



SIEMENS DIGITAL INDUSTRIES SOFTWARE

# HEEDS 2304 Release Notes

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**SIEMENS**



## Welcome!

The release of HEEDS 2304 brings significant enhancements that accelerate your product development processes. Our priority remains to ensure that HEEDS can be easily and productively leveraged by all users.

In this release, we've expanded our portal offering with a new interface to ANSYS STK along with customer requested enhancements to both Simcenter 3D and STAR-CCM+ portals.

This release we have further enhanced our Efficient Search capabilities with significantly improved capabilities of MO-SHERPA to handle Many Objective Optimization problems (Ma-OOPs), as well as improvements and migration of Adaptive Sampling as a dedicated study type to reflect the current and anticipated future usage we see across our customer bases.

Enhancing our Insight & Discovery capabilities, we brought improvements to the overall surrogate modelling workflow in HEEDS and have added support for evaluating predictive generalizable performance of surrogates.

HEEDS 2304 also offers several other new features and updates that continue to streamline design space exploration. We are confident that these updates will help you to continue to drive innovation in product development and discover better designs, *faster!*

Please reach out to us for any questions:

[heeds.support.plm@siemens.com](mailto:heeds.support.plm@siemens.com)

[www.siemens.com/heeds](http://www.siemens.com/heeds)

—The HEEDS Team

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# RELEASE HIGHLIGHTS

With design space exploration at the forefront of an organization's innovative drive, entire product lines can see a transformative and dramatic change in performance. All enhancements and updates to HEEDS 2304 increase usability, connectivity, and productivity to put you more in control of the design process, the interpretation of results, and the insight gained.

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## *NEW PORTAL FOR ANSYS SYSTEMS TOOL KIT (AGI STK)*

New portal to ANSYS Systems Toolkit bringing design space exploration to complex mission planning analyses of ground, sea, air, and space platforms. [→](#)

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## *DOWNLOAD STUDY RESULTS FROM HEEDS CONNECT*

Support has been added to download results from HEEDS Connect databases. [→](#)

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## *MO-SHERPA ENHANCEMENTS*

Added support for Many-Objective Optimization Problems (Ma-OOP's) [→](#)

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## *ADAPTIVE SAMPLING AS A NEW STUDY TYPE + ENHANCEMENTS*

Adaptive Sampling for surrogate and knowledge search is now a dedicated study type, and edge case detection has been added as a new profile. [→](#)

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## *IMPROVED WORKFLOWS FOR CREATING AND EVALUATION SURROGATE MODELS*

Surrogates can now use a customized subset of input variables from the project, and new capabilities have been added to evaluate a hold-out/test-set for evaluating generalizable predictive performance. [→](#)

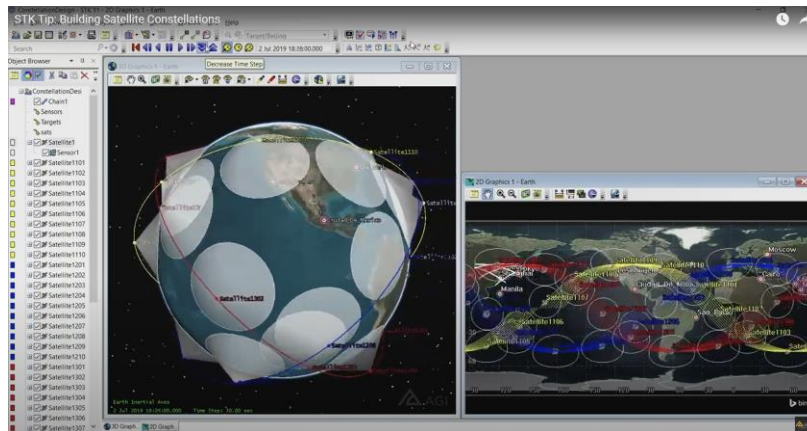
# PROCESS AUTOMATION

## NEW ANSYS SYSTEMS TOOL KIT (STK) PORTAL

HEEDS MDO

HEEDS WM

This new portal provides a direct interface with Ansys STK, a simulation software that enables engineers and scientists to perform complex mission planning analyses of ground, sea, air, and space platforms.



### Notes:

- STK portal in HEEDS uses the STK Desktop python API(only available for Windows OS) on Windows and STK Engine python API on Linux. You may notice differences in the portal behavior on Linux vs Windows as there are limitations in STK Engine python API compared to the Desktop python API. Please refer STK programming help documentation for these limitations.

### Key benefits:

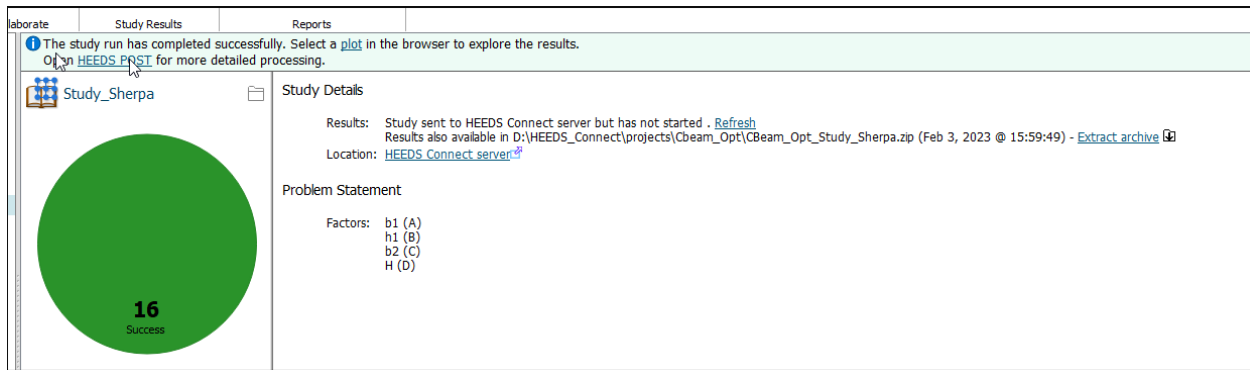
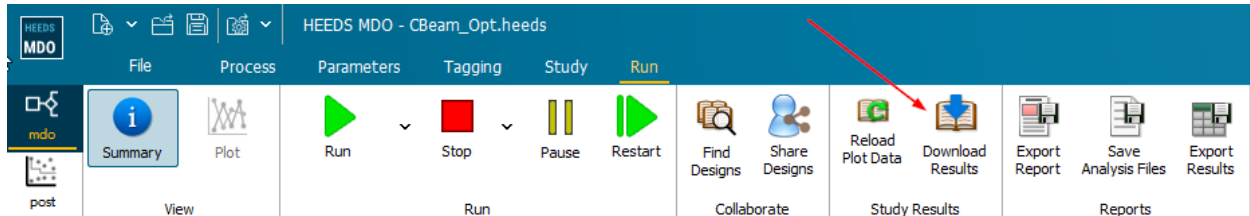
- Provides users with a direct and intuitive interface to tag inputs and outputs in their ANSYS STK simulation models.
- Critical input parameters for satellites like inertia or trajectories can be optimized
- Metrics associated with satellite ground coverage, as well as the absolute and relative positions/angulations of any vehicles/ground-facilities involved in a mission can be processed.
- Enables process automation and design space exploration within HEEDS workflows.

## DOWNLOAD STUDY RESULTS FROM HEEDS CONNECT

HEEDS MDO

HEEDS WM

In the previous version of HEEDS, only study upload was available for HEEDS Connect. With this new release, the HEEDS Connect study results can be downloaded and imported in HEEDS MDO.



### Key benefits:

- Downloading the study results from HEEDS Connect helps to provide easy access to HEEDS POST Insight & Discovery Capabilities

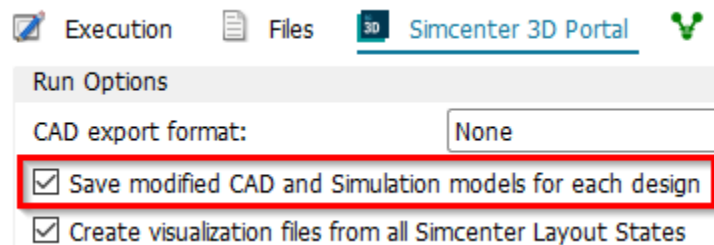
## SIMCENTER 3D PORTAL ENHANCEMENTS

HEEDS MDO

HEEDS WM

### Support for saving modified CAD and Simulation Models for each design

In the previous version of HEEDS, Simcenter 3D files (\*.prt, \*\_i.prt, \*.fem, \*.sim) were never saved if an error occurred during the design evaluation, regardless of whether or not the user selected the **Save modified CAD and Simulation models for each design** checkbox. With this new release, selecting the checkbox will result in the files being saved even if an error occurred.



### Key benefits:

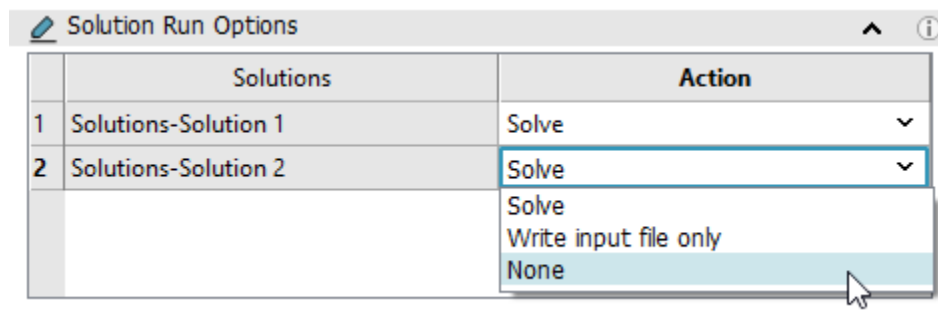
- Users will be able to debug their error designs more easily now that the Simcenter 3D files can be saved in the state that they were in at the time of the error.

### Support for writing input files only for solutions and selecting which solutions to run specifically

In the previous version of HEEDS, solution input deck files were written by default even if the solution was not checked in portal tab to be solved and no responses from the solution were tagged. In case of large \*.sim file with multiple solutions, it is very time consuming to write input deck files which are not needed.

With this new release, HEEDS-Simcenter3D portal will provide three options for each solution.

1. **Solve** – Portal will solve the solution.
2. **Write input file only** – Portal will export the solution input deck file without solving the solution
3. **None** - Portal will not do anything with that solution.



### Notes:

- If you output responses tagged in the solutions, then Simcenter3D portal will run those simulation solutions no matter what action you have selected on the portal tab.

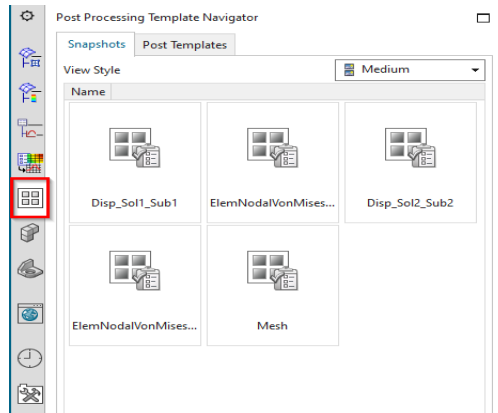
### Key benefits:

- The Simcenter3D sim file can have several predefined solutions as template which are activated/deactivated within a workflow. These new portal options will provide users a great flexibility to work with large \*.sim files and save overall design time by not writing the input deck files for unwanted solutions.

### Added support for export of layout state images in batch mode

In the previous version of HEEDS, Simcenter3D portal was using pre-defined macros to get Simcenter3D running in GUI mode to extract Layout State/Snapshot images. The problem with macros was that they need a Simcenter3D version signature so that Simcenter3D will execute the macro that is made for the exact same version of SC3D that is being run. This approach to create Layout State/Snapshot images was more error prone.

With this new release, the Simcenter 3D portal now support generation of Layout State/Snapshot images in batch mode without using any macros. In Simcenter3D v2206 and later versions, the layout states or snapshot images can be generated in batch mode.



**Notes:**

- If you change the Solver install back to the older Simcenter3D version, then HEEDS do not automatically remove the NX\_ENABLE\_HEADLESS\_GRAPHICS environment variable.
- Ensure you are not using the NX\_ENABLE\_HEADLESS\_GRAPHICS=1 environment variable when using the portal with Simcenter3D 2022.1. It may result in unexpected portal behavior.
- Layout State/Snapshot images generation in batch mode depends on graphic hardware capability. So, Linux machines may not support image generation.

**Key benefits:**

- The Layout State/Snapshot images generation without using version specific macros leads to more robust and less error prone approach.
- Faster image extraction and consequential study execution time

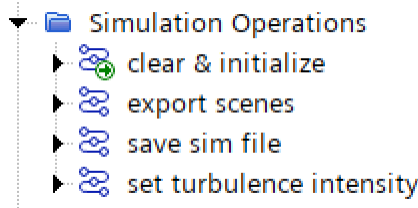
**SIMCENTER STAR-CCM+ PORTAL ENHANCEMENTS**

HEEDS MDO

HEEDS WM

**Support for Simulation Operations**

In the previous version of HEEDS, users had to customize the java template as a workaround to execute any simulation operations defined in a STAR-CCM+ model. With this new release, the portal can populate the simulation operations when importing the .sim file to HEEDS.





Users can select what simulation operations to be executed before meshing, after meshing or after running.

	Execution Phase	Macro
1	Before meshing	clear & initialize
2	Before meshing	set turbulence intensity
3	After running	export scenes
4	After running	save sim file
5	After meshing	completeMesh.java
		None clear & initialize save sim file set turbulence intensity export scenes completeMesh.java

**Note(s):**

- Simulation Operations is only available from STAR-CCM+ version 15.02 and above.
- “Reset Simulation Operations” is currently not supported. If needed, the user should reset it in the STAR-CCM+ model before importing the .sim file to HEEDS. The portal will subsequently use “Play/Resume Simulation Operations” to execute any selected Simulation Operations.

**Key benefits:**

- Allows the user to directly use any simulation operations defined in a STAR-CCM+ model.
- Simulation Operations can be executed in different execution phases, i.e., before meshing, after meshing or after running in the same way as Java macros.

**MISCELLANEOUS PORTAL UPDATES**

HEEDS MDO

HEEDS WM

**Optional Response Support**

Over the last couple releases, optional responses have been introduced to support situations where a failure to extract any response from a design would result in the entire design being marked as an error. In multiple-path workflows whereby the execution sequence of process analyses branches based on certain conditions, all responses on non-executing branches of the workflow would result in design errors.

Value:  Required  Optional (if possible) ⓘ

Default value:  ⓘ

For this release, support for optional responses has been added for the following portals:

Adams  
Simcenter 3D  
Simcenter 3D Motion  
FEMAP

Simcenter FLOEFD  
STAR-CD  
STAR-CD es-ice

*Key benefits:*

- Users no longer need to set up complex workarounds involving dependent variables.
- Faster and easier setup of Response definitions in a “multiple-path” complex execution workflow.

# EFFICIENT SEARCH

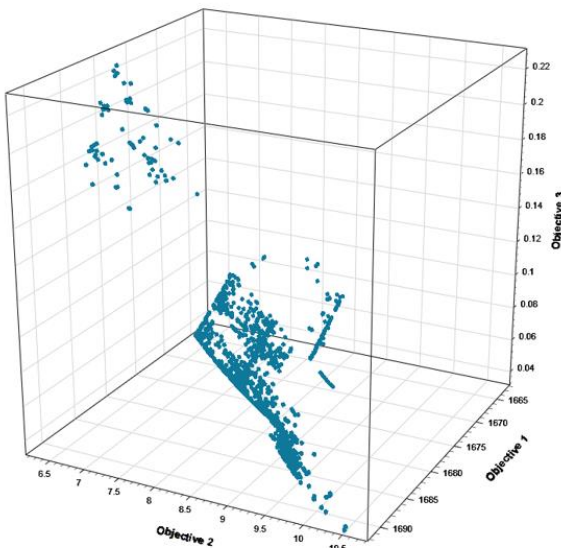
## MO-SHERPA ENHANCEMENTS

HEEDS MDO

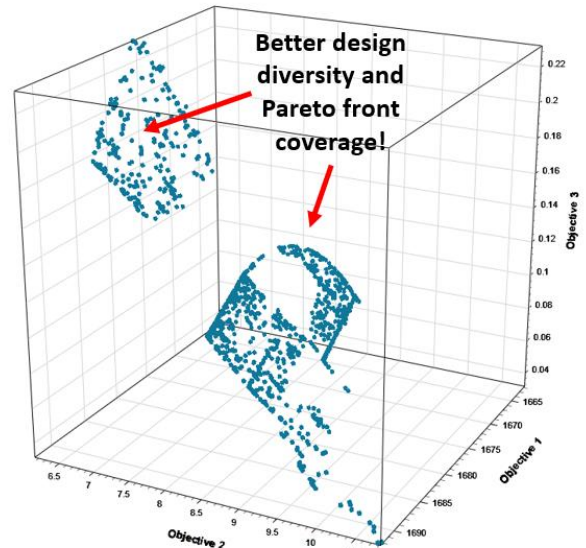
For this release we have enhanced MO-SHERPA to better support Many-Objective Optimization Problems (Ma-OOPs) whereby a pareto trade-off is sought and are those classed as having  $\geq 3$  objectives. This enhancement incorporates concepts from state-of-the-art research on Ma-OOPs, specifically NSGA-III.

The comparison below shows the Rank 1 Pareto designs found with the common Crashworthiness benchmark design problem.

Old MO-SHERPA



New MO-SHERPA



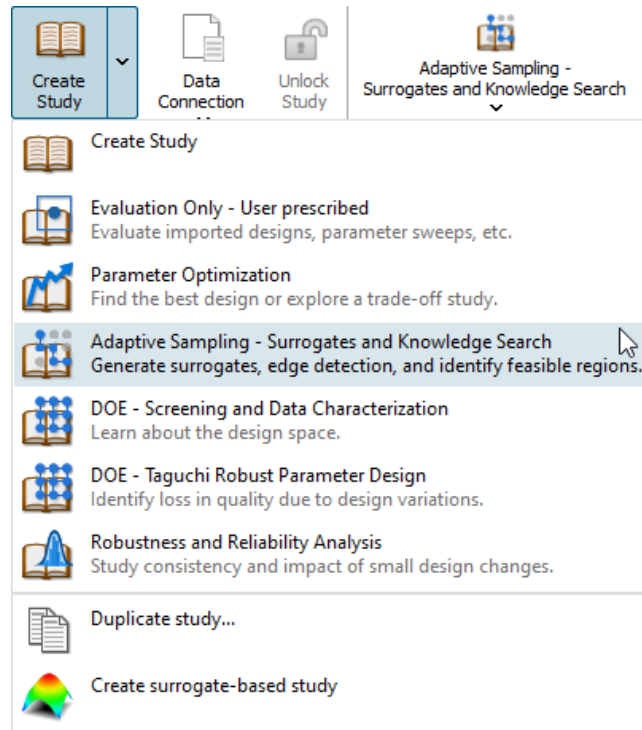
### Key benefits:

- Better design diversity across pareto fronts allowing for more informed decision making of designs to take forward into production or further downstream engineering
- Increased stability, and search pressure throughout the optimization towards finding pareto optimal designs
- Better (Pareto Optimal) Designs, Faster!

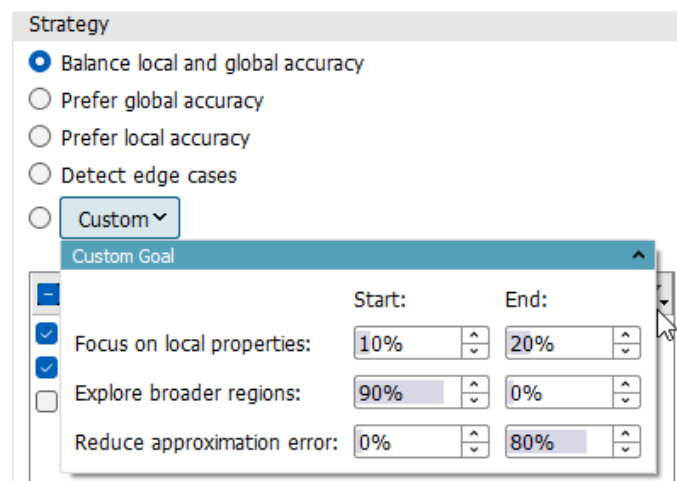
## ADAPTIVE SAMPLING IS NOW A DEDICATED STUDY TYPE

HEEDS MDO

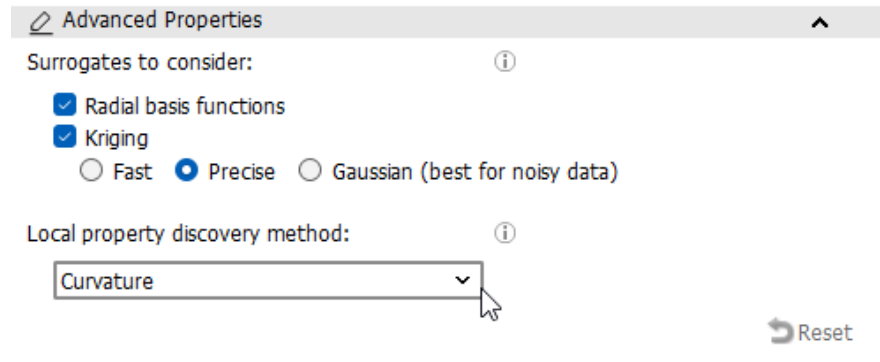
With this new release a new study type is available: “Adaptive Sampling – Surrogates and Knowledge search”. Previously Adaptive Sampling was under the DOE study type, despite it not being a truly DOE based methodology.



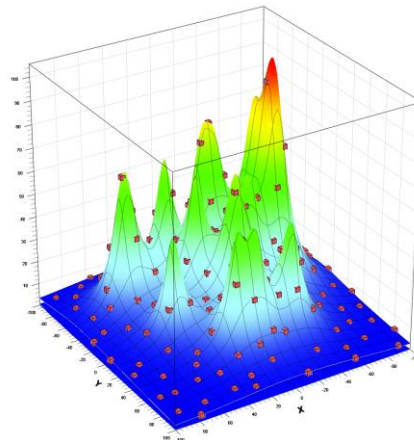
As part of this change, an additional strategy associated with detection of edge cases has been made available to focus adaptive sampling on areas around edges and discontinuities across the design space, and lastly a custom sampling strategy allows finer control over the profile of different sampling strategies.



Advanced properties for Adaptive Sampling allow the user to control the surrogates under consideration, as well as the discovery method used for identifying local properties of the design landscape.



Surrogate models selected by the user are used to firstly provide some representation of the design space in which sampling design points are generated from, and are secondly, once the Adaptive Sampling study is finished, evaluated again, of which the best surrogate for each response is automatically created and added to the project to evaluate further for example within the Investigate Surrogates tab of HEEDS POST.



HEEDS POST 3D Surface Plot showing sampled design points over a multi-model landscape test function.

#### Key benefits:

- Enables full flexibility towards knowledge discovery, data-set generation for ML/AI models, as well as optimal and automatic construction of surrogate models.

## WORKFLOW MANAGER NOW SUPPORTS DOE STUDIES

HEEDS WM

DOE studies can now be created and run using workflow manager.

# INSIGHT AND DISCOVERY

## TEST DESIGN SET FOR EVALUATING SURROGATE PREDICTIVE PERFORMANCE



HEEDS MDO

HEEDS WM

In surrogate modelling workflows, design datasets are typically split into training, validation and test data. In previous releases of HEEDS, surrogate models were trained using all non-error designs, with a subsequent k-fold cross validation performed to compute predictive performance scores. The downside of this approach is that whilst some models may appear to perform well, when used for predicting out-of-bag samples (i.e. samples that were never encountered during model training and cross-validation), models often performed poorly.

This release, we have extended capabilities within the **Investigate > Surrogates** tab for users to specify their own test set for evaluating surrogate predictive performance.

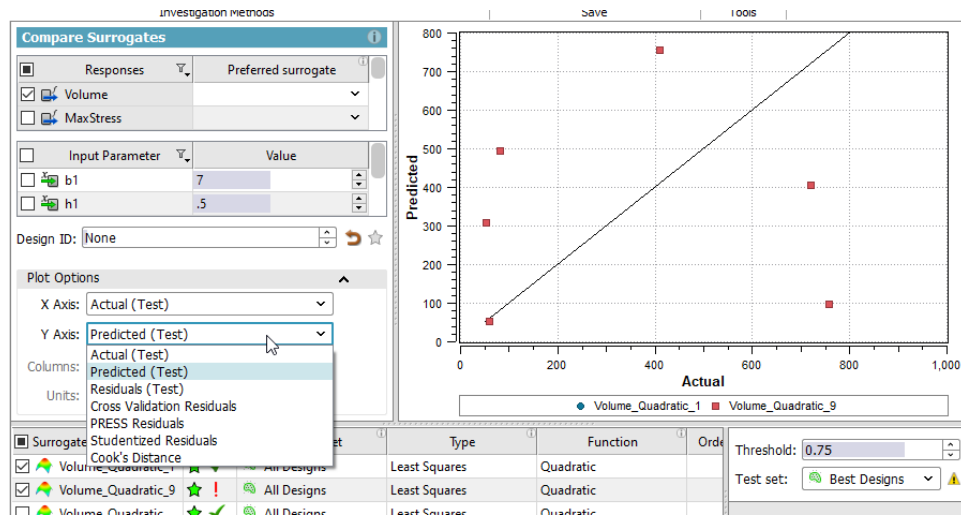
Design ID	Volume Actual	Predicted
1	58.5	51.7846
2	409	409.866
3	757.3	755.808
4	52.99	52.5666
5	80.97	74.6807
6	721.3	720.4
7	97.08	97.5317
8	295.7	308.384
9	96.36	96.8104
10	234	222.384
11	510.2	494.61
12	404.3	404.715
13	285.9	300.241

Surrogate	Score	Design Set	Type
Volume_Quadratic_1	★	All Designs	Least Squares
Volume_Quadratic_9	★ !	All Designs	Least Squares
Volume_Quadratic_...	★	All Designs	Least Squares

When a Test set is specified, surrogate scores such as  $R^2$  pred and RMSE are updated to reflect corresponding predictive performance scores.

	R2pred (Test)	RMSE (Test)	
	0.998696	8.67607	6.
	0.998696	8.67607	6.
	0.998696	8.67607	6.

Additionally, **Preview > Design Table** and Surface fit plots can be used to inspect quantitatively the predictive performance scores on the Test set.



HEEDS API scripting updates include corresponding methods to calculate test results based on a design set, along with functions to return specific calculated values, please refer to HEEDS API documentation for further information.

#### Key benefits:

- Enables proper evaluation of surrogate predictive performance on unseen data
- Avoids pitfall associated with data leakage

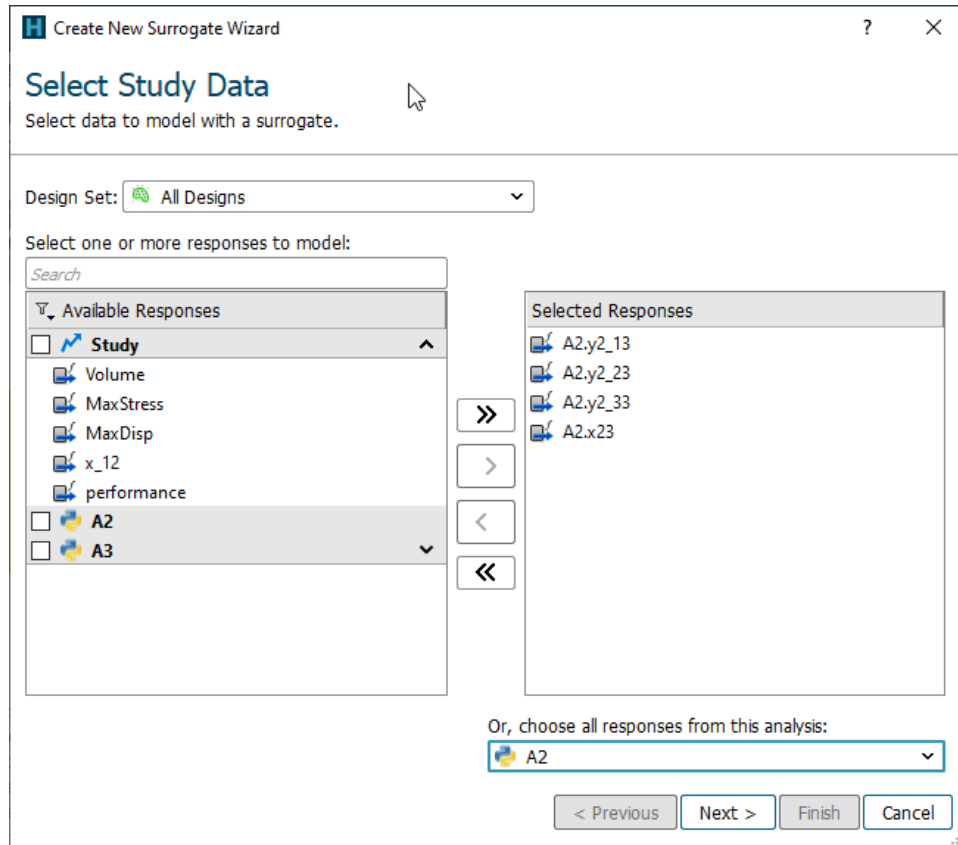
## SURROGATE MODELLING WORKFLOW ENHANCEMENTS

HEEDS MDO

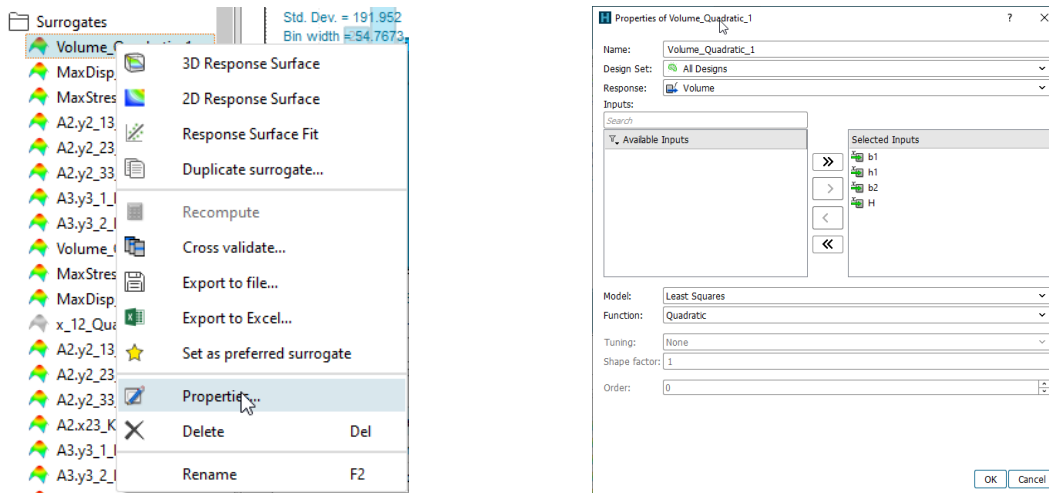
HEEDS WM

This release of HEEDS we have introduced the ability to customize variable inputs to surrogate models. Often after performing DOE, it is desired to select important or influential variables that effect a particular output response.

When a new surrogate model is created, users can now specify in the Create Surrogate wizards a subset of input variables to use when creating a surrogate. Furthermore, the user can specify the design set on which they wish to train their surrogate model with.

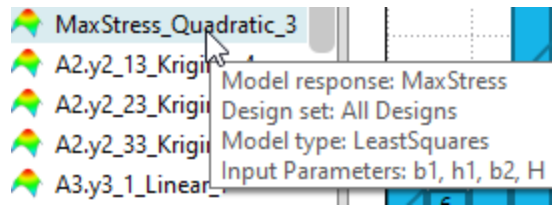


Users will also be able to open a properties view of surrogates from a context menu:

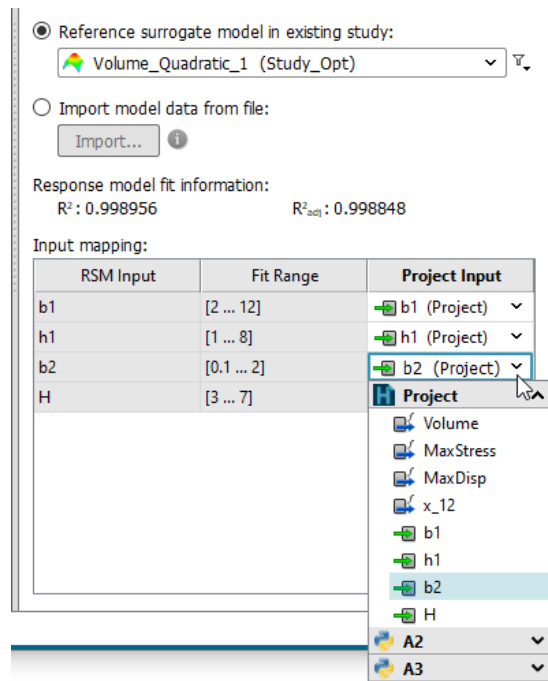


Hovering over a surrogate will also display a new tooltip, displaying some basic information on the surrogate:





When selecting a surrogate for an RSM response, the input mapping will be filtered to input parameters actually used for the surrogate, including input responses:



Exporting Surrogates to files will also include all input parameters in the surrogate, including input responses.

Lastly, corresponding HEEDS API scripting updates include the ability to get and set the list of input parameters that a particular surrogate model uses.

#### Key benefits:

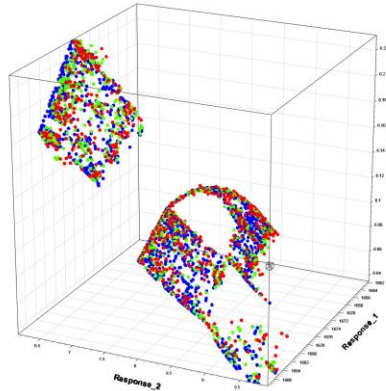
- Enables simpler surrogate models that typically result in better predictive performance when non-influential variables are excluded from the surrogate model

## 2D AND 3D PARETO PLOT UPDATES

HEEDS MDO

HEEDS WM

The Pareto plot in a multi-objective study now calculates a non-dominated sort for each selected cycle. Optionally, unranked designs can also be shown on the plot. This changes previous behavior whereby the Pareto plot only showed designs that were part of the archive at each cycle.



### Key benefits:

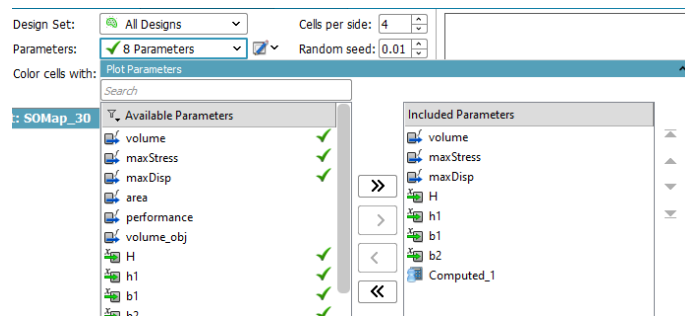
- Easier to see the progression of the whole Pareto front during an optimization study.
- Helps users to better discover trade-offs and evaluate design decisions.

## IMPROVED UX FOR PARAMETER SELECTION IN PLOTS

HEEDS MDO

HEEDS WM

Selecting parameters for the parallel plot, design table, and other similar plots has been streamlined to enable faster selection of parameters, user can search for and easily identify specific parameters for display.



### Key benefits:

- Faster search and selection of parameters for plot display

# KNOWN LIMITATIONS

Notice for users of the ANSYS Workbench portal:

- Users who intend to use ANSYS Mechanical 2022 R2 on Windows as part of a HEEDS study will first need to update a setting within ANSYS Mechanical. This is due to a known limitation of Intel MPI that this version of ANSYS Mechanical uses. Please see the **Steps for product configuration** in the **ANSYS Workbench Portal** documentation.
- Region-based meshing has been removed in Simcenter STAR-CCM+ 2302: it is no longer possible to change mesh settings or re-mesh without creating parts-based mesh operations. The recommended practice is to use parts-based meshing. See the section "Simcenter STAR-CCM+ > Pre-Processing > Meshing > Parts-Based Meshing" in the Simcenter STAR-CCM+ User Guide. As a consequence, if you try to use Simcenter STAR-CCM+ 2302 (and above) with HEEDS 2210 (and below), the STAR-CCM+ Portal will fail. We recommend to use the latest version of HEEDS (2304 and above).
- Simcenter Flomaster 2301 has a bug related to retrieving the Sub forms of any component in a Network. As a result, the portal cannot parse component data within Flomaster 2301. This issue is expected to be resolved in Simcenter Flomaster 2304.

# BUG FIXES AND OTHER ENHANCEMENTS



## MISCELLANEOUS MDO FIXES AND ENHANCEMENTS

HEEDS MDO

HEEDS WM

### *[Bug 2771] Sub-directories within an analysis input folder were not copied to the remote machine*

In the past release, when trying to copy multiple directories and subdirectories to the remote location, the directories and sub-directories were not actually copied. This is now fixed, and files are properly copied

### *[Bug 2778] Copying directories to the remote machine did not work*

In the past release, when trying to copy multiple files to the remote location, the files were not actually copied. This is now fixed, and files are properly copied.

### *[Bug 4099] Changing parameter name did not update placeholders*

In the past release, if a parameter name was changed, all references in formula/dependent parameters were changed automatically. However, this did not happen with placeholders where the parameter was used. This is now fixed, and placeholders are automatically updated when a parameter name is changed.



## MISCELLANEOUS SOLVER FIXES AND ENHANCEMENTS

HEEDS MDO

HEEDS WM

### *[Bug 11003] The wrong analysis flag was reported in the analysis details after restart*

In the past release, when performing a restart of a study, the analysis status was not always reported correctly, for example reporting as successful design analyses that were actually skipped. This is now fixed, and the correct analysis detail is reported after restart.

### *[Bug 11769] Output files from a child folder of the analysis folder could not be copied*

In the past release, when using the remote evaluation server with Python portal, the files from the local analysis folder could not be copied to the remote location. This is now fixed, and files are properly copied.



## MISCELLANEOUS PORTAL AND TAGGING FIXES AND ENHANCEMENTS

HEEDS MDO

HEEDS WM

### *[Bug 9705] Creo portal produced error designs if its option "end session after each design" is inactive*

In the previous releases, the Creo portal could produce error designs if its option "end session after each design" is inactive. By activating the option, all designs were generated normally. This is now fixed, and the portal works as expected.

**[Bug 5733] Creo portal gave an error for some cases of output extraction with regeneration**

In the previous versions, in some cases where an update of the parameters of the Creo portal was linked to a CAD regeneration before extracting the responses, the portal was giving an error. A workaround was to include a dummy variable in the process. In this release, the workaround is not needed anymore, and the portal works correctly.

**[Bug 5487] Creo portal - input parsing worked on the wrong instance of the prt-file**

In the previous releases, the Creo portal was loading the higher instance of the model instead of the file specified in the user interface. This was leading to parameter baseline values on the tagging panel to not match the file shown, thus being misleading. This is now fixed, and the portal works as expected.

**[Bug 10007] Excel portal – file parsing failed with Japanese sheet name**

In the previous releases, the Excel portal failed to parse the xlsx file when including Japanese characters in the sheet name. This is now working properly, and Japanese characters are supported for Excel sheet names.

**[Bug 12041] Excel portal – parallel execution failed with local evaluation server**

In the previous release, the Excel portal failed to run in parallel when the local evaluation server. This is now fixed and working properly.

**MISCELLANEOUS POST FIXES AND ENHANCEMENTS**

HEEDS MDO

HEEDS WM

**[Bug 3161] Responses other than RSM type are checked when a surrogate-based study is created**

In the previous release, when creating a surrogate-based study and activating all the factors of the study, the study resulted in error as study responses that are not dependent on the RSM responses were also activated because they referenced a missing tagging operation. This is now fixed and non RSM responses are not activated.



## HEEDS DESIGN EXPLORATION TEAM AT SIEMENS DIGITAL INDUSTRIES SOFTWARE

The HEEDS Design Exploration Team provides software and services to help you discover innovative solutions, reduce product development time and risks, and meet or exceed customer expectations.

4572 S Hagadorn Rd, Ste 3-A  
East Lansing, MI 48823  
Phone: +1 517.664.1137  
Fax: +1 517.664.1175

[heeds.support.plm@siemens.com](mailto:heeds.support.plm@siemens.com)

## ABOUT HEEDS

HEEDS, offered in the Simcenter portfolio, enables simulation to be used as a tool that drives innovation within an organization. HEEDS interfaces with all commercial CAD and CAE tools, connects seamlessly with computational resources, finds better designs – *faster*, and uncovers trends in the design space.

[www.siemens.com/heeds](http://www.siemens.com/heeds)

