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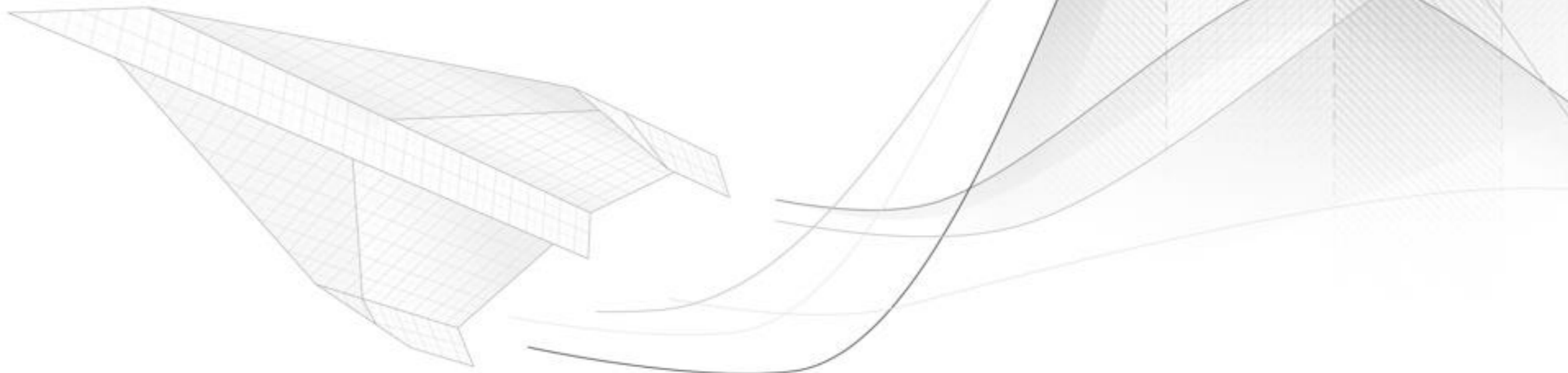
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SoS

New developments in Statistics on Structures

Sebastian Wolff



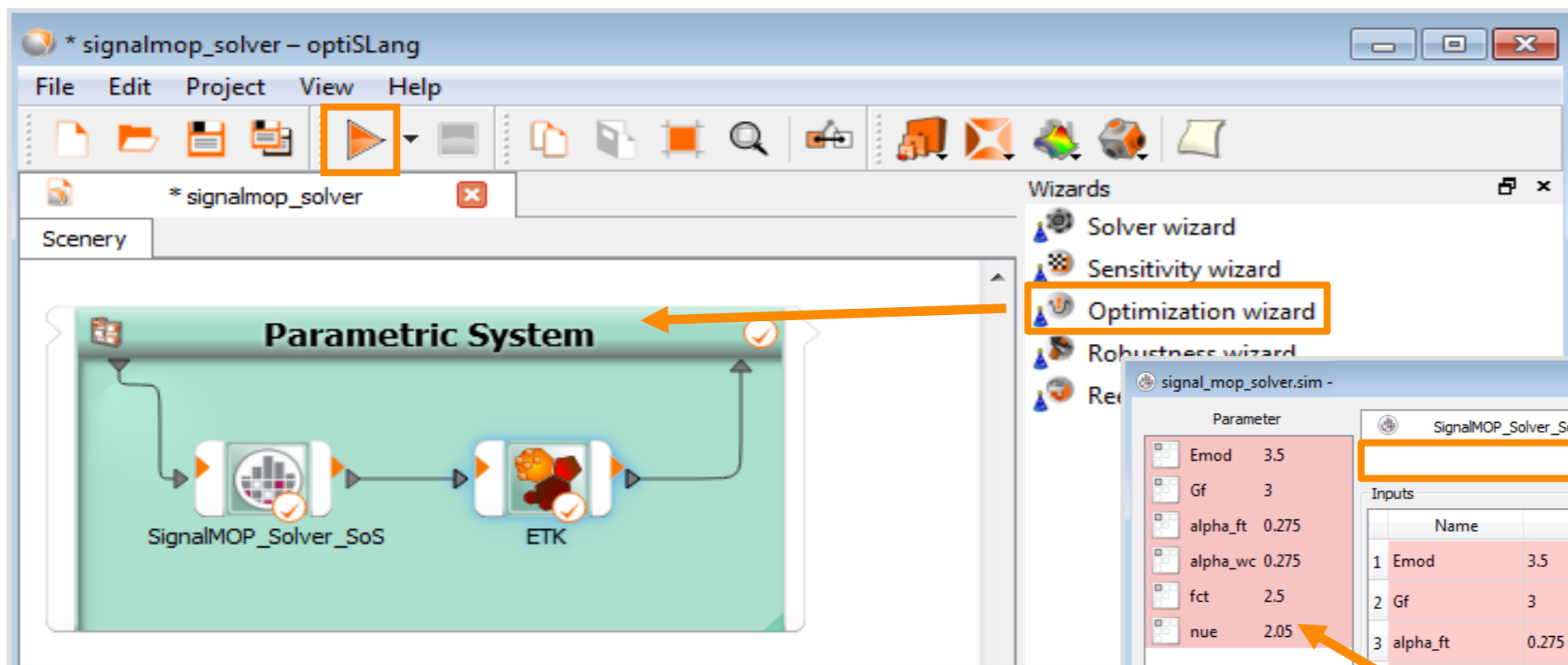
New developments in SoS

Overview

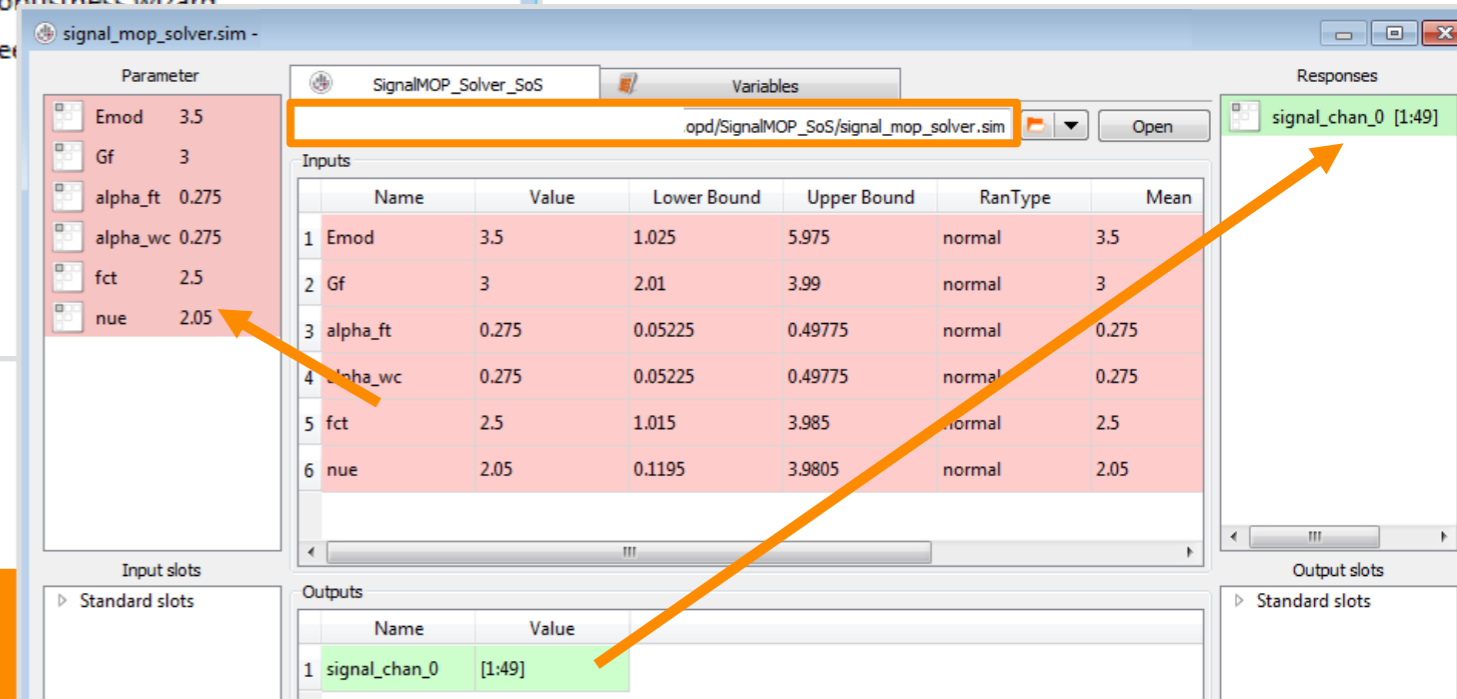
- Releases since WOST 2016
 - SoS 3.3.0 March 2017 for optiSLang 6.0
 - SoS 3.3.1 May 2017 for optiSLang 6.1
- Major advances in these fields:
 - SignalMOP in optiSLang
 - Geometric variations
 - Shape optimization
 - Field meta models
 - Process integration

Signal MOP

- Create a meta model for a complete signal !
 - Direct integration in optiSLang 6.1
- Used if
 - Location of interest is not yet known
 - Distribution of signal data in time is of importance



SignalMOP Solver:
Settings dialog



SignalMOP Solver:
Apply optimization wizard

Signal MOP

- Analyze
 - Sensitivities
Where is which input parameter important ?
 - Random field shapes
What are the correlations in time ?
 - Variation intervals
Where is the largest variation?
 - Explainability
What is responsible for bad explainability, where can I explain a signal well ?

Sensitivity analysis with SignalMOP directly in optiSLang 6.1 post processing

Scenery

Create a SignalMOP:
Drag'n'drop from Add-ins

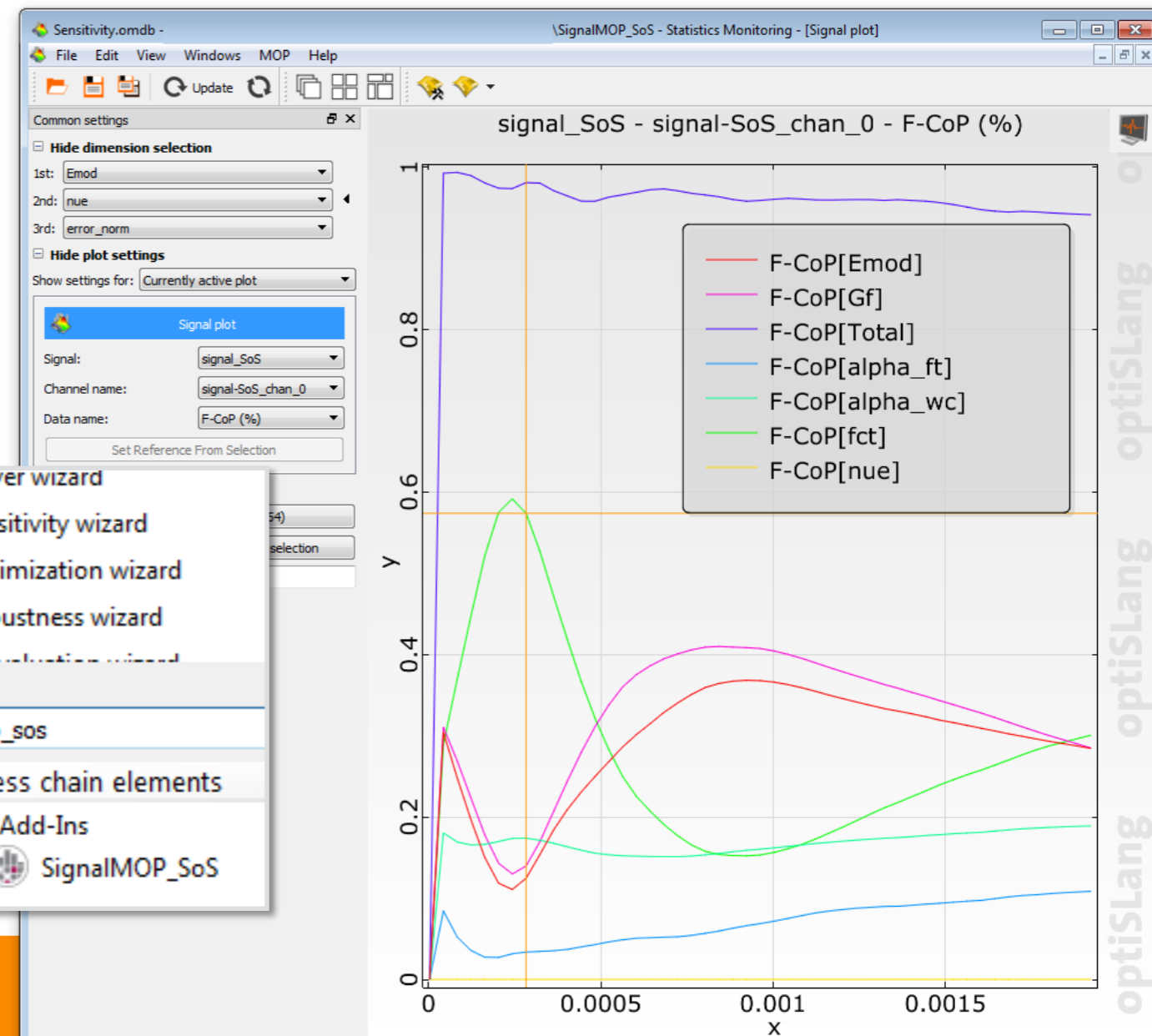
SignalMOP_SoS

Solver wizard
Sensitivity wizard
Optimization wizard
Robustness wizard
Reproduction wizard

Modules
signalmap_sos

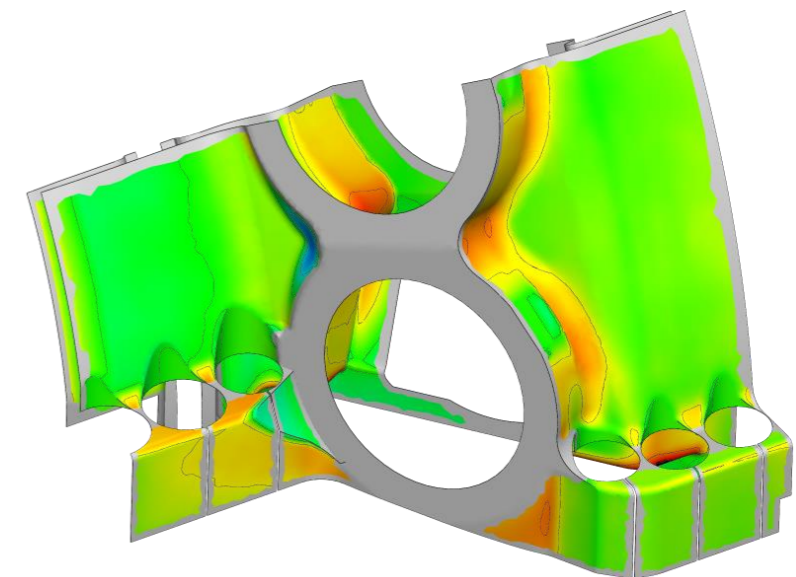
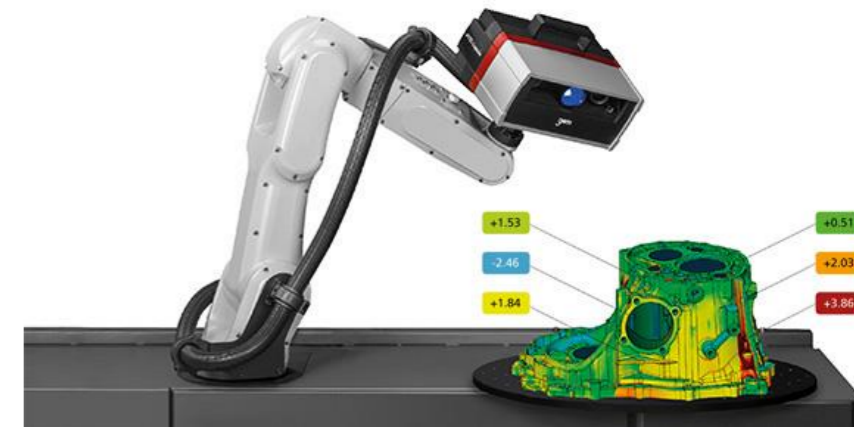
Process chain elements

Add-Ins
SignalMOP_SoS



Generation of geometric imperfections

- Motivation:
 - Create a statistical model based on measurements (laser scans) of true geometry, e.g. after production
 - Generate new random geometries which reflect the statistical distribution as found in reality
- New developments:
 - Define regions on your mesh which are not part of the variation (e.g. polished parts, screws, etc.)
 - Change coordinates of nodes in the interior of a volume as well
 - Advanced algorithms to stabilize the deformed meshes (e.g. mesh smoothing, ensure positive Jacobians)
- **Generate relatively large deformations !**

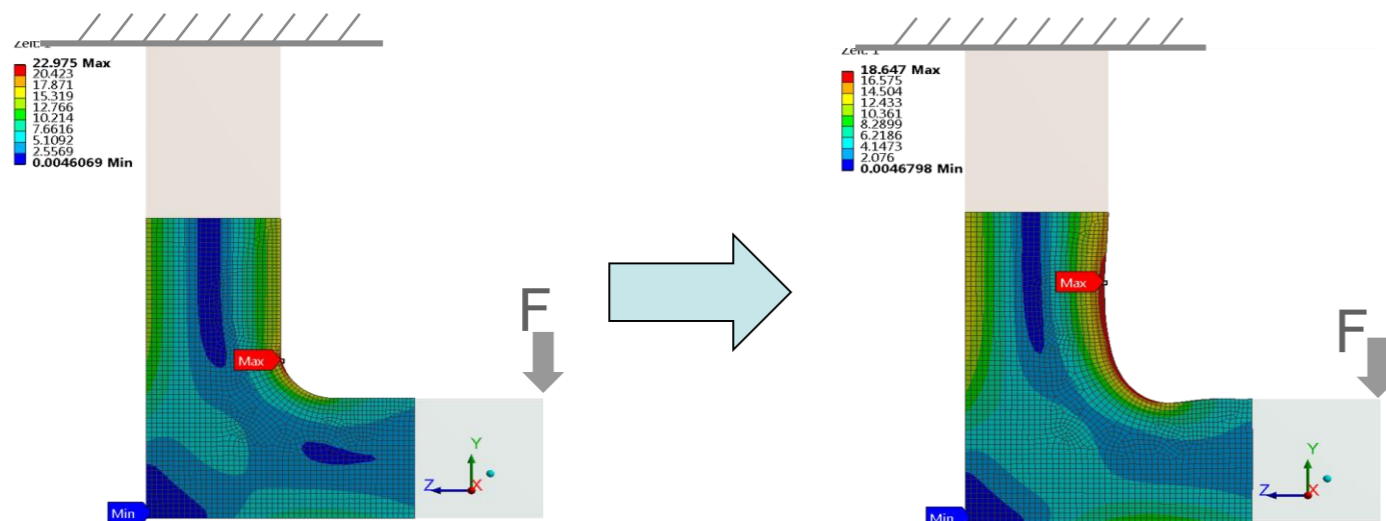


With courtesy of SIEMENS,
Source: Lohse et al WOST 2016

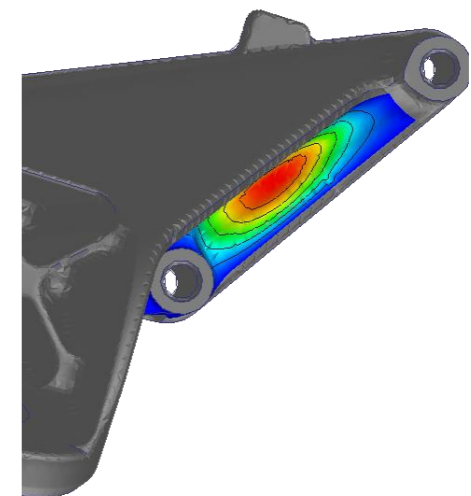
Shape optimization

- New ways to auto-parameterize geometric variations of FEM meshes to be used in free-form shape optimization
 - Change FEM node coordinates directly
 - Define smooth tent-shaped variation patterns to remove/add material in optimization after a topology optimization
- Reduce number of required CAD cycles after optimization

Shape optimization example with ANSYS and SoS:

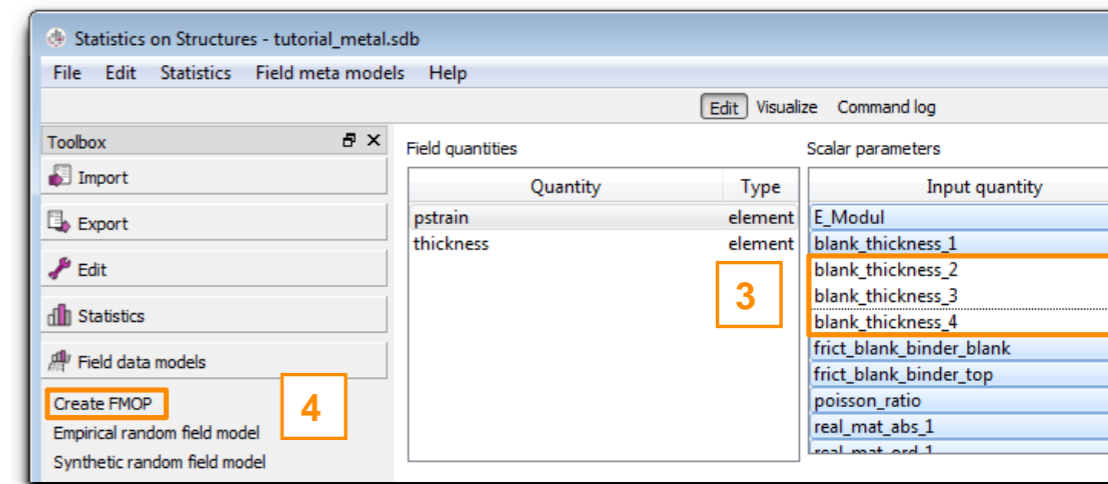


Example of a single variation shape on a complex geometry:

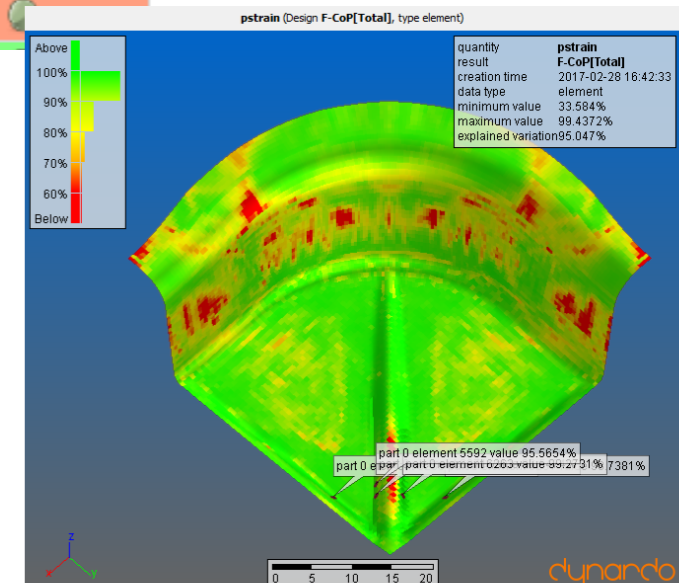


Field meta models

- FMOP = Approximating meta model for dynamic processes (signals) and 3D data (e.g. stresses, strains, displacements)
- New developments:
 - Improved usability (One-click solution in SoS GUI, no optiSLang required)
 - Custom integration node in optiSLang 6 (FMOP solver)
 - Improved accuracy for computing the prognosis quality even in large dimensions (SoS 3.3.0)
 - Improved accuracy for computing the sensitivities of input parameters even in large dimensions (SoS 3.3.2)
- Under development: Binary interface to FMOP solver for approximation in real-time

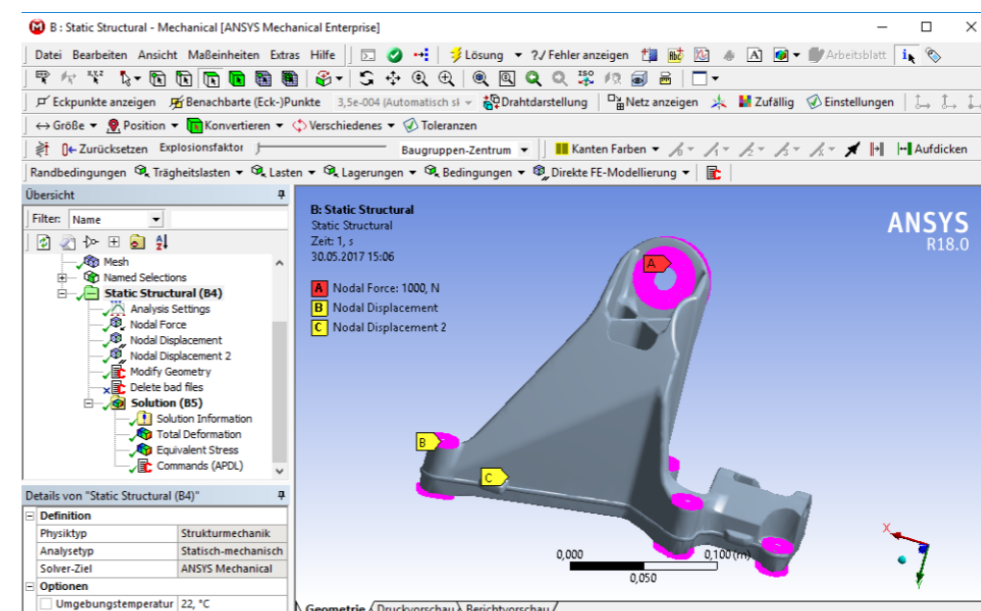
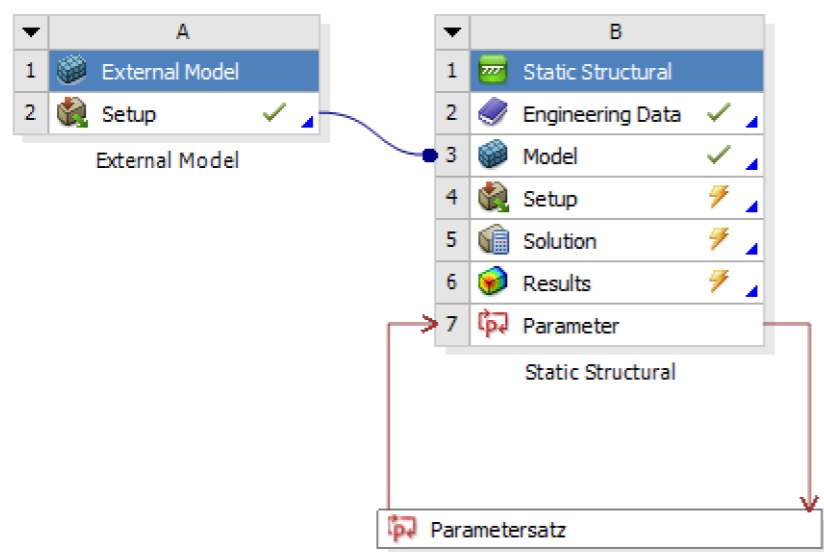


	pstrain
F-CoP[E_Modul]	0.09 %
F-CoP[Total]	95.05 %
F-CoP[blank_thickness_1]	9.49 %
F-CoP[frict_blank_binder_blank]	0.04 %
F-CoP[frict_blank_binder_top]	0.03 %
F-CoP[poisson_ratio]	0.21 %
F-CoP[real_mat_abs_1]	2.52 %
F-CoP[real_mat_ord_1]	23.51 %
F-CoP[rho]	



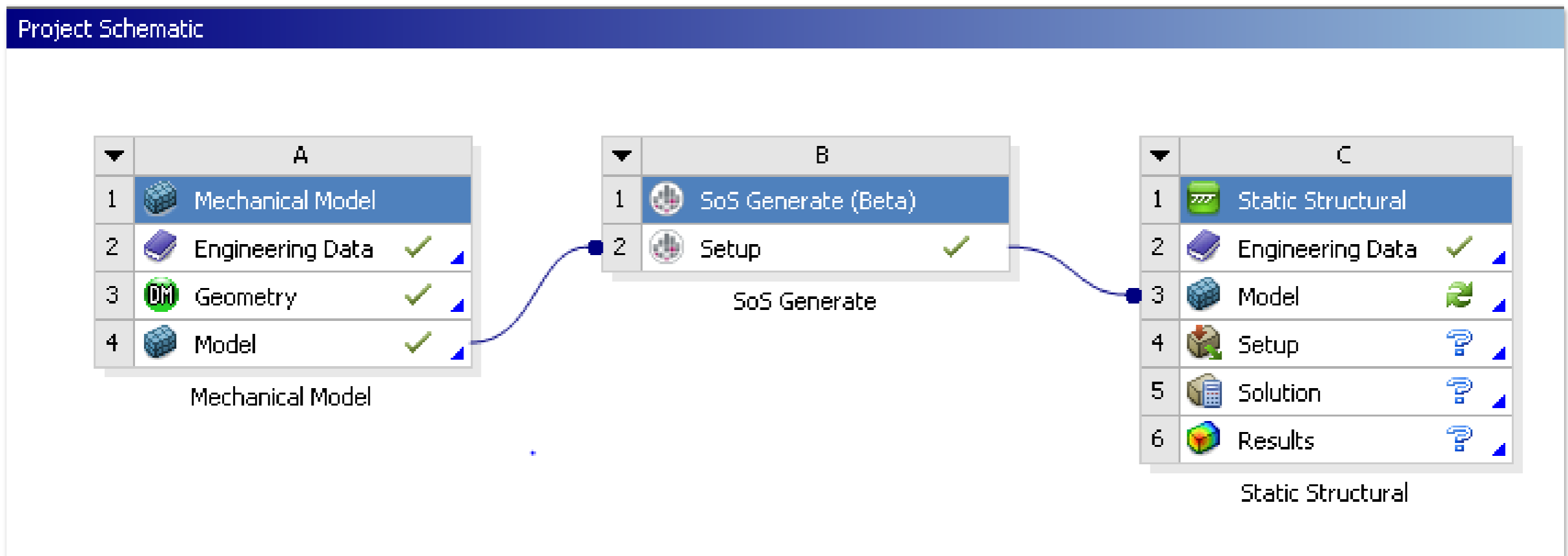
Process integration

- Many new and improved file formats
 - ANSYS RST: Import results from structural analysis directly into SoS
 - ANSYS CDB: Import meshes and components directly into SoS
 - ANSYS APDL: Modify geometries through APDL
 - LS-DYNA: Now with support for many elements including shells and volumes
 - Structured grids: generic format for import of large scale 2d grids
- Established workflows for modifying geometries with ANSYS Workbench and optiSLang



Process integration

- Under development:
 - Direct integration of SoS into ANSYS Workbench
 - Objective: safe and easy-to-use generation of modified geometries in shape optimization and robustness analysis



New developments in SoS

Summary

- Current version: SoS 3.3.1 (to be used with optiSLang 6.1)
- Major advances in these fields:
 - SignalMOP in optiSLang
 - Geometric variations in tolerance analysis
 - Shape optimization
 - Field meta models (FMOP) in 1d (e.g. signals), 2d (e.g. engine maps), 3d (e.g. FEM models)
 - Process integration with ANSYS Workbench

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