

# Instrument Panel Pendulum Impact



# What is the IPP function?

- The IP Pendulum function can be used to specify multiple Instrument Panel Pendulum impact models for ECE R21 or FMVSS201.
- This function is accessed under “Safety” → “IP Pendulum”.
- The IPP function supports interactive and batch model processing. Automated positioning and depenetration is available.
- The IPP impactor model for use with this tool can be found in \$OA\_INSTALL/primer\_library/Arup\_Pendulum — where \$OA\_INSTALL represents the directory where the software is installed.



# General Description of the Panel



# IP Pendulum Impact Panel

Note: the impactor must be added as an include into the model containing the trim to activate the IP Pendulum tool.

- **Contact** – A contact must be defined between the impactor and the vehicle dashboard.
- **Velocity** – This is the linear velocity at centre of the impactor.
- **H-Point** – Coordinates of H-Point to use in the setup. The base of the IPP pendulum model will be positioned to this point.

IP PENDULUM IMPACT

Model 1 :: IPP 1 selected

Title: IPP impactor

Contact: 1 Create

velocity: 6694.444 Settings

H-point: 1395.0 420.0 525.0

Target name: n/a

Target coord: n/a Sketch

Impact coord: n/a Sketch

Angle to IP normal: n/a

Theta: n/a

Beta: n/a

Alpha: n/a

Line of flight: n/a

Velocity(at centre): n/a

IPP targetting panel

☐ FMVSS201 ☒ No redraw

☒ ECE R21 ☐ Redraw

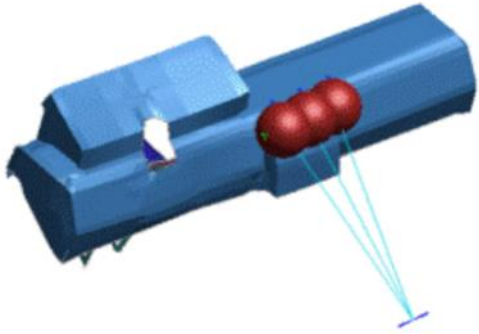
☐ ECE R21 (Deprecated)

☐ Converge aim point to target point

☐ Converge contact point to target point

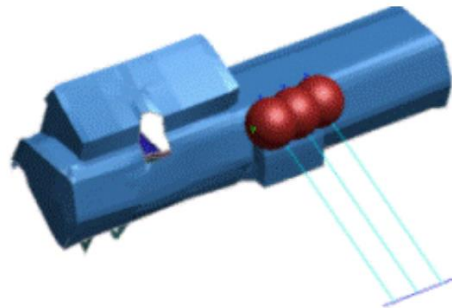
☒ Combined solution

# IP Pendulum Impact Panel



- **ECE R21** – In default mode a subsequent **DEFINE\_TRANSFORMATION** is applied to rotate the line of flight onto the trim normal if the impact angle is more than 5 degrees.
- **ECE R21 (Deprecated)** – The base of the pendulum is located at the H-point.

- **FMVSS201** – After achieving a position the base is translated in Y to align with each impact point.



IP PENDULUM IMPACT

Model 1 :: IPP 1 selected

Title: IPP impactor

Contact: 1 Create

velocity: 6694.444 Settings

H-point: 1395.0 420.0 525.0

Target name: n/a

Target coord: n/a Sketch

Impact coord: n/a Sketch

Angle to IP normal: n/a

Theta: n/a

Beta: n/a

Alpha: n/a

Line of flight: n/a

Velocity(at centre): n/a

IPP targetting panel

☐ FMVSS201

☒ ECE R21

☐ ECE R21 (Deprecated)

☐ No redraw

☐ Redraw

☐ Converge aim point to target point

☐ Converge contact point to target point

☒ Combined solution

# IP Pendulum Impact Panel

- **Converge aim point to target point** – The aim point of the impactor is aligned with the specified target point.
- **Converge contact point to target point** – The initial contact point between the impactor and the vehicle is aligned with the specified target point.
- **Combined solution** – Take into account both aim point and initial contact point when positioning to the specified target point – this tries to minimize both aim point to target distance and contact point to target distance.

IP PENDULUM IMPACT

Model 1 :: IPP 1 selected

Title: IPP impactor

Contact: 1

velocity: 6694.444

H-point: 1395.0 420.0 525.0

Target name: n/a

Target coord: n/a

Impact coord: n/a

Angle to IP normal: n/a

Theta: n/a

Beta: n/a

Alpha: n/a

Line of flight: n/a

Velocity(at centre): n/a

IPP targetting panel

☐ FMVSS201  
☒ ECE R21  
☐ ECE R21 (Deprecated)

☒ No redraw  
☐ Redraw

☐ Converge aim point to target point  
☐ Converge contact point to target point  
☒ Combined solution

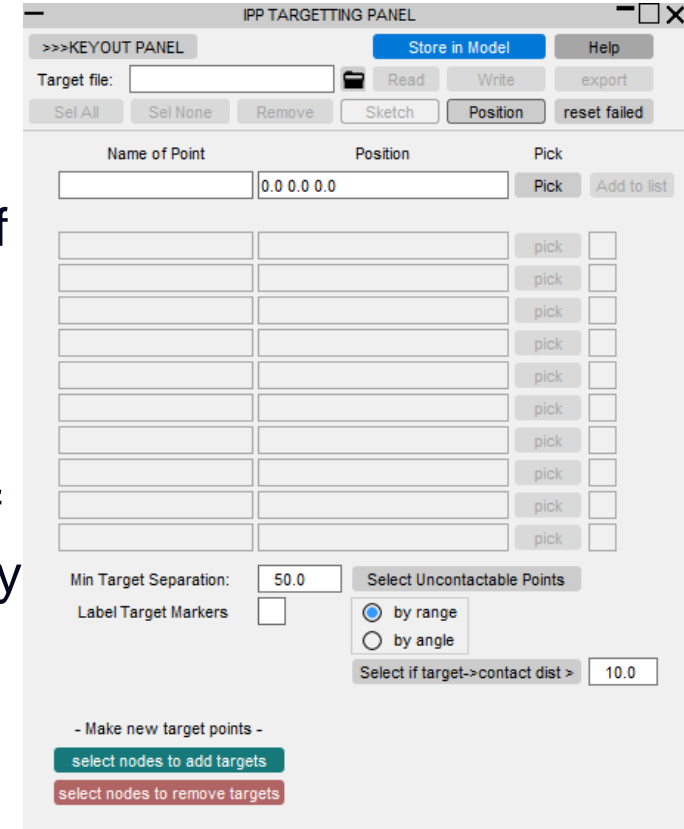
# IPP Settings Panel

- Default settings are available for both ECER21 and FMVSS201. The settings are applied depending on the option selected.
- The max/min achievable distance between the H-point and target points are:
  - Rod max extent + head diameter/2
  - Rod min extent – head diameter/2
  - Targets that fall outside of these bounds are rejected as grossly out of range, as they can never be reached.
- For acceptable target points, the head will be positioned so that the contact point is as close as possible to the target point.
- The rod distance is then measured and the point rejected if it exceeds the max rod extent or is less than the minimum.
- **Initial Velocities** – Defaults are set in the post-end IPP \*VELOCITY card.
- **Max target-contact distance option** – When positioning is complete the distance between the target point and the contact node will be measured and the point rejected if it exceeds the given value (default 1e20).

The screenshot displays two windows from a software interface. The top window, titled 'IP PENDULUM IMPACT', shows settings for 'Model 1 :: IPP 1 selected'. It includes fields for Title ('IPP impactor'), Contact (a dropdown menu with '1' selected), velocity ('6694.444'), and H-point ('1395.0 420.0 525.0'). There are 'Create' and 'Settings' buttons, and a 'Target name: n/a' label. The bottom window, titled 'IPP SETTINGS', is highlighted with a red border. It features 'APPLY' and 'RESET ALL' buttons at the top. Below are several input fields with corresponding labels: '165.0' for 'Diameter of head', '757.5' for 'Max extent of rod', '653.5' for 'Min extent of rod', '25.4' for 'Min distance above H-point', '6694.444' for 'Initial velocity standard', '5361.111' for 'Initial velocity reduced', and '1.0E20' for 'Max target-contact distance'. At the bottom of this window are radio button options: 'ECE R21' (selected), 'ECE R21 (Deprecated)', 'Redraw', 'Converge aim point to target point', 'Converge contact point to target point', and 'Combined solution'.

# IPP Targeting Panel (Setup Panel)

- The IPP targeting panel displays existing targets within the model.
- A CSV file can be read in using the “Read” button to load new points.
- New target points can also be added using the “select nodes to add/remove targets” buttons – this will automatically determine a cloud of impact points on selected nodes using the “Minimum target separation” value and the pendulum reach specified in the settings on the previous panel.
- Prior to the positioning, target points appear on a light blue background if they are misaligned with the trim normal. This indicates that they probably cannot be contacted by the pendulum.
- A white background shows that the points are not yet positioned, green that they are successfully positioned, red that they failed to position.





# IPP Targeting Panel (Setup Panel)

- **Write** – Writes the targeting information to a CSV file. This can be used to import at a later date, or for batch positioning.
- **Export** – Export detailed information on setup for each point after positioning.
- **Sel All** – Selects all the target points shown in the list.
- **Sel None** – Deselects any target points that are selected in the list.
- **Remove** – Removes any selected target points.
- **Sketch** – Sketches any selected target points.
- **Reset failed** – Resets the target points that have failed to position so you can try again.
- **Pick** – Allows the user to manually pick the node for target point.
- **Label Target Markers** – will configure sketch so each target point is labelled with the name.

IPP TARGETTING PANEL

>>>KEYOUT PANEL Store in Model Help

Target file: Read Write export

Sel All Sel None Remove Sketch Position reset failed

Name of Point	Position	Pick
	0.0 0.0 0.0	Pick Add to list
		pick
		pick
		pick
		pick
		pick
		pick
		pick
		pick
		pick
		pick

Min Target Separation: 50.0 Select Uncontactable Points

Label Target Markers ☐ ☒ by range ☐ by angle

Select if target->contact dist > 10.0

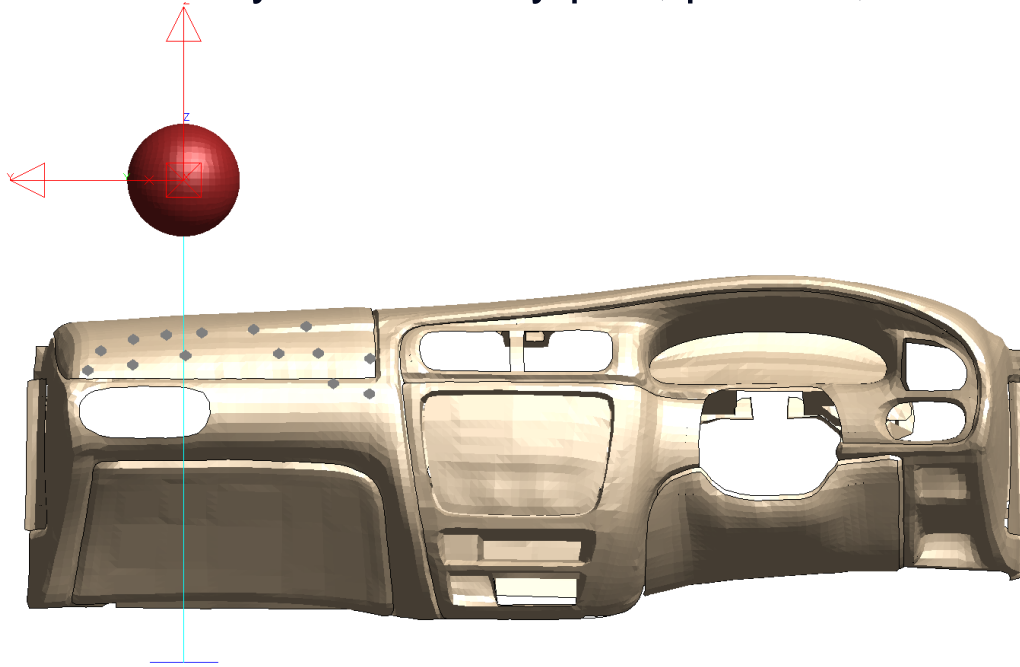
- Make new target points -

select nodes to add targets

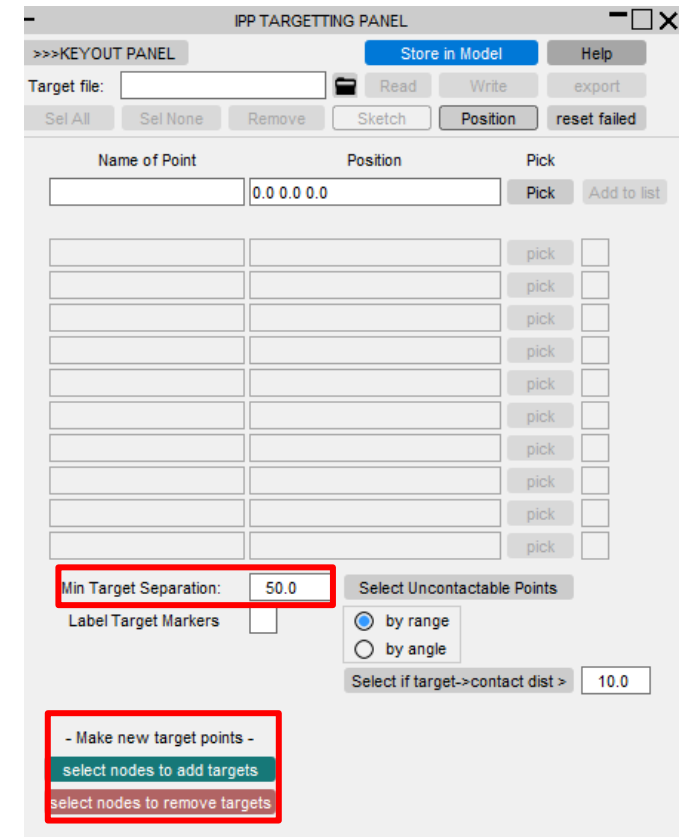
select nodes to remove targets

# Automatically Selecting Targets

- **Select nodes to add targets** – By selecting a group of nodes (you can select by part, part set etc.) PRIMER will determine which points within the selection can geometrically be reached. Note the “Min target separation” setting is used to create a suitable cloud of target points. This value can be set by user.
- **Select nodes to remove targets** – By selecting this option you will be able to automatically remove all targets on selected nodes. Selection may be made by part, part set, etc.



Grey dots indicate target points that have been identified.



# Dealing with Uncontactable points

- **Select Uncontactable points** – Selects any target points that can not be contacted. You can select by two methods:
  - **By range** – Points are un-contactable by range if the distance from H-point to target point exceeds the maximum allowable. (red background)
  - **By angle** – Points are considered un-contactable by angle if the angle between the trim normal and the line of flight exceeds 45 degrees. Line of flight is taken to be the cross product of horizontal and line between H-point and target point. (light blue background)
- **Select if target -> Contact dist >** - This function allows you to select positioned targets for removal when the distance from initial contact point to target point exceeds the specified value

The screenshot shows the KEYOUT PANEL interface. At the top, there are buttons for 'Store in Model', 'Help', 'Read', 'Write', 'export', 'reset failed', 'Sel All', 'Sel None', 'Remove', 'Sketch', and 'Position'. The 'Position' button is highlighted with a red box. Below these buttons is a table with columns 'Name of Point', 'Position', and 'Pick'. The table contains several rows of data. Two rows are highlighted with red boxes: 'node\_7028582' and 'node\_7027290' (both with red backgrounds), and 'node\_7052116' and 'node\_7004357' (both with light blue backgrounds). Below the table, there are input fields for 'Min Target Separation' (50.0) and 'Label Target Markers'. A 'Select Uncontactable Points' dialog is open, showing 'by range' selected and 'by angle' unselected. The 'Select if target->contact dist >' field is set to 10.0. At the bottom, there are buttons for 'select nodes to add targets' and 'select nodes to remove targets'.

Name of Point	Position	Pick
node_7054490	0.0 0.0 0.0	Pick Add to list
node_7028582	747.6 127.4 974.1	pick
node_7027290	677.0 25.8 989.2	pick
node_7027259	632.7 179.8 978.5	pick
node_7052116	957.0 -211.2 794.6	pick
node_7004357	802.1 287.6 560.1	pick
node_7004466	861.4 226.5 621.4	pick
node_7010283	724.7 220.5 974.6	pick
node_7010297	801.9 308.8 849.4	pick
node_7010302	797.3 368.1 849.4	pick
node_7010307	791.9 427.8 849.4	pick

Min Target Separation: 50.0  
Label Target Markers: ☐

Select Uncontactable Points  
☒ by range  
☐ by angle  
 Select if target->contact dist > 10.0

- Make new target points -  
 select nodes to add targets  
 select nodes to remove targets

# Positioning of targets

- When the “Position” button is clicked, the impactor is positioned at selected target points and de-penetrated.
- Following this process, there may be some targets that the impactor could not reach and these will be highlighted red which can then be removed by selecting the points by range and by angle respectively.
- A green background indicates that the targets were positioned successfully in reach of the impactor.

>>>KEYOUT PANEL

Store in Model Help

Target file:  Read Write export

Sel All Sel None Remove Sketch Position reset failed

Name of Point	Position	Pick	
node_7054490	0.0 0.0 0.0	Pick	Add to list
node_7028582	747.6 127.4 974.1	pick	<input type="checkbox"/>
node_7027290	677.0 25.8 989.2	pick	<input type="checkbox"/>
node_7027259	632.7 179.8 978.5	pick	<input type="checkbox"/>
node_7052116	957.0 -211.2 794.6	pick	<input type="checkbox"/>
node_7004357	802.1 287.6 560.1	pick	<input type="checkbox"/>
node_7004466	861.4 226.5 621.4	pick	<input type="checkbox"/>
node_7010283	724.7 220.5 974.6	pick	<input type="checkbox"/>
node_7010297	801.9 308.8 849.4	pick	<input type="checkbox"/>
node_7010302	797.3 368.1 849.4	pick	<input type="checkbox"/>
node_7010307	791.9 427.8 849.4	pick	<input type="checkbox"/>

Min Target Separation:  Select Uncontactable Points

Label Target Markers ☐ ☒ by range ☐ by angle

Select if target->contact dist >

- Make new target points -

select nodes to add targets

select nodes to remove targets

# Keyout Panel

- All the positions can now be written to individual models.
- This can be done by switching to the “Keyout Panel”.
- File path, sub-directory names, and file names can be modified by users prior to keyout.
- **Replace with user impactor? –**
  - If the pref is set and the switch is active, PRIMER IPP build will be performed in the usual way but before the keyout, the IPP impactor will be replaced with the user impactor as specified by the preference.
  - The initial build may be done in ECE R21, ECE R21 (deprecated) or FMVSS201 (hinge point aligned in Y).
  - The user impactor will be oriented into position and moved to a point of contact along the line of flight (linear depenetration).

## How to access the Keyout panel

IPP TARGETTING PANEL

>>>KEYOUT PANEL

Store in Model Help

Target file: Read Write export

Sel All Sel None Remove Sketch Position reset failed

Name of Point Position Pick

node\_7054490 0.0 0.0 0.0 Pick Add to list

>>>SETUP PANEL Apply Keyout

Sel All Sel None Remove Sketch

Output dir: C:\work\lpr74

Name	Subdir	Filename
node_7028582	NODE_7028582_R	node_7028582_R.key
node_7027290	NODE_7027290_R	node_7027290_R.key
node_7027259	NODE_7027259_R	node_7027259_R.key
node_7052116	NODE_7052116_R	node_7052116_R.key
node_7004357	NODE_7004357_R	node_7004357_R.key
node_7004466	NODE_7004466_R	node_7004466_R.key
node_7010283	NODE_7010283_R	node_7010283_R.key
node_7010297	NODE_7010297_R	node_7010297_R.key
node_7010302	NODE_7010302_R	node_7010302_R.key
node_7010307	NODE_7010307_R	node_7010307_R.key

Replace with user impactor? ☐ ?

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