Release 2023 R1 Highlights
Ansys optiSLang

Faster Optimization and Access across the Portfolio

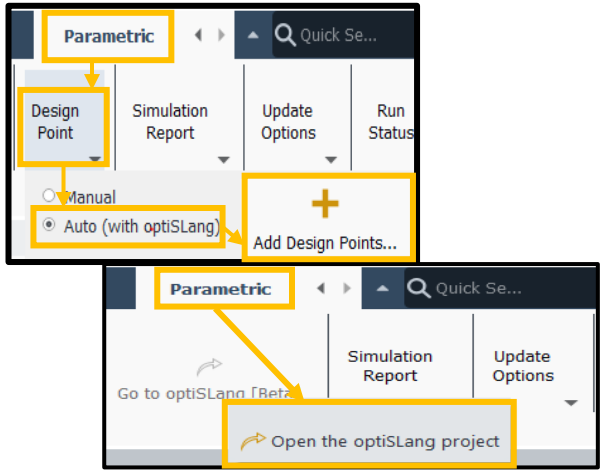
Speed design time up to 98% faster

- ✓ Workflows now faster than ever
- ✓ Opens new horizons for optiSLang use
- ✓ More parameters, more loops, more designs
- ✓ Enables power of optiSLang in applications such as Electrification, Autonomous Drive, etc.

One-Click Optimization

One Click Optimizer

- ✓ Hybrid Optimization Strategy:
  AI assisted optimizer, automatically combining different optimization algorithms
- ✓ **Requires minimal user knowledge and interaction w/ interface—effortless**



OSL in Fluent

- ✓ optiSLang algorithms now easily accessible in
  - ✓ Workbench
  - ✓ AEDT
  - ✓ Fluent
  - ✓ MotorCAD
  - ✓ LS-OPT
  - ✓ ModelCenter
- ✓ … more to come…

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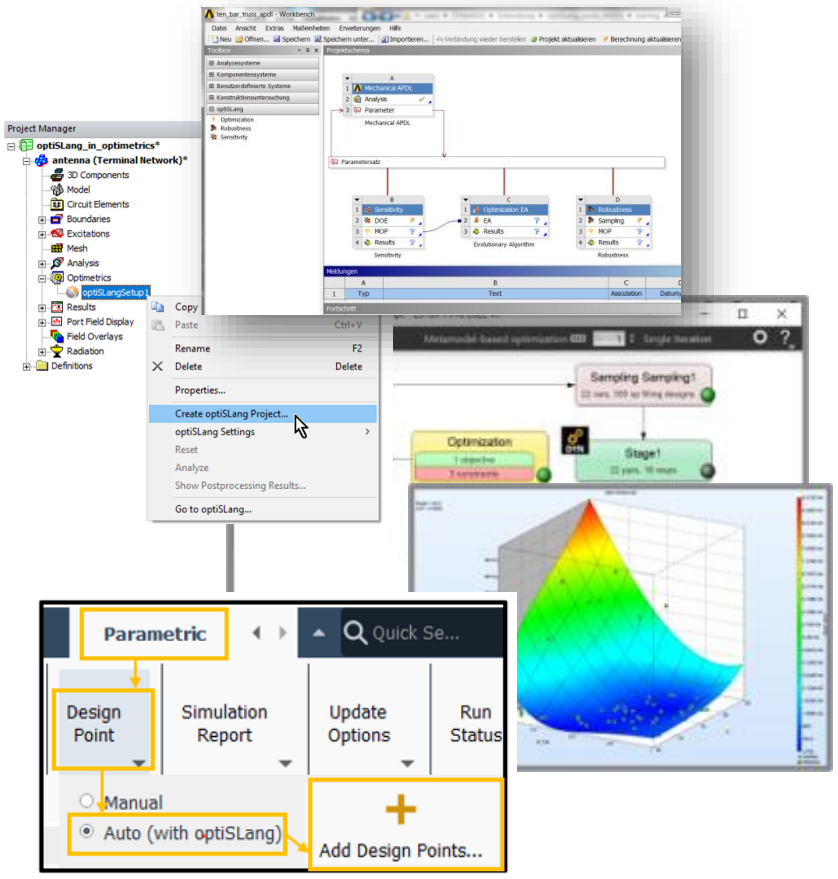
Reminder: optiSLang Pro

New License Option in 2022R2

Use optiSLang – Connect to Simulation

Embedded
direct use of algorithms



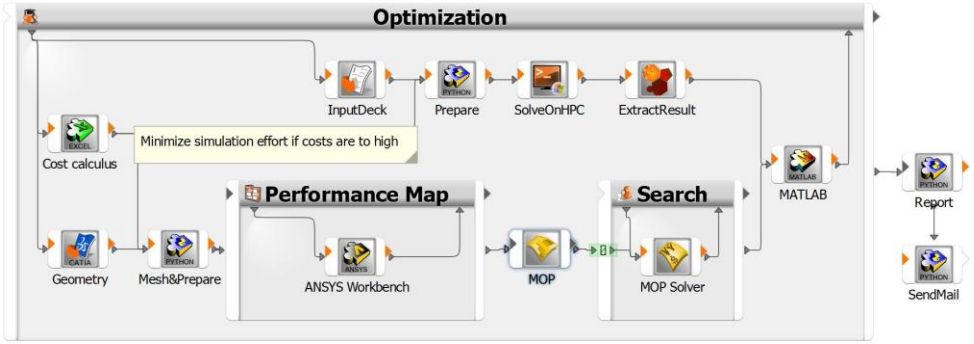
AEDT, Workbench, LS-DYNA

NEW: DOE in Fluent (23R1)

optiSLang GUI
connect tools & algorithms

Best in class connectors to
The Ansys tools
(incl. HPC licensing)

Direct plugins + open interfaces
→ 150++ propietary tools connected
→ 100% vendor neutral



Linux/Windows, HPC&Cloud, Open API, GUI & Batch, …

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Ansys optiSLang

Capabilities	Pro	Premium	Enterprise
Design Studies			
Classic DOE	✓	✓	✓
Sampling & Sensitivity Analysis	✓	✓	✓
Robust Design Optimization	✓	✓	✓
Classic scalar meta-modeling	✓	✓	✓
Reliability Analysis		✓	✓
Process Integration and Workflow Orchestration			
Embedded in Ansys + LS-OPT*	✓	✓	✓
Build and automate workflows		✓	✓
Integrate 3rd party tools		✓	✓
App generation			✓
Advanced Meta Modeling & AI/ML			
Field meta-modeling (signals, 2D/3D)			✓
UQ for signals, 2D/3D			✓
AI/ML for RDO			✓
Concurrent Solver Variant Licensing			
Solver variations for parametric design study		+3	+7

optiSLang Pro

Get attracted to design studies
Offer unlimited Sensitivity Analysis, Robust Design Optimization, all from within the applications they are accustomed to using.

optiSLang Premium

Win the workflow
Accelerate engineering design studies by automating workflows with 3rd party tools and maximize customer ROI.

optiSLang Enterprise

Scale parametric design studies
Add advanced reduced order modeling and AI technology and deploy workflows across the engineering organization via Apps.

*LS-OPT versions <2022 R1 stay free from licensing for LS-DYNA users

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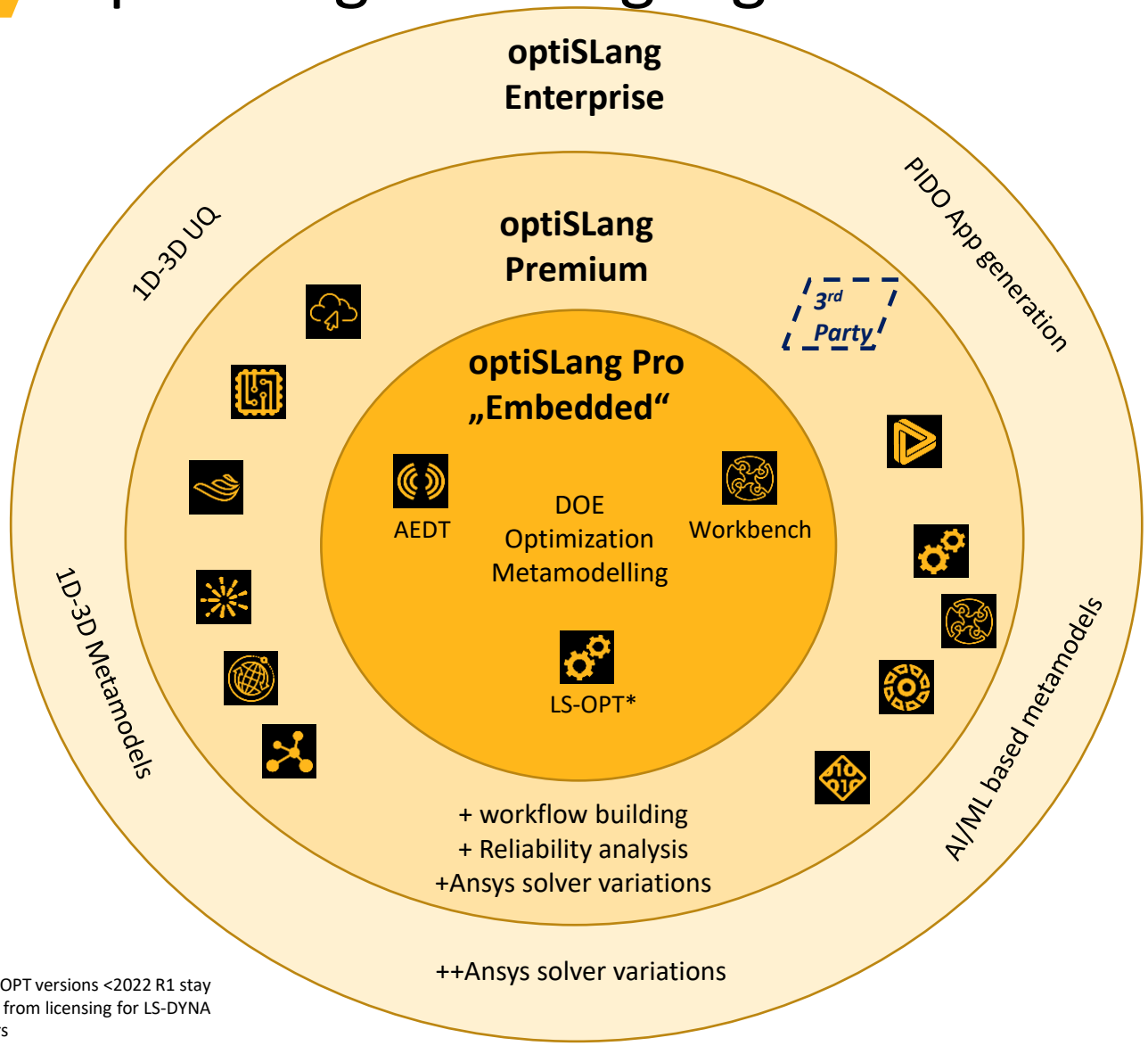
optiSLang licensing - grows with usage & learning



*LS-OPT versions <2022 R1 stay free from licensing for LS-DYNA users

Start „optimization“ directly in Ansys CAE environment

- Easy to use
- Wizard guided
- Pro licensing for different physics
- Share across team – build optimization know-how

More complex workflows

- Multi-disciplinary
- Include non-Ansys and inhouse tools
- More HPC & Cloud computing options
- Use Ansys concurrent licensing

Algorithm and Workflow Expert

- AI/ML based metamodels
- 1-3D Metamodels
- 1-3D Uncertainty Quantification
- Publish workflows for Minerva, MBSE, …

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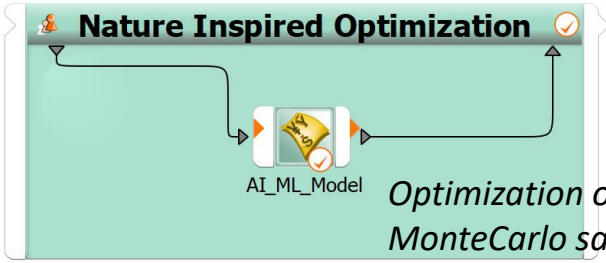
General

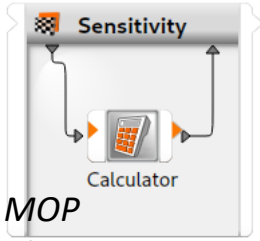
SPEED

TSTUDY SUPPORT

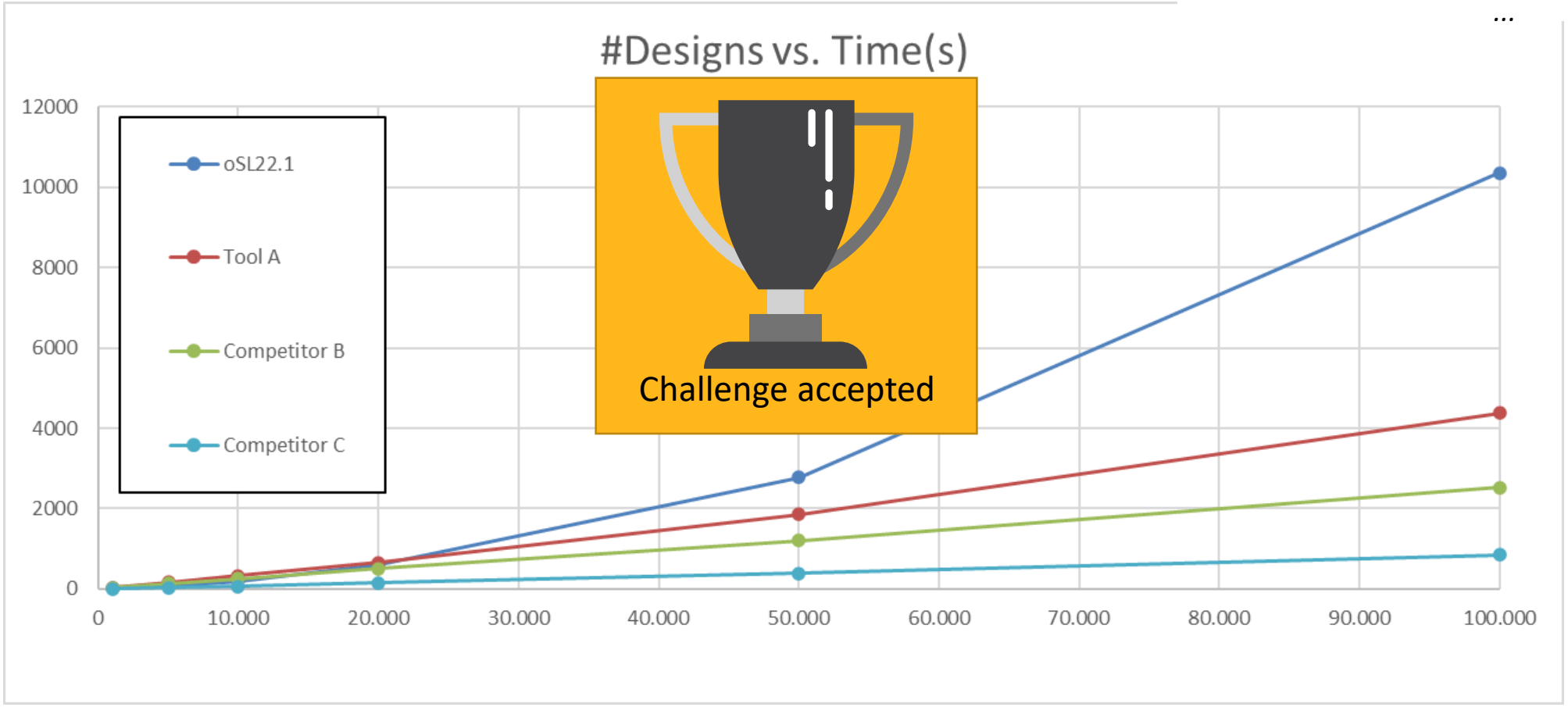
…

optiSLang performance with many Designs





Optimization on MOP
MonteCarlo sampling
...



22R1: 3 hours

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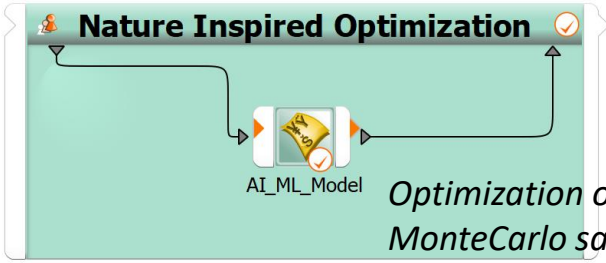
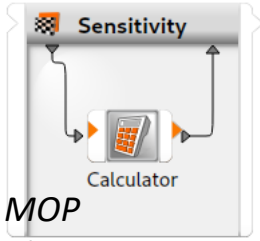
NOW: Much faster





Optimization on MOP
MonteCarlo sampling
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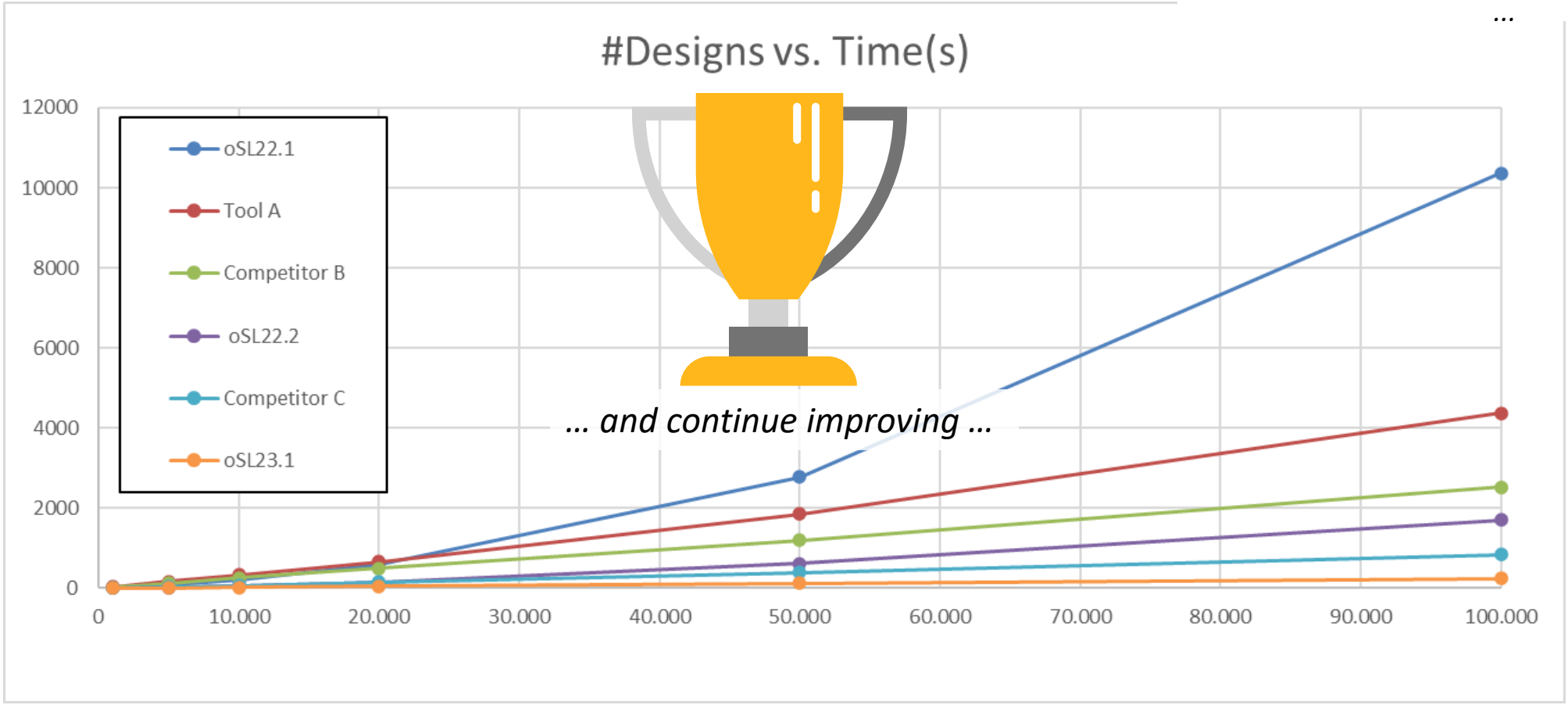

22R1: 3 hours

23R1: 4 minutes

Cubic behavior (22.1) → Linear in 23R1 → Time for design #1 == Time for design #100.000 (almost)

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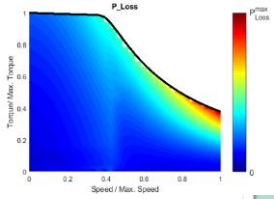
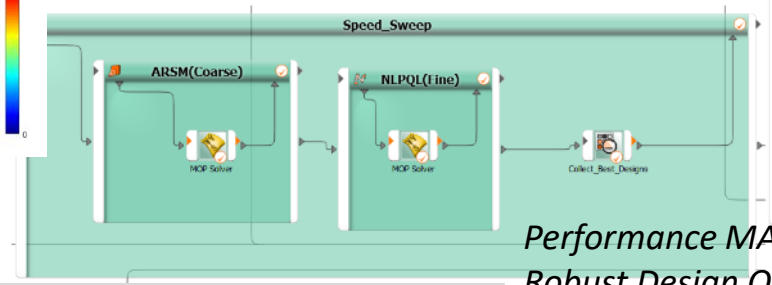
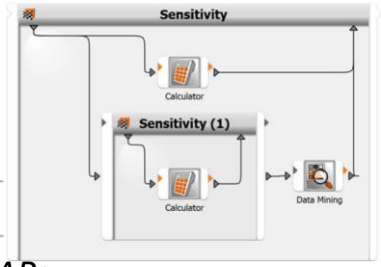
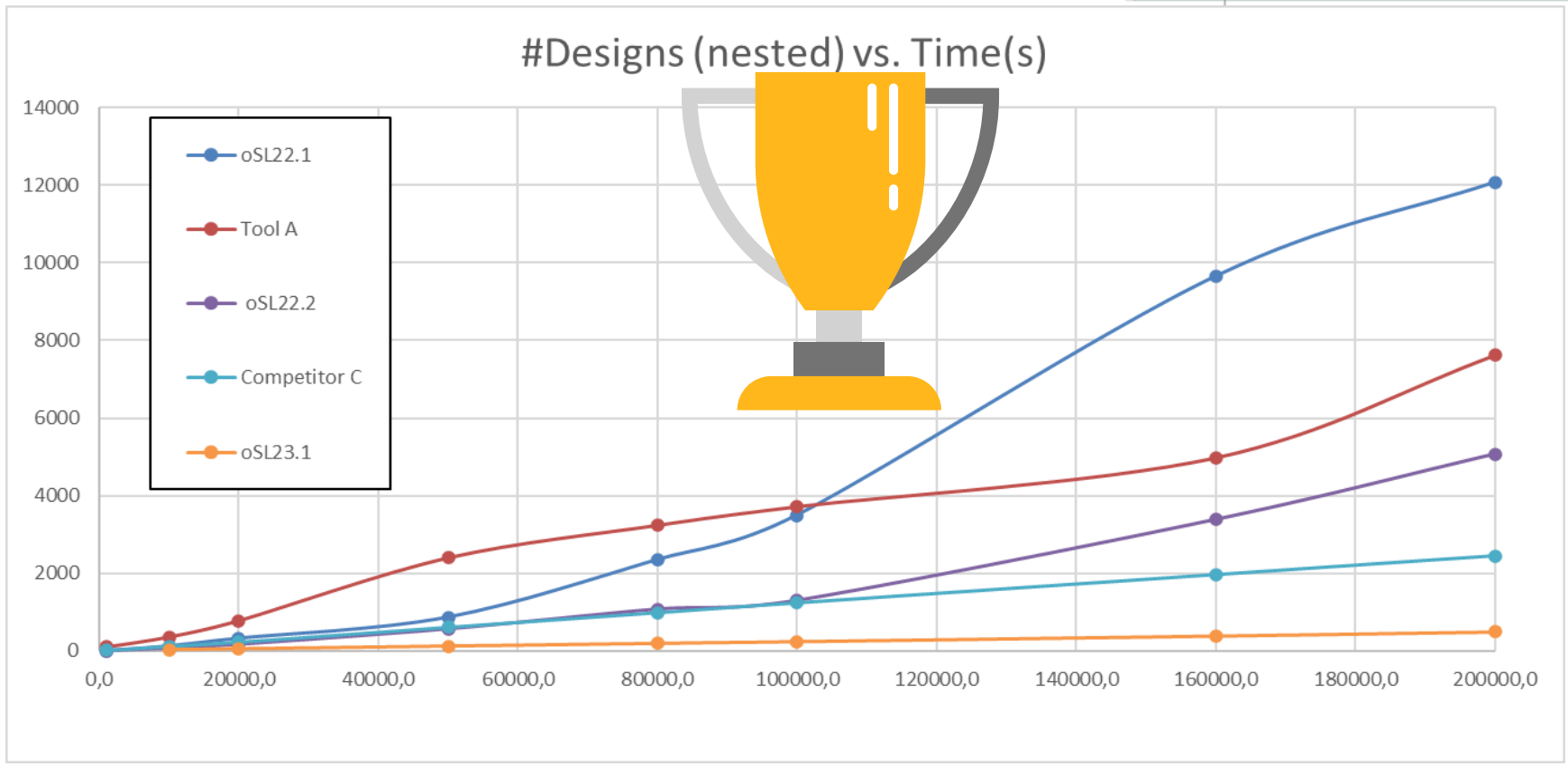
NOW: Much faster







Performance MAPs
Robust Design Optimization



22R1: 3.5 hours

23R1: 6 minutes

Cubic behavior (22.1) → Linear in 23R1 ➔ Time for design #1 == Time for design #100.000 (almost)

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A word on significant settings

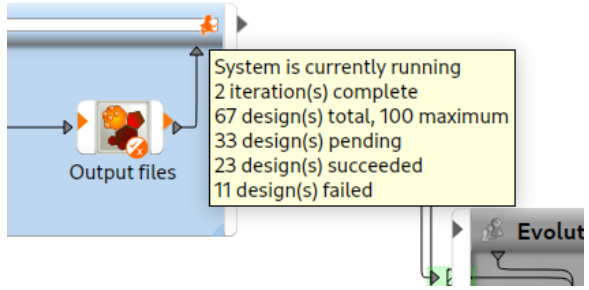
The goal of this feature was to achieve performance improvements with default settings as far as possible.

This goal has been achieved; **no settings need to be changed from default to achieve the improvements**.

Two additional settings have been introduced which (may) have an impact on performance:
See Menu →Edit →Settings or config.ini

- "Fine-grained node status":
  - Introduced already in 22R2 / Default: On
  - Switches between basic and detailed tooltips for node status emblems
  - Detailed view has been optimized in 23R1
  - Setting has no significant impact anymore and could be removed

- "Protocol file write interval (ms)":
  - Introduced in 23R1 / Default: 1000ms
  - Controls the interval in which the project protocol file is written
  - Default setting is suitable for delivering desired performance improvements



Message log

	Date	Time	Log level	Actor	HId	Message
1	2022-Jun-24	10:15:58.512335	INFO			Saving project “tenbar_74_2”
2	2022-Jun-24	10:15:30.745269	INFO	tenbar_74_2		*** EXECUTION FINISHED ***
3	2022-Jun-24	10:15:30.743263	INFO			Total execution time: 151 seconds
4	2022-Jun-24	10:15:29.655948	INFO			Stop requested
5	2022-Jun-24	10:15:29.219869	INFO	Evolutionary Algorithm	0.48200	Collected Design 48200
6	2022-Jun-24	10:15:29.219172	INFO	MOP Solver	0.48200	MOP Solver processed successfully in 0h 0m 0s 1ms [Design 48200]
7	2022-Jun-24	10:15:29.218663	INFO	Evolutionary Algorithm	0.48199	Collected Design 48199
8	2022-Jun-24	10:15:29.218028	INFO	MOP Solver	0.48199	MOP Solver processed successfully in 0h 0m 0s 1ms [Design 48199]
9	2022-Jun-24	10:15:29.217667	INFO	Evolutionary Algorithm	0.48198	Collected Design 48198
10	2022-Jun-24	10:15:29.217053	INFO	Evolutionary Algorithm	0.48200	Current iteration successfully prepared

General guidelines still apply and should be followed

→ See optiSLang Users Guide → Trouble shooting → Workflow Performance

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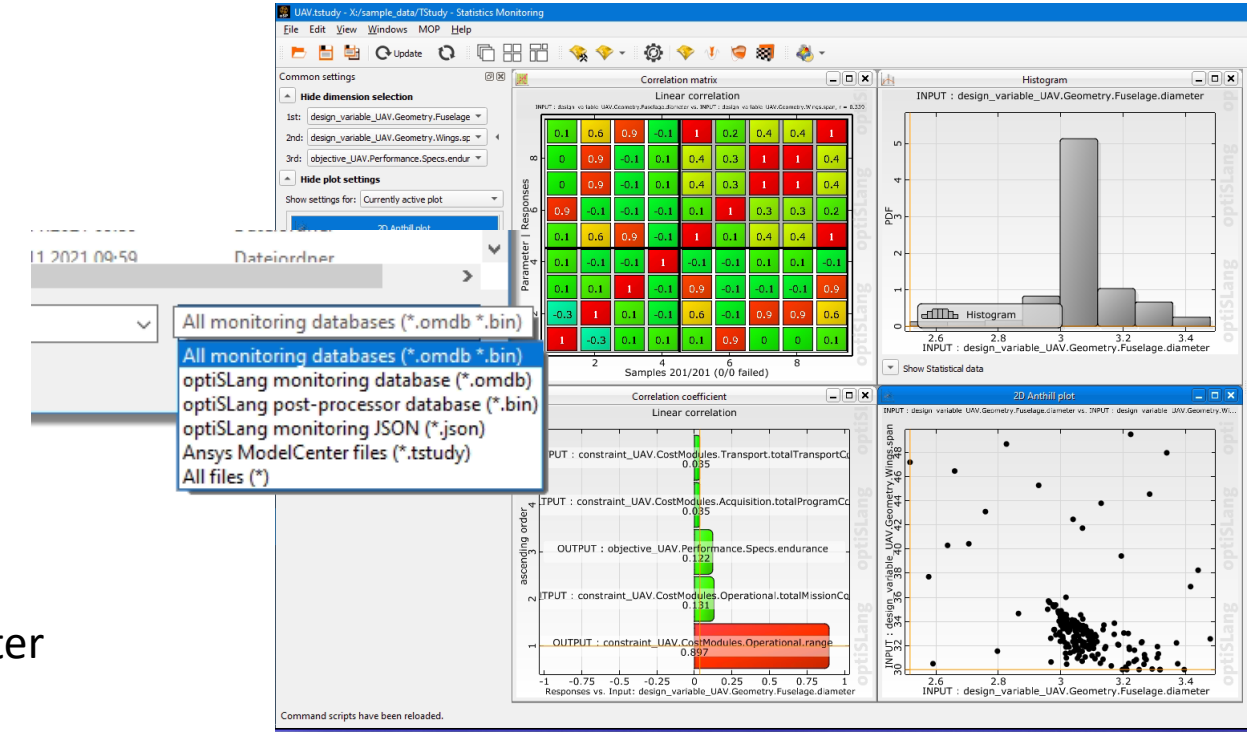
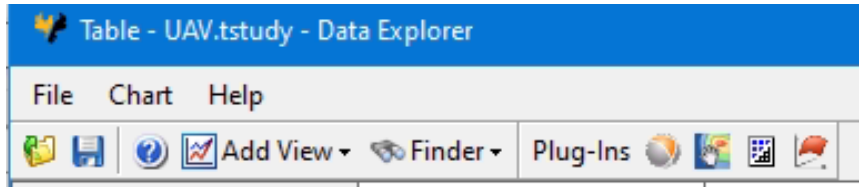
optiSLang Postprocessing supports ModelCenter .tstudy file

- Open *.tstudy in optiSLang postprocessing
  - In Postprocessing directly
  - Using Postprocessing node
  - Using optiSLang main menu "Open"
  - Using command line options



- Open optiSLang Postprocessing from within ModelCenter
  - Plugin in ModelCenter's Postprocessing



→Interactive postprocessing, more Plots, build MOP, Report generation…

➔ Make more out of your data

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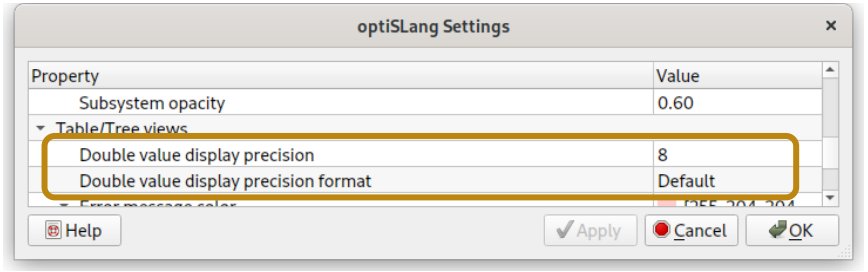
Configurable maximum number of display digits option in UI design tables

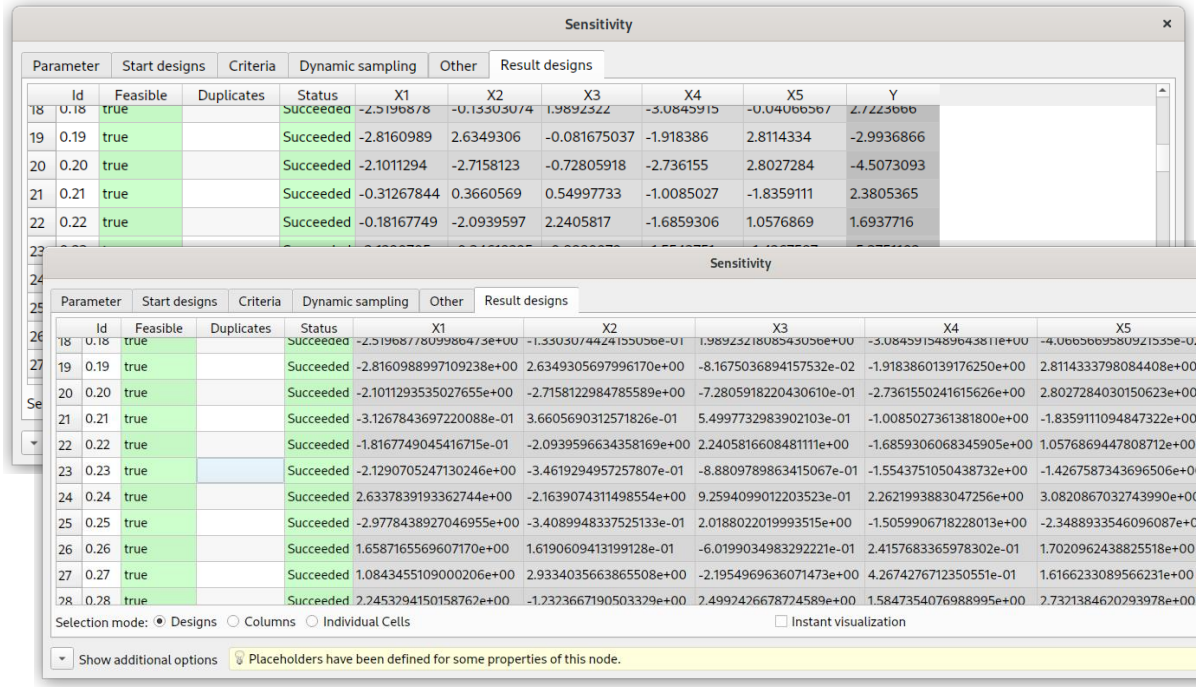
- Configure floating point format and precision in UI design tables

- Introduced new config settings (Table/Tree views group):
  - "Floating point precision":
    - Specifies the precision of floating point numbers in display mode
    - Default value: 16
  - "Floating point format":
    - Specifies the format of floating point numbers in display mode
    - Can be one of:
      - "Default": "%g"
      - "Fixed": "%f"
      - "Exponential": "%e"

- Setting is used for all design tables in optiSLang and optiSLang Postprocessing



Precision: 8
Format: Default



Precision: 16
Format: Exponential

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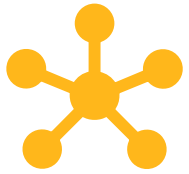
Orchestrate & Automate

New: Inside Fluent



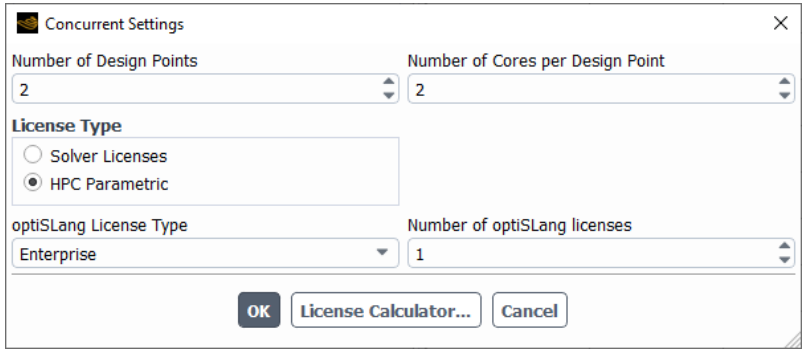
New: Discovery node

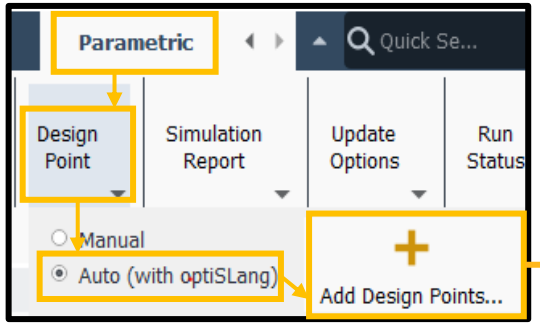
DX: Maintainability

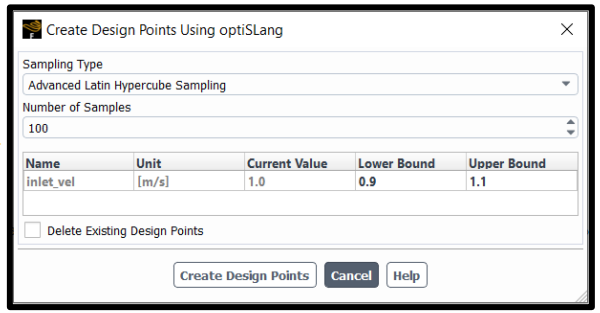
…

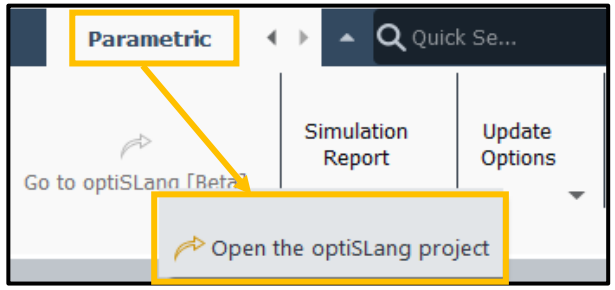
2023R1: optiSLang inside Fluent

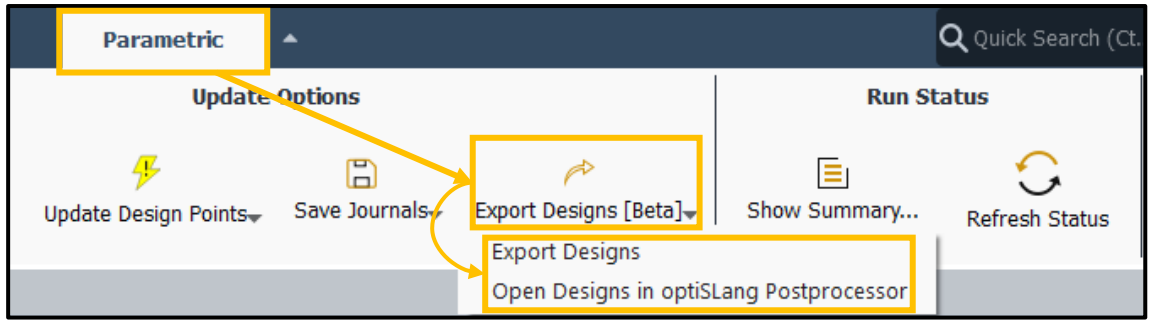
- Use optiSLang Premium/Enterprise for update
- Creation of Design Points using optiSLang
- Export Designs [Beta]
- Go to optiSLang [Beta]











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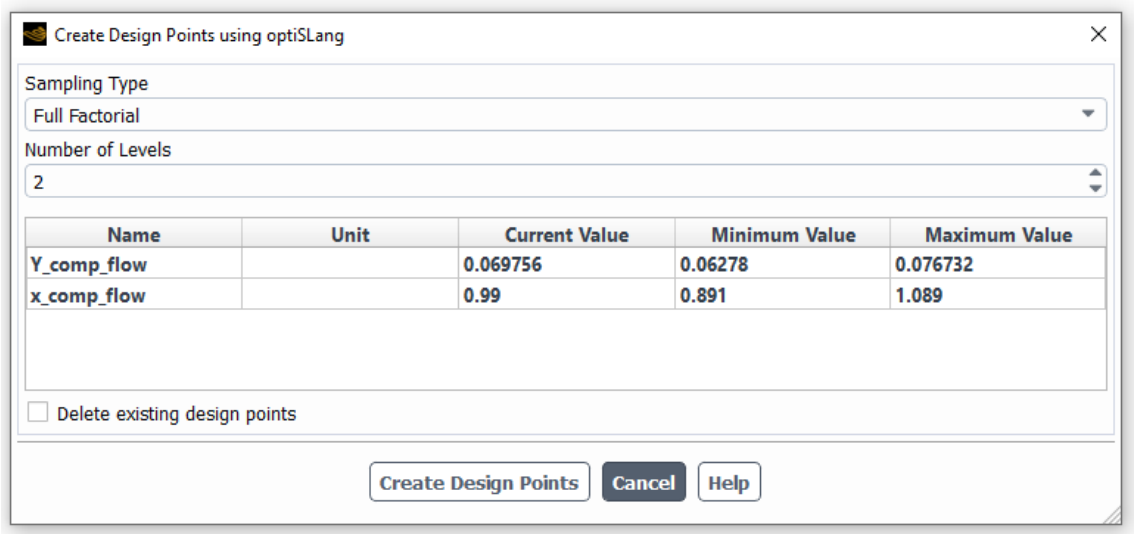
2023R1: optiSLang inside Fluent

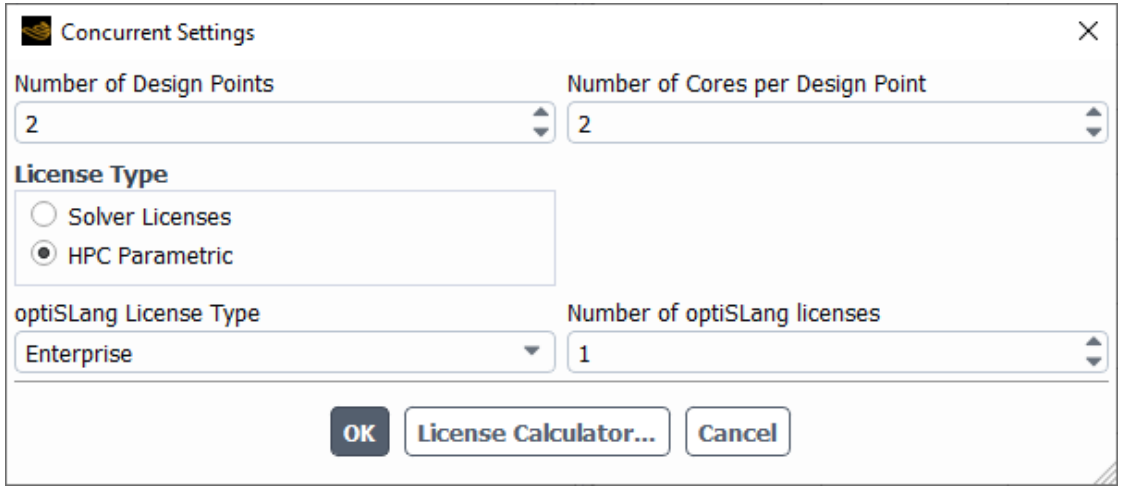
- DoE creation using optiSLang

DOE with optiSLang Pro license
- D-optimal linear
- D-optimal quadratic
- D-optimal customizable
- Plain Monte CARLO
- Latin Hypercube Sampling
- Adv. Latin Hypercube Sampling
- Space Filing Latin Hypercube Sampling
- Sobol sequence

DOE with Fluent license:
- Koshal Linear
- Koshal Quadratic
- Full Factorial
- Full combinatorial
- Central composite
- Star points



- optiSLang License support



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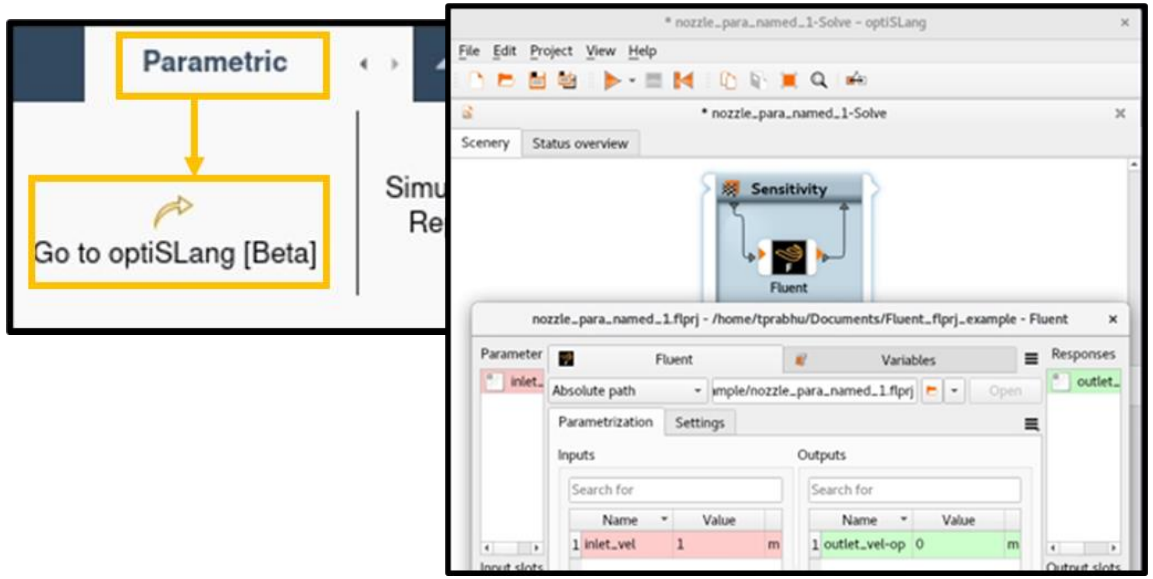
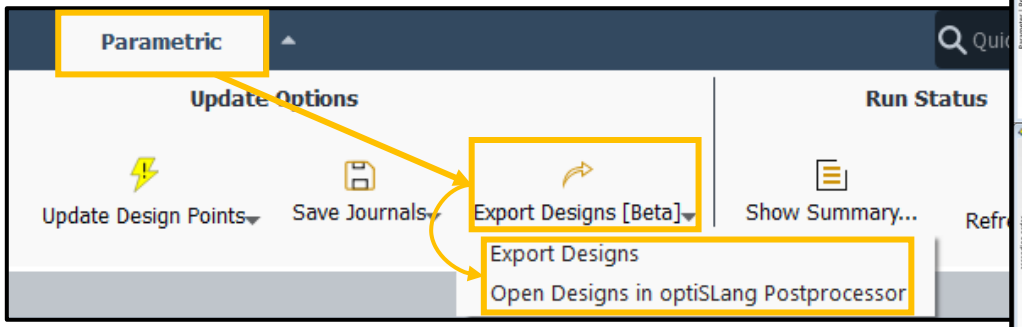
2023R1: optiSLang inside Fluent (Beta Features)

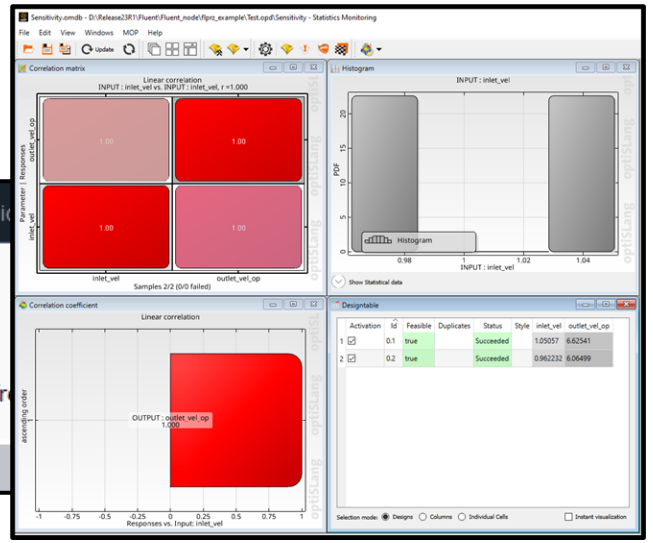
- Go to optiSLang
  - Opens project in oSL
  - Captures input parameters/values
  - Don’t capture info about completed DP results

  → Manual import of start designs needed



- Export Designs
  - to JSON
  - to optiSLang postprocessing





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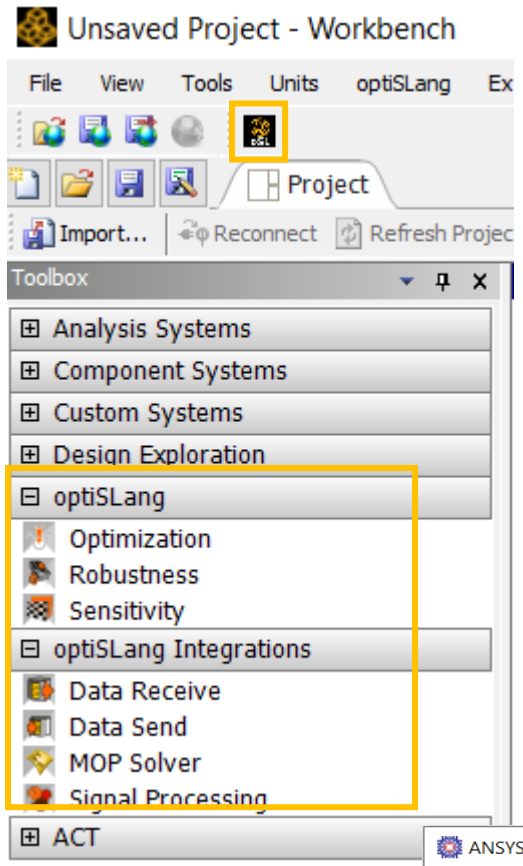
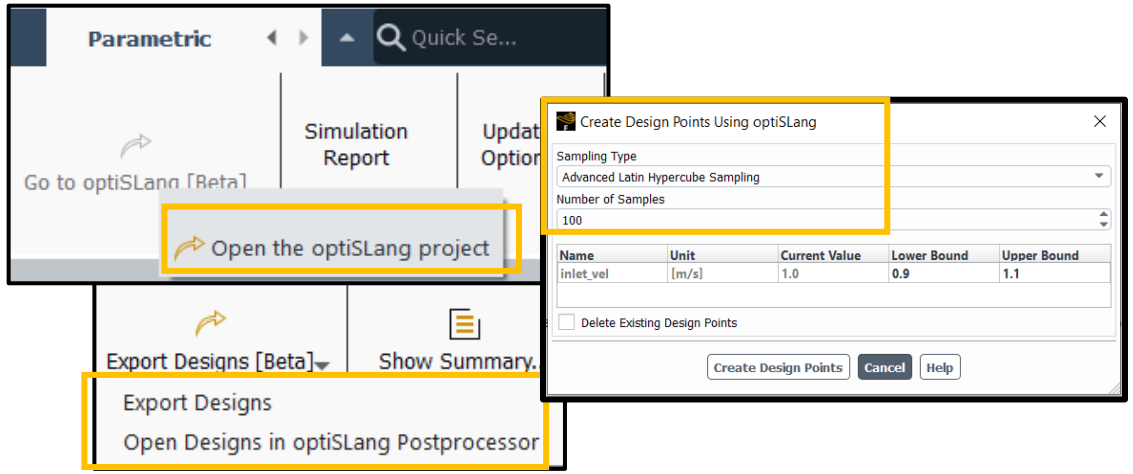
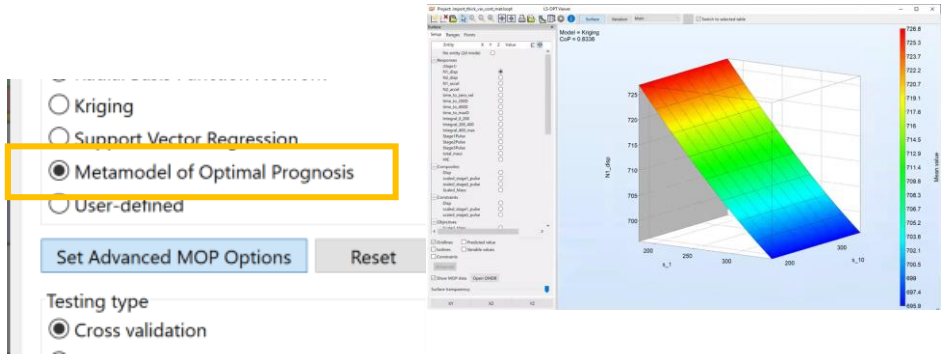
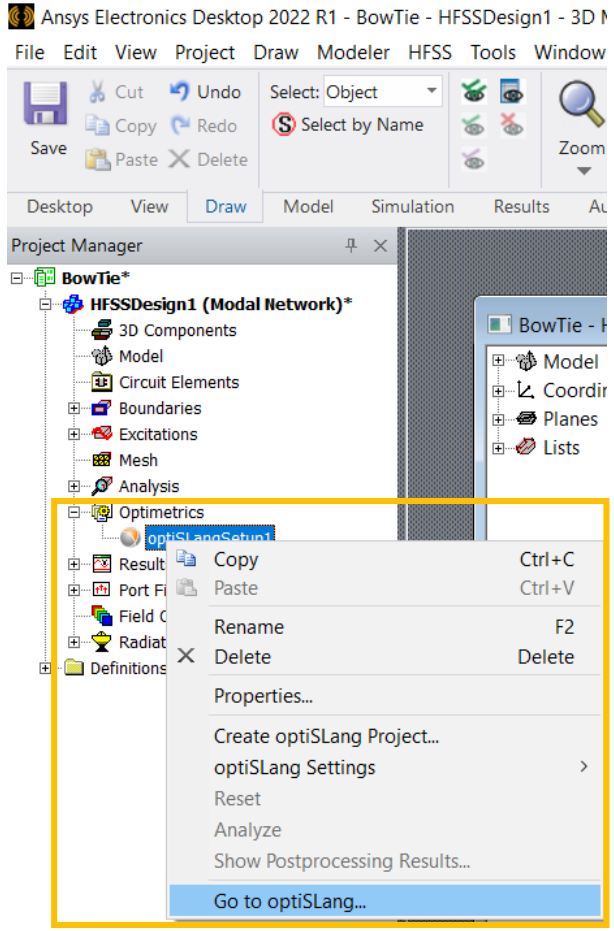
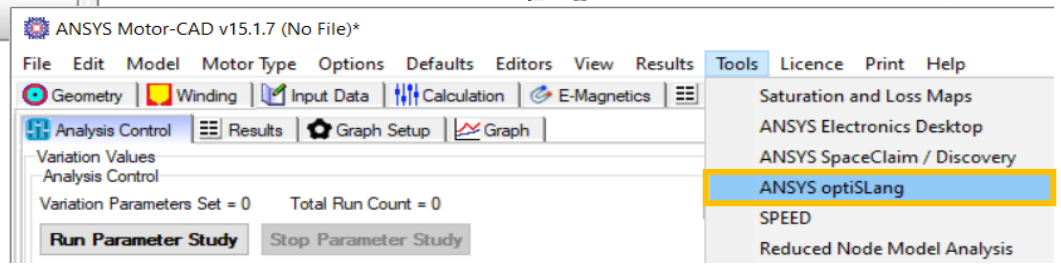
optiSLang inside AEDT/Fluent/LS-Opt/MotorCAD/Workbench

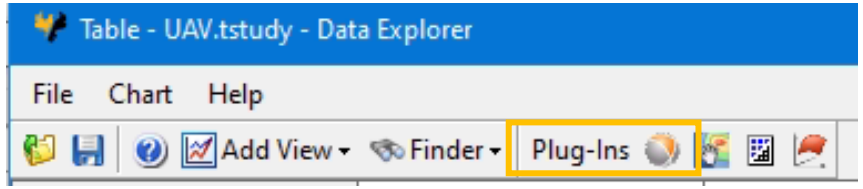












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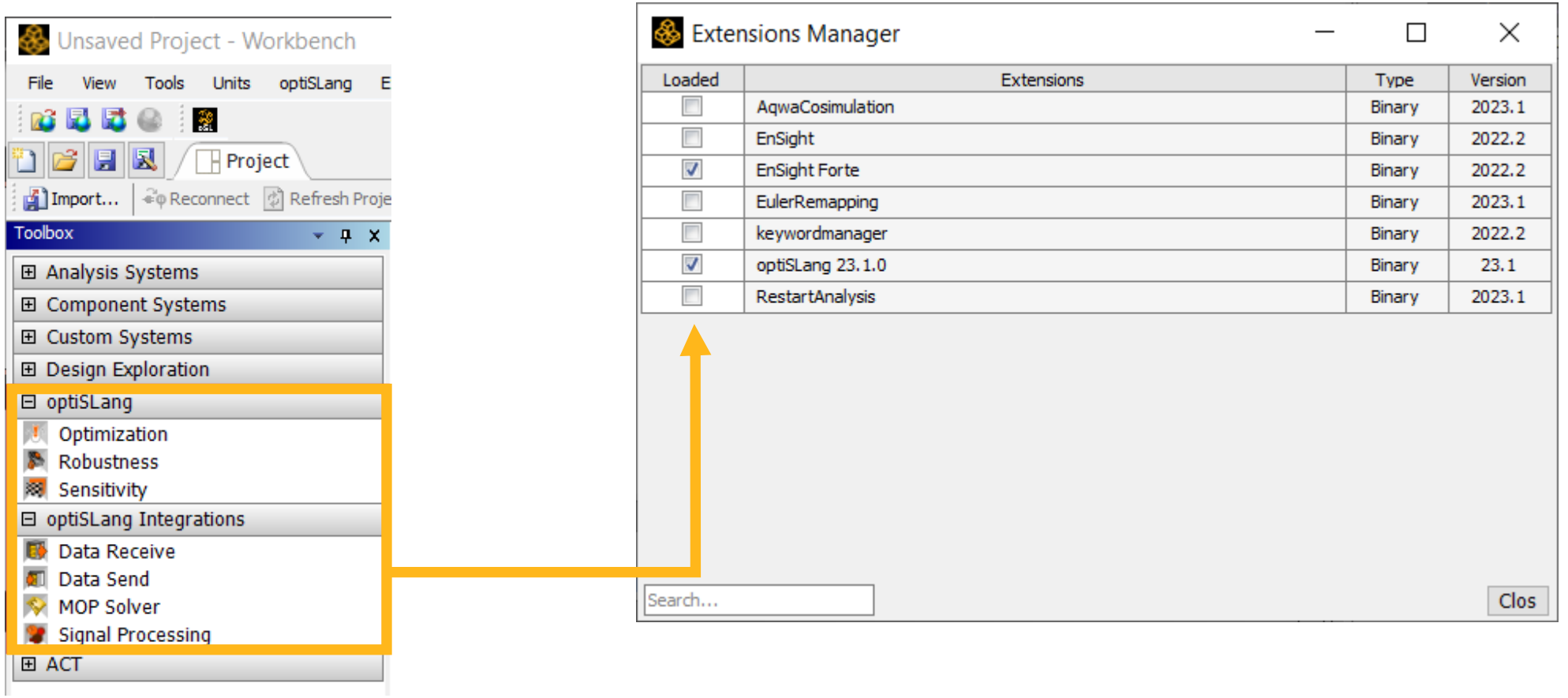
optiSLang inside Workbench – default

optiSLang modules loaded on startup

„Manual registration“ not needed anymore



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2023R1+: DX maintainability

We want to give reliable and sustainable solutions and tools to our customers.

We needed to think about maintainability etc. of existing capabilities in e.g. DesignXplorer.

Following the feedbacks which we got on stability, support efforts, state of the art/correctness of algorithms … we came to disable following capabilities in DX:

- Disable Beta-feature
- Disable Extensibility features
- Disable SixSigma
- Disable >10 Parameters

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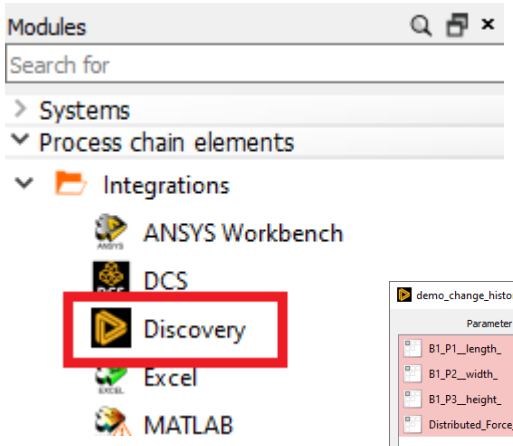
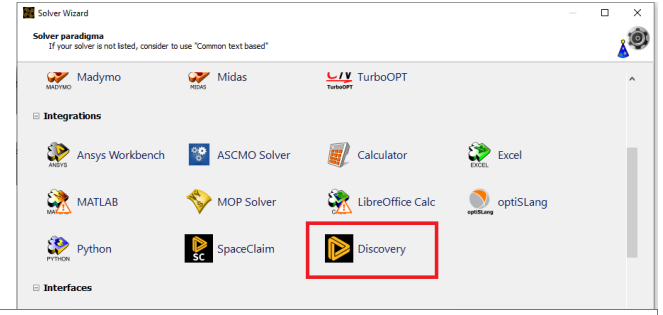
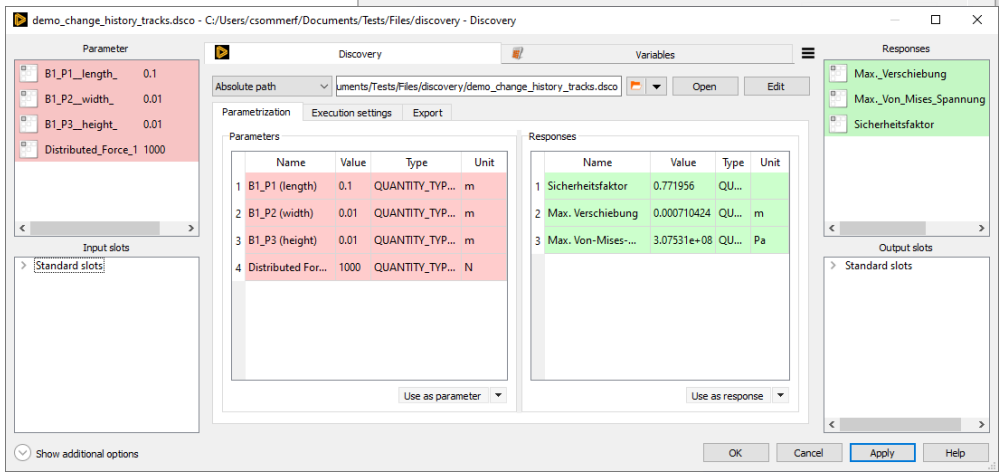
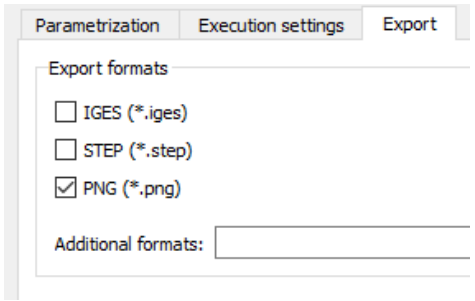
2023R1: Discovery node

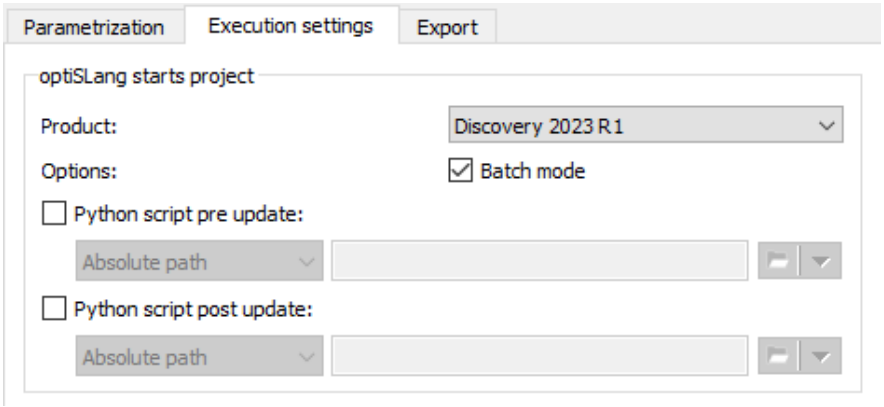
- Easy to use
  - Drag & Drop: Inputs
  - Drag & Drop: Outputs
  - Export geometries
- Flexibility
  - Execute in Batch or GUI mode
  - Discovery journals for pre and post
- All standards
  - HPC licence forwarding
  - Solverwizard support
  - Max. runtime, parallel, auto-save …











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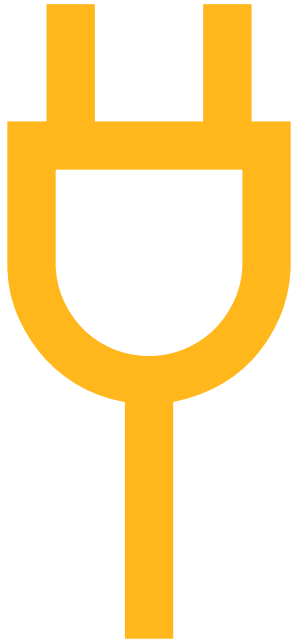
23R1: Connector improvements



- Speos: 2 new nodes (solver, result extract)
- OpticStudio: Replace Zemax node
- CFX: 3 new nodes (Solve, Beta: Pre, Partitioner)
- Fluent node (Beta): Remote solve, PyFluent, Postproc, …
- New ETK nD: Less scripting with SoS in optiSLang workflow
- Design Import: Import CSV in workflow (no scripting)
- optiSLang node: submit to DCS

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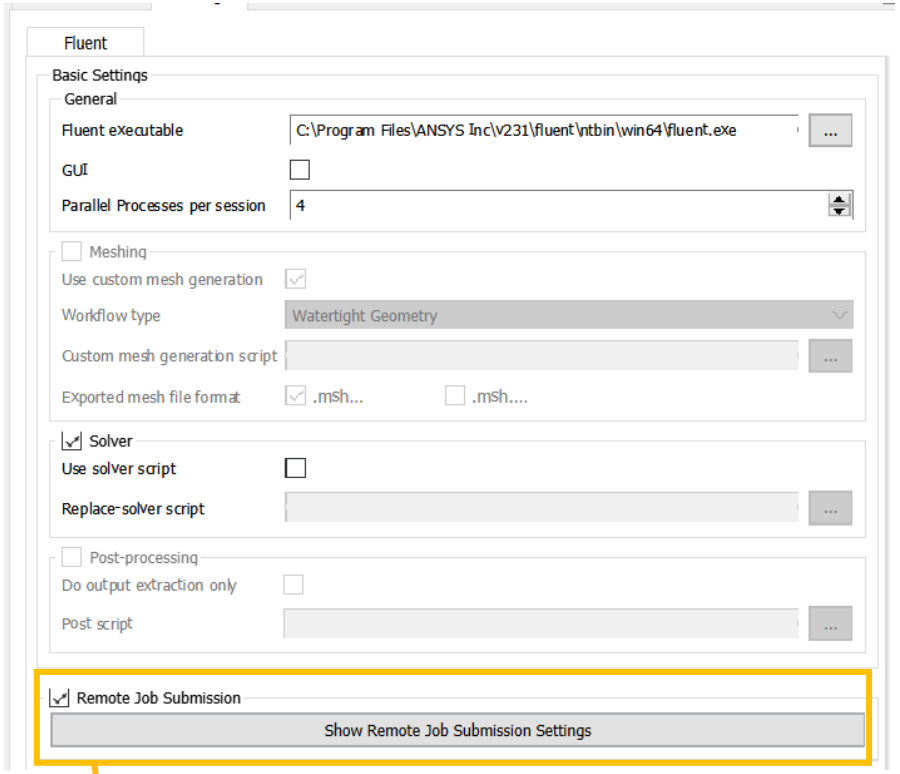
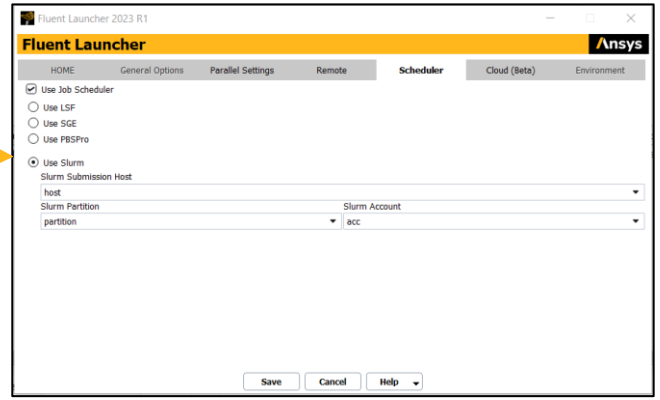
Fluent Node Updates (Beta)

- pyFluent modules installed in optiSLang-python as OSS
- List Parameters and Responses without launching Fluent
  ➔ reducing the time required to read the input file (cas/flprj)
- Automatic query of dimension and precision of case file
- Extend post-processing
  - User can export images and videos (using post-script)
  - can be imported in optiSLang post processing
- Support Remote Job submission
  - Set the Remote Job submission settings
  - Use Fluent Launcher dialog





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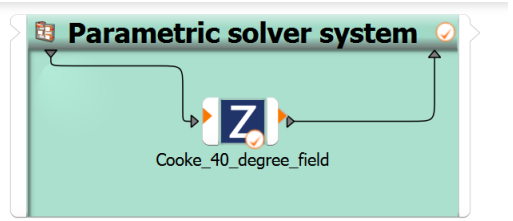
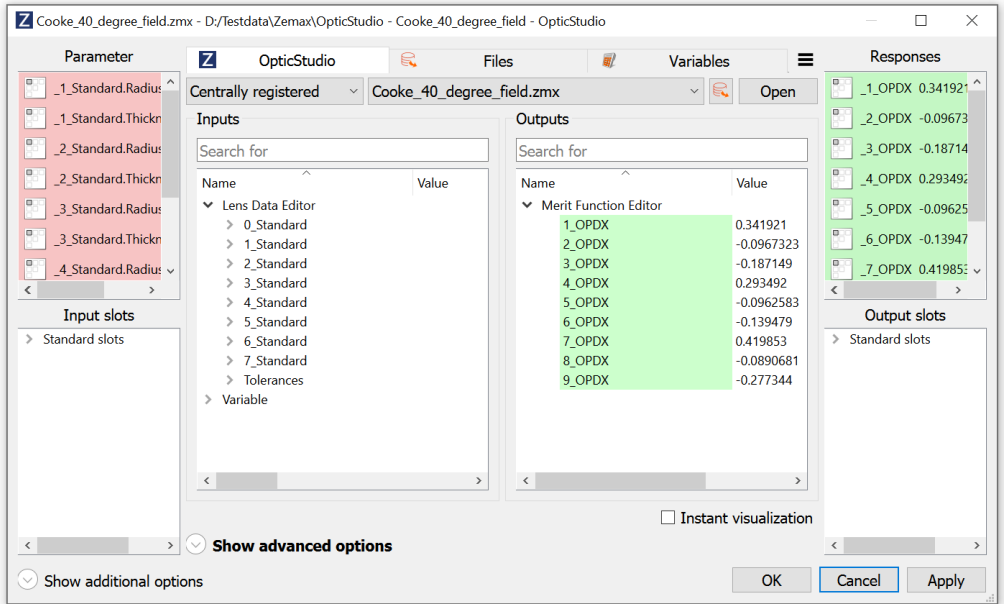
OpticStudio integration re-write



- Update based on Ansys engineering team experience
- The integration now always works on a copy of the project in the design directory
- The settings have been removed
- Training material has been updated



- The existing Zemax CIs have been marked as deprecated

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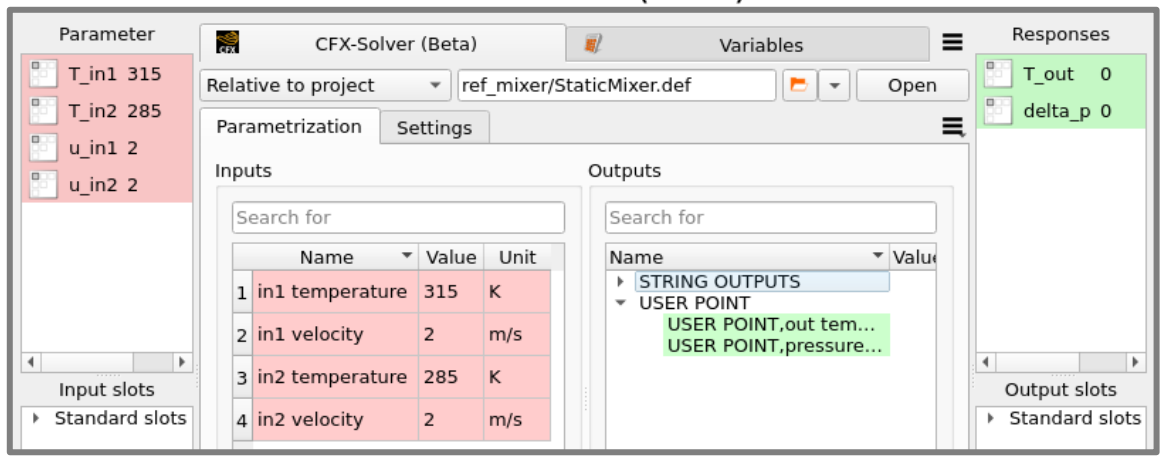
CFX integration maintenance

New nodes & features

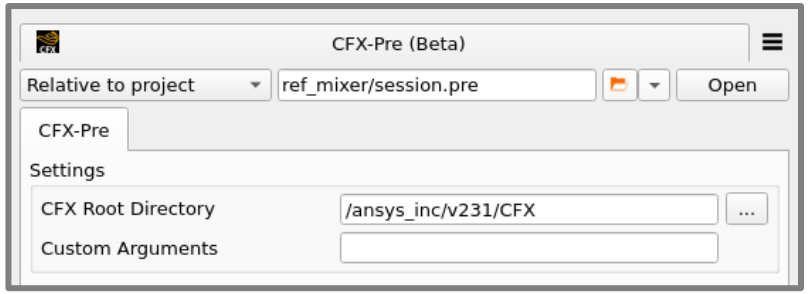
- three nodes for distinct functions
  - CFX-Solver
  - CFX-Pre
  - CFX-Partitioner
- devel work by CFX team
  - with support from Weimar

CFX-Solver (Beta)

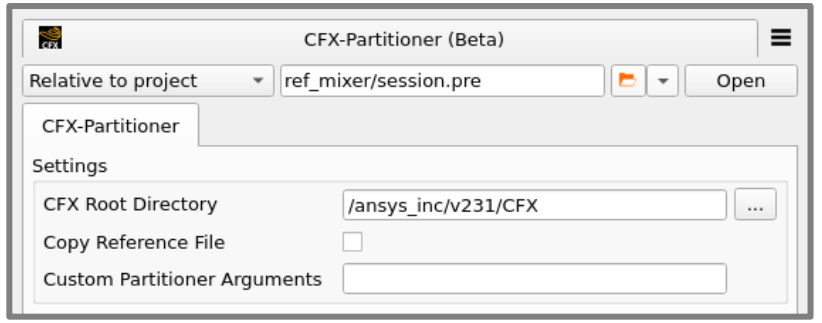


new helper nodes for specific workflow sub-tasks

CFX-Pre (Beta)



CFX-Partitioner (Beta)



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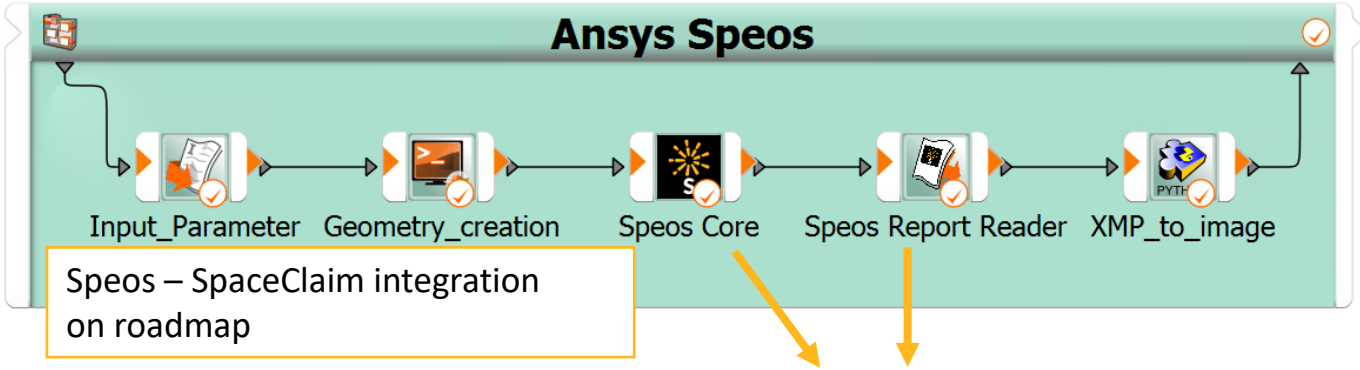
New nodes for Speos



- **Speos Core**
  - Solver node
  - Takes a Speos Simulation file (*.sv5 / *.speos)
  - Define solver settings (CPU/GPU, number of cores, rays, pass)
  - runs the Speos simulation

Speos Report Reader

- **Speos Report Reader**
  - Output node
  - Extract results from the Speos report (.html-file)
  - *Limitation: Does not work for head-up display analysis yet*

Speos Core

➔ Build Speos workflow with much less scripting

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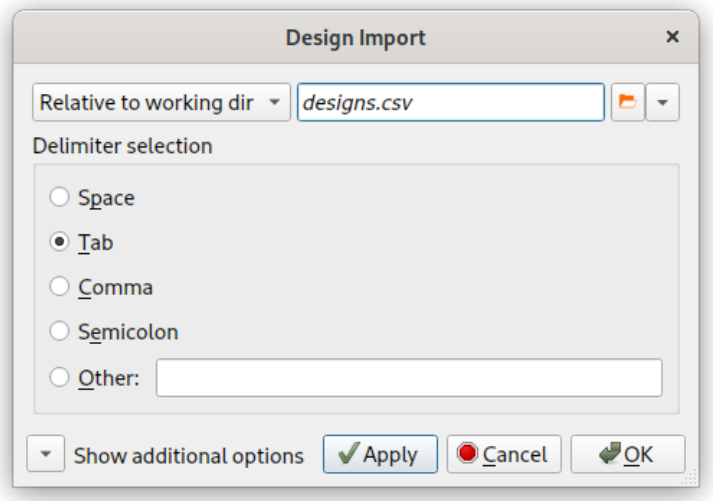
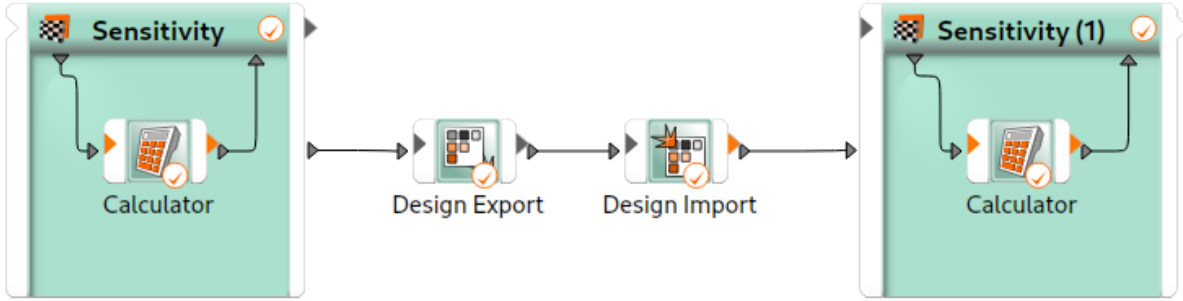
New "Design Import" Node

- Design Import" node as a counterpart of "Design Export" Node
- Imported designs can be passed to workflow via "ODesigns" slot
- Configuration options:
  - Path to CSV file containing designs
  - CSV delimiter

➔ Reduced scripting





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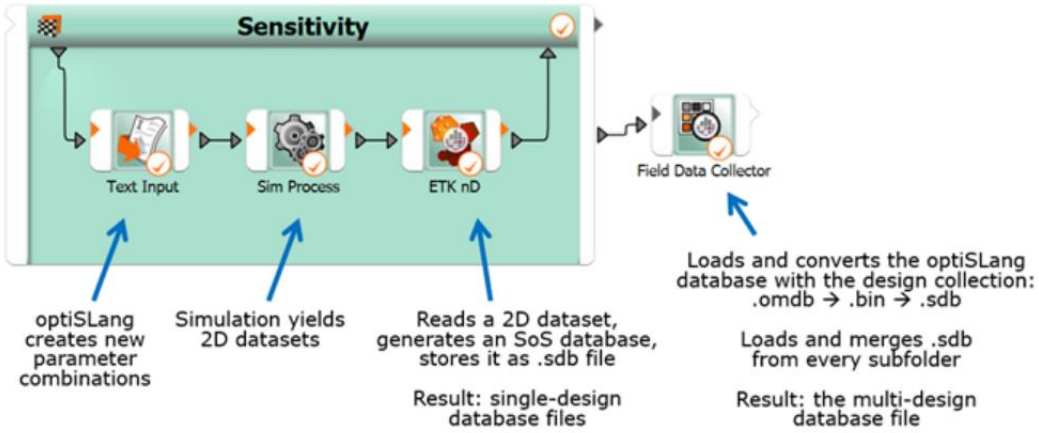
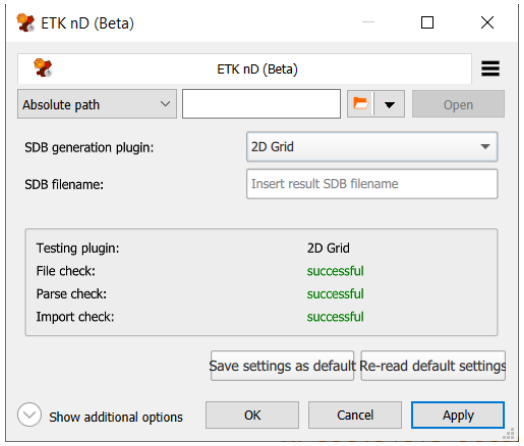
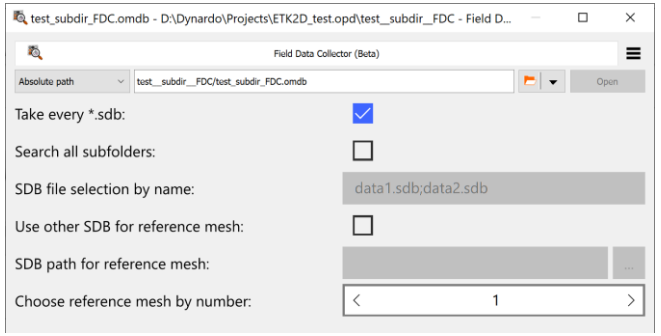
Direct integration of SoS in optiSLang workflows

ETK nD + Field Data Collector

- Extract results directly like used from ETK
- Collect to Field MOP SDB
- Support with 2023R1:
  - 2D Grid
- Plugin mechanism
  - More formats/options to come
  - Can be extended
- Less scripting – Less errors







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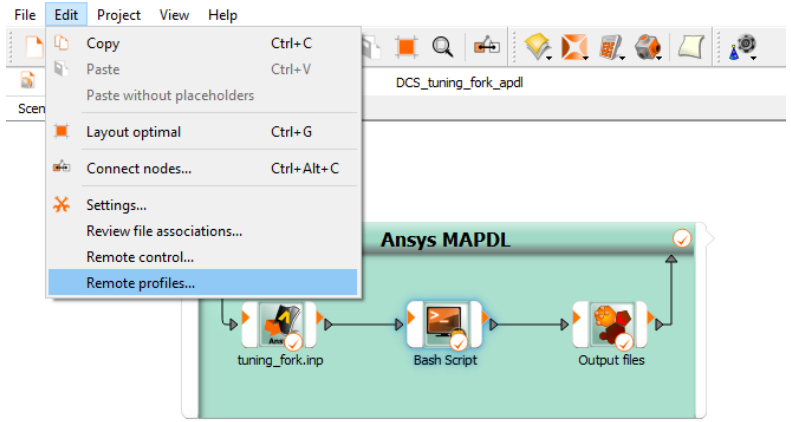
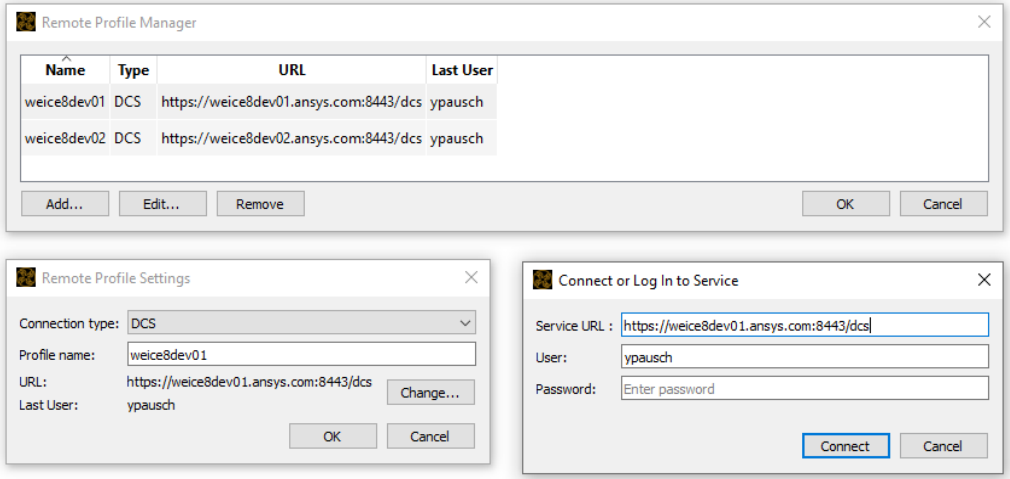
Submit to DCS – manage large amounts of concurrent runs

Submit process calls to the remote compute environment "DCS"

- Define DCS profile(s) with connection & login data
- Ability to choose individual profile in all Process/Batch/Bash nodes
- Ansys HPC licensing supported
- Minimum data transfer





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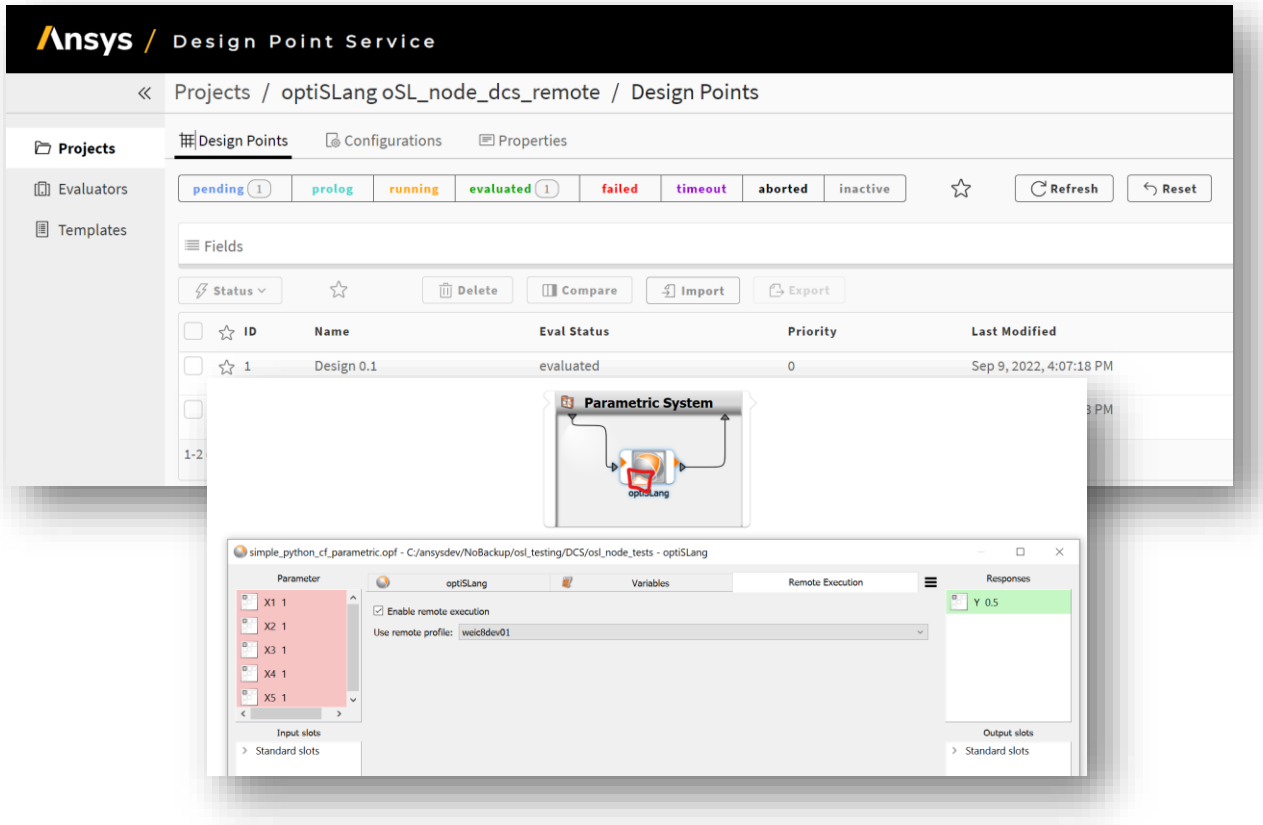
Submit optiSLang workflow parts / **D**istributed **C**loud **S**ervices

Remotely execute optiSLang project node on DC evaluators

- Select your remote DCS profile
- .opf and dependencies are sent to DCS
- DCS manages queueing and parallelization
  - Minimum data transfer

→ Easy to set up for existing DCS install

➔ Very efficient for many design points



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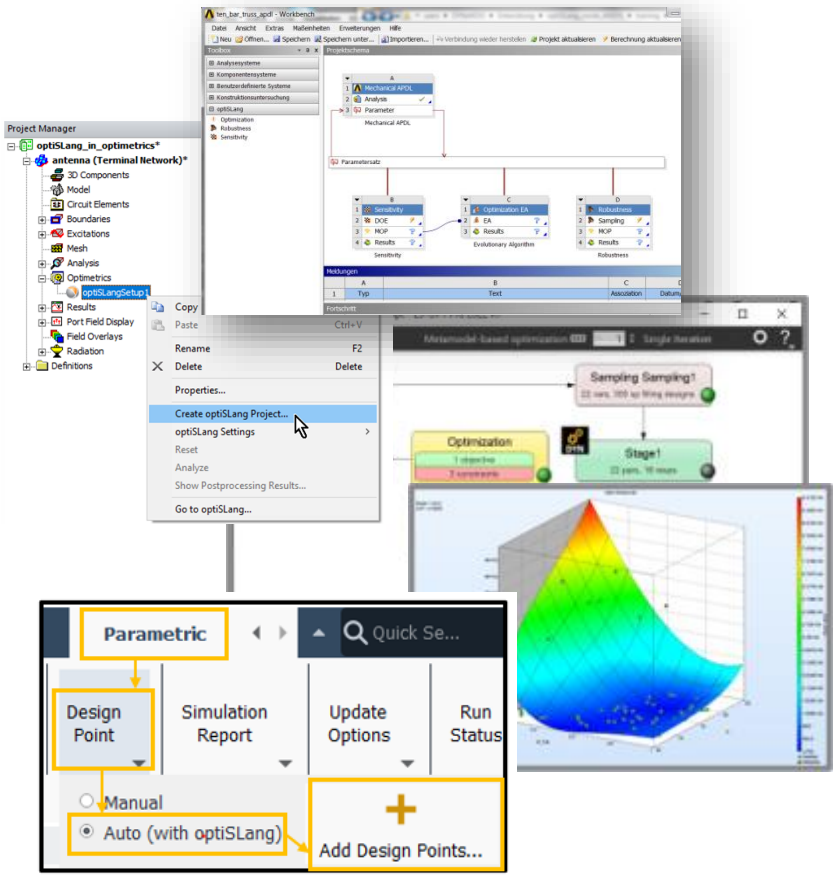
Use optiSLang – Connect to Simulation

Embedded
direct use of algorithms

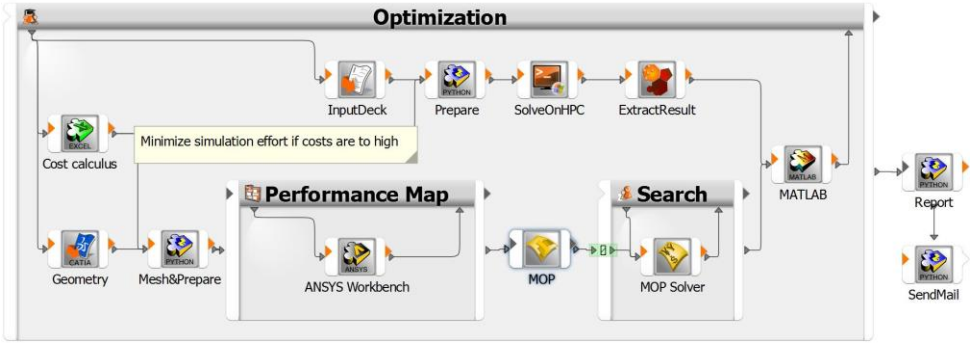


AEDT, Workbench, LS-DYNA, Fluent (23R1)

optiSLang GUI
connect tools & algorithms

Best in class connectors to
The Ansys tools
(incl. HPC licensing)

Direct plugins + open interfaces
→ 150++ propietary tools connected
→ 100% vendor neutral



Linux/Windows, HPC&Cloud, Open API, GUI & Batch, …

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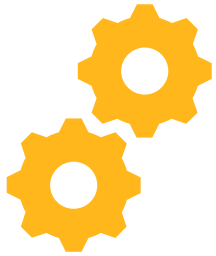
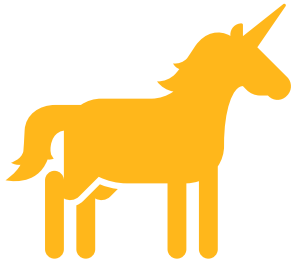
Understand & Optimize



One Click Optimizer



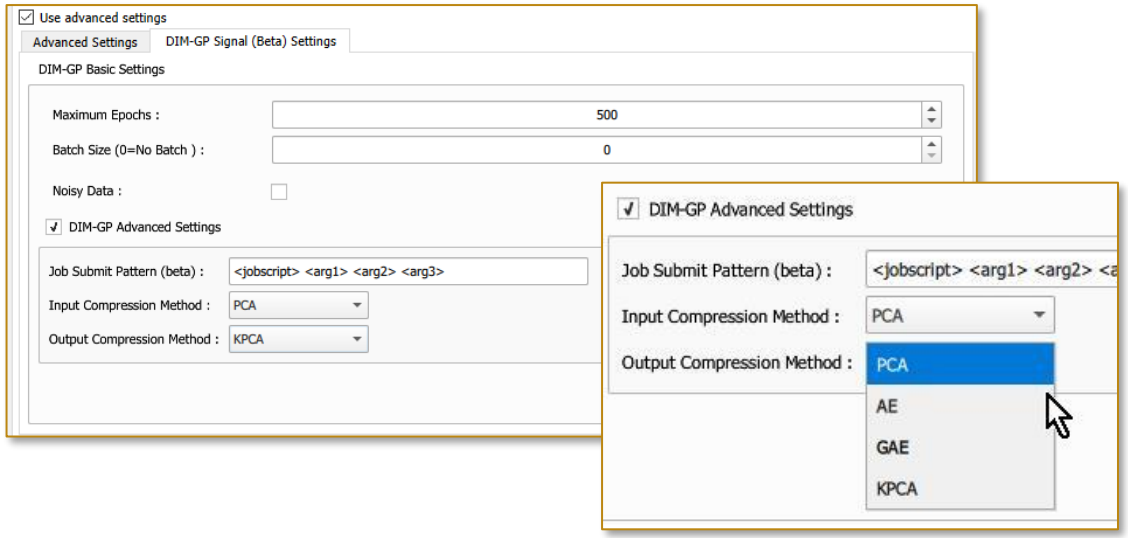
Wizard

Signals

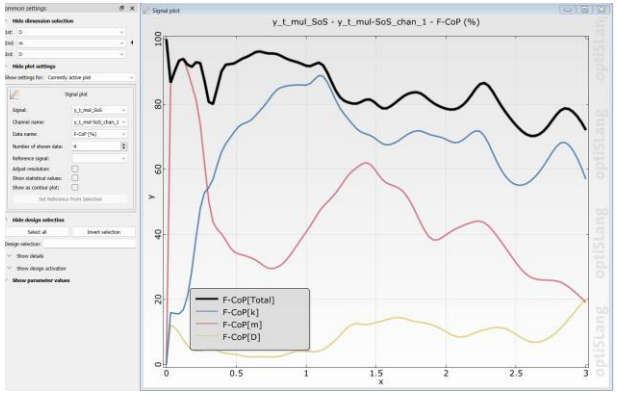
DIM-GP signals (beta)

- **Rework of the settings dialog:**
  - Introduction of advanced settings
  - Customization of the compression methods possible
    - PCA
    - KPCA: Kernal PCA
    - AE: Auto-encoder
    - GAE: Gated recurrent unit auto-encoder

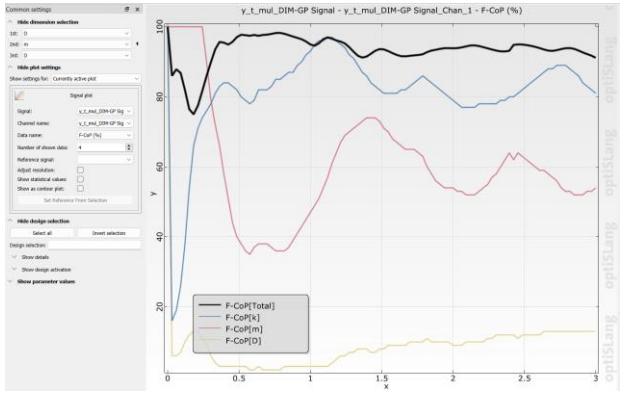
- **Postprocessing:**
  - Sensitivities like Signal MOP



SOS



DIM-GP signal



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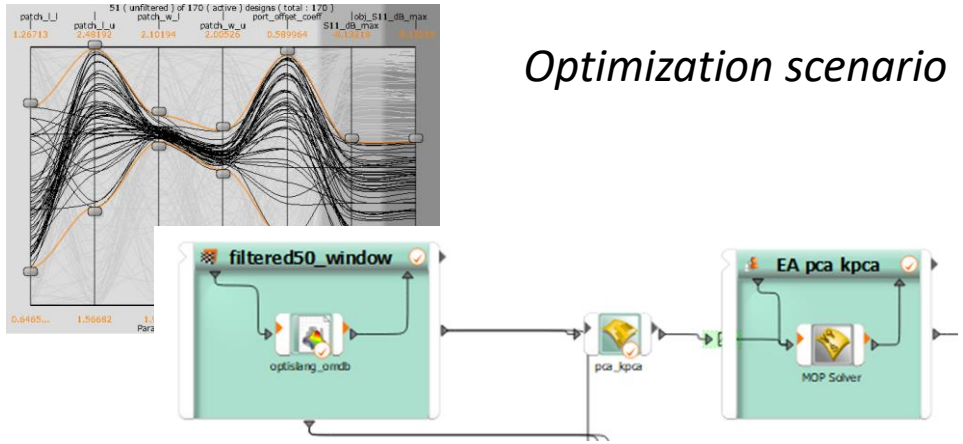
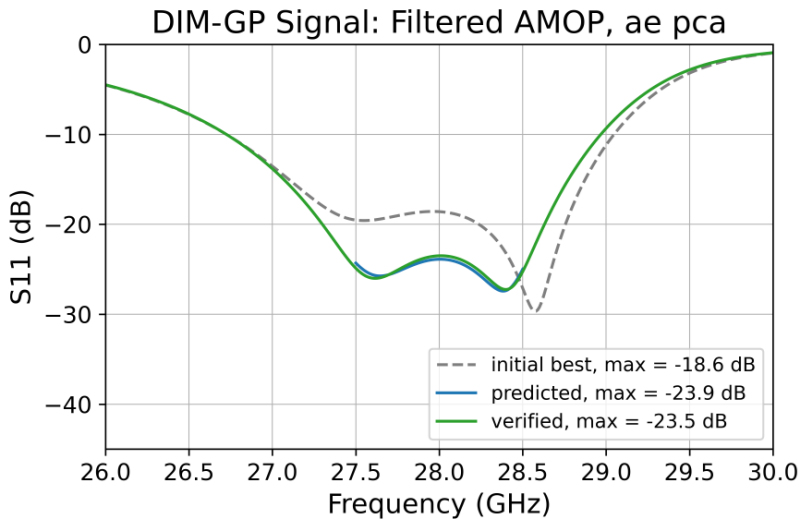
DIM-GP signals (beta) – Status slide

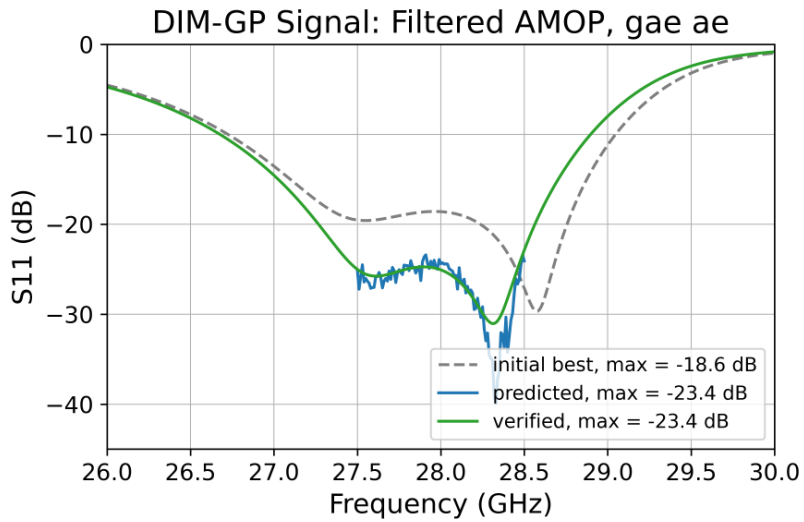
Example: evaluation results on Antenna application

- Significant Improvement of the results
- Good match of the optimal predicted with evaluated solution



Optimization scenario





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Optimization Approaches: general approaches

Using expert knowledge

Using a brute computational approach

Using a heuristic combining several optimizers

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Optimization for a part of non-expert users…

Too many buttons…

Hard…

Random…

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Our objectives…

Simple & easy:
"Settingless" algorithm

Use **Ansys (DX/oSL) experience**…

Self-Learning approach

Outperform existing methods

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One-Click Optimization Approach

- One setting: the **maximum number of design evaluations**
- Use optimization methods exposed in optiSLang (incl. DX)
- Run optimization methods in parallel & competition

- Combine High & Low Fidelity Models to speed-up the optimization's convergence
  - High-Fidelity Model: Any solver
  - Low-Fidelity Model: Metamodel of Prognosis (MOP)

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OCO Launch project

One Ansys project:
optiSLang + DX

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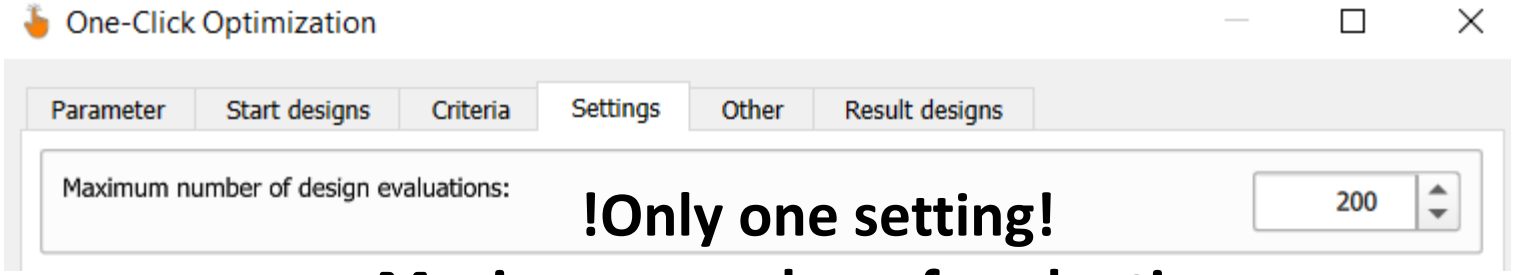
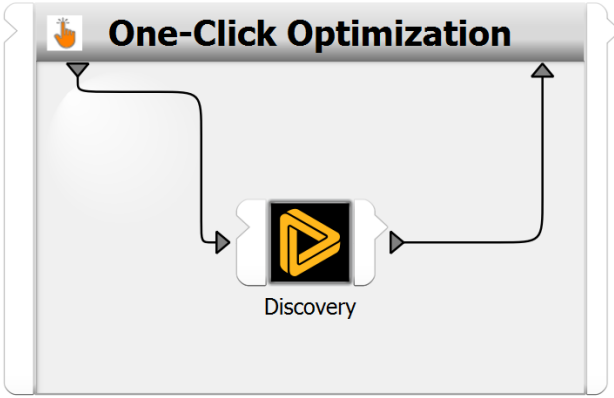
One-Click-Optimization (OCO)



!Only one setting!

Maximum number of evaluations



Internal AI runs multiple optimization approaches simultaneously

Selects automatically & dynamically the most suitable optimization algorithms

- *Support discrete and continuous parameters*
- *For single-objective optimization applications (SOO) and Multi-Objective Optimization (MOO)*
- *Use MOP know-how to dynamically reduce to important parameters for SOO & MOO*
- *Enables parallel design evaluations*
- *…*

Available inside AEDT, Workbench, optiSLang GUI

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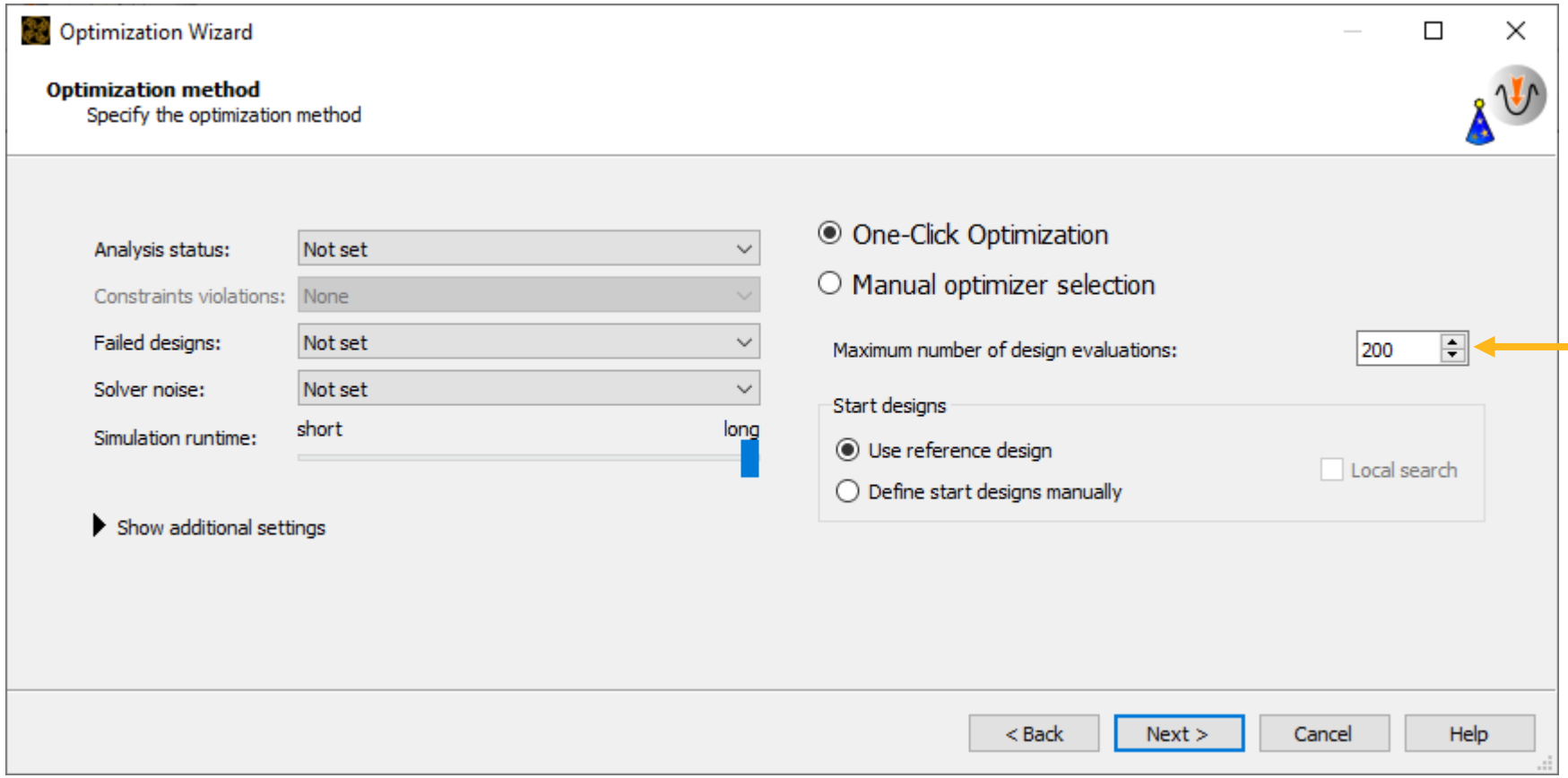
2023R1: Optimization Wizard



Main setting

Other settings available for advanced/expert users to tune:

- **Initial sampling**
- **Convergence criteria**
- **Low fidelity models**
- **Optimizers in competition**
- **…**

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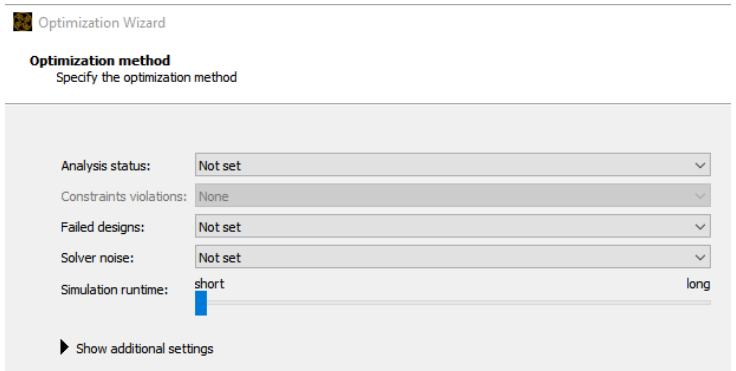
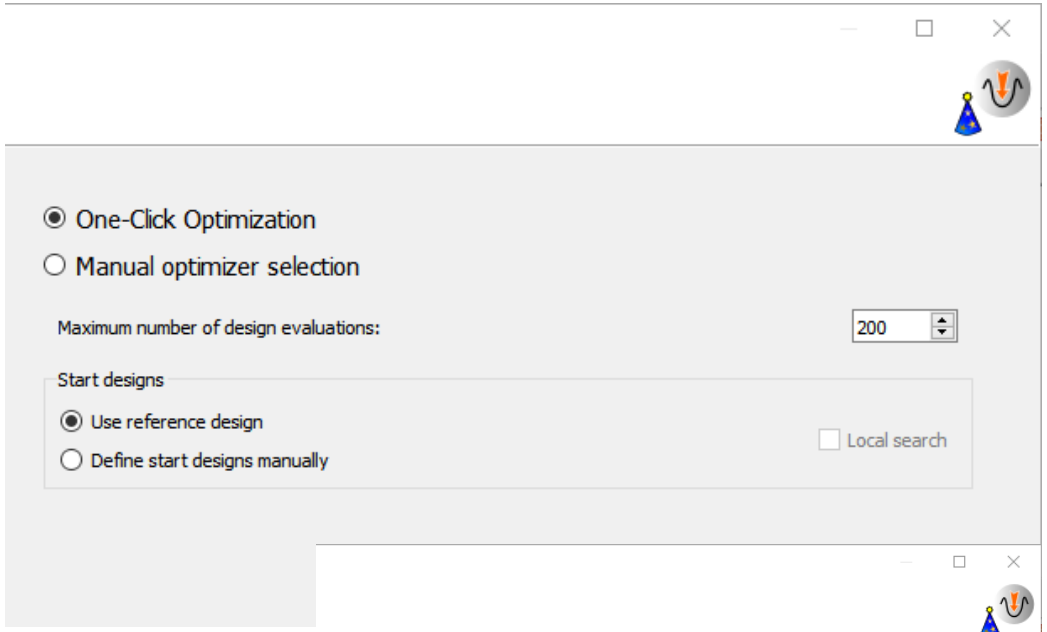
2023R1: Optimization wizard

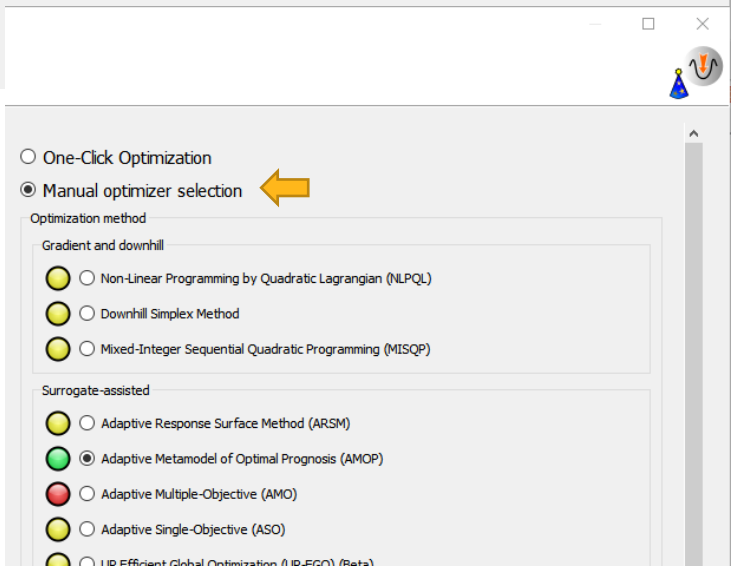
- **OCO is the new default**

- **Manual optimizer selection**
  - Classical view if OCO is deselected
  - Traffic light system

- Background: adaptation of settings based on
  - Short / long simulation time
  - Number of criteria
  - …







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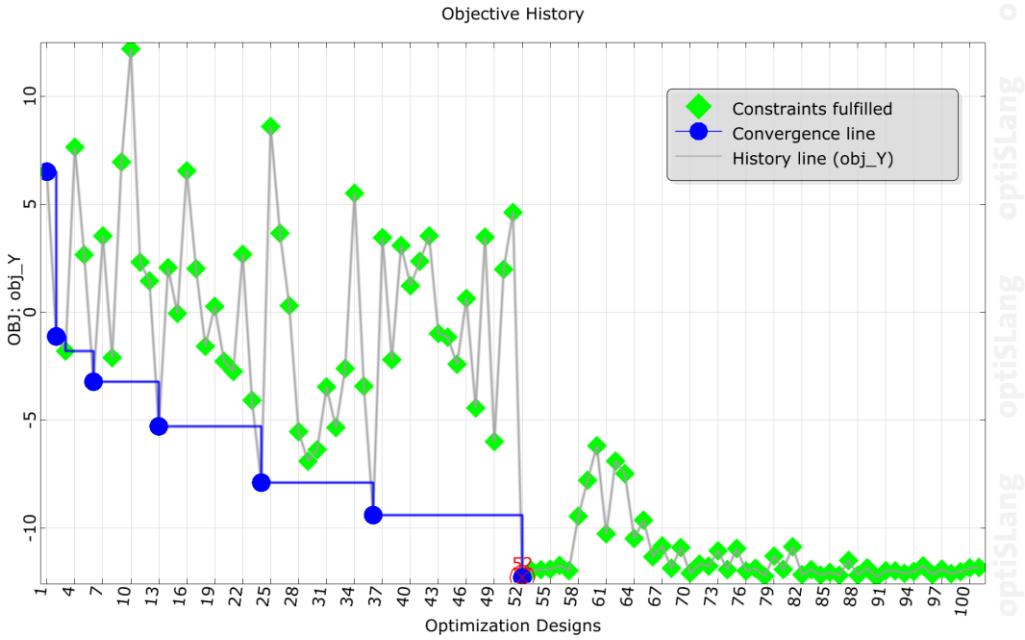
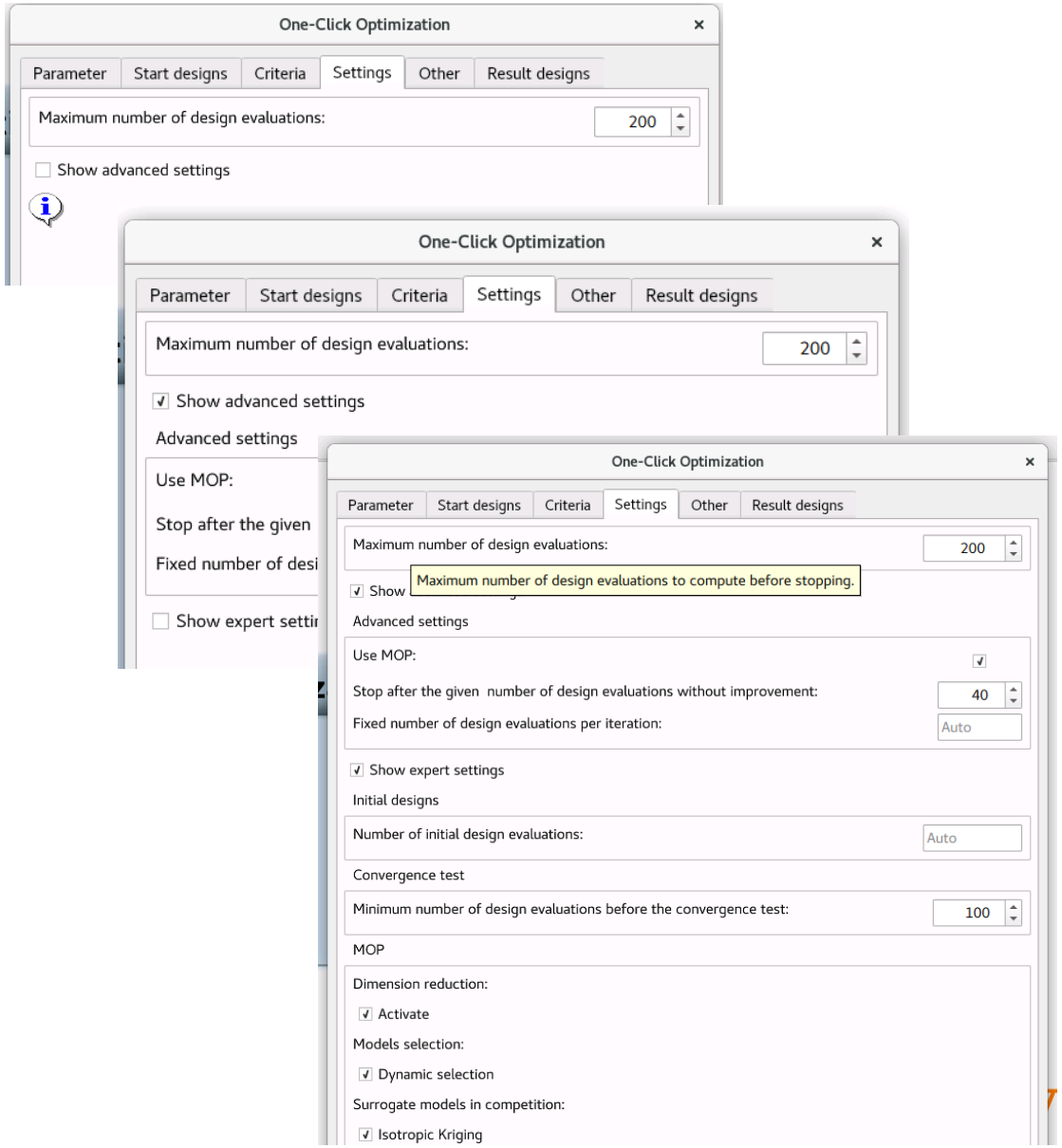
OCO beta → Release

- Most relevant work items / enhancements
  - Improve OCO convergence
  - Rework of the settings
  - Post-processing
  - OCO log messages
  - Documentation / auto tests / etc.





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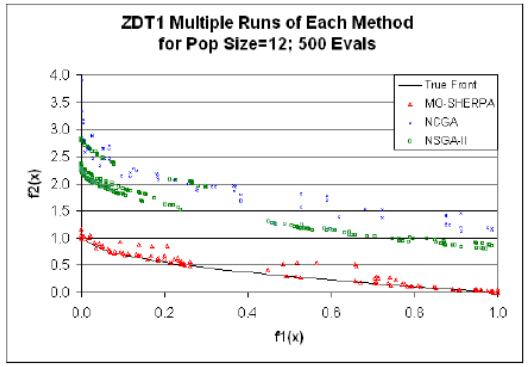
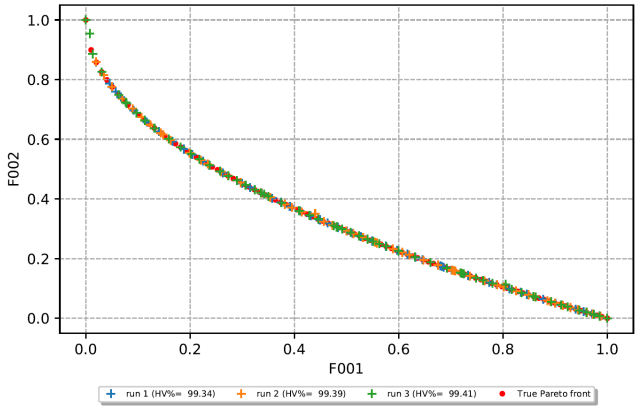
OCO Release

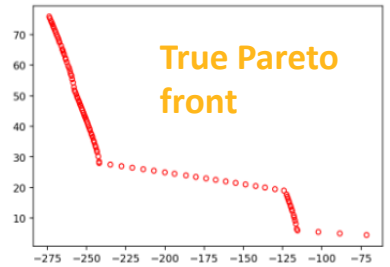
MOO Convergence improved

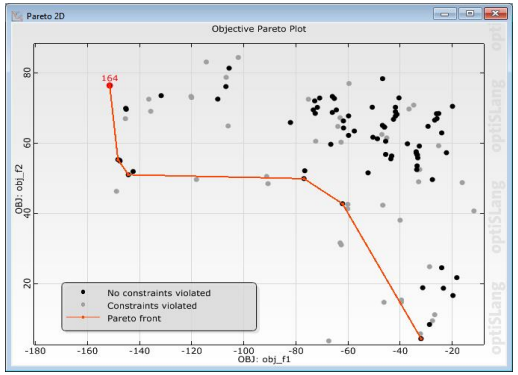
Competition [1] – 500 designs



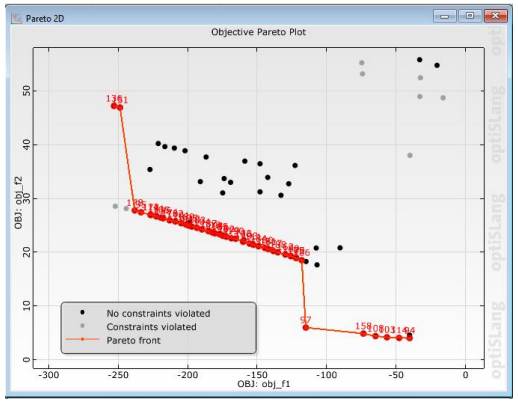
optiSLang – OCO – 250 designs





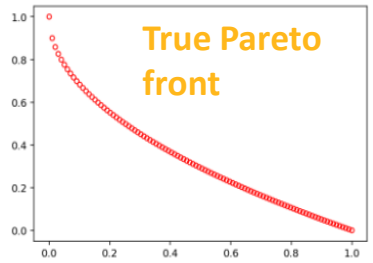


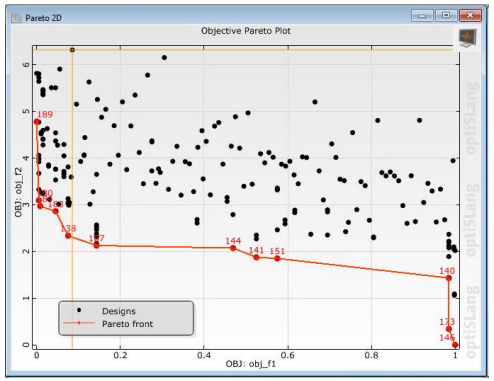
OCO 22.2



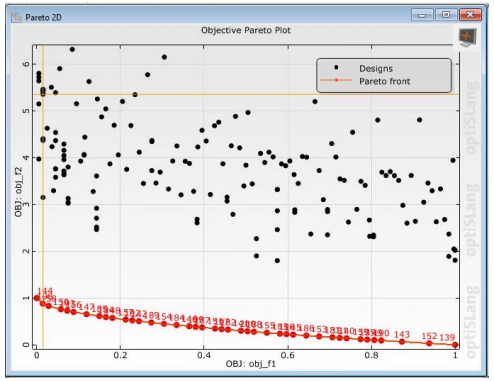
OCO 23.1

OSY function in 6D with 2 objectives (& 6 constraints)





OCO 22.2



OCO 23.1

ZDT1 function in 10D with 2 objectives (& 0 constraint)

[1] A Benchmark Study of Multi-Objective Optimization Methods; N. Chase, M. Rademacher, E. Goodman, R. Averill, R. Sidhu

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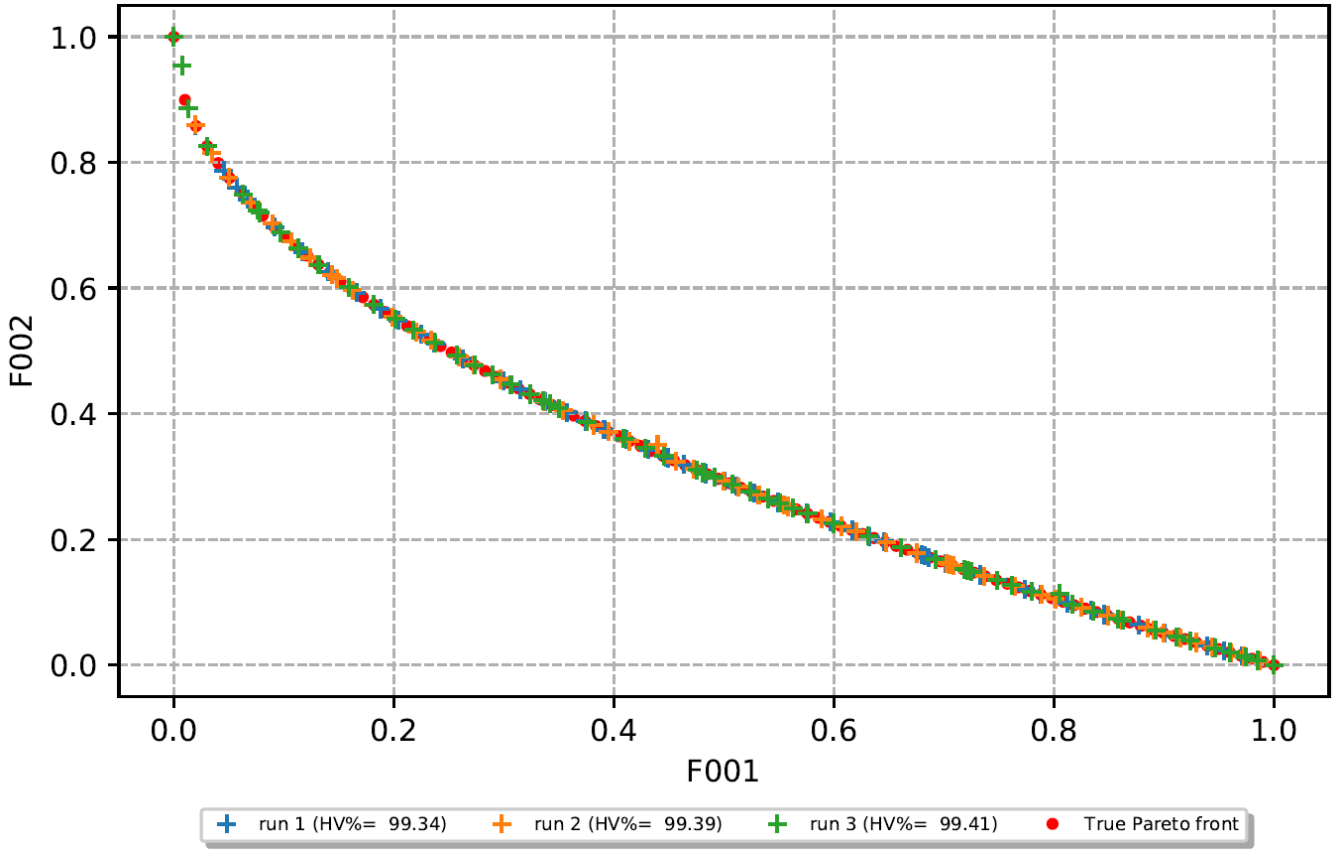
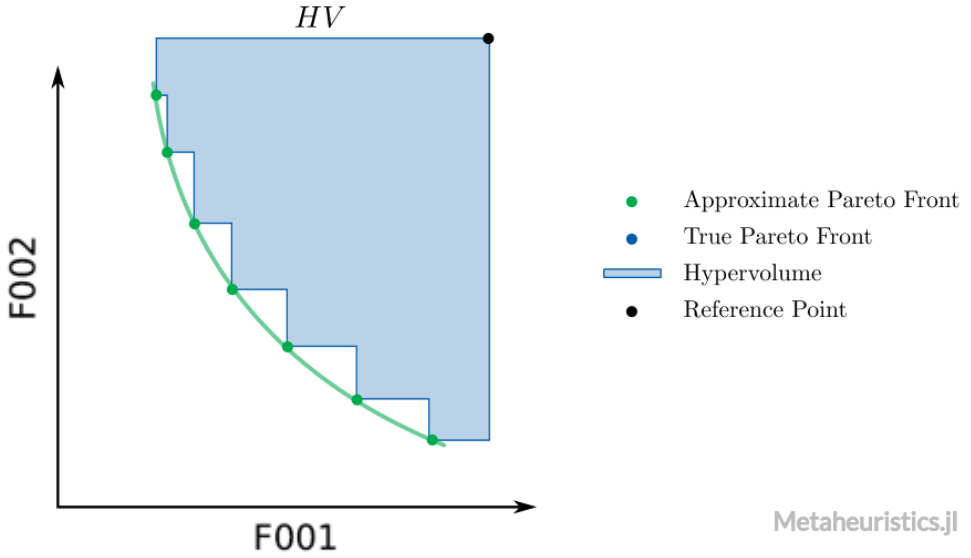
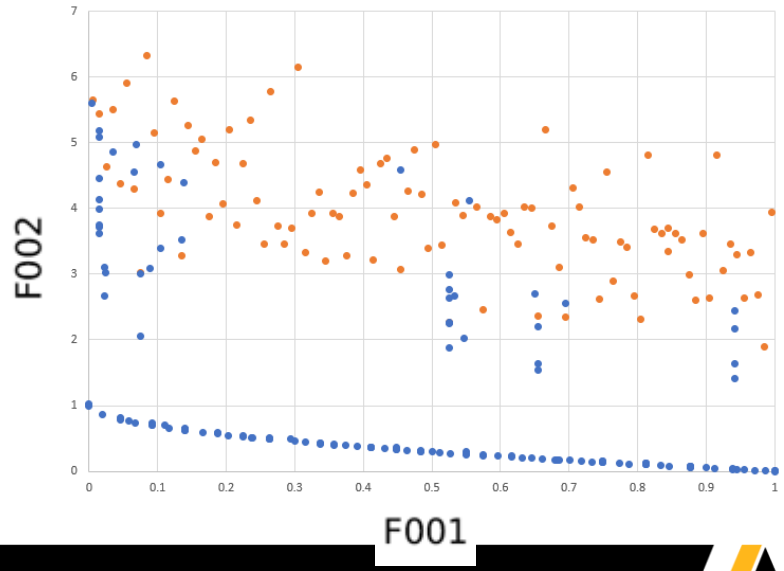
One-Click Optimization for multi-objective problems

ZDT1 example in 10D (250 evaluations)







Initial sampling

Next generations

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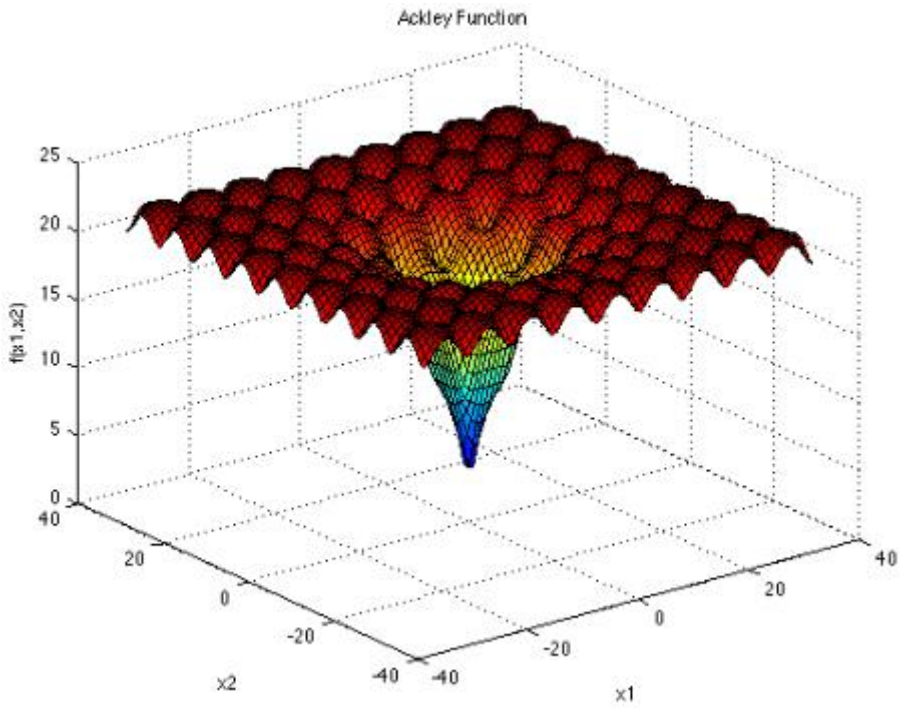
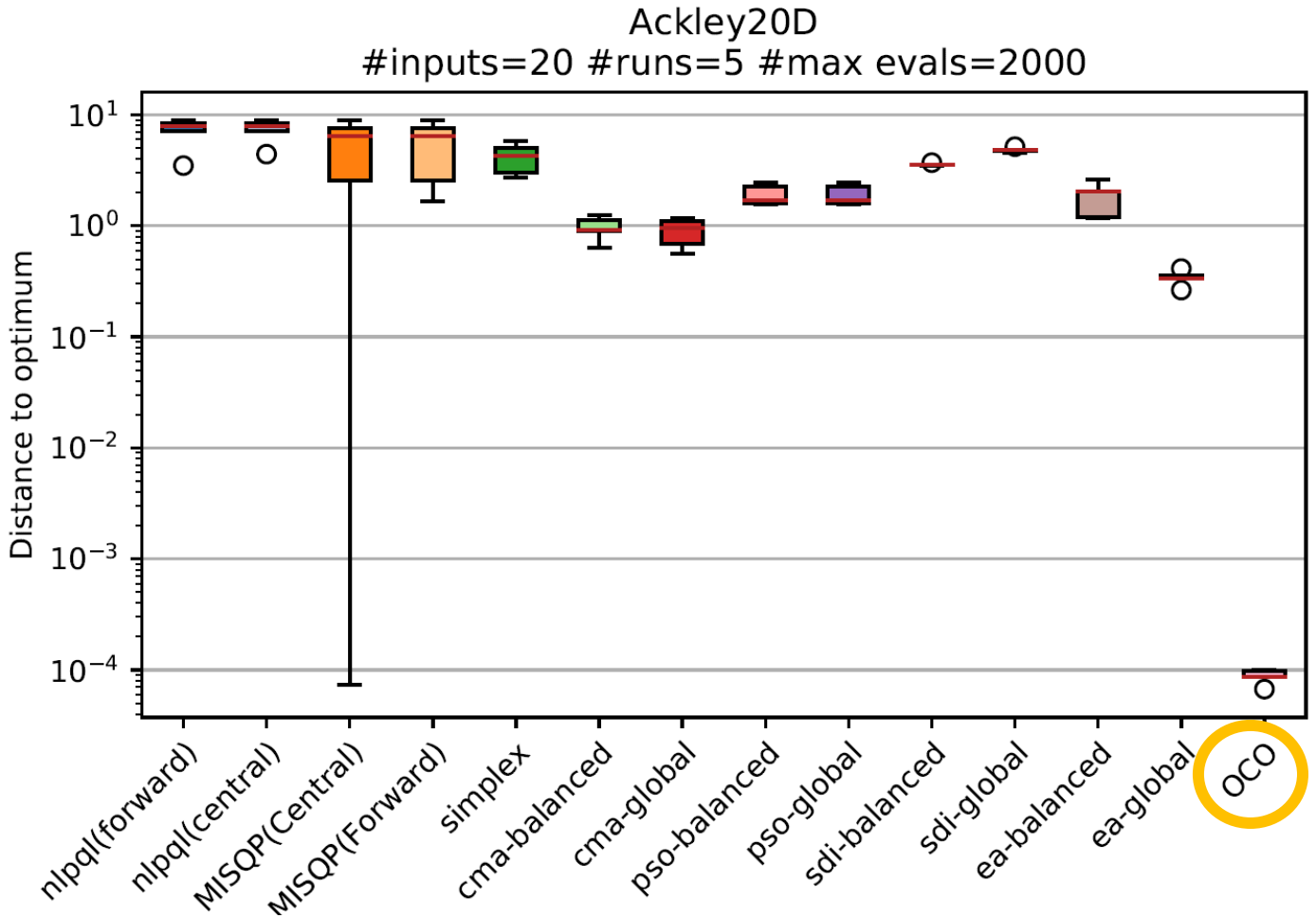
Large benchmark library

Ackley function in 20D: benchmark results



$$f(\mathbf{x}) = -a\exp\left(-b\sqrt{\frac{1}{d}\sum_{i=1}^{d}x_i^2}\right) - \exp\left(\frac{1}{d}\sum_{i=1}^{d}\cos(cx_i)\right) + a + \exp(1)$$



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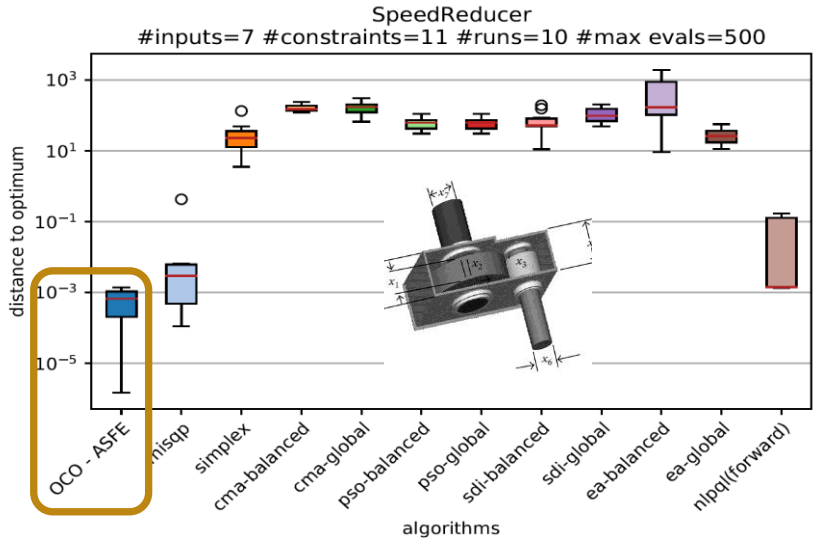
One Click Optimizer (OCO)

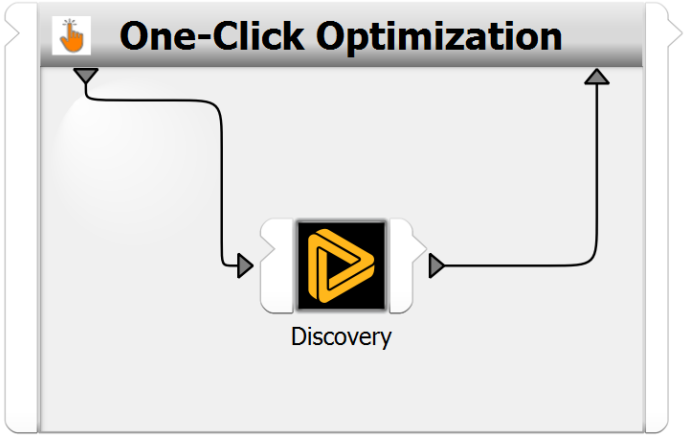
ANSYS solution which outperforms any existing commercial solutions

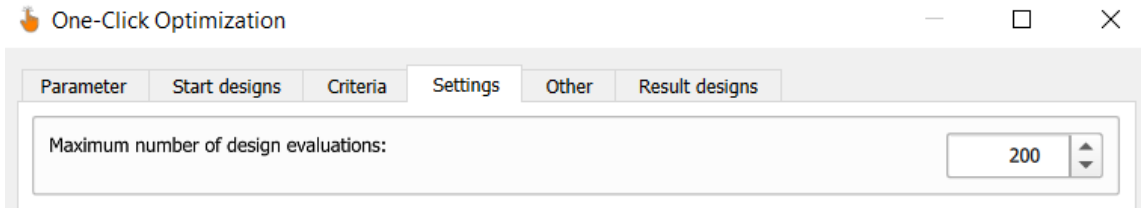


Hybrid Optimization Strategy:

A surrogate assisted optimizer, automatically combining different optimization algorithms.

Requires a minimum of user knowledge and interaction.





Roadmap

2020	2021	2022	2023
✓ Overview Science & Competitors	✓ **Concept (alpha) (2021R2)**	✓ **Beta Version (2022R1)**	✓ **Release (2023R1)**
	✓ **Customer preview (2021R2)**	✓ **Multiobjective (2022R2)**	

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LS-OPT

News in LS-OPT 2023R1

- LS-DYNA fields and field-histories, available in LS-*Extractor*

  ➔ value to any code which interfaces with LS-DYNA solver.

- *Surrogate design:* LS-OPT exports data ready for TwinBuilder

- LS-OPT is now able to *track vibration modes of topologically different designs* (both in mesh and shape)

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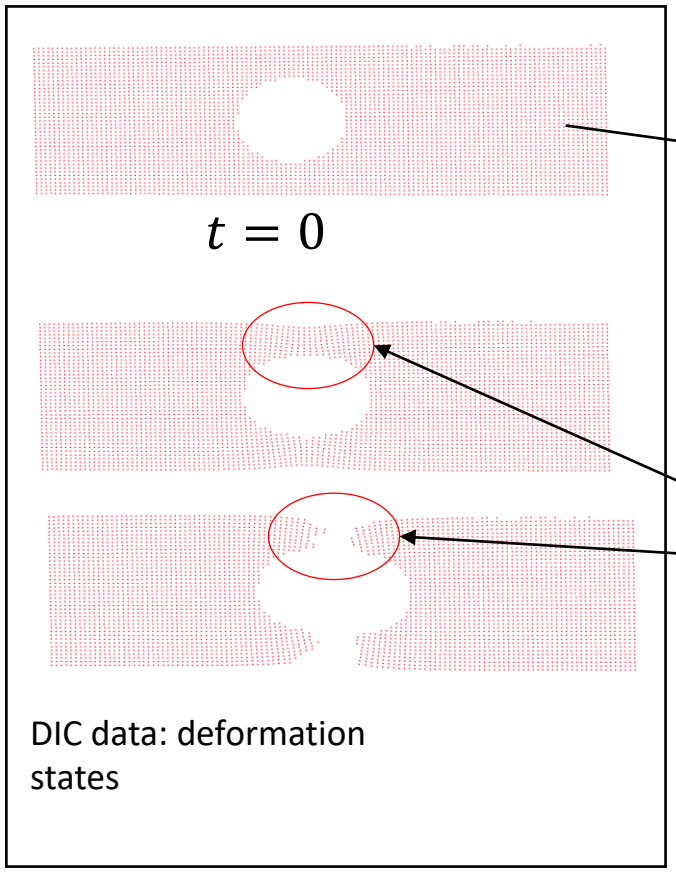
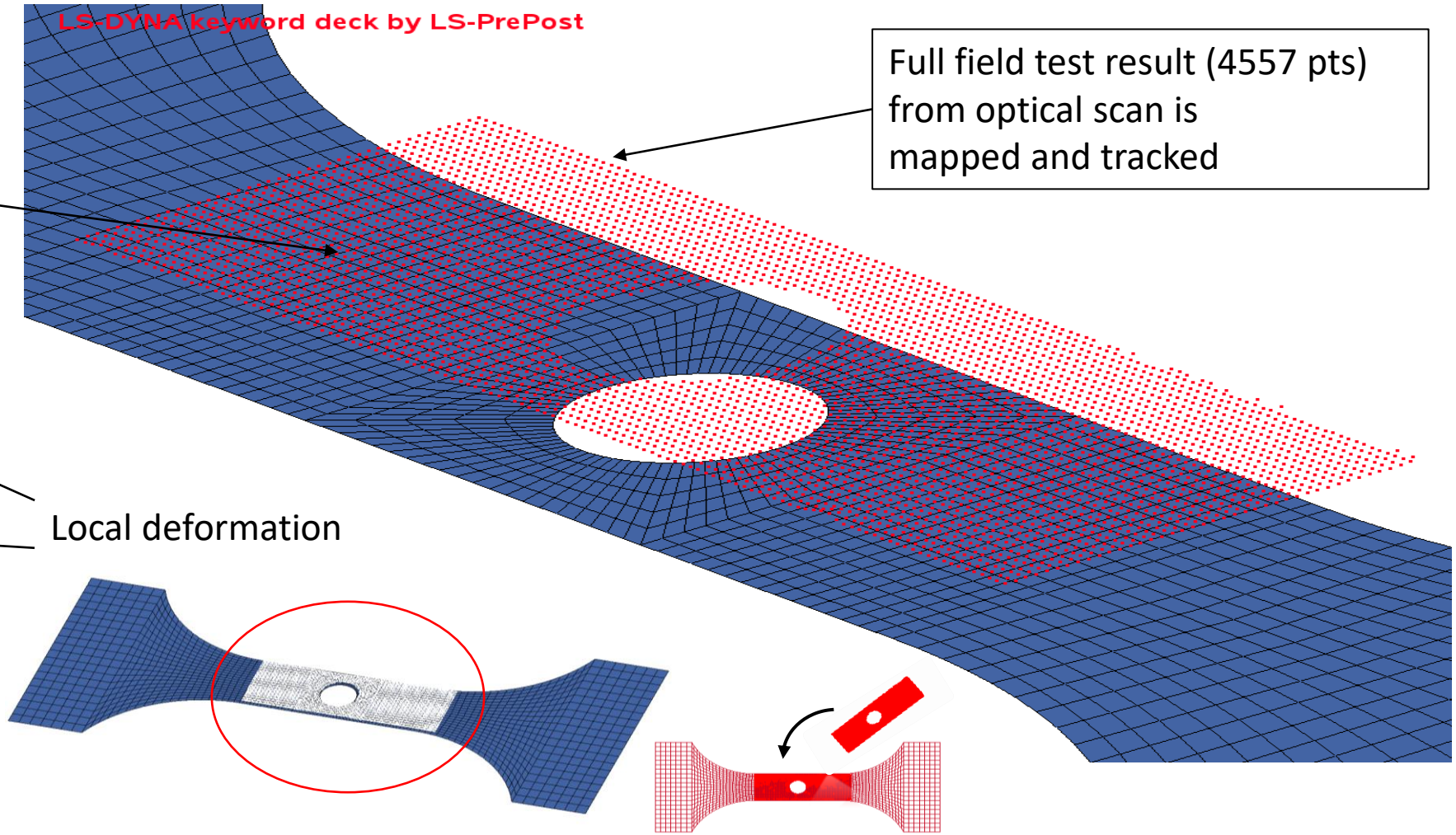
How does LS-OPT used fields? Digital Image Correlation (DIC)

Space-time data





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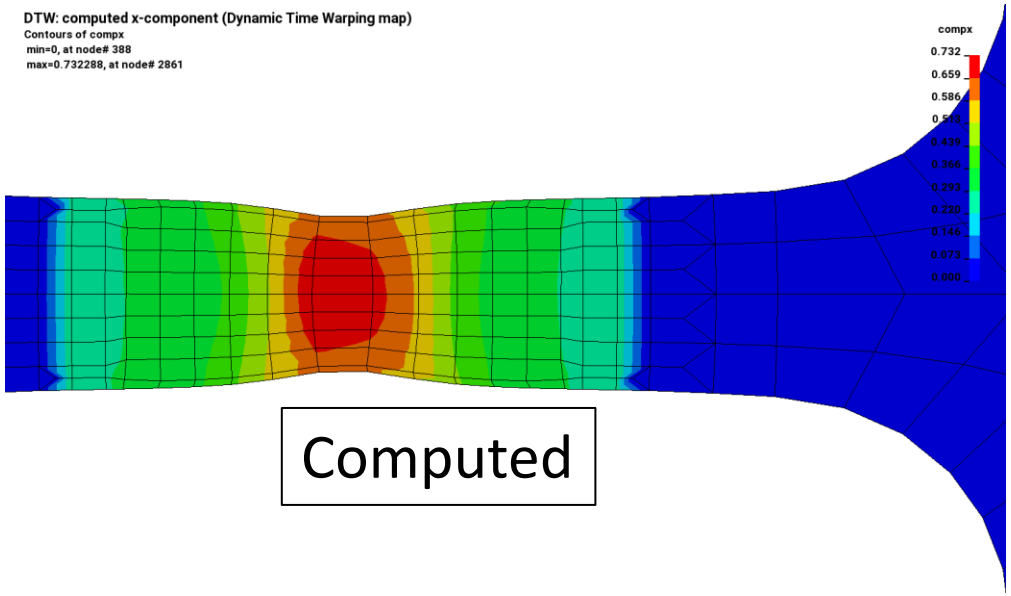
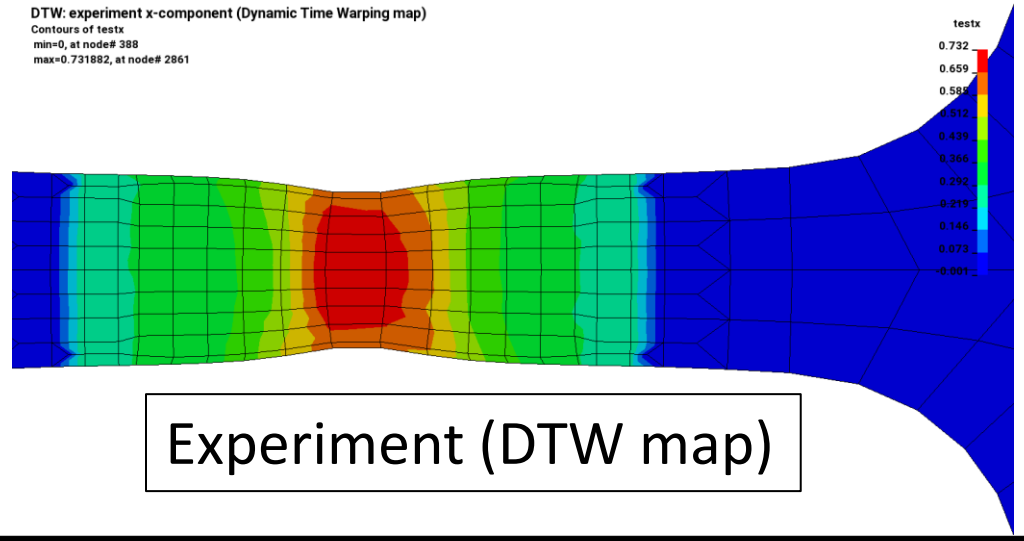
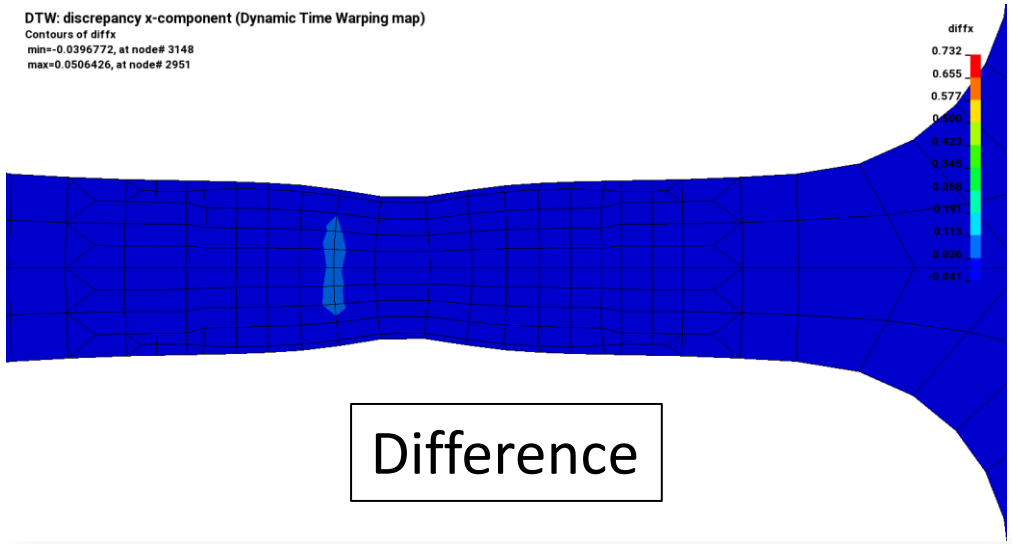
Material Calibration (DIC): Optimal Strain Contours



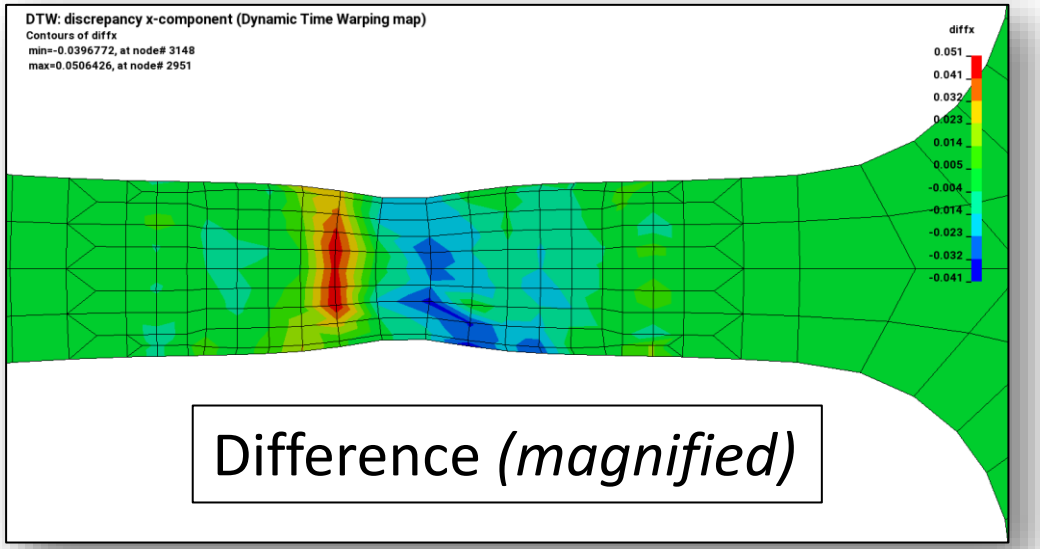
Computed



Experiment (DTW map)



Difference



Difference *(magnified)*

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LS-DYNA® Fields: LS-OPT® capabilities

- Utilizes the full-field dynamic output of *LS-DYNA (d3plot)*
- Fields and Field-histories
  - *Displacement*, *strain* and *stress*-based quantities
  - *Solids* and *shells*
  - Element-based quantities (stress, strain) are *mapped to nodes*
- Part or Part set can be selected

- Applications
  - Digital Image Correlation
    - *Fields* are mapped to *multi-histories* and *multi-responses* by inverting them
  - Input to *Twin Builder* to create Static/Dynamic ROMs for selected structural components

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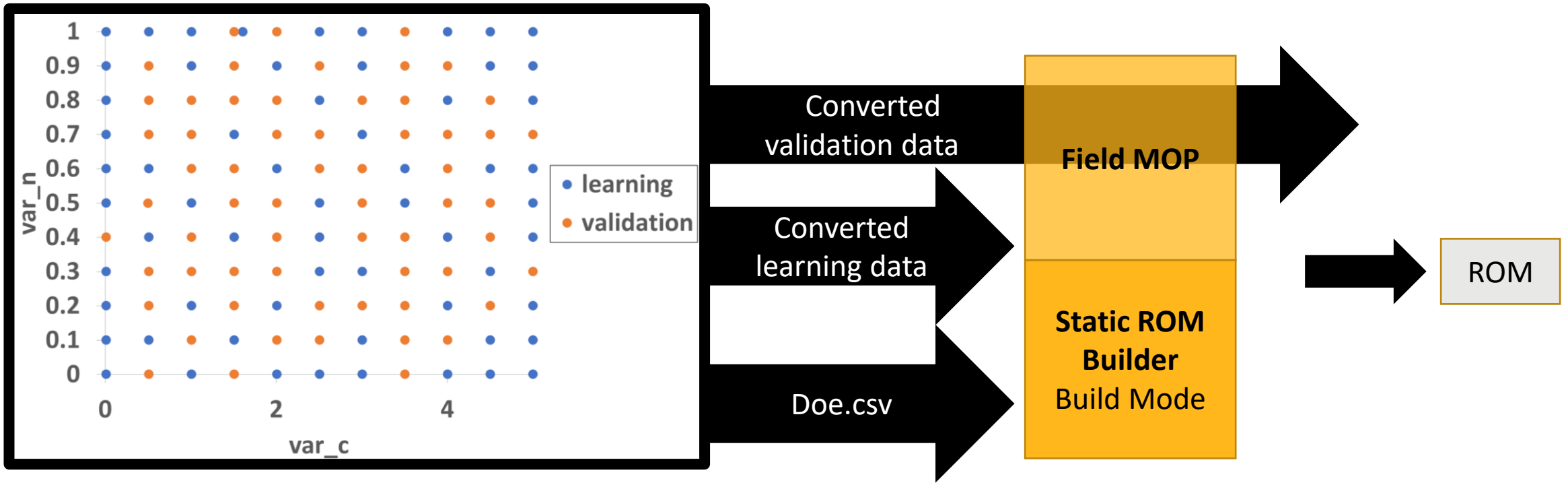
ROM creation with LS-OPT data export



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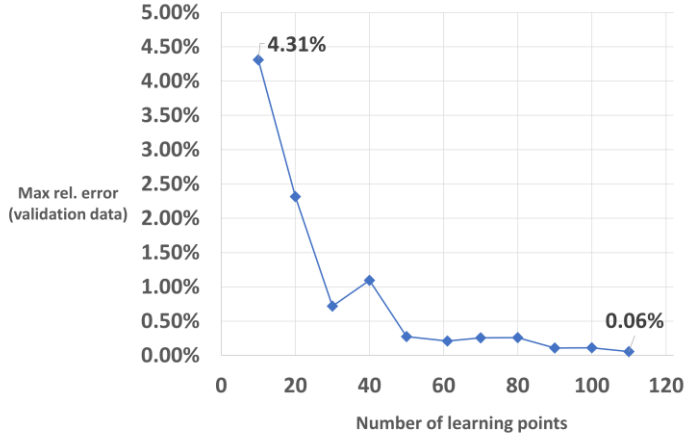
Fast solutions with LS-OPT/LS-DYNA/Ansys Twin Builder

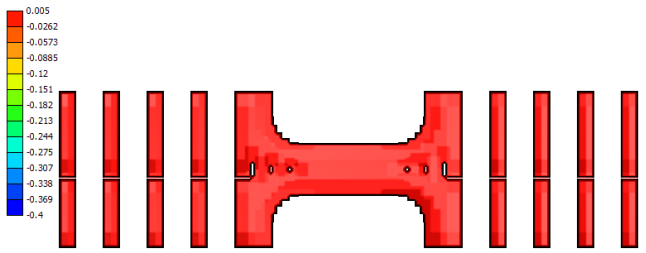
- ***Challenge: Interactive optimization using full-field LS-DYNA models***

- *Calibration example:*
  - 2 material variables: c *[0.01, 5],* n *[0.001, 1]*
  - Model: 122 samples with LS-OPT
  - 376 strain values
  - 81 time frames

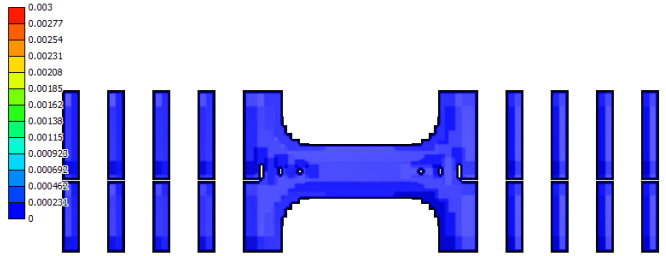


Learning point relevance

LS-DYNA FE model



yy*-strain over time*



Error in yy*-strain over time*

Twin Builder Dynamic ROM model with material [c =0.9, n =0.509] *(TB User Interface)*

In collaboration with: V. Morgenthaler, C. Grivot, O. Crabbé (Ansys Digital Twin)
Example by DYNAmore GmbH, Stuttgart-Vaihingen, Germany

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Mode tracking with topologically different designs

Ansys

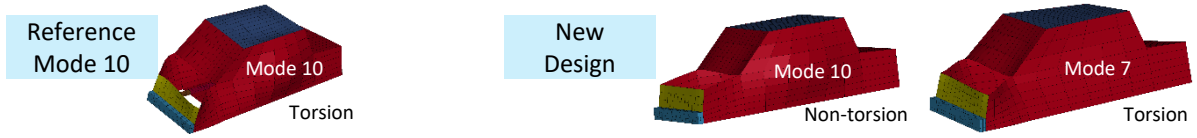
Mode Tracking in the Presence of Shape and Meshing Changes

- Mode tracking is needed if a particular shape is of interest during design
- ***Current Mode Tracking*** using Modal Assurance Criterion (MAC) in LS-OPT ***requires identical mesh*** for eigenvector comparison.

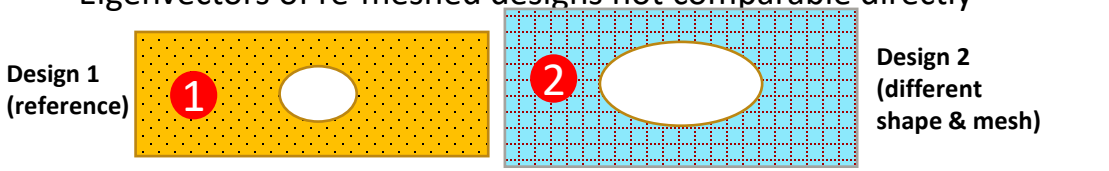
Reference mode / Compared mode

$$\max_j \frac{\{\varphi_0\}^H \{\varphi_j\}\{\varphi_j\}^H \{\varphi_0\}}{\{\varphi_0\}^H \{\varphi_0\}\{\varphi_j\}^H \{\varphi_j\}} = \max_j MAC_j$$

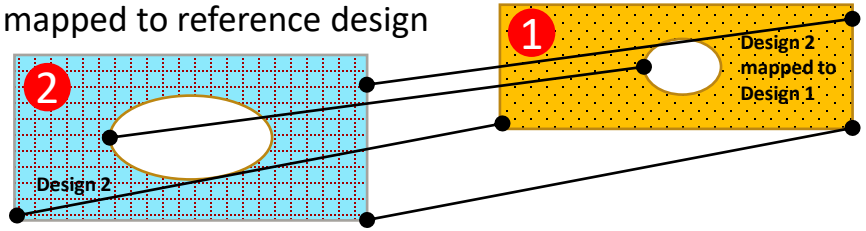
Eigenvectors φ_0 and φ_j must have same length and node order



- ***New method enables MAC calculation for varying shape/mesh***
  - Eigenvectors of re-meshed designs not comparable directly

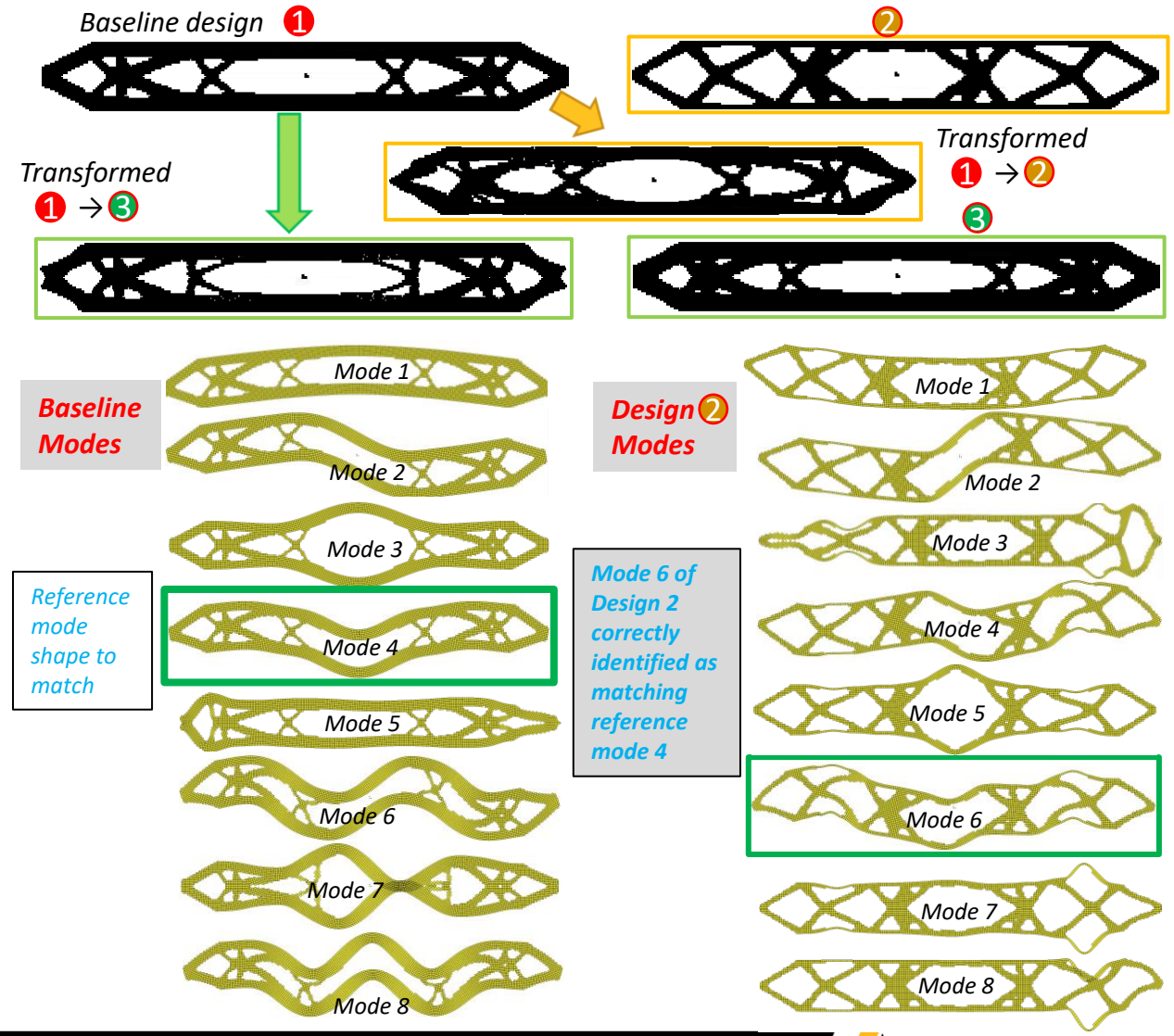


  - New mesh mapped to reference design



  - Mapping using Coherent Point Drift non-rigid point set registration

Myronenko A, Song X. Point set registration: Coherent point drift. IEEE transactions on pattern analysis and machine intelligence. 2010 Mar 18;32(12):2262-75.
Basudhar, A. et al. Mode Tracking Using LS-OPT® In the Presence of Shape and Mesh Changes. 16th LS-DYNA Forum, Bamberg, Germany, 2022



Part of LS-Extractor → can run in parallel and can be submitted

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A look behind the curtain…

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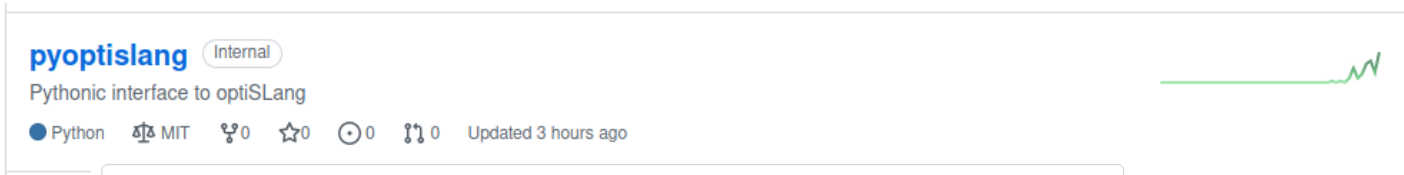
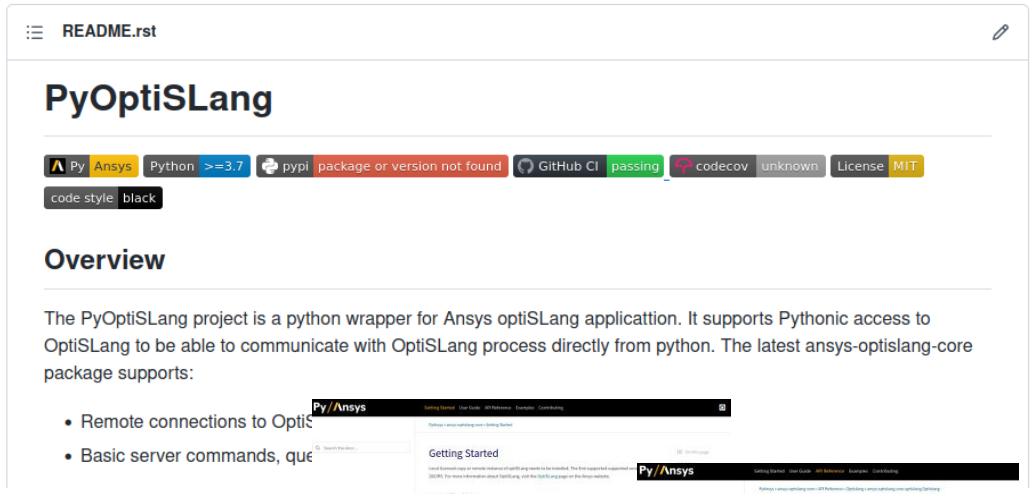
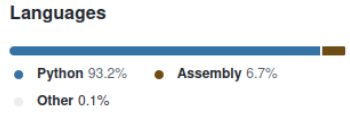
PyOptiSLang – Available for public soon

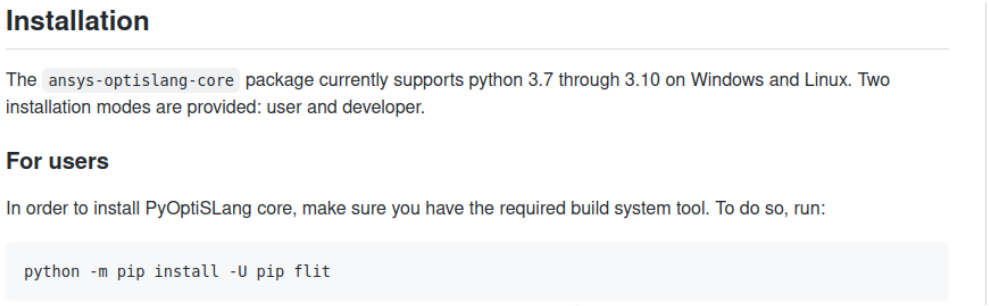
Py/Ansys

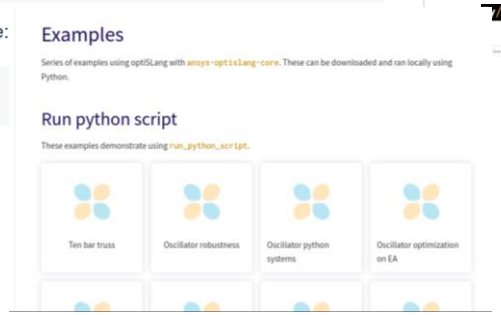
- Start new local optiSLang instance or connect to a running (local or remote) optiSLang instance (batch- mode)
- Open / Create New / Save project
- Reset project
- Start / Stop / Abort project
- Build/set workflow
- Documentation available
- Examples available

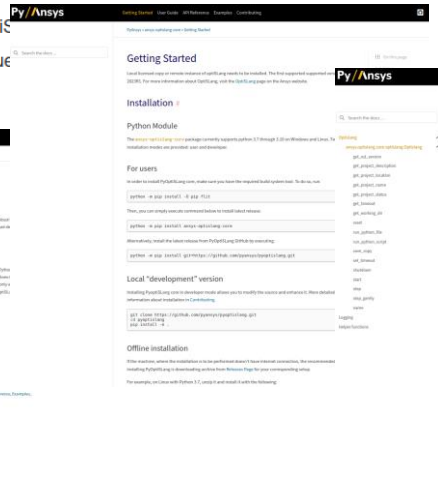


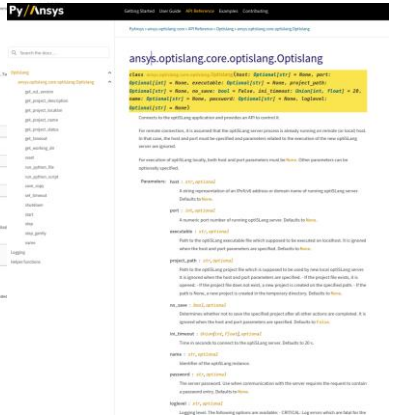













```
""" Launch optiSLang locally
You can launch optiSLang locally using Optislang().
other parameters can be optionally specified.
"""
from ansys.optislang.core import Optislang
osl = Optislang()
osl.shutdown()

""" Connect to a remote optiSLang server
For remote connection, it is assumed that the Optis
(or local) host. In that case, the host and port mu
execution of the new optiSLang server are ignored.
"""
host = "127.0.0.1"
port = 5310
osl = Optislang(host=host, port=port)
osl.shutdown()

""" Basic usage
Use Optislang() with default arguments to create a
run_python_script to execute a native optiSLang Py
to start project execution and wait for it to finis
"""
osl = Optislang()
file_path = r"C:/Users/Username/my_scripts/myscrip
osl.run_python_file(path=script_path)
# osl.run_pyton_script("""print("hello world")""")
osl.start()
osl.save_copy("MyNewProject.opf")
osl.shutdown()

""" Open existing project
Use Optislang(project_path="/path/to/project.opf")
project is automatically saved, unless no_save arg
"""
osl = Optislang(project_path="/path/to/project.opf
osl.start()
osl.shutdown()
```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optiSLang Free Trial

https://www.ansys.com/products/connect/ansys-optislang

Ansys optiSLang

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Country/Region * | City *

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