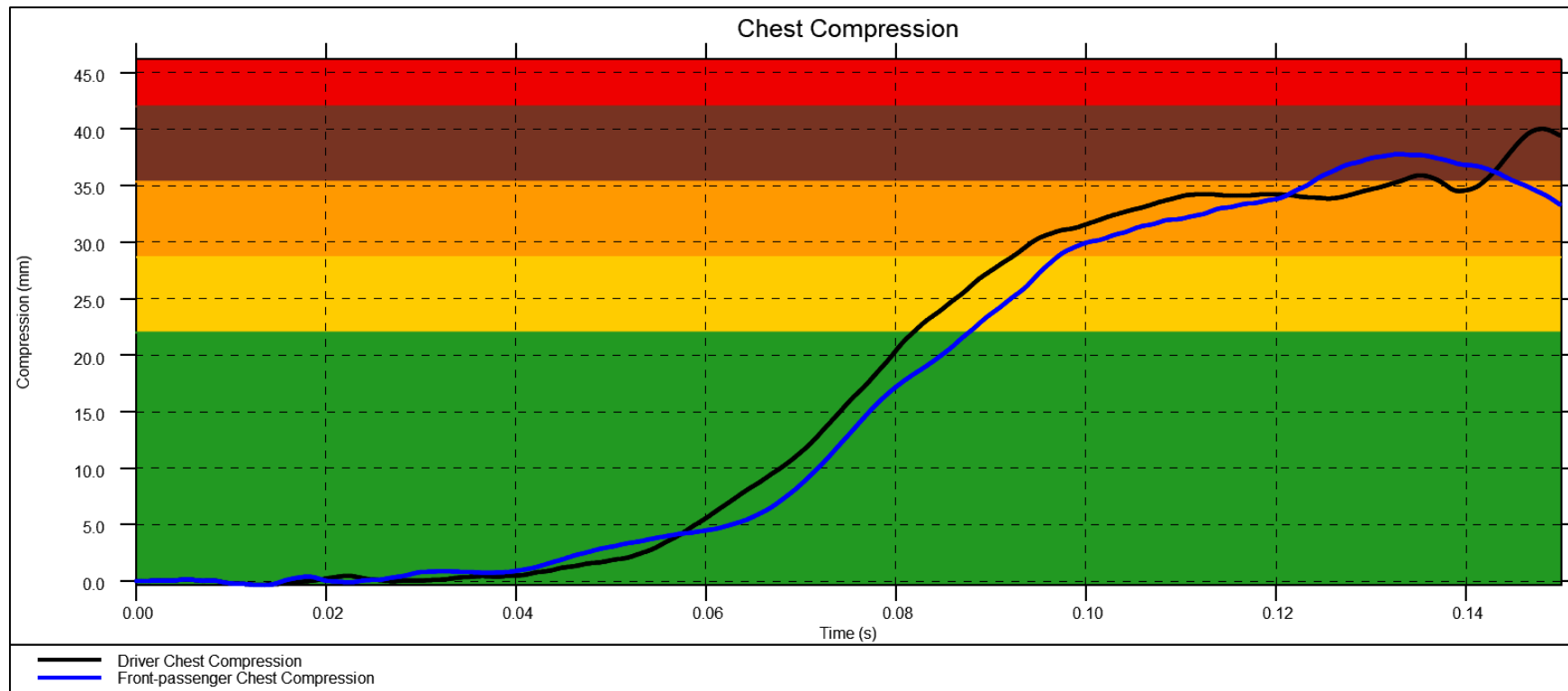
Workflows: Automotive Assessments

The tool allows you to plot results from multiple models. This is useful when you want to compare results between different runs:
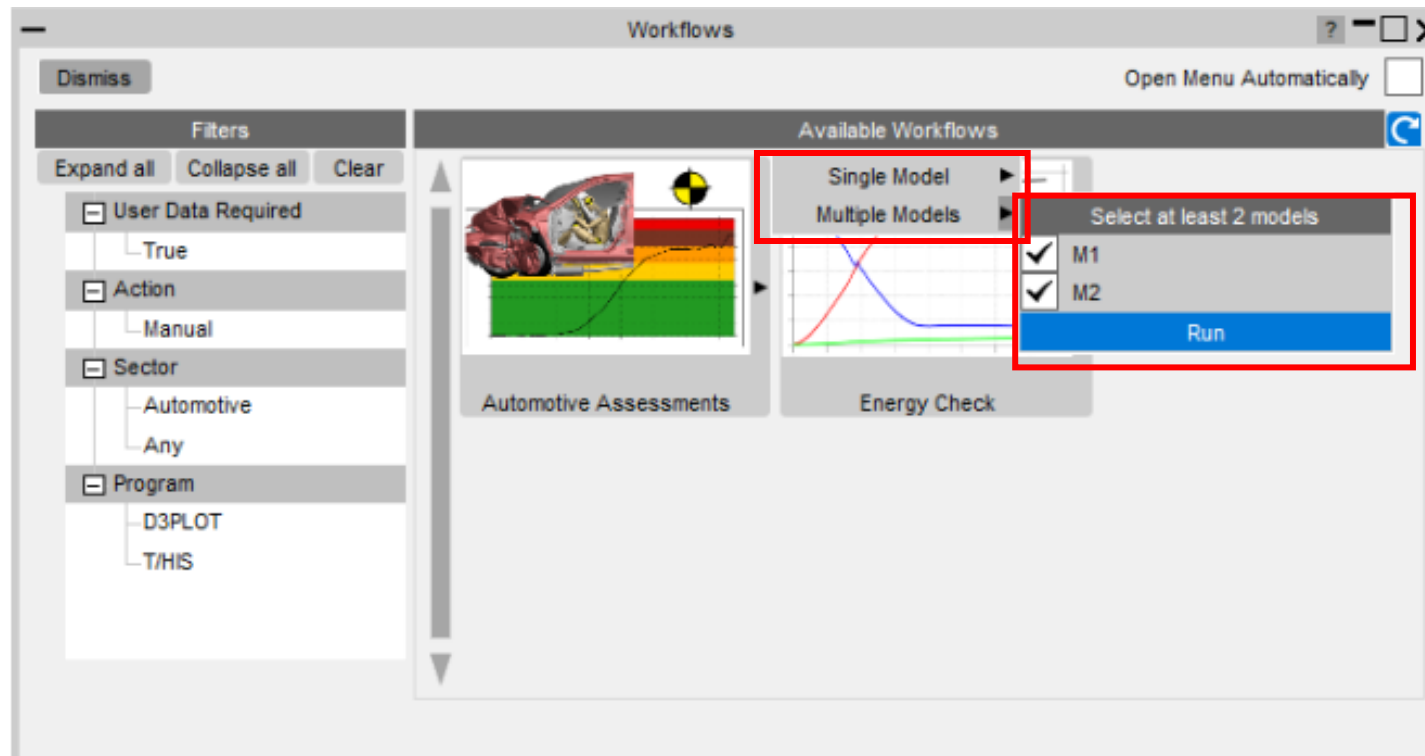
Workflows: Automotive Assessments

- When launched in D3PLOT, the Automotive Assessments Workflow will extract the data required for the assessment and process it according to the rules set out in the regulation.

- Example output from Euro NCAP Far Side assessment:
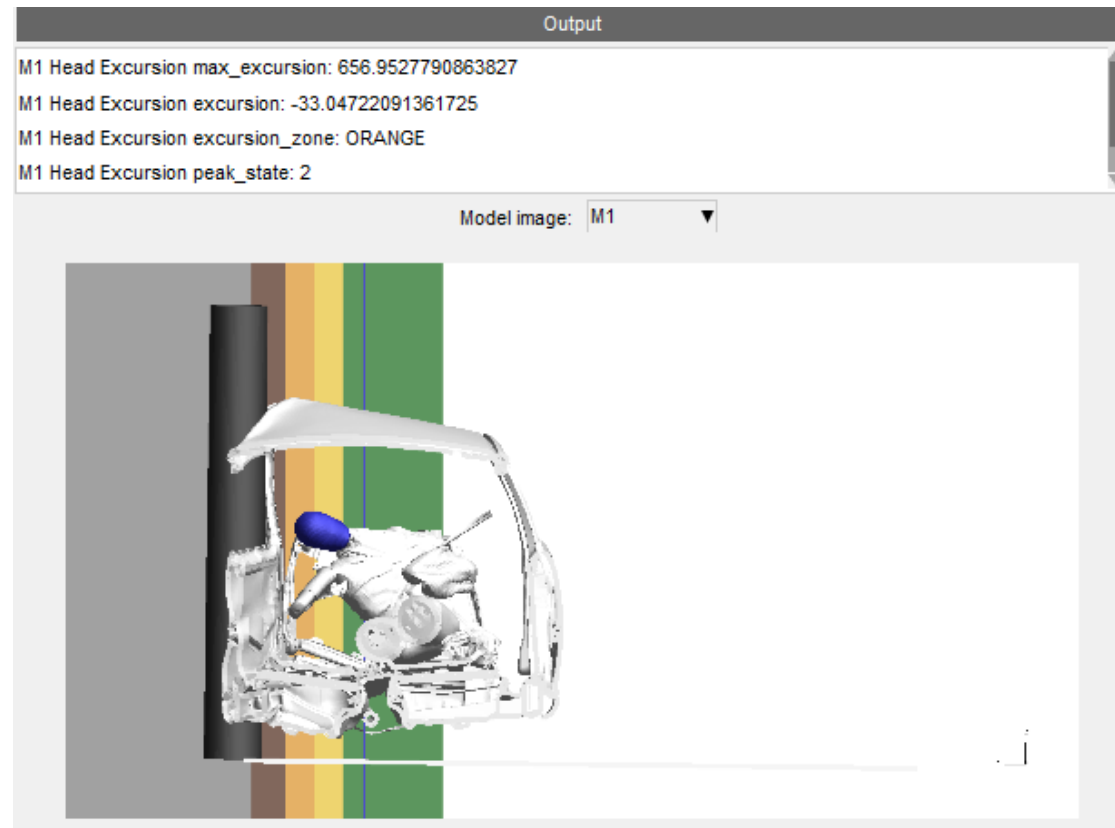
Workflows: Energy Check

The **Energy Check** Workflow is a quick tool to help plot global energies for your model. In PRIMER, select a unit system (to define the energy units plotted). Then in T/HIS, select the Energy Check Workflow to plot a graph of total energy, kinetic energy, internal energy and hourglass energy for your model.
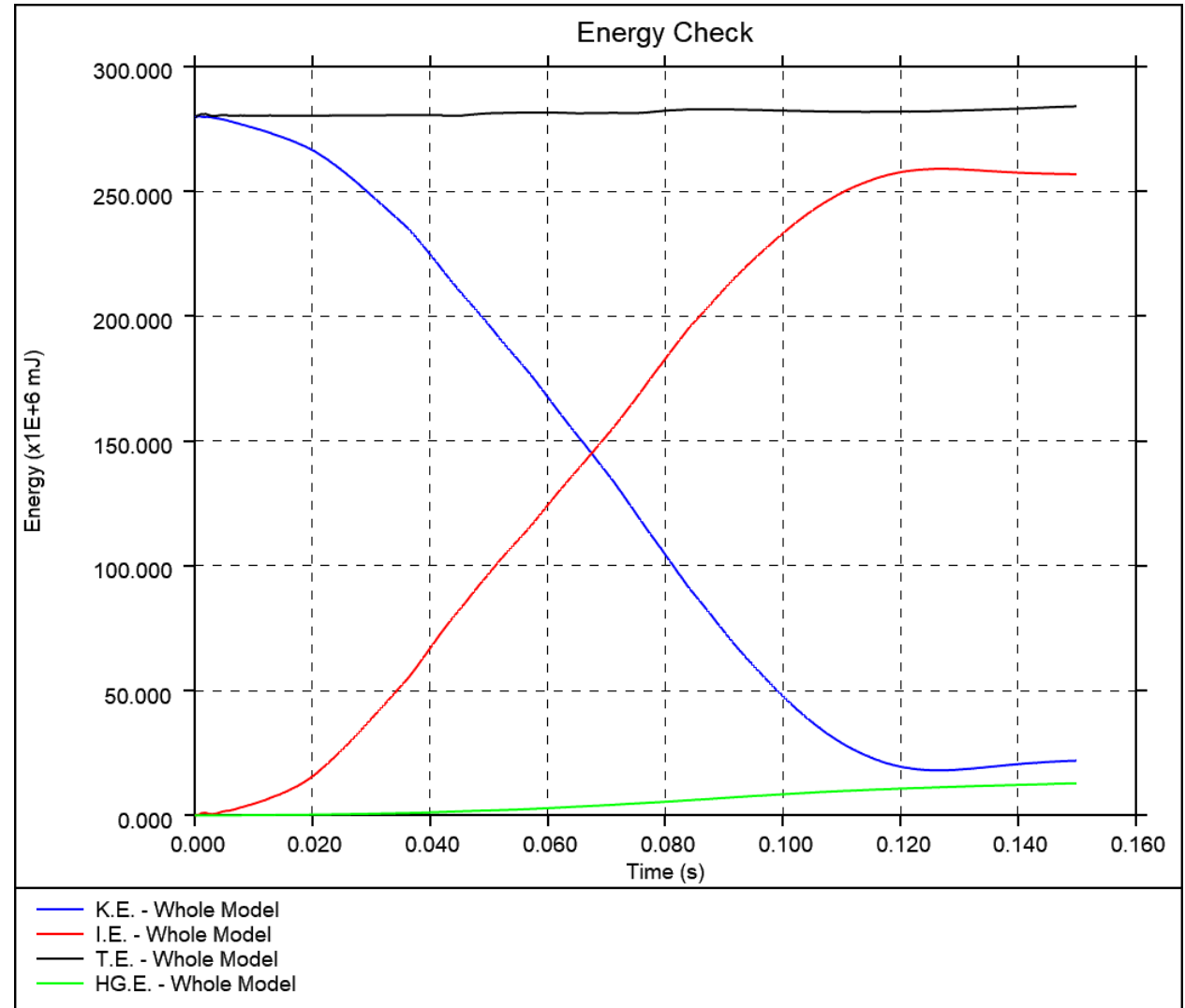
Workflows: Entities of Interest

- The Entities of Interest tool allows you to visualise specific groups of entities quickly in D3PLOT and action them.

- First, create a list of Entities of Interest in PRIMER – the list can comprise Parts and Part Sets.

Entities of Interest

Name

Type Parts ▼ Select... Add

Unblank all | Only | Edit | Delete

Only the selected entities

Front Suspension | Parts | 300000,300001,300002,300003,3000
Rear Suspension | Parts | 700000,700001,700002,700003,7000
Steering Wheel | Parts | 450005,450013
Footwell | Parts | 100166
Front Bumper | Parts | 260000,260001,260002,600028

Save To File | Save To Model
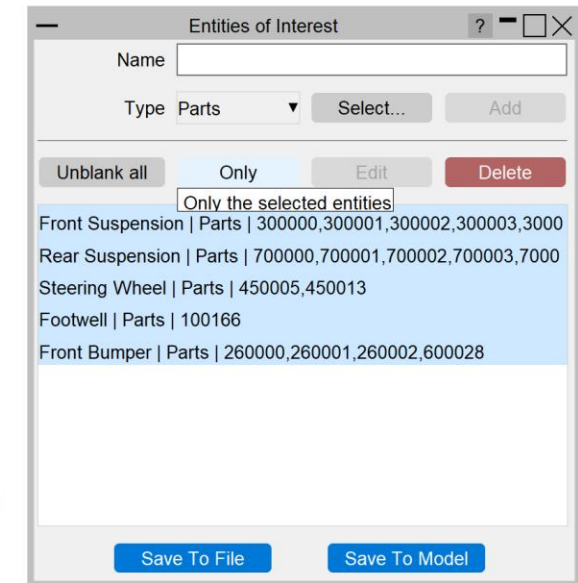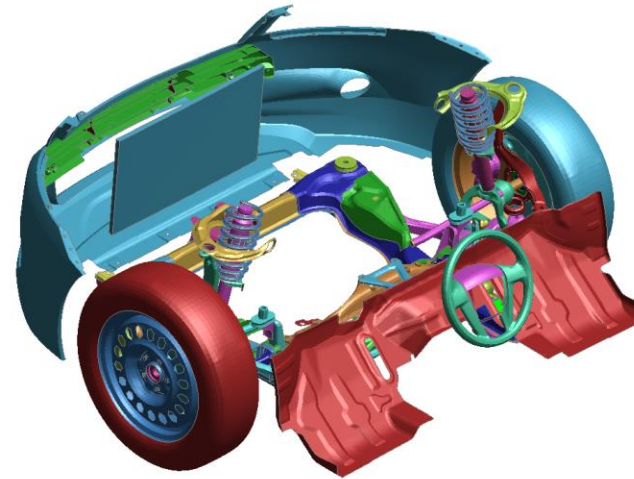
Only
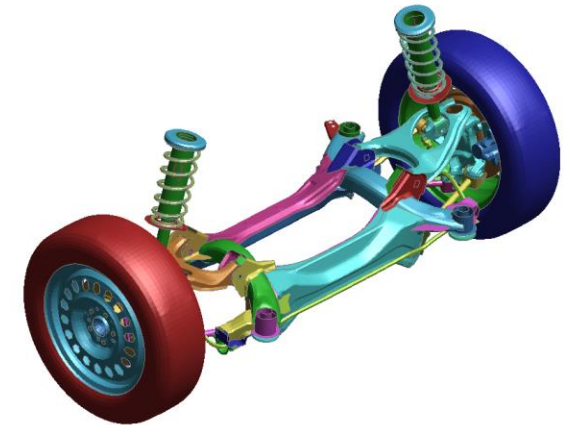
Workflows: Entities of Interest

In D3PLOT, you can then execute various actions, including highlighting the selected entities, and exporting them as a set of GLB files for viewing in D3PLOT Viewer.

Highlight

Entities of Interest | ? — □ ✕

M1 | Front Suspension | Parts | 300000,300001,300002,300003,
M1 | Rear Suspension | Parts | 700000,700001,700002,700003,
M1 | Steering Wheel | Parts | 450005,450013
M1 | Footwell | Parts | 100166
M1 | Front Bumper | Parts | 260000,260001,260002,600028

Reset   Only   Highlight   GLB Export
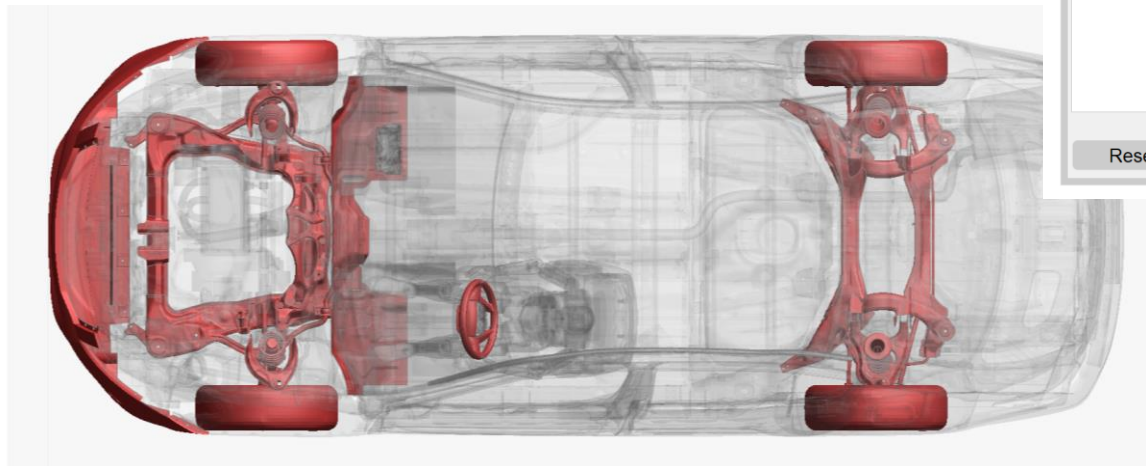
GLB Export

Name	Type
Footwell.glb	3D Object
Front Bumper.glb	3D Object
Front Suspension.glb	3D Object
Rear Suspension.glb	3D Object
Steering Wheel.glb	3D Object

Workflows: Eroded Elements

The **Eroded Elements** Workflow provides a quick method of visualising eroded (deleted) elements in your LS-DYNA simulation.

- Note that while using this tool, elements are drawn as they appear at state 1.
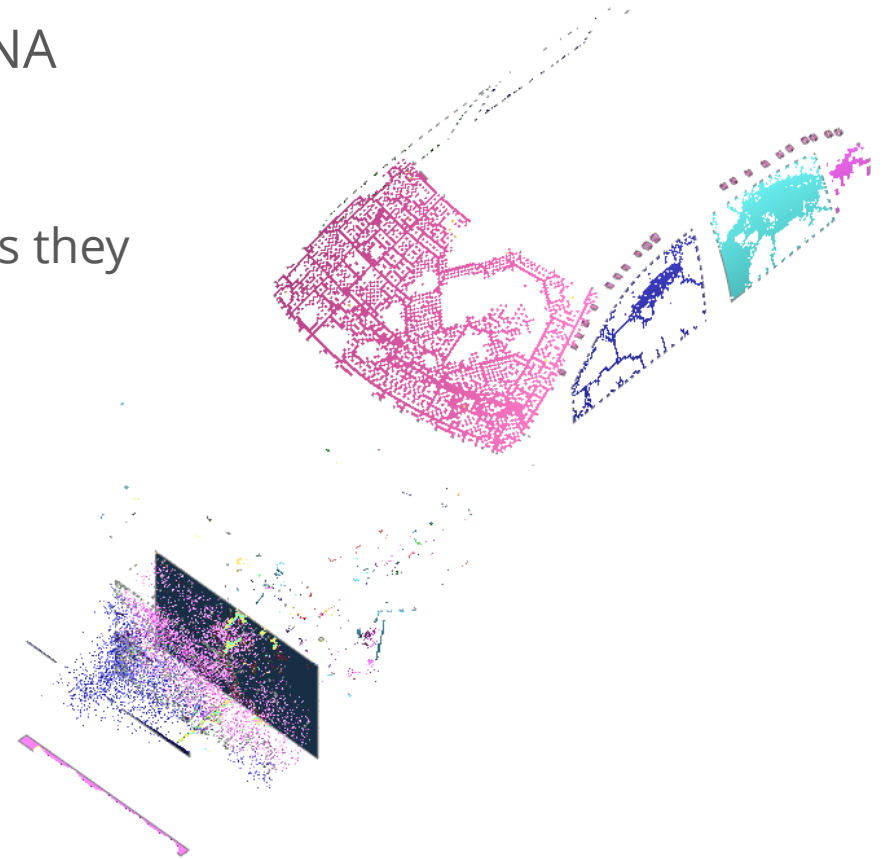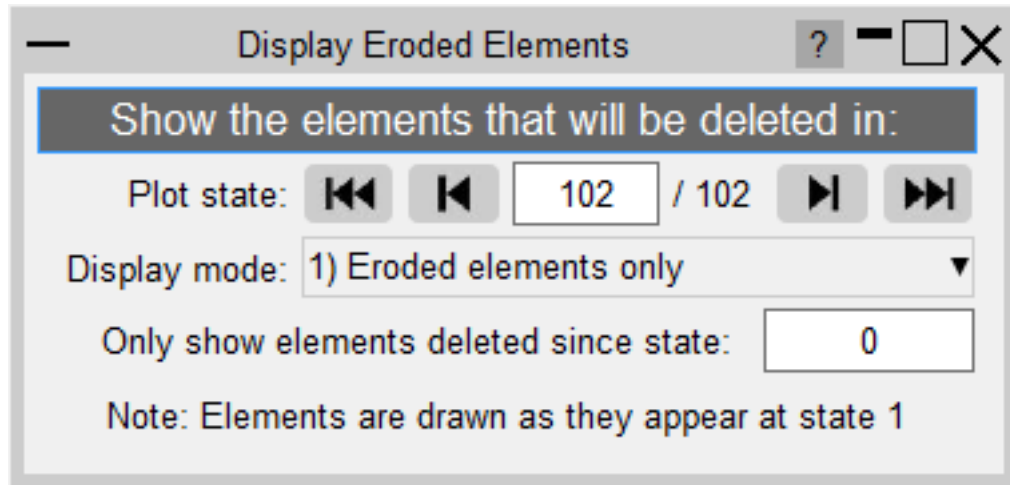
Workflows: Eroded Elements

There are three display modes:

1. Eroded elements only (default)
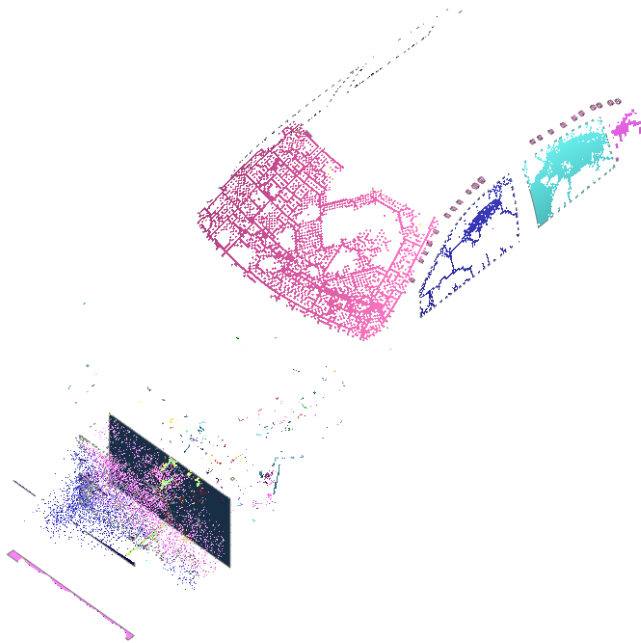
2. Eroded elements in red
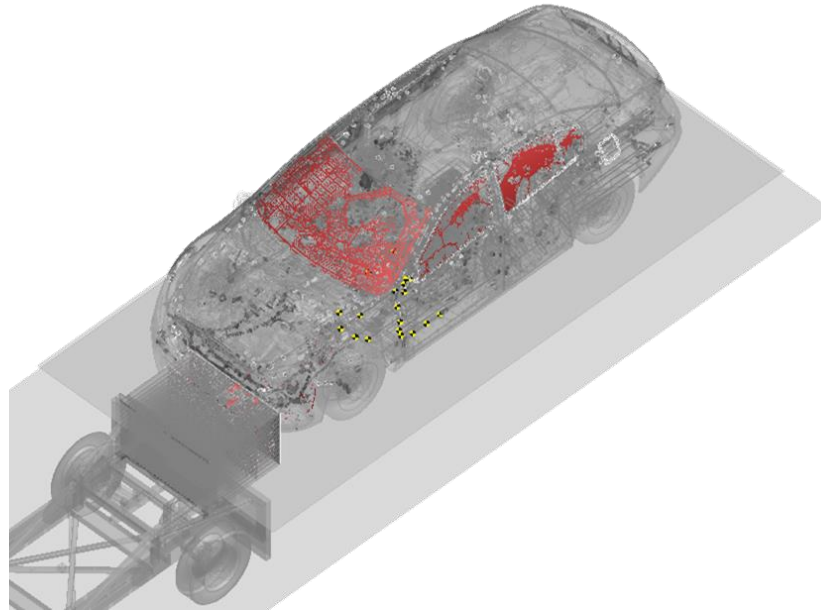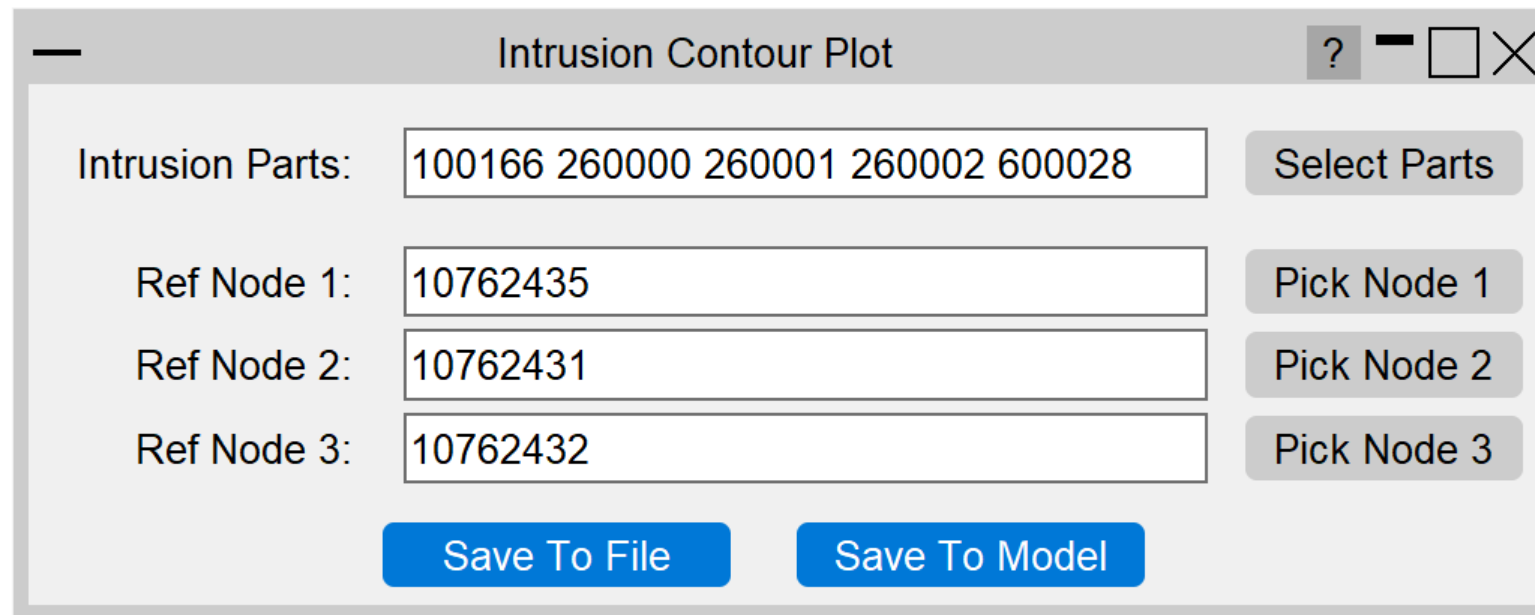
3. Parts containing eroded elements
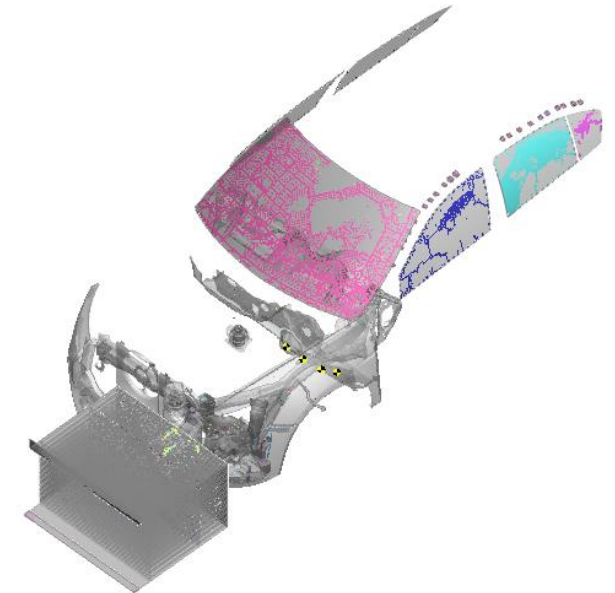
Workflows: Intrusion Contour Plot

- The Intrusion Contour Plot tool creates a contour plot of intrusion displacements for selected parts, relative to specified reference coordinates.

- Configure the plot in PRIMER:

Workflows: Intrusion Contour Plot

In D3PLOT, you can control the plot state, plot the intrusion values relative to a reference state or different model, and control the view. Here is an example plot:
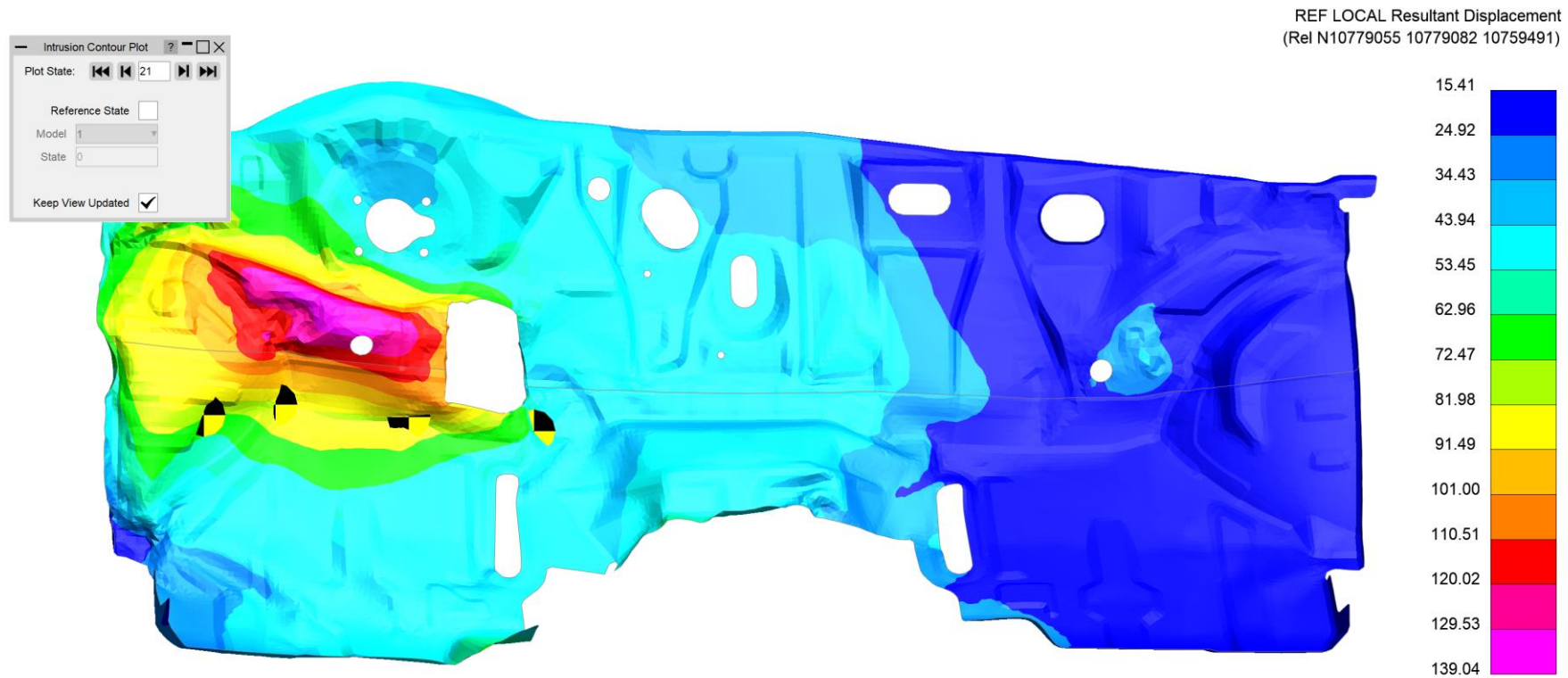
Workflows: Pulse Index
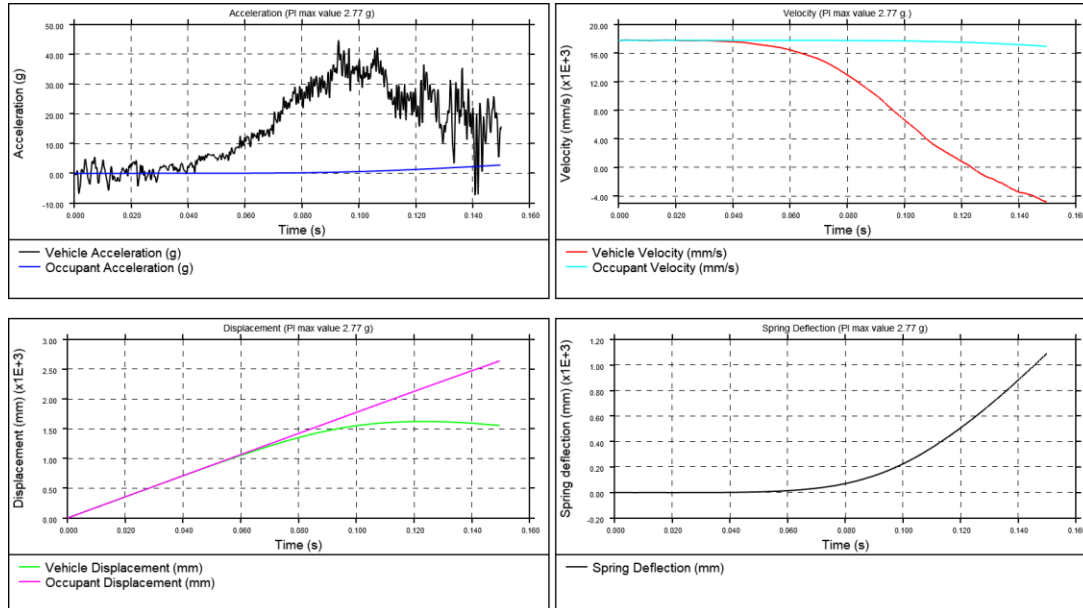
- During the early stages of vehicle development, it can be useful to understand occupant acceleration without needing to include a complex and computationally expensive occupant model.

- The **Pulse Index** Workflow allows you to estimate the acceleration that would be experienced by a vehicle occupant in a crash test scenario.

- The tool assumes a virtual single-degree-of-freedom mass-spring system in which the occupant is represented by a **mass** and the seatbelt is represented by a **spring**.

- This virtual mass-spring system is effectively attached to a selected **node** moving with a set **initial velocity**.

- The tool optionally takes a **slack** input to account for seatbelt engagement.

- Occupant parameters are computed and visualised in T/HIS.

Workflows: Strength Check

The Strength Check tool allows you to visualise *yielding parts in D3PLOT:
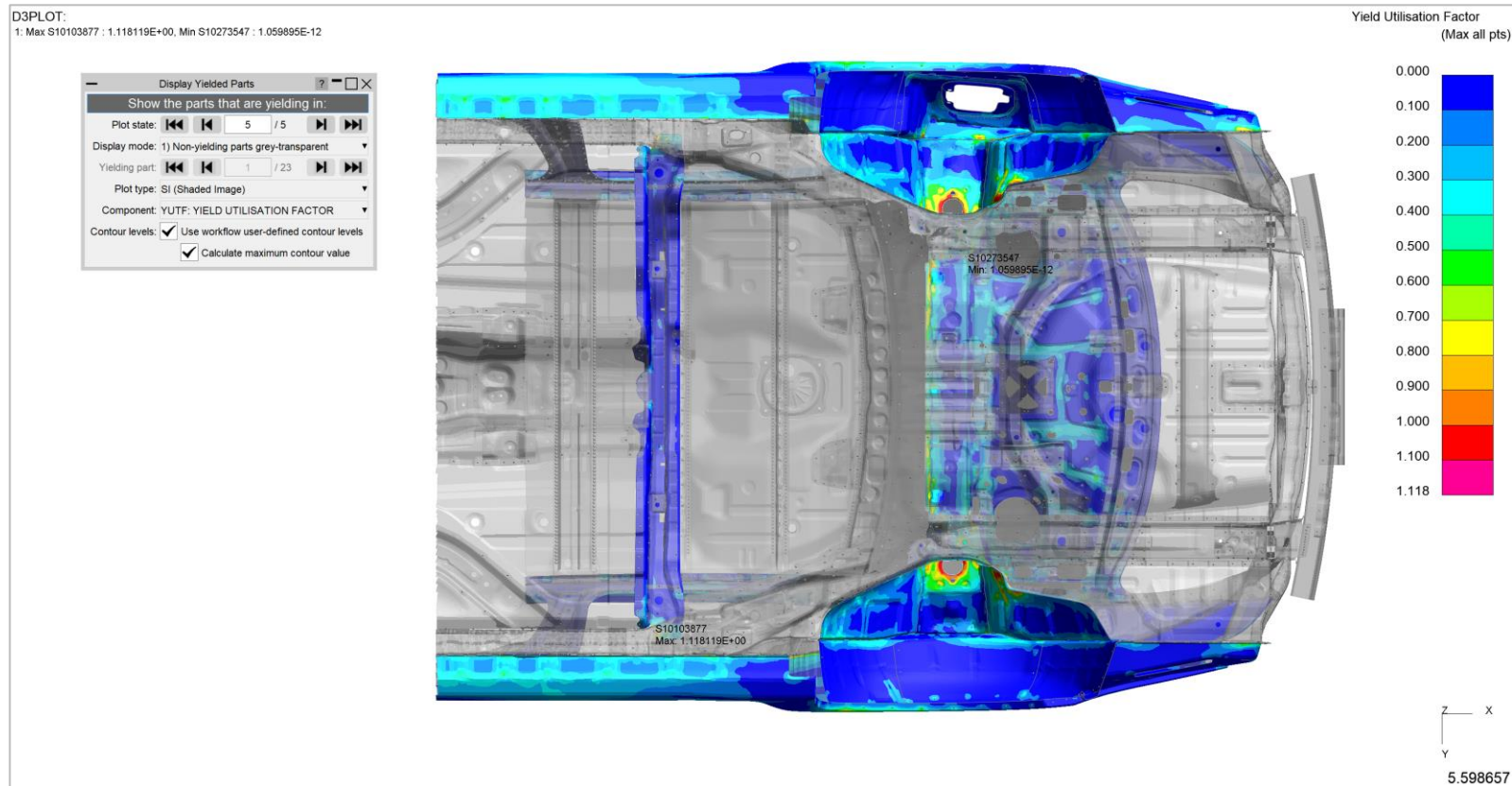
*Note: Yielding parts are parts containing at least one yielding element, measured as an element with a <u>Yield Utilisation Factor</u> greater than one (or <u>Yield Utilisation Percentage</u> greater than 100%).

Workflows: Strength Check

There are three display modes:

1. Non-yielding parts transparent-grey
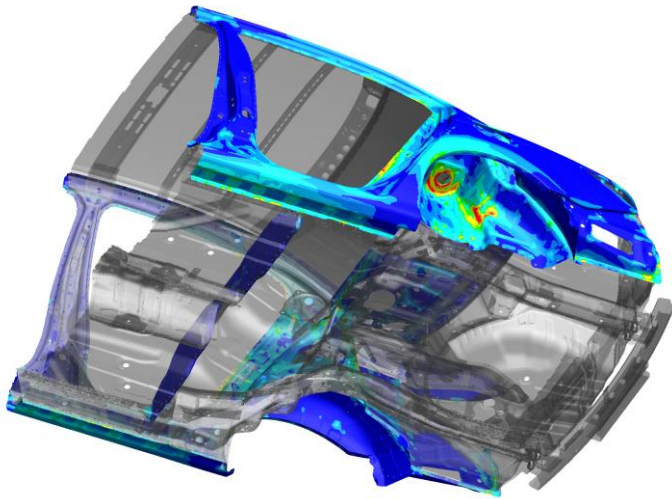
2. Cycle through yielding parts
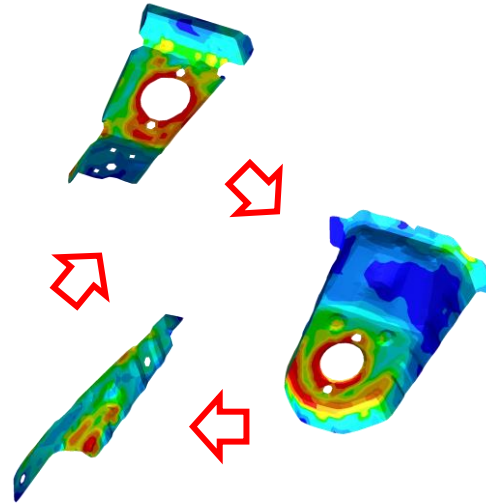
3. Plot of entire model
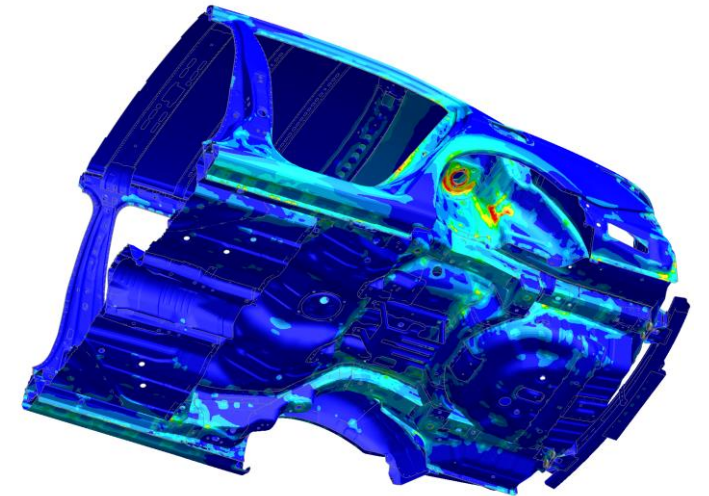
Workflows: Strength Check

You can also control the contour bar levels:

- **Use workflow user-defined contour levels**
  To better visualise yielding parts, this option is enabled by default. The contour bar has values from 0.0 to 1.0 (blue to dark orange) in increments of 0.1, and then three further contour levels in red and magenta, so that all yielding material is clearly indicated in red/magenta. If this option is unchecked, automatic contour levels will be used.

  - **Calculate maximum contour value**
    With the above option enabled then by default, the actual maximum data value will be calculated for the maximum contour level. For example, if the maximum yield utilisation factor is 1.263 then the contour levels above 1.0 will be 1.1, 1.2 and 1.263. This makes the maximum yield utilisation clearer. You can uncheck this option to speed up the plot (skips the maximum value calculation). In this case, the contour levels above 1.0 will be fixed to 1.1, 1.2 and 1.3.

Non-user-defined	User-defined without maximum calculation	User-defined with maximum calculation (Default)
Yield Utilisation Factor (Max all pts)	Yield Utilisation Factor (Max all pts)	Yield Utilisation Factor (Max all pts)
0.000	0.000	0.000
0.097	0.100	0.100
0.194	0.200	0.200
0.291	0.300	0.300
0.389	0.400	0.400
0.486	0.500	0.500
0.583	0.600	0.600
0.680	0.700	0.700
0.777	0.800	0.800
0.874	0.900	0.900
0.971	1.000	1.000
1.069	1.100	1.100
1.166	1.200	1.200
1.263	1.300	1.263

Workflows – Creating Custom Workflows

In addition to the Workflows provided, you can also add your own custom workflows.

Workflows are written in JavaScript with three steps required to create them:

1. Create a **Workflow Definition** file to describe what the workflow does and point to the scripts to run in PRIMER, D3PLOT and/or T/HIS

2. Create a script to run in PRIMER that will collect data from user inputs and write it to a file or save it in the keyword file as post *END data

3. Create scripts to run in D3PLOT and/or T/HIS that will read the data and use it to carry out any appropriate actions

If you have an idea for a tool and would like some help creating it, have a look a the following slides, or please <u>contact us</u>.

Workflows – Creating Custom Workflows

1. Create a Workflow Definition file...

- The Workflow Definition file is a JSON file containing information about the tool and which scripts it should run.

- It can be created by hand or by using the 'Create Workflow Definition' function in the PRIMER Workflow menu.
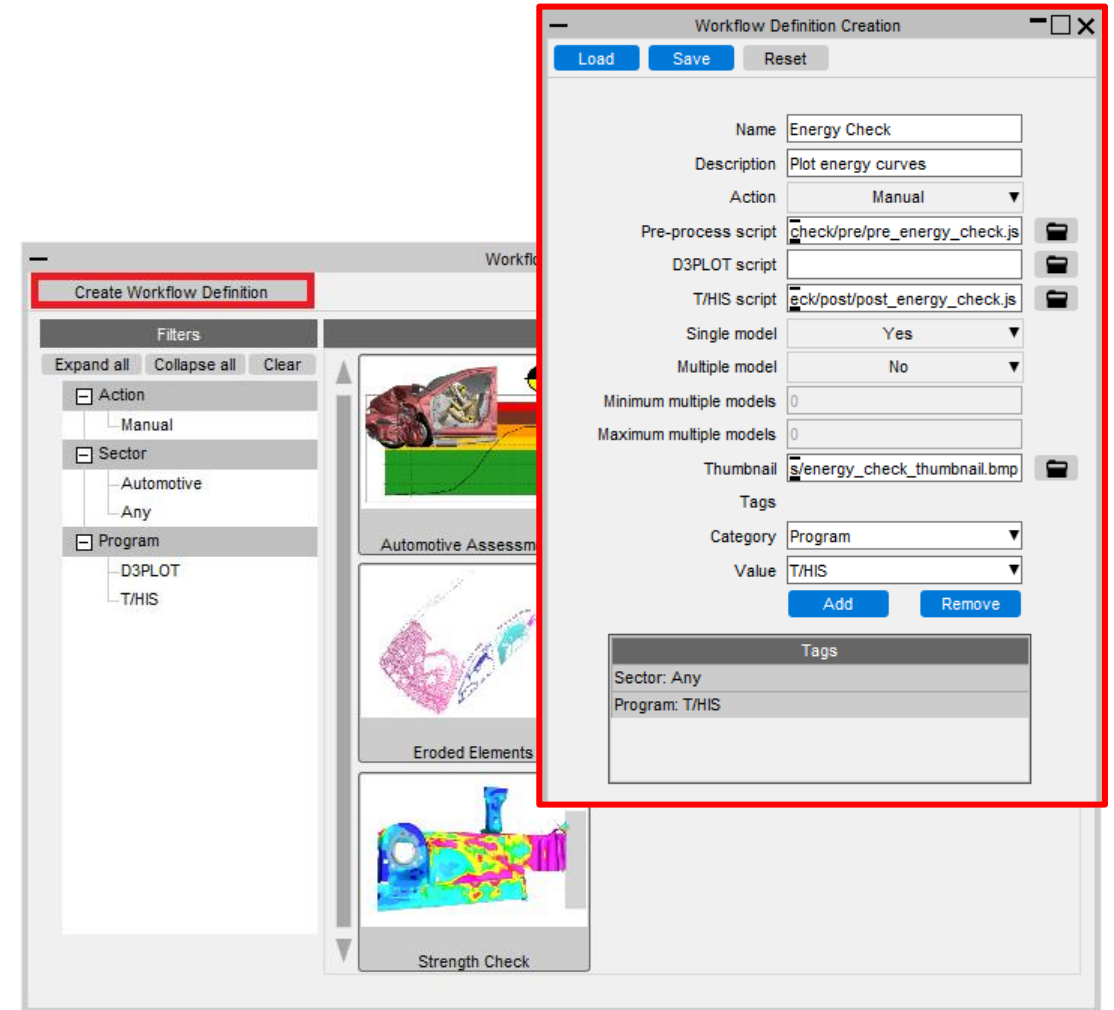
Workflows – Creating Custom Workflows

1. Create a Workflow Definition file...

The Workflow Definition file needs to be saved in one of the following directories:

- The directory set by the ***oasys*workflow_definition_directory*** preference
- ***OA_HOME/workflows***
- ***OA_INSTALL/workflows***
- ***OA_ADMIN/workflows***
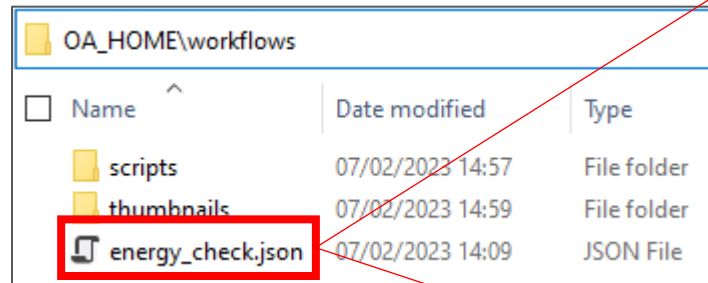

```
{
    "name": "Energy Check",
    "description": "Plot energy curves",
    "user_data_required": true,
    "pre_process_script": "scripts/energy_check/pre/pre_energy_check.js",
    "t_his_script": "scripts/energy_check/post/post_energy_check.js",
    "action": "Manual",
    "single_model": true,
    "multiple_models": false,
        "thumbnail": "thumbnails/energy_check_thumbnail.bmp",
    "tags": {
        "Sector": "Any"
    }
}
```

Workflows – Creating Custom Workflows

2. Create a script to run in PRIMER...

The script to run in PRIMER needs to collect data from user inputs and then save it to a JSON file or as post *END data in the keyword file.

The `Workflow` JavaScript API class has helper methods to make it easy to save the data:

```
Workflow.WriteToModel()

Workflow.WriteToFile()
```

Please see the JavaScript API manual for further information.

Workflows – Creating Custom Workflows

3. Create scripts to run in D3PLOT and/or T/HIS…

The scripts to run in D3PLOT and/or T/HIS need to read the data saved with the model and then use it to provide the desired functionality.

The `Workflow` JavaScript API class has helper methods to make it easy to read the data for the models selected:

```
Workflow.NumberOfSelectedModels()

Workflow.ModelIdFromIndex()

Workflow.UserDataFromIndex()

Workflow.UnitSystemFromIndex()
```

Please see the JavaScript API manual for further information.

If you have an idea for a tool and would like some help creating it, please contact us.

Internal and Kinetic Energies

Internal and Kinetic Energies

A new Quick-Pick option has been added to D3PLOT to make it easier to display the internal and kinetic energy of Parts. When the new option is selected, a linked T/HIS session is started automatically and the Energy time histories for the selected parts are plotted.
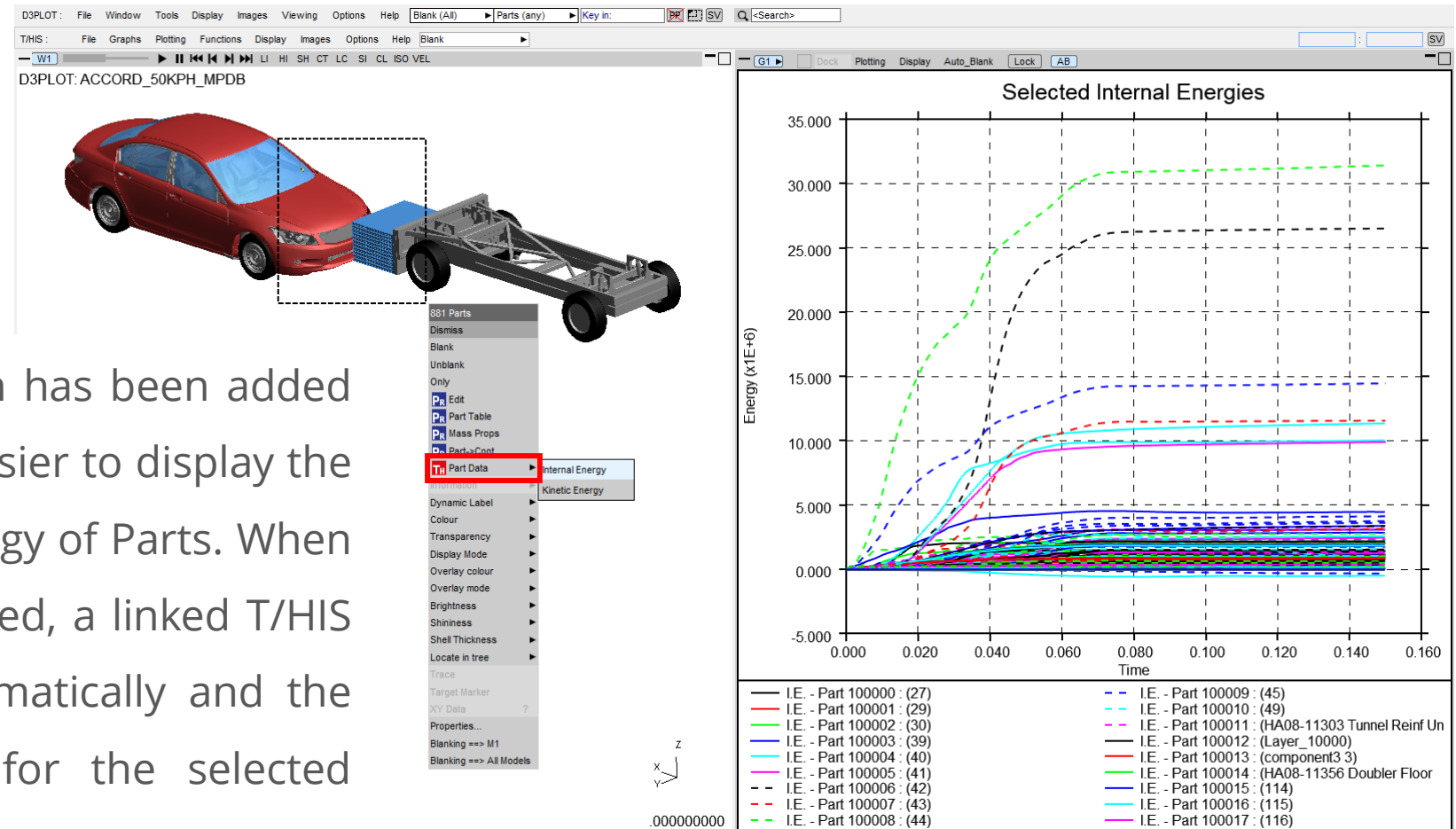
Editing Curve Labels

Editing Curve Labels

In the Style menu, you can use the Search and Replace fields to make bulk modifications to curve labels. The characters ^ and $ can be used to insert or append the replacement string at the start or the end of each label respectively. In T/HIS 20.0, the asterisk character * can now be used to replace the entire label of the selected curve(s) with the specified replacement string.
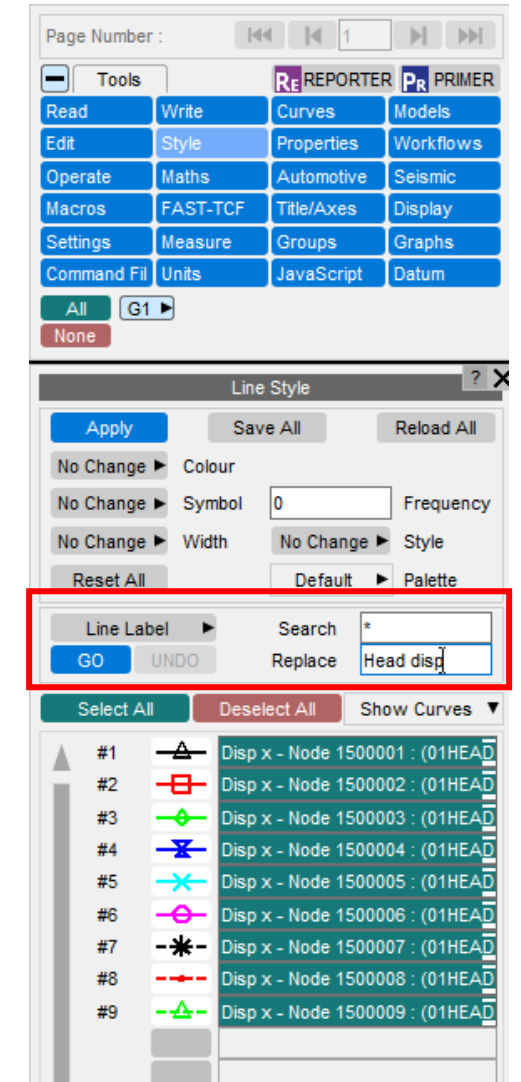
HDF5

HDF5

T/HIS 20.0 comes with improved support for reading HDF5 files:

- FAST-TCF support has now been added

- Significant improvements have been made to the layout and usability of the HDF5 panel

- HDF5 **attributes** are now visible in the X Dataset and Y Dataset attributes of the HDF5 panel – this includes parent and group attributes
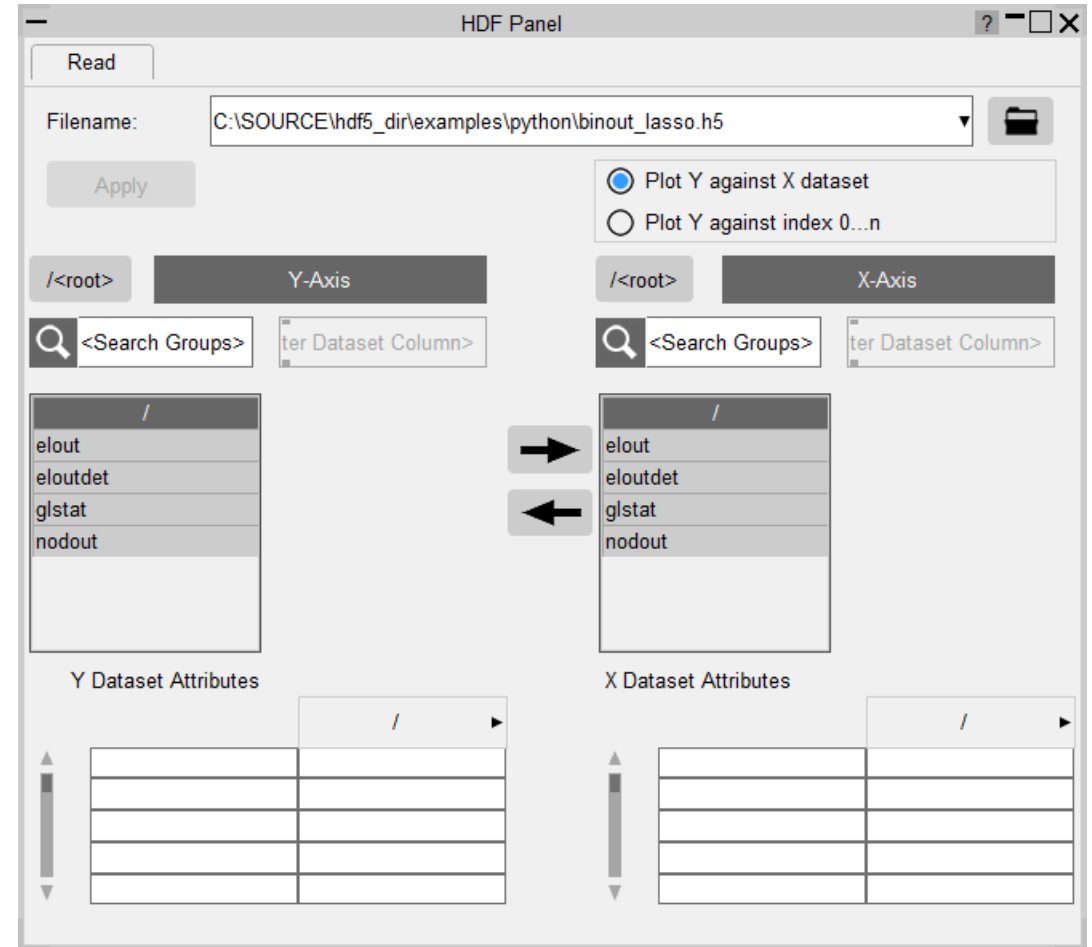
HDF5 Panel – Search

The search boxes make it easier to find the datasets you wish to read into T/HIS. Supposing you want to plot *x*-stress "sig_xx" you can search for it directly and the path (e.g. **elout → elout → shell → sig_xx**) will be returned. Clicking on the popup will take you directly to the location in the file.
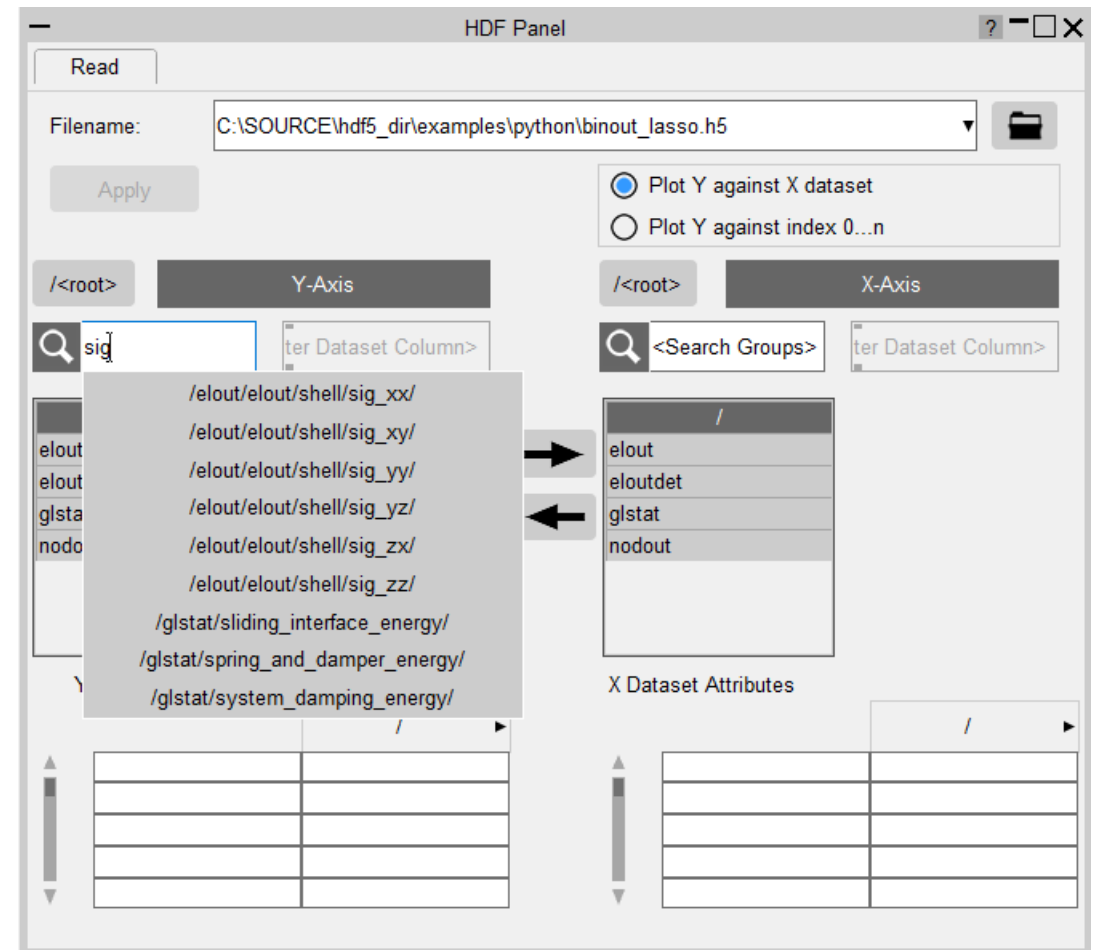
HDF5 Panel – Dataset Columns

The **<Enter Dataset Column>** textbox allows you to select multiple column entries quickly. The following examples are all valid searches:

- "1" or "Column 1"

- "1-4" or "Column 1-4"

- "1, 2, 3, 5" or "1 2 3 5" or

  "Column 1, 2, 3, 5" or "Column 1 2 3 5"
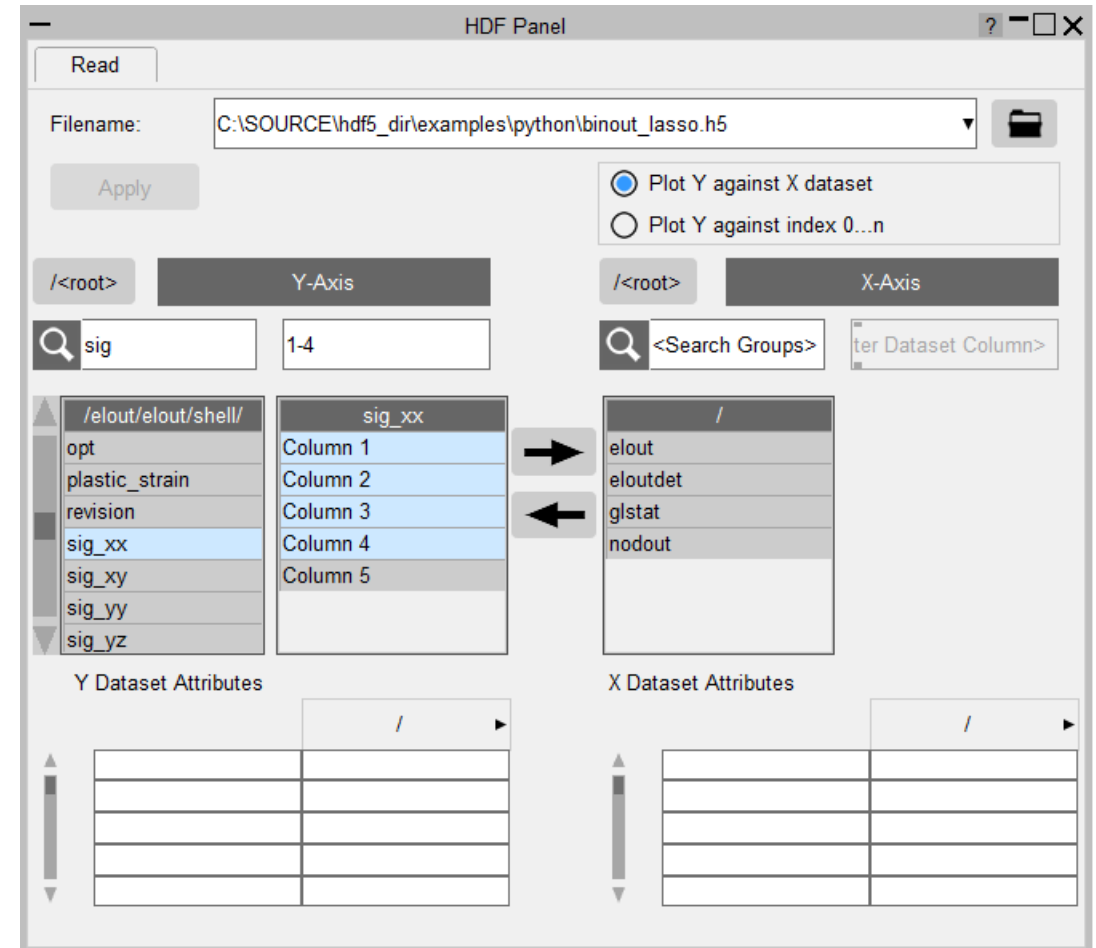
HDF5 Panel

The left and right arrows simply copy the Y-Axis path to X-Axis path and vice versa. This can make it quicker to plot *Y* versus *X* data. Supposing you wish to plot *x*-stress versus *time*. Once you have selected the *sig_xx* dataset for the Y-axis, you can copy the path to the X-Axis and quickly switch the X-Axis selection to *time* if it is in the same location in the file.
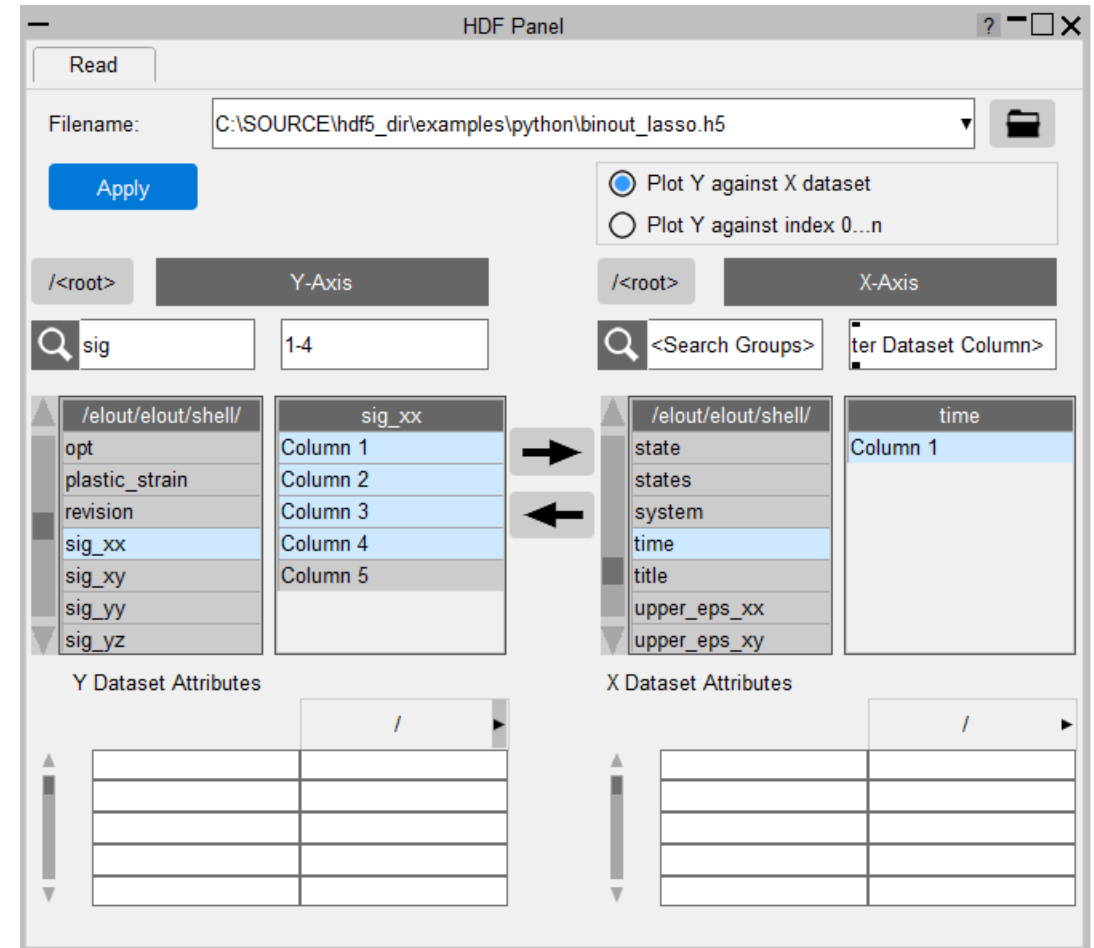
Recent Files

Recent Files

- When **reading** files, you will now find a list of **recent files** in the drop-down attached to the input file textbox. This should make it easier to retrieve and read recent files more quickly. This feature is supported in most of the commonly used menus.

- When **writing** files, as well as the recent files list, you will find a **recent directories** list attached to the file selector button. This allows you to select a recent directory without having to re-specify the filename.
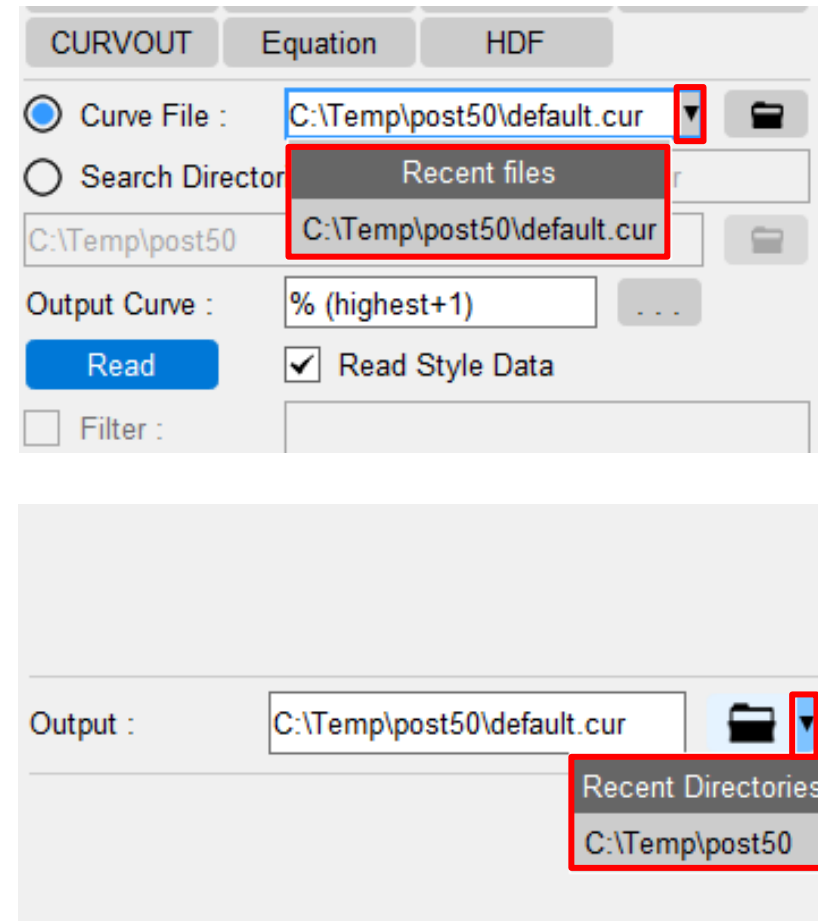
JavaScript

JavaScript widget additions – Radio buttons

- Radio button widgets allow you to choose a single option from a list:

```
Window.Theme(Window.THEME_CURRENT);

let wi;

// Create window
let w = new Window("JavaScript Radiobutton widget example", 0.85, 1.0, 0.75, 1.0);

// Create radiobutton widget
let r = new Widget(w, Widget.RADIOBUTTON, 1, 51, 1, 41);

// Add widgetitems to the radio button
wi = new WidgetItem(r, "SHELL");
wi = new WidgetItem(r, "PRIMER");

// Select the PRIMER widgetitem
wi.selected = true;

wi = new WidgetItem(r, "LS-DYNA");
wi = new WidgetItem(r, "D3PLOT");
wi = new WidgetItem(r, "T/HIS");
wi = new WidgetItem(r, "REPORTER");
wi = new WidgetItem(r, "D3PLOT Viewer");

// Show the window and start event loop
w.Show();
```
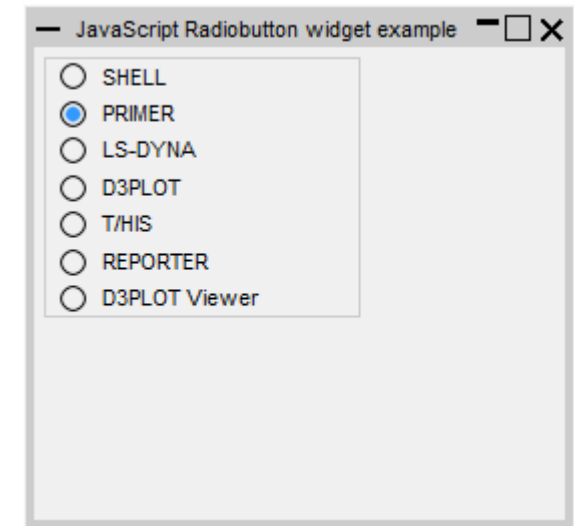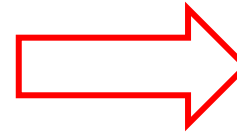
`25,9          All`

JavaScript widget additions – Trees

- Tree widgets allow you to display data in a hierarchical structure:

```
// Create window
let w = new Window("JavaScript Tree widget example", 0.85, 1.0, 0.75, 1.0);

// Create tree widget
let t = new Widget(w, Widget.TREE, 1, 71, 1, 61, "Suite");

// Add a root node to tree
let env_wi = new WidgetItem(t, "Oasys Ltd LS-DYNA Environment");

// Add a child to the root node
wi  = new WidgetItem(t, "SHELL", Widget.CHILD, env_wi);
// add a child to the child node
cwi = new WidgetItem(t, "Portal to the environment", Widget.CHILD, wi);

wi  = new WidgetItem(t, "PRIMER", Widget.CHILD, env_wi);
cwi = new WidgetItem(t, "Prepare", Widget.CHILD, wi);
// Add a mouseOver callback for the WidgetItem
wi.onMouseOver = wi_onmouseover;
cwi.hover = "Efficient, reliable model setup with support for all of the latest
LS-DYNA features";

wi  = new WidgetItem(t, "LS-DYNA", Widget.CHILD, env_wi);
cwi = new WidgetItem(t, "Analyse", Widget.CHILD, wi);
                                                    18,1         11%
```
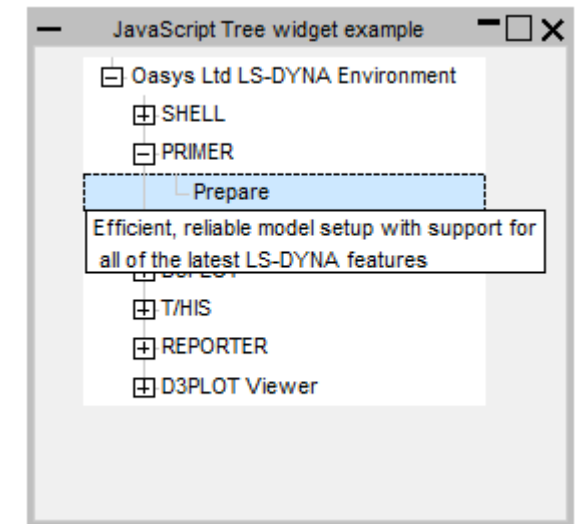
JavaScript API updates

- The JavaScript engine has been upgraded (Spidermonkey ESR102)

- A new function UpdateCurveMenu() has been added to update the curve menu. This is helpful when a script generates a lot of curves and you want to update the curve menu without exiting the script.

- Added a new OpenManual() global function to open an Oasys manual at a specified page

- A new member function IsOnGraph() has been added to the Datum class to check whether a datum is on a graph.

Oasys
T/HIS

Oasys

Preferences

New Preferences

Preference	Description
oasys*online_manuals	Whether to open manuals online or using the local HTML copy
oasys*workflow_definitions_directory	Location that will be scanned for Workflow definitions
oasys*workflow_auto_open_post_menu	Automatically open the **Workflow** menu in D3PLOT or T/HIS when reading in a model that has workflow data
this*iso_list_labels	Default list labels in **Read → ISO** panel (**Channel Codes** or **Filenames**)
this*output_directory	Default output directory for images and other files when multiple models have been read (first or latest model read)

Help & Documentation

Help & Documentation

- The manuals are now online by default.

  - Powerful search tool.

  - Google translation available.

  - Continuous updates and fixes.

- A local HTML version of the manuals can still be used.

  - Useful if there there is no Internet access.

  - Local or online can be saved via a preference:

    oasys*online_manuals: TRUE/FALSE.

- The new JS API manual combines documentation for PRIMER, D3PLOT, T/HIS and REPORTER.

  - i.e. D3PLOT, T/HIS and REPORTER JS-API documentation is no longer in separate appendices.

  - Local HTML and PDF versions are available.

  - The new JS API manual is not yet online.
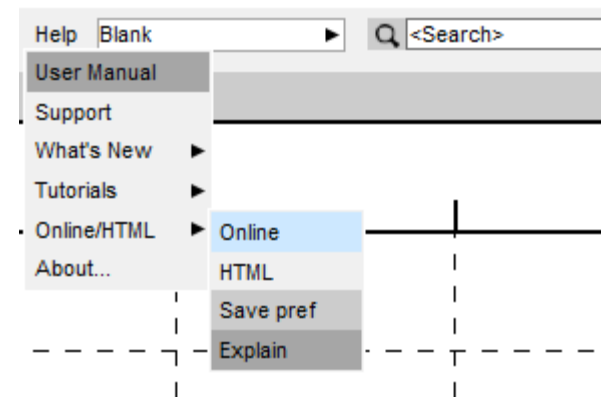
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