HWX 2020 DESIGN EXPLORER

Optimization & Exploration

Altair

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AGENDA

- Design Explorer Overview
  - What it is & Who it's for
- Design Explorer Workflow and Features
  - Creating Explorations
  - Populating Explorations
  - Evaluating Explorations
  - Interpreting Explorations
- Summary & Additional Information

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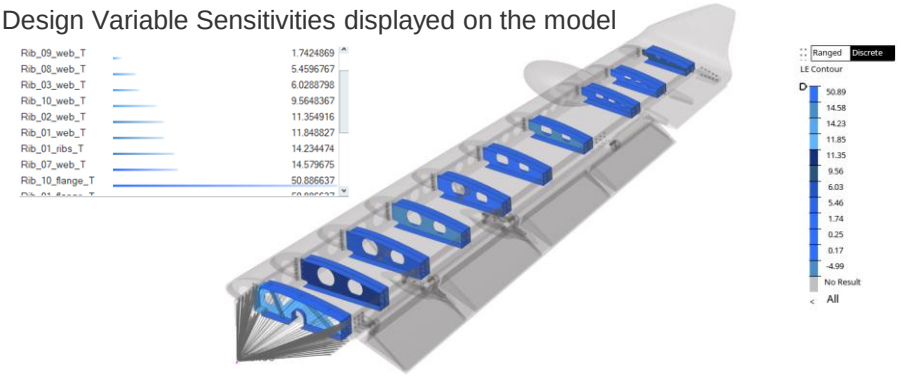
New in HyperWorks X 2020!

DESIGN EXPLORER

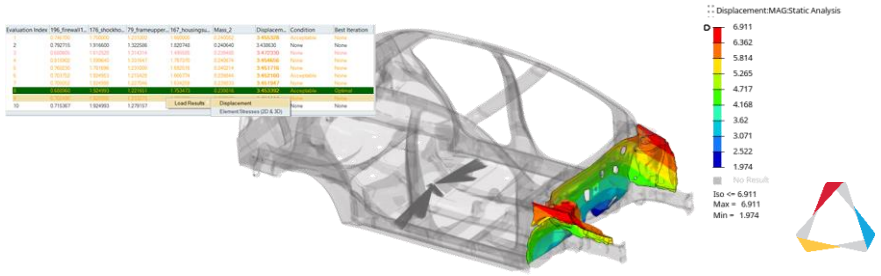
End-to-end workflow providing multi-run (Optimization & DOE) setup, execution, interpretation

- Gain insight into your product's performance
  - Learn which attributes contribute most to its behavior
  - Review, plot, and compare results from multiple runs
  - Find optimal designs
- Quick and easy evaluation set up
  - Step-by-step workflow, accessible to every HWx user
  - Graphical design variable and response definition
  - Design variable preview
- Solver independence
  - OptiStruct & Radioss support

Design Variable Sensitivities displayed on the model



Run Result Visualization



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TARGET AUDIENCE

1. All HyperWorks X users can benefit from multi-run insights!

2. Users who are unfamiliar with, or may be intimidated by, HyperStudy

3. Users who are unfamiliar with, or may be intimidated by, OptiStruct and optimization

Model graphics-based interactive setup and post-processing make the workflow accessible

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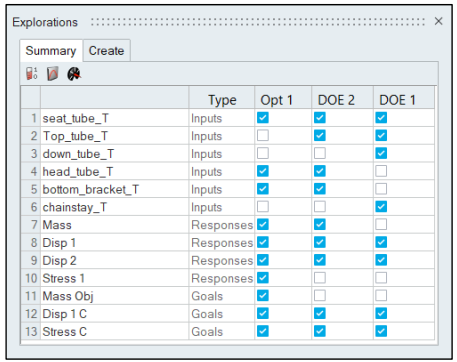
END-TO-END WORKFLOW

Management

- Create Explorations
- Manage Explorations' contents



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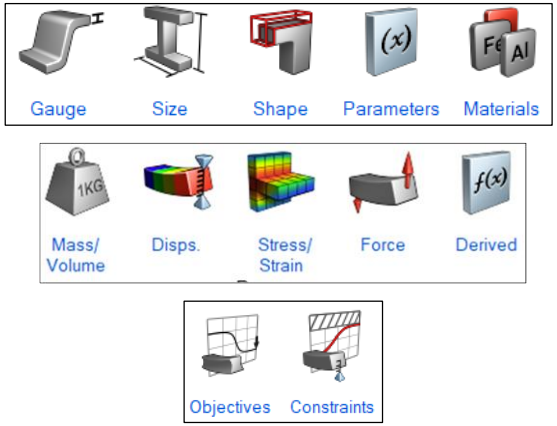
1	seat_tube_T	Inputs	☑	☑	☑
2	Top_tube_T	Inputs	☐	☑	☑
3	down_tube_T	Inputs	☐	☐	☑
4	head_tube_T	Inputs	☑	☑	☐
5	bottom_bracket_T	Inputs	☑	☑	☐
6	chainstay_T	Inputs	☐	☐	☑
7	Mass	Responses	☑	☑	☐
8	Disp 1	Responses	☑	☑	☑
9	Disp 2	Responses	☑	☑	☑
10	Stress 1	Responses	☑	☐	☐
11	Mass Obj	Goals	☑	☐	☐
12	Disp 1 C	Goals	☑	☑	☑
13	Stress C	Goals	☑	☑	☑

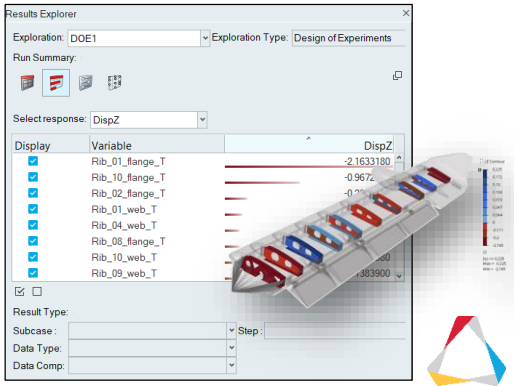
Setup



- Define exploration inputs/design variables
- Define exploration responses
- Define exploration goals

Evaluation & Interpretation

- Job submission and monitoring
- Results display and interpretation



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EXPLORATION CREATION & MANAGEMENT

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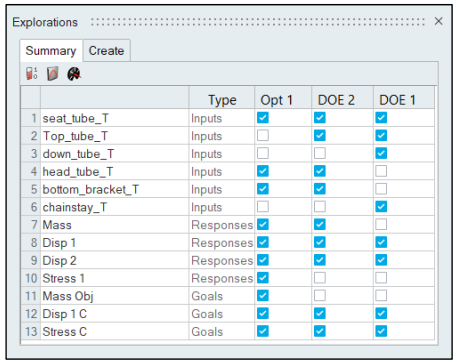
END-TO-END WORKFLOW

Management

- Create Explorations
- Manage Explorations' contents



		Type	Opt 1	DOE 2	DOE 1
1	seat_tube_T	Inputs	☑	☑	☑
2	Top_tube_T	Inputs	☐	☑	☑
3	down_tube_T	Inputs	☐	☐	☑
4	head_tube_T	Inputs	☑	☑	☐
5	bottom_bracket_T	Inputs	☑	☑	☐
6	chainstay_T	Inputs	☐	☐	☑
7	Mass	Responses	☑	☑	☐
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9	Disp 2	Responses	☑	☑	☑
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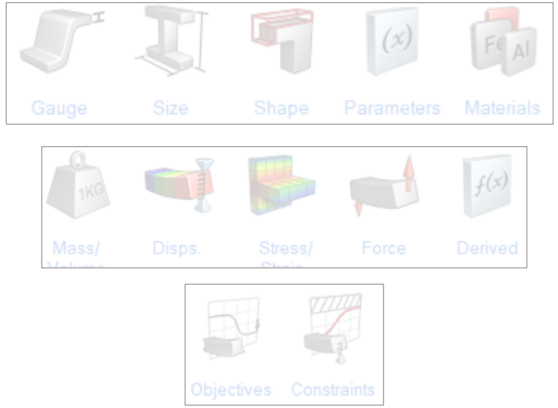
11	Mass Obj	Goals	☑	☐	☐
12	Disp 1 C	Goals	☑	☑	☑
13	Stress C	Goals	☑	☑	☑

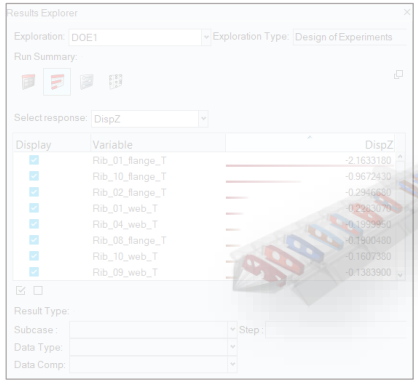
Setup



- Define exploration inputs/design variables
- Define exploration responses
- Define exploration goals

Evaluation & Interpretation

- Job submission and monitoring
- Results display and interpretation



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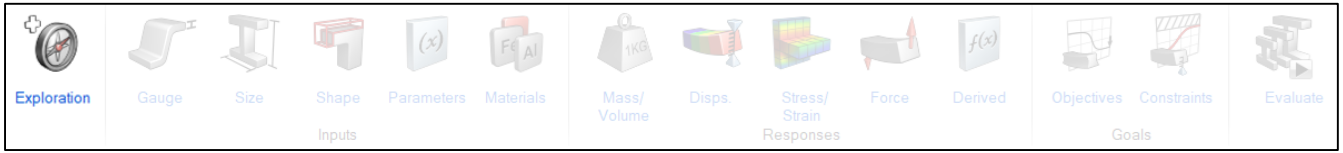
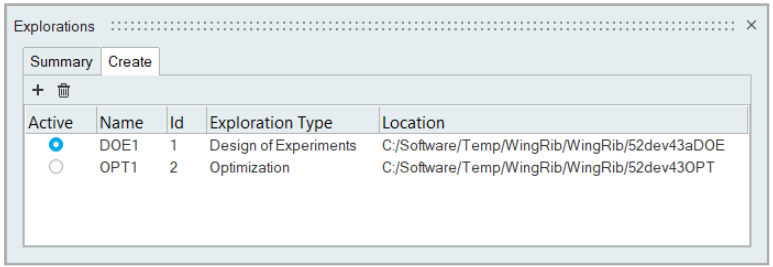
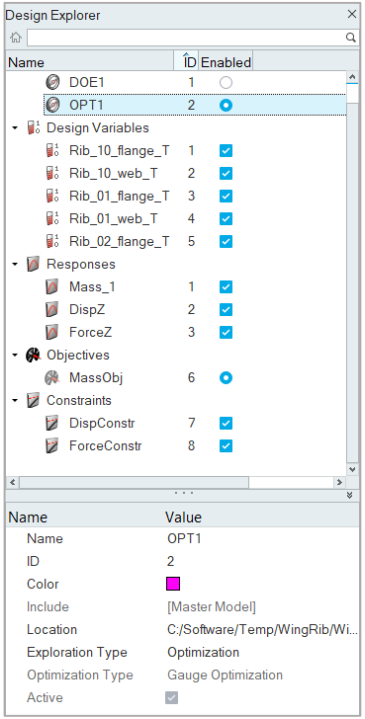
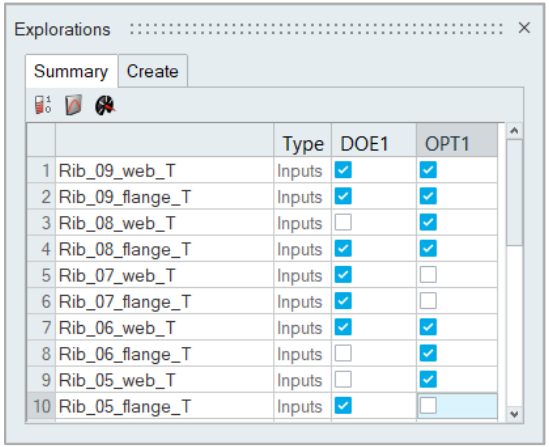
EXPLORATION



- Create Explorations
- Design Explorer browser
- Review & Manage Exploration contents







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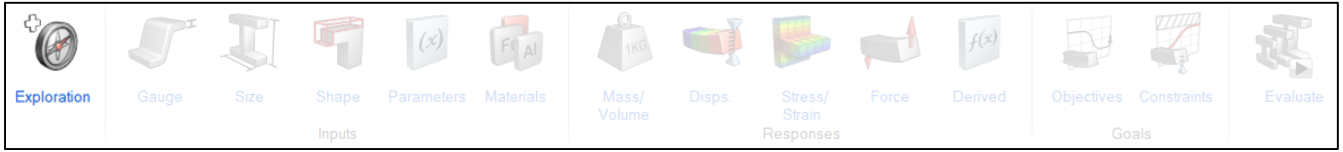
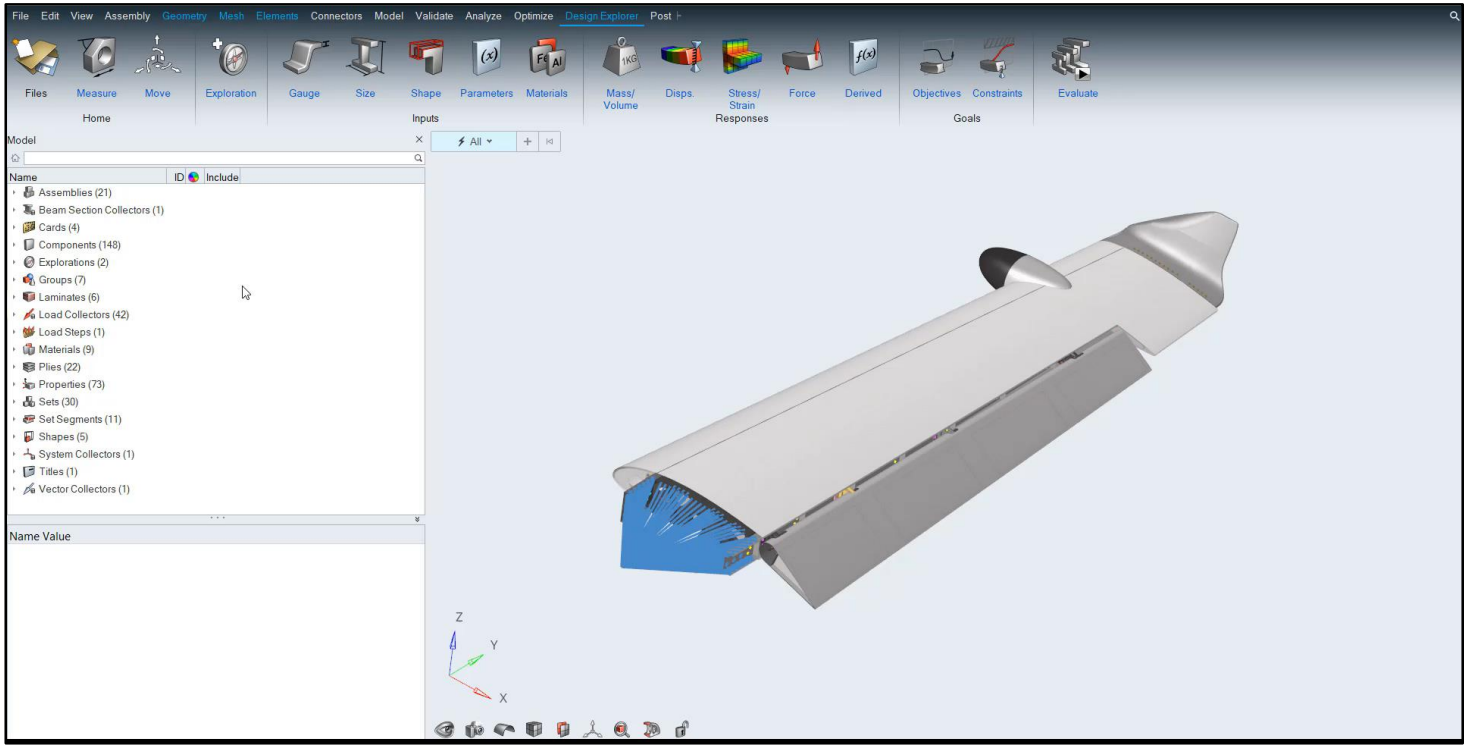
EXPLORATION





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EXPLORATION SETUP

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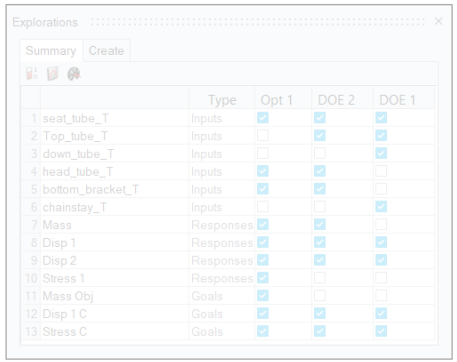
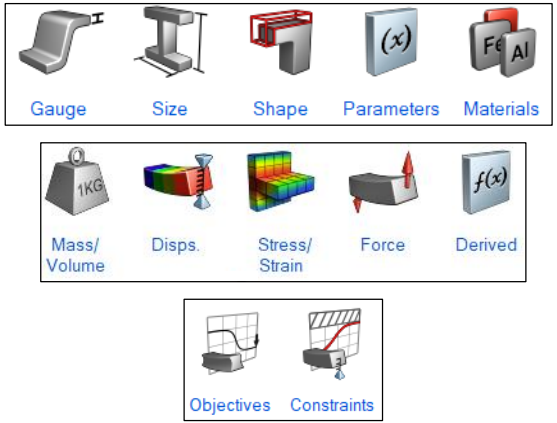
END-TO-END WORKFLOW

Management

- Create Explorations
- Manage Explorations' contents



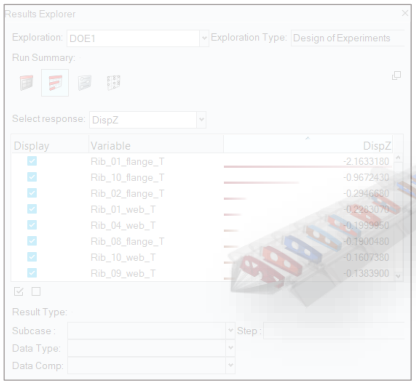
Setup



- Define exploration inputs/design variables
- Define exploration responses
- Define exploration goals

Evaluation & Interpretation

- Job submission and monitoring
- Results display and interpretation



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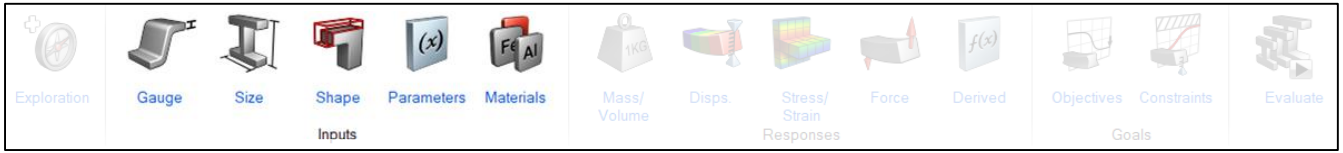
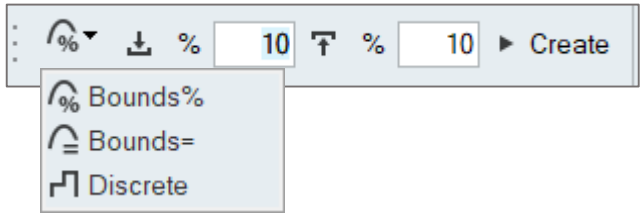
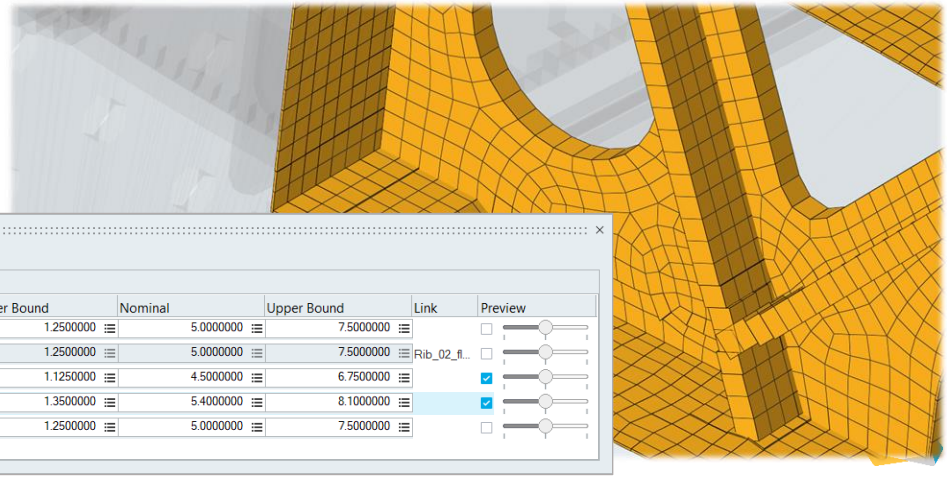
INPUTS



- Gauge, Size, Shape, and Material DVs
- Interactive design variable creation via model graphics
- Inputs review table
- Design variable linking
- Preview for thickness and shape variables





Inputs

Summary | Details

Active	Name	Id	Type	Lower Bound	Nominal	Upper Bound	Link	Preview
☑	Rib_10_flange_T	1	T	1.2500000	5.0000000	7.5000000		☐
☑	Rib_10_web_T	2	T	1.2500000	5.0000000	7.5000000	Rib_02_fl...	☐
☑	Rib_01_flange_T	3	T	1.1250000	4.5000000	6.7500000		☑
☑	Rib_01_web_T	4	T	1.3500000	5.4000000	8.1000000		☑
☑	Rib_02_flange_T	5	T	1.2500000	5.0000000	7.5000000		☐

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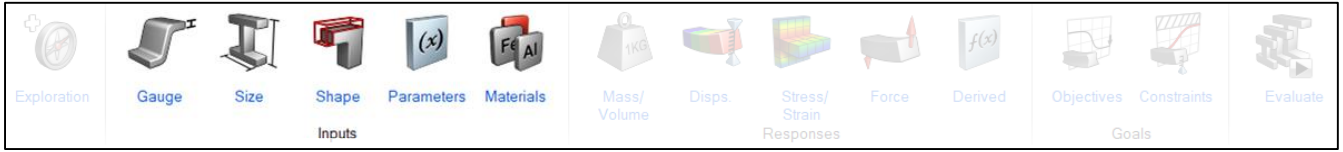
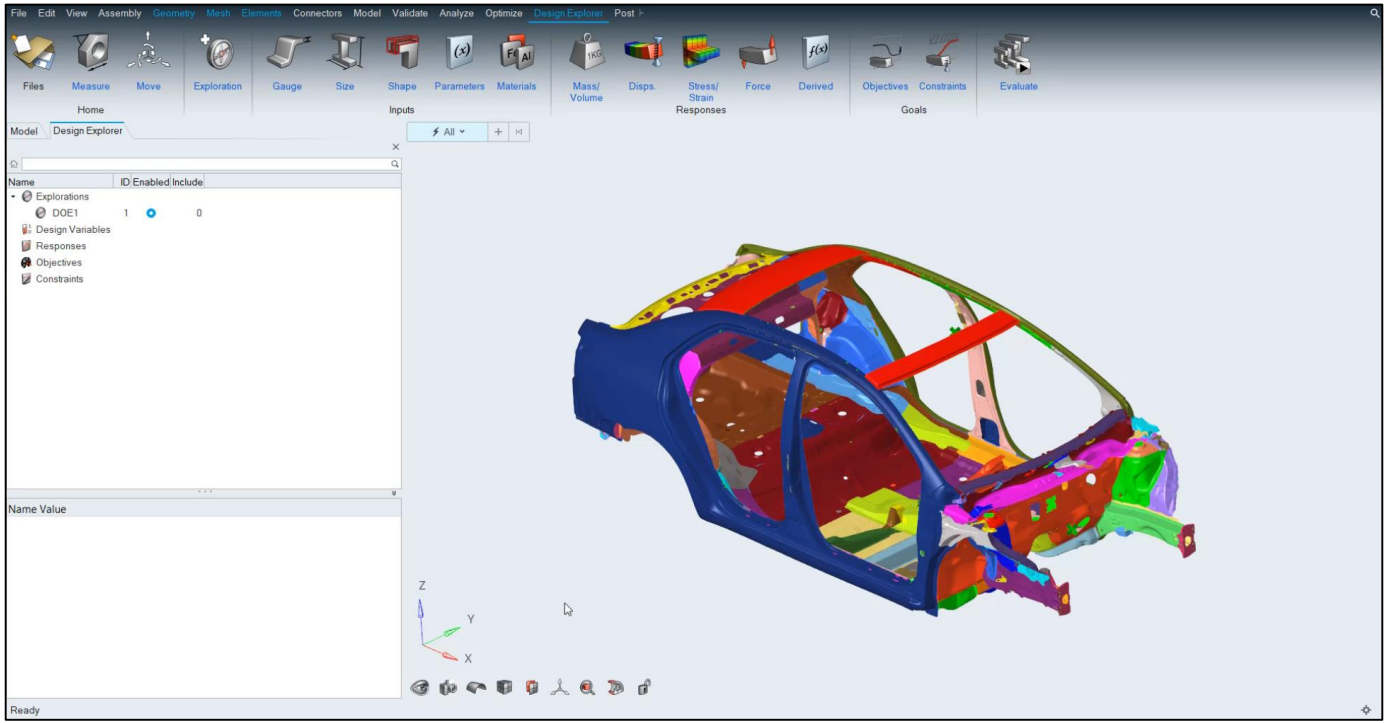
INPUTS





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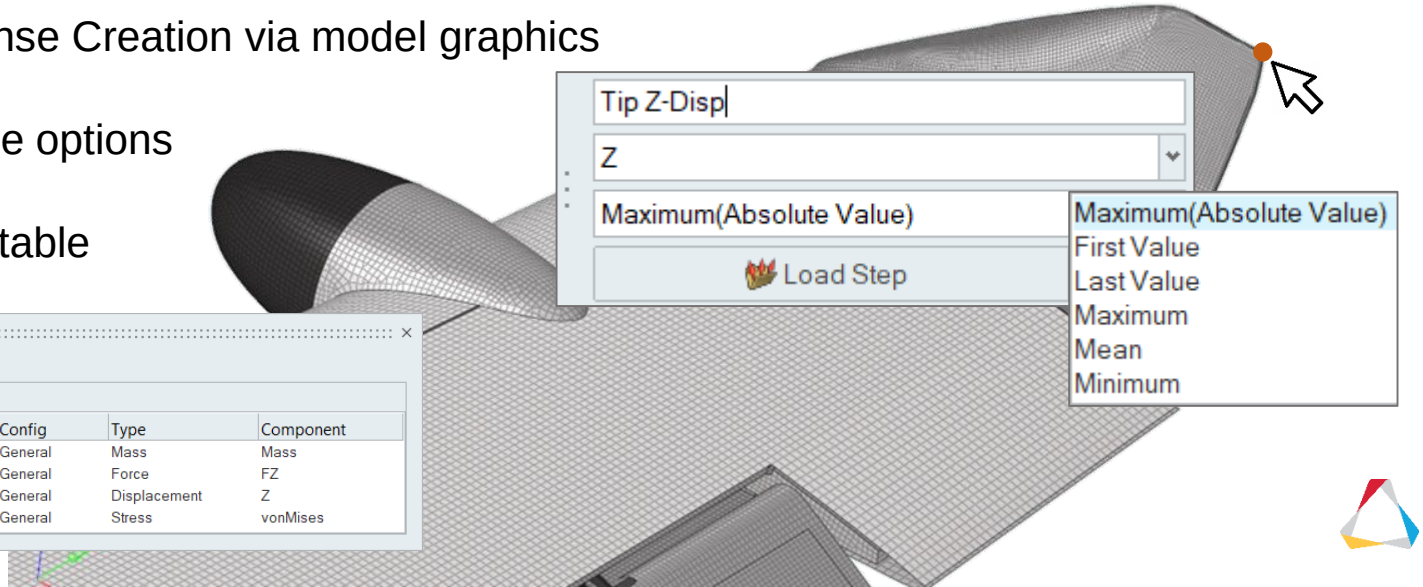
RESPONSES

- Mass/Volume, Displacement/Rotation, Stress/Strain, 1D & Reaction Force Responses
- Derived Responses: Combine responses, e.g. Derived Displacement 3 = Disp. 2 – Disp. 1
- Interactive Response Creation via model graphics
- Updated Response options
- Response review table



Responses

Summary | Details

Active	Name	Id	Config	Type	Component
☑	Mass	1	General	Mass	Mass
☑	React Fz	3	General	Force	FZ
☑	Tip Z-Disp	10	General	Displacement	Z
☑	Rib Stress	11	General	Stress	vonMises

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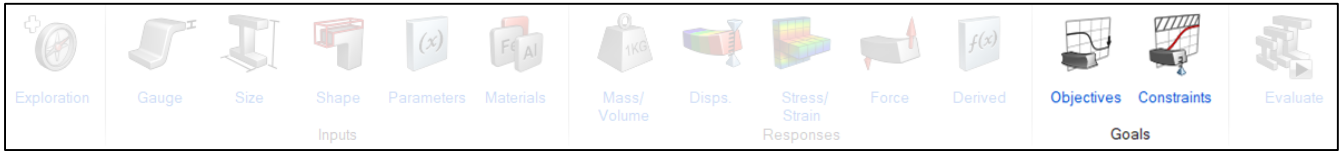
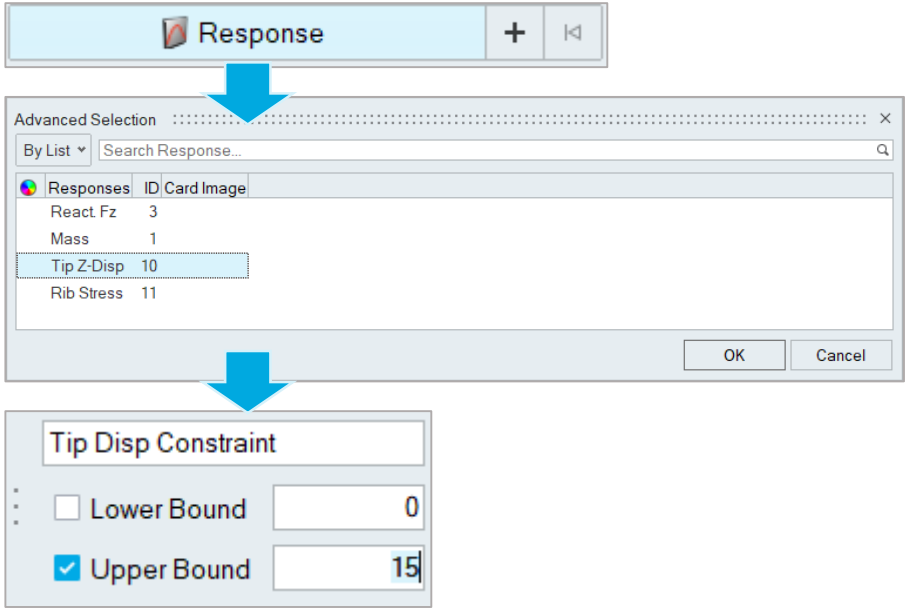
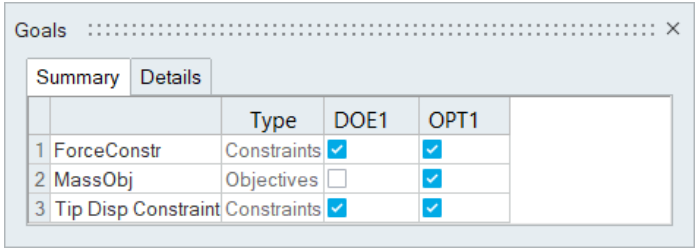
GOALS



- Define optimization objective
- Define constraints – now valid for DOEs as well as optimizations





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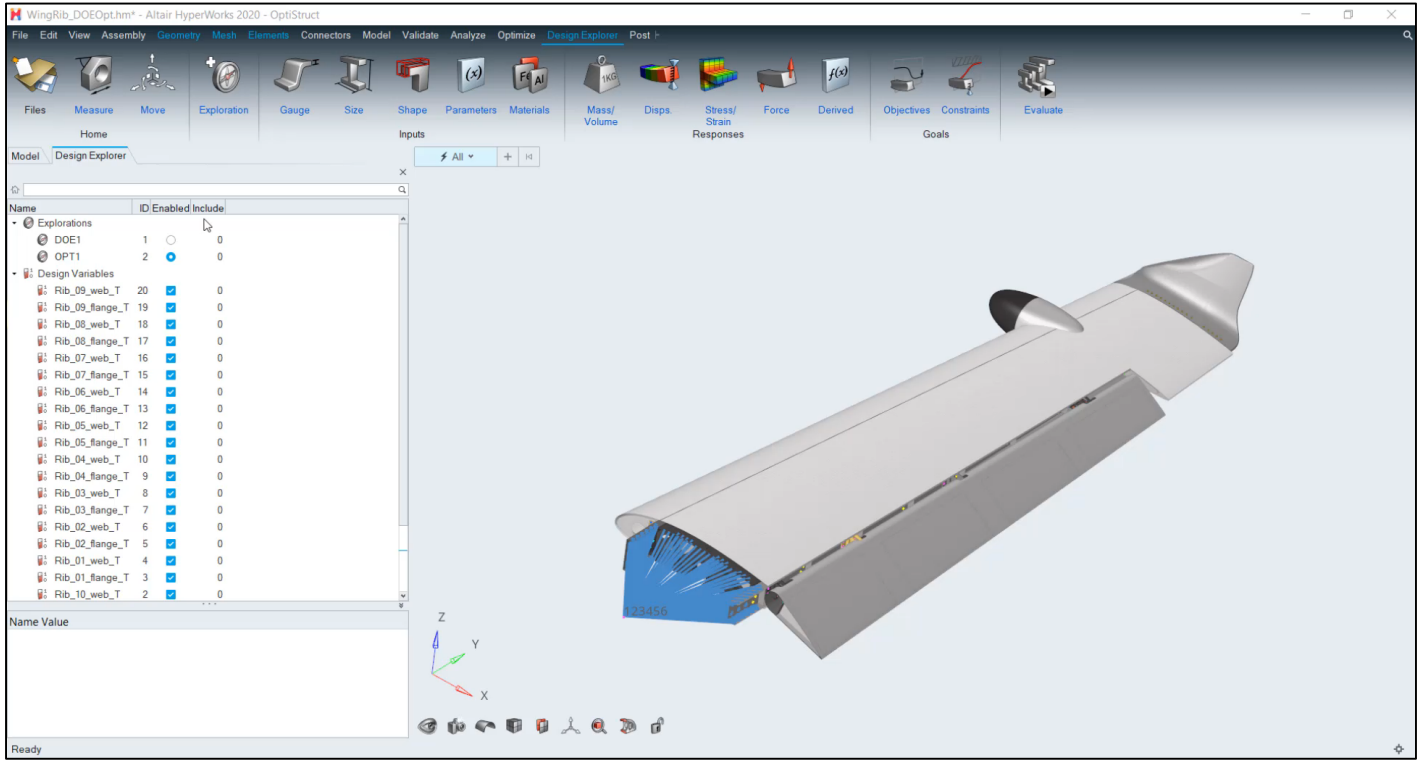
RESPONSES & GOALS



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EXPLORATION EVALUATION & INTERPRETATION

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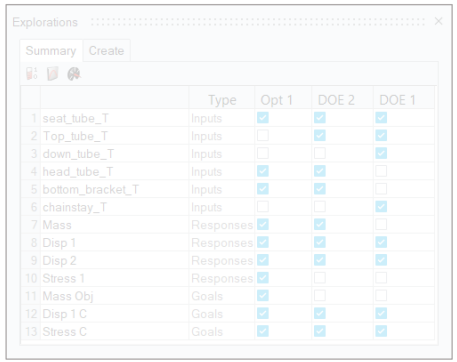
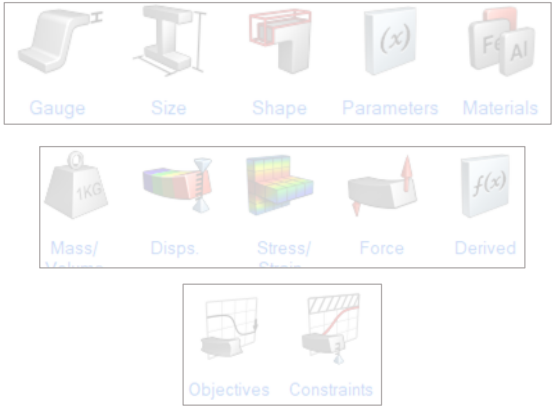
END-TO-END WORKFLOW

Management

- Create Explorations
- Manage Explorations' contents



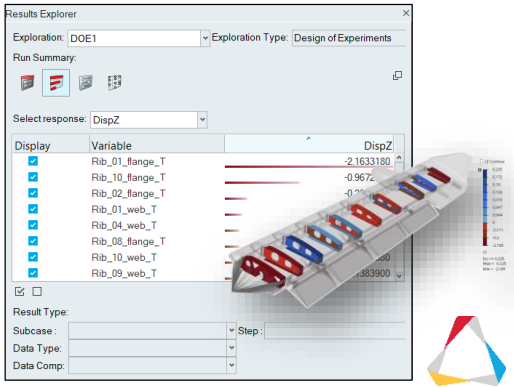
Setup



- Define exploration inputs/design variables
- Define exploration responses
- Define exploration goals

Evaluation & Interpretation

- Job submission and monitoring
- Results display and interpretation



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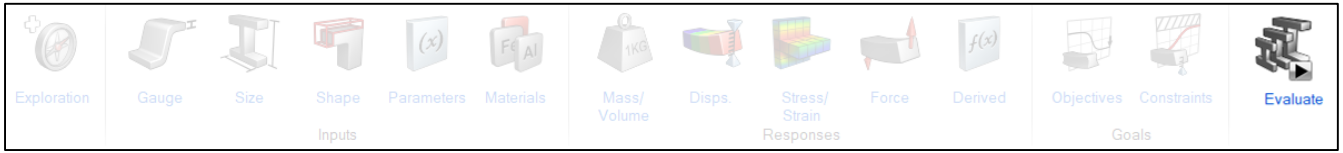
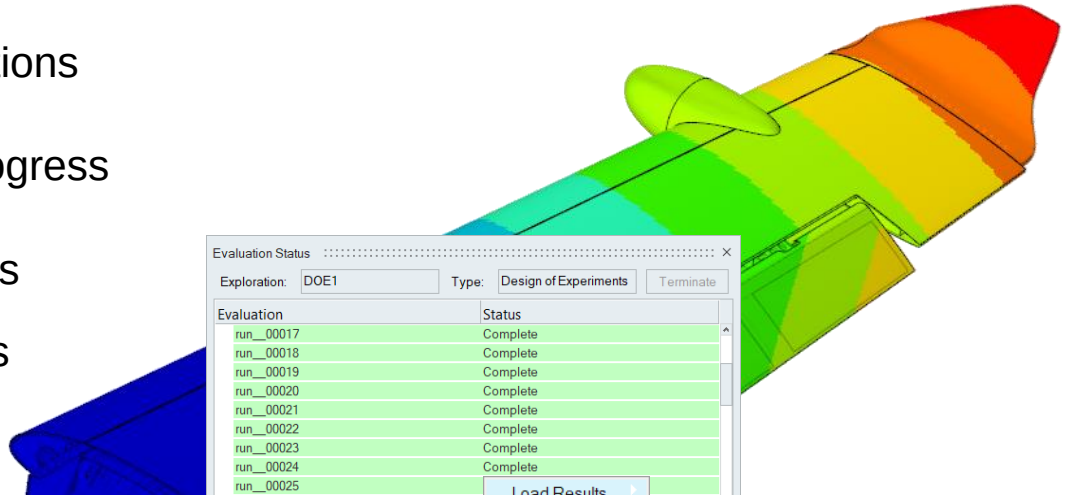
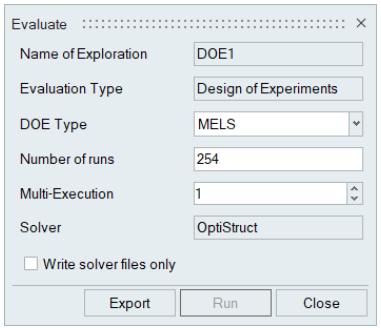
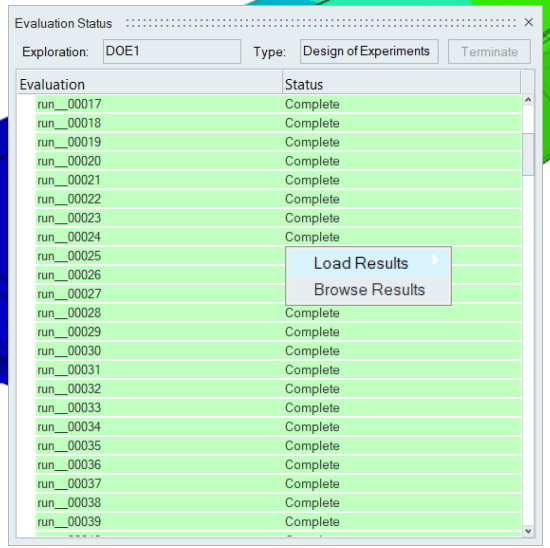
EVALUATE



- Evaluate (run) explorations
- Monitor exploration progress
- Contour completed jobs
- View & Interpret results (Results Explorer)







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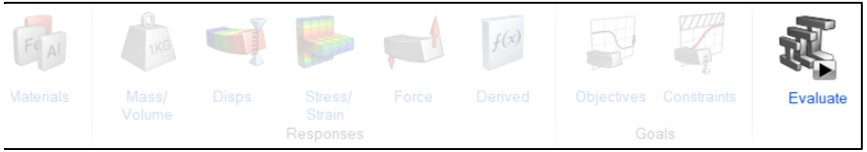
EVALUATE – RESULTS EXPLORER



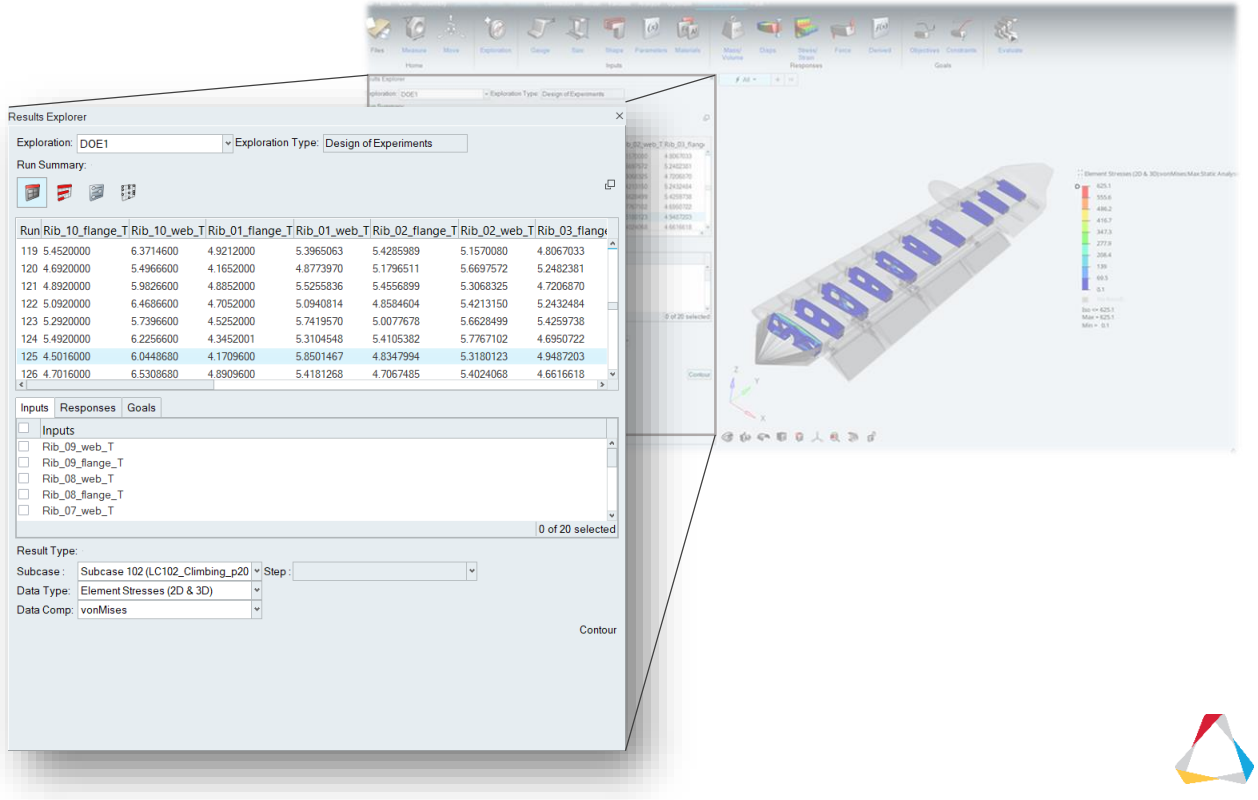
One-stop interactive Exploration post-processing

Select Exploration

Exploration Type-specific Tools

Tool-specific Display

Utilize Model Graphics



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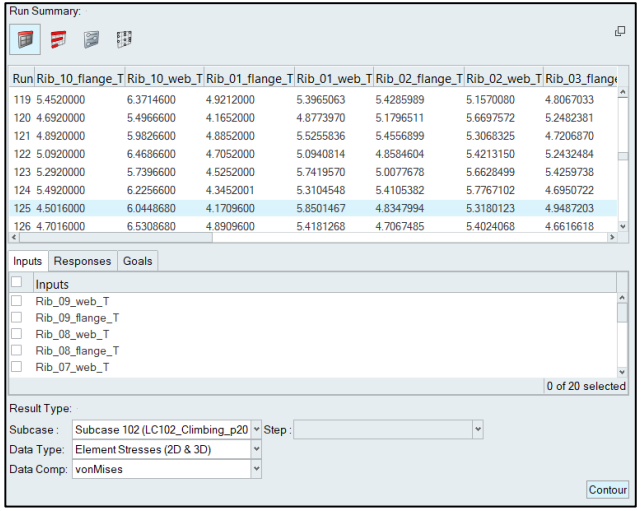
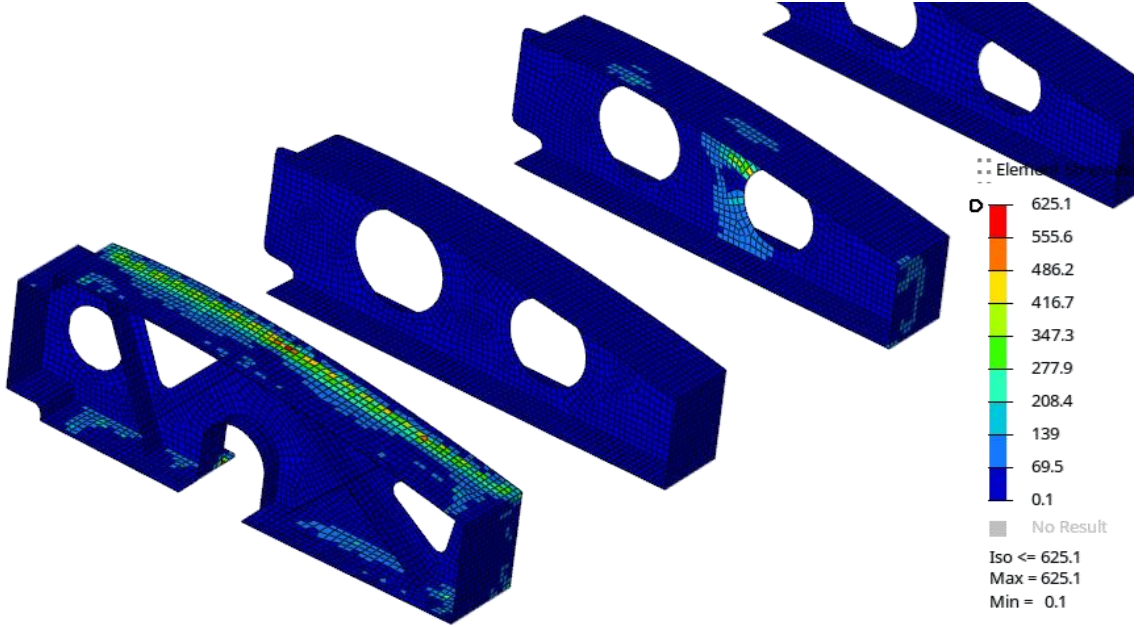
EVALUATE – RESULTS EXPLORER

DOEs

- DOE Run Summary Table
- Contour Results





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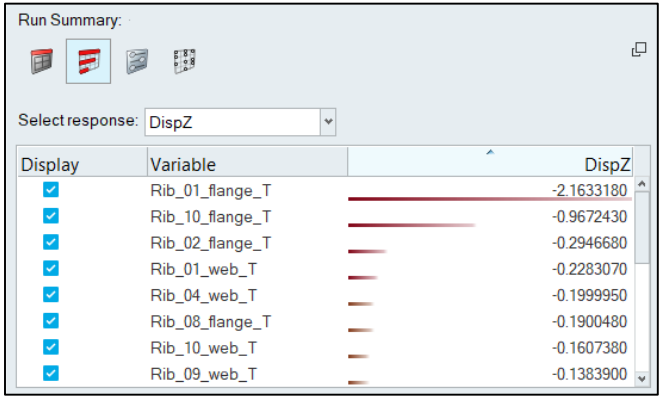
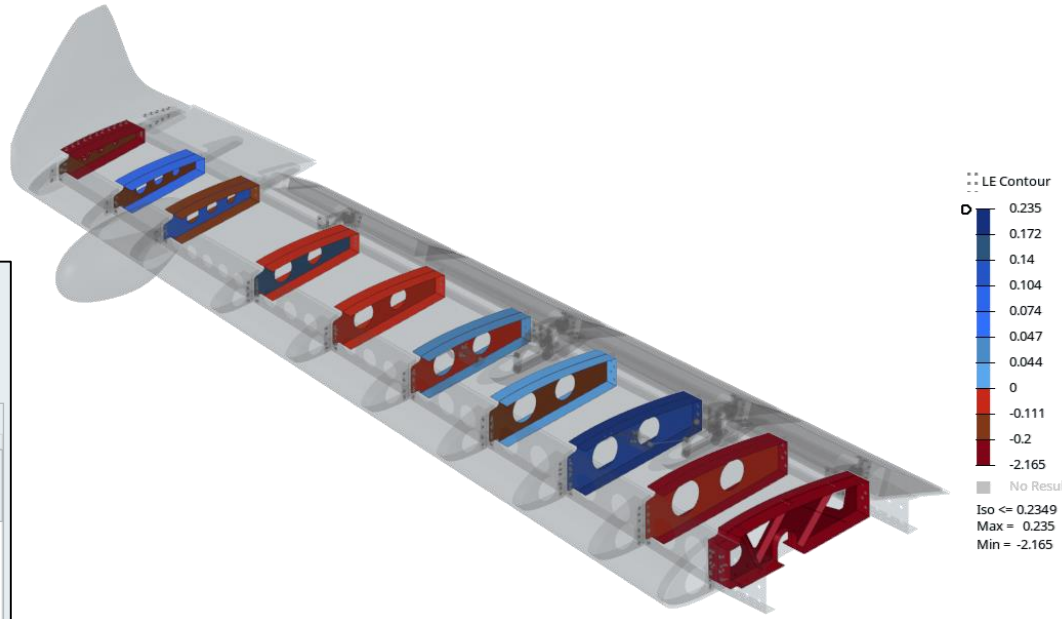
EVALUATE – RESULTS EXPLORER

DOEs

- Linear Effects
  - Bar Chart
  - Mapped onto graphics
  - Chart-Graphics interactivity





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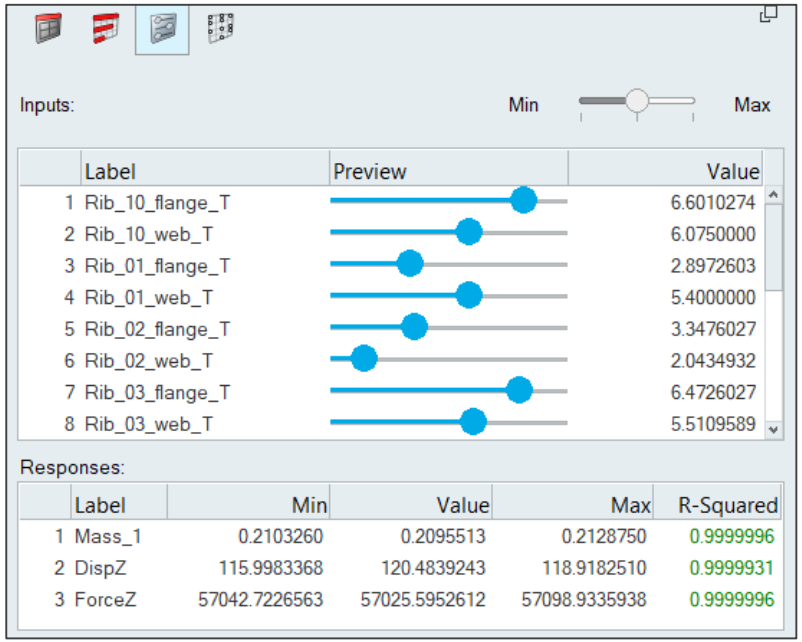
EVALUATE – RESULTS EXPLORER

DOEs

- Trade-off
- Fit automatically run
- Move sliders to view predicted Response values



Inputs: Min Max

	Label	Preview	Value
1	Rib_10_flange_T		6.6010274
2	Rib_10_web_T		6.0750000
3	Rib_01_flange_T		2.8972603
4	Rib_01_web_T		5.4000000
5	Rib_02_flange_T		3.3476027
6	Rib_02_web_T		2.0434932
7	Rib_03_flange_T		6.4726027
8	Rib_03_web_T		5.5109589

Responses:

	Label	Min	Value	Max	R-Squared
1	Mass_1	0.2103260	0.2095513	0.2128750	0.9999996
2	DispZ	115.9983368	120.4839243	118.9182510	0.9999931
3	ForceZ	57042.7226563	57025.5952612	57098.9335938	0.9999996

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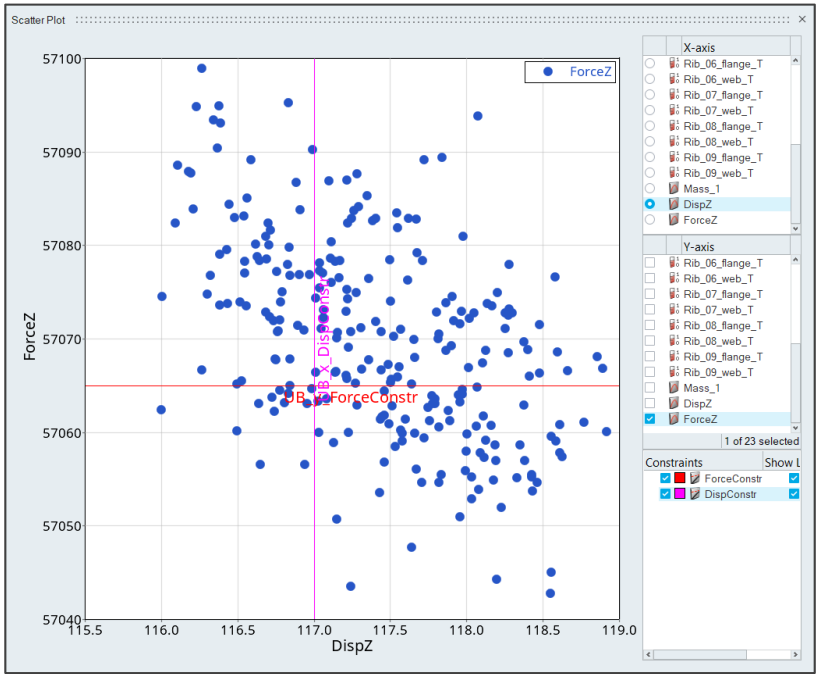
EVALUATE – RESULTS EXPLORER

DOEs

- Scatter Plot
- View relations between exploration inputs & outputs
- Overlay constraints
- Evaluate design trade-offs



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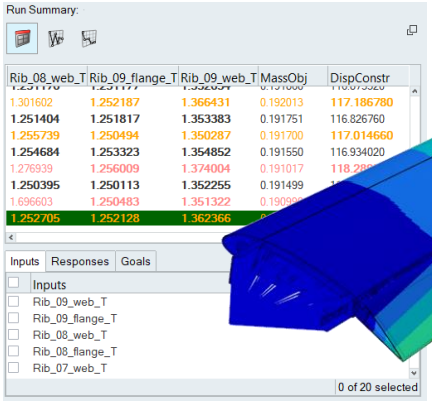
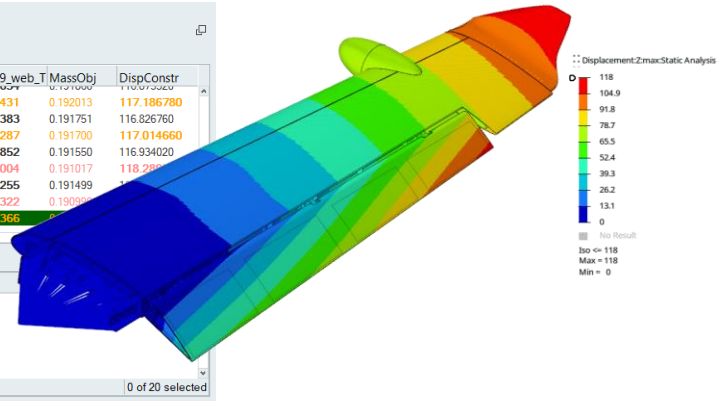
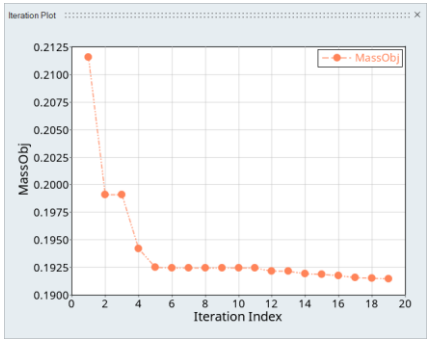
EVALUATE – RESULTS EXPLORER

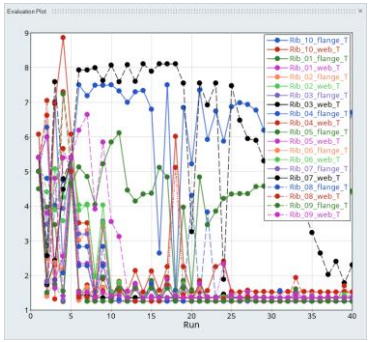
Optimizations

- Optimization Run Summary Table
  - Color-coded information
  - Results contouring
- Evaluation & Iteration Plots
  - Plot inputs, responses, and goals









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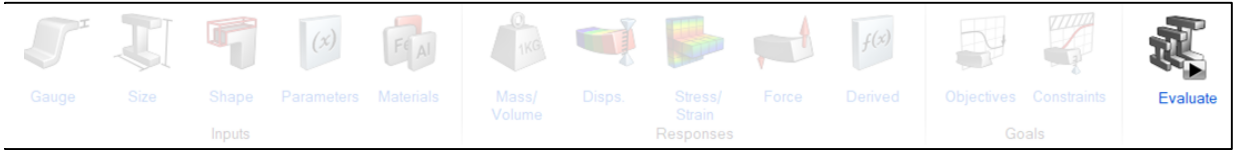
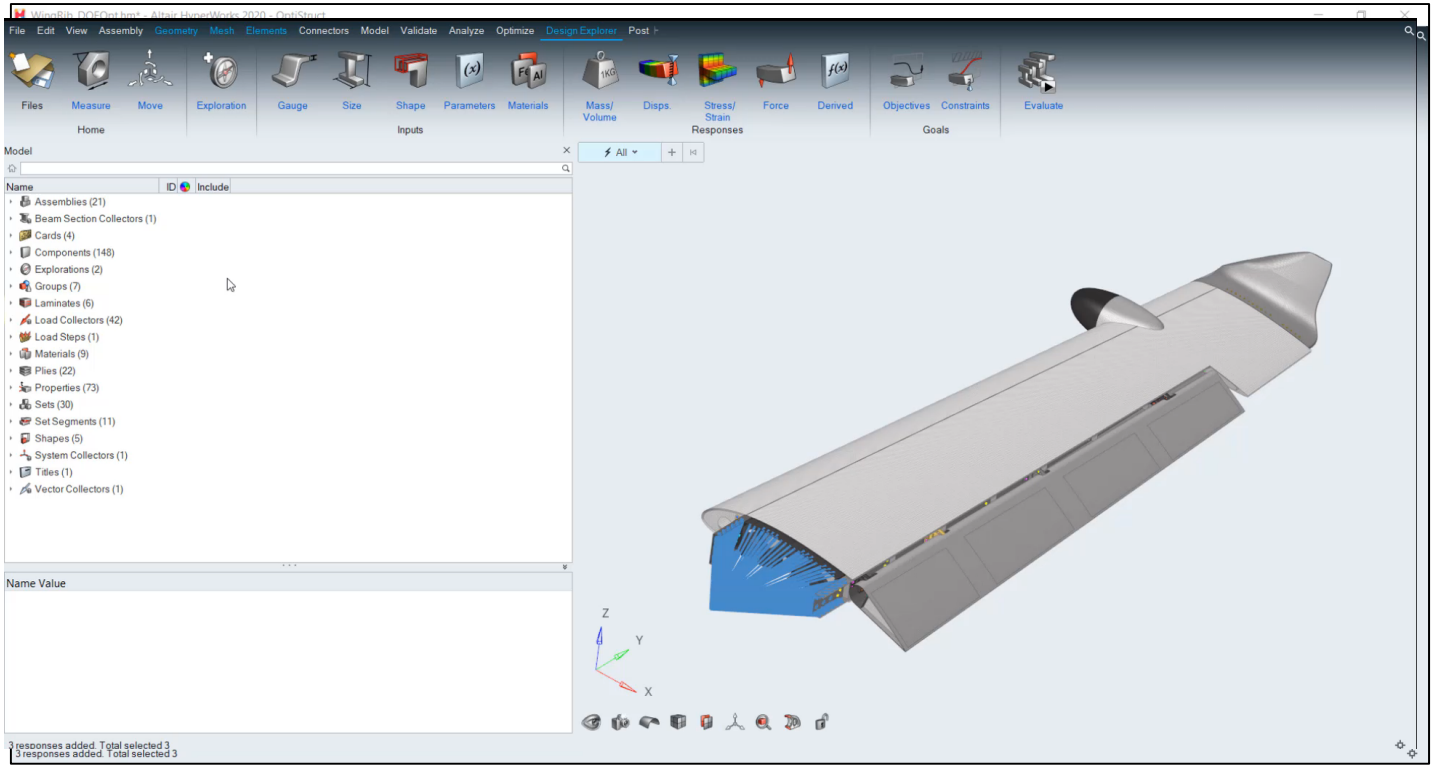
RESULTS EXPLORER





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SUMMARY

SUMMARY

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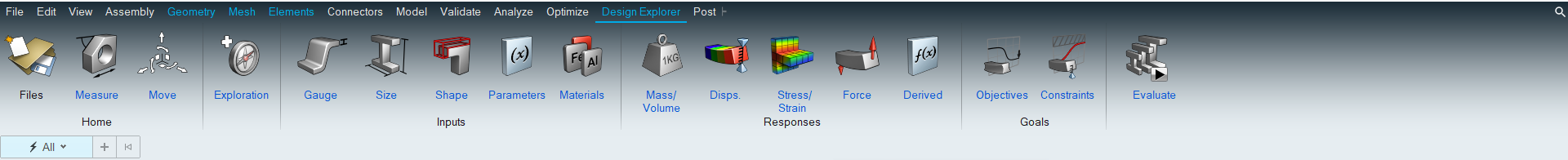
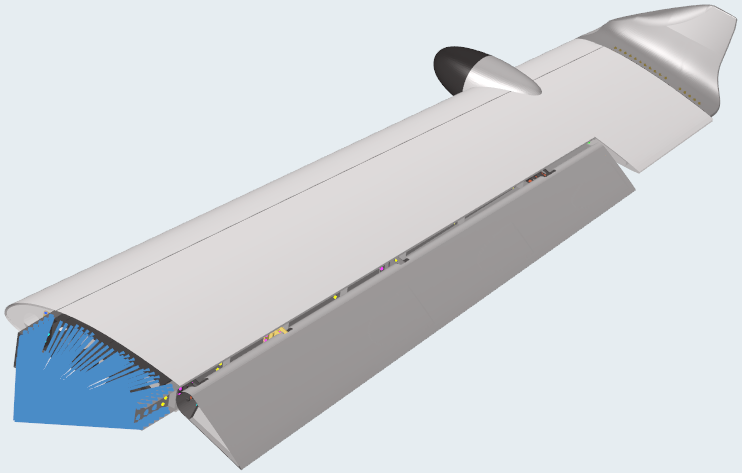
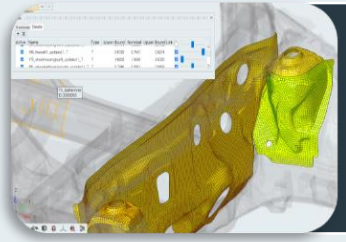




The **HyperWorks Design Explorer** provides a complete end-to-end workflow for multi-run simulations, including designs-of-experiments and optimizations. The workflow includes set-up, evaluation, and – most importantly – insightful interpretation of results, in an easy-to-use, intuitive environment, tightly integrated into the pre-processing environment.

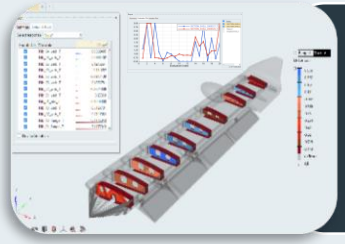
End-to-End Workflow

Ribbon-based workflow captures everything from input & response definition, to multi-run execution, to post-processing and results interpretation



Ease of Use

Interaction with model graphics makes design variable creation and response definition interactive



Insight

- Learn which attributes contribute most to behavior
- Review, plot, and compare results from multiple runs
- Find optimal designs

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THANK YOU!