

Chances and limits of CAD/CAE parametric in ANSYS Workbench/optiSLang

Weimarer Optimierungs- und Stochastiktage 6.0

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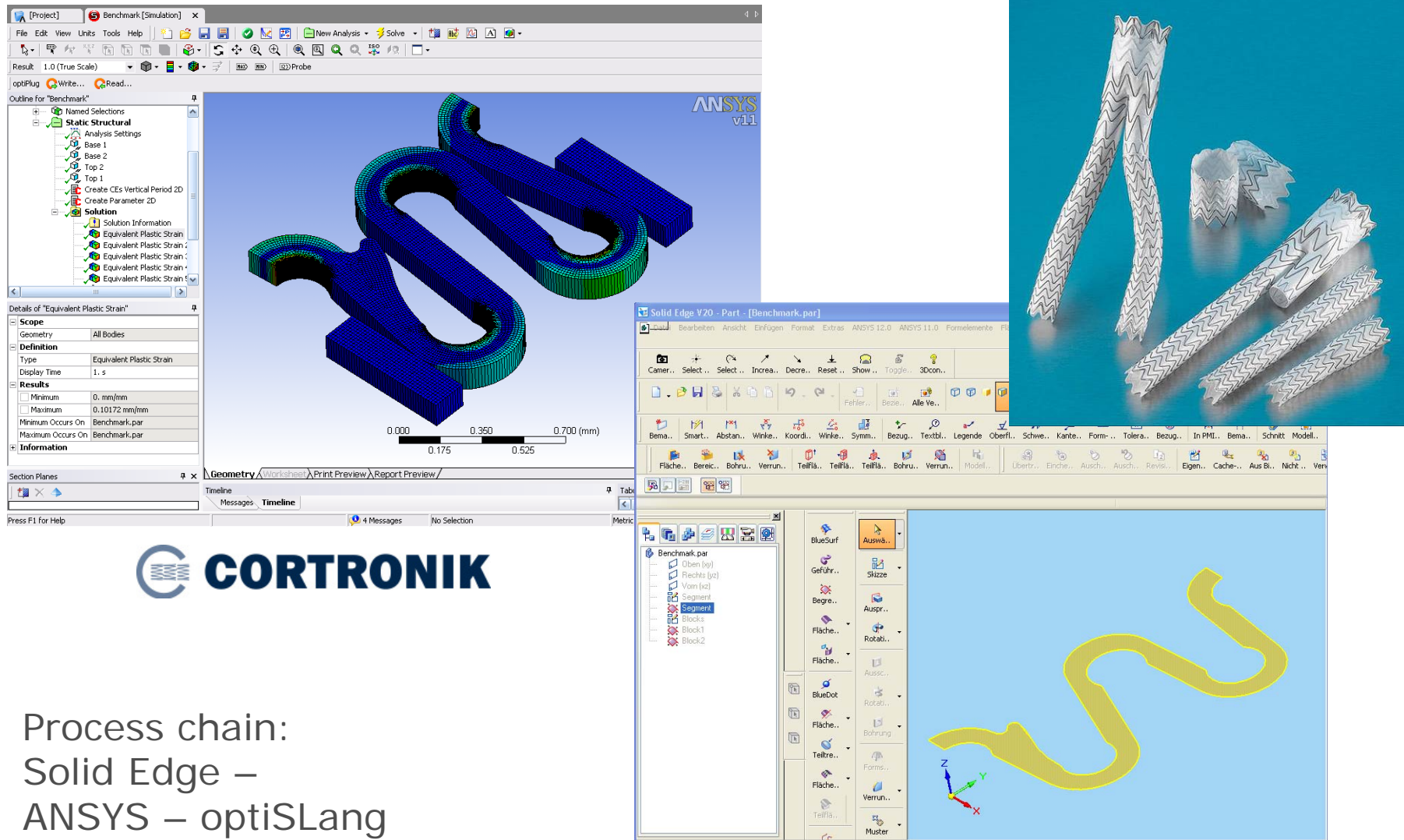


Chances of CAD/CAE parametric

- CAD/CAE parametric can be used in different ways:
 - Direct geometry transfer of the structure from a CAD system
 - Simplifications of the CAD model in the CAD system
 - Simplifications and re-design of complex geometry in ANSYS Design Modeler
 - Geometry variation by using random fields

1. Direct interface to CAD parameters

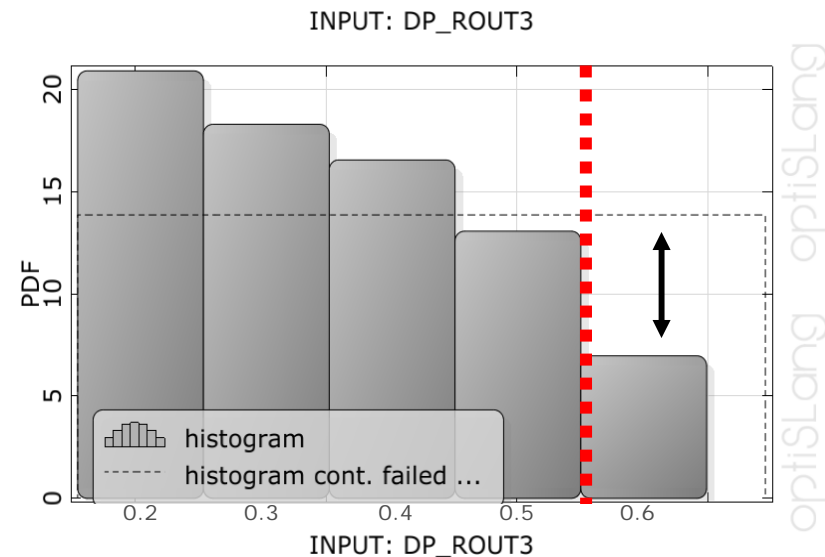
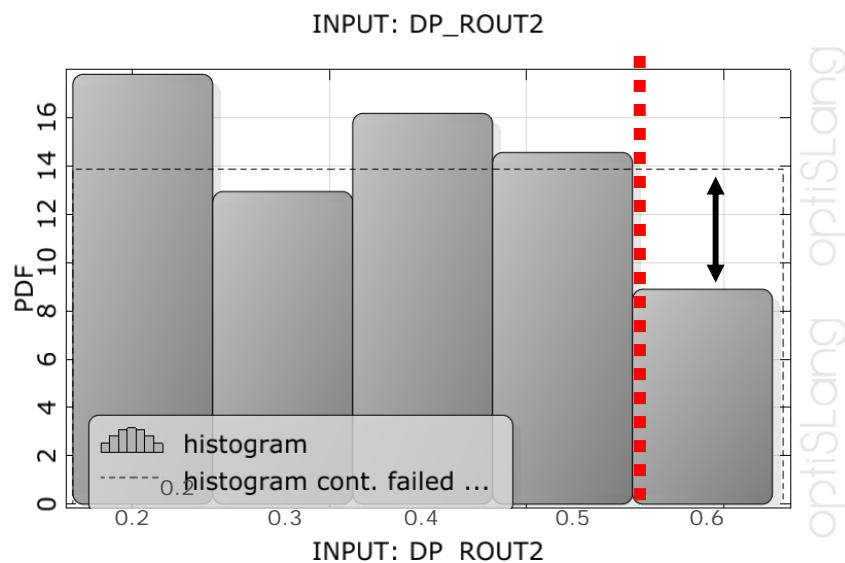
Example: 2D geometry in Solid Edge parametrized



Process chain:
Solid Edge –
ANSYS – optiSLang

1. Direct interface to CAD parameters

- First hint by regarding the histograms of the input parameters:

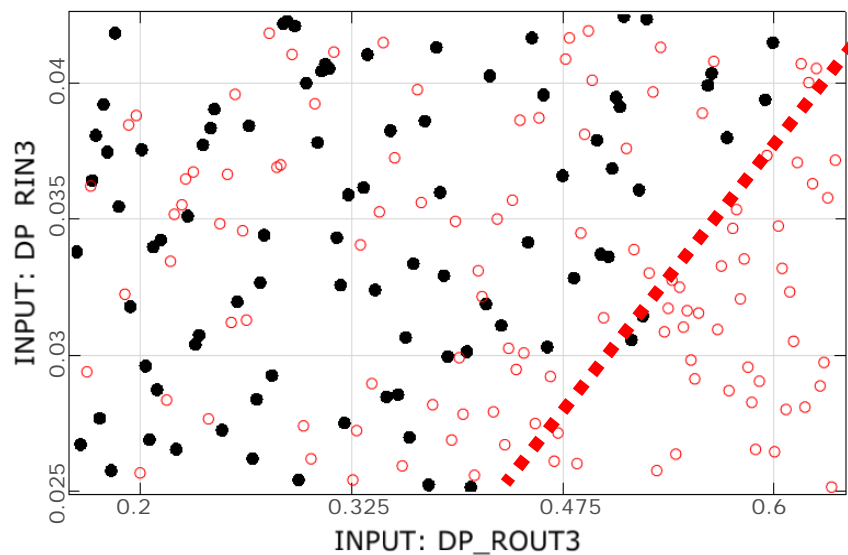


- A large abnormality of the basically uniform variation of this parameters indicate failures during the geometry update.

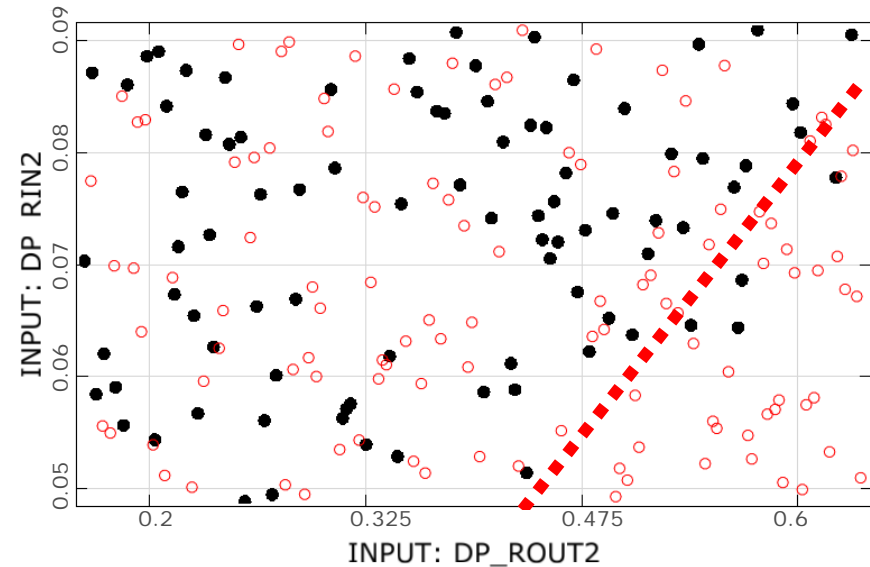
1. Direct interface to CAD parameters

- Problematic geometry combinations occur in the CAD system
- Therefore, we got high rates of failed designs
- Apart from the histograms, it became quite clear in this case by regarding the anthill plots of the suspicious parameters.

INPUT: DP_ROUT3 vs. INPUT: DP_RIN3, (linear) $r = 0.261$



INPUT: DP_ROUT2 vs. INPUT: DP_RIN2, (linear) $r = 0.222$



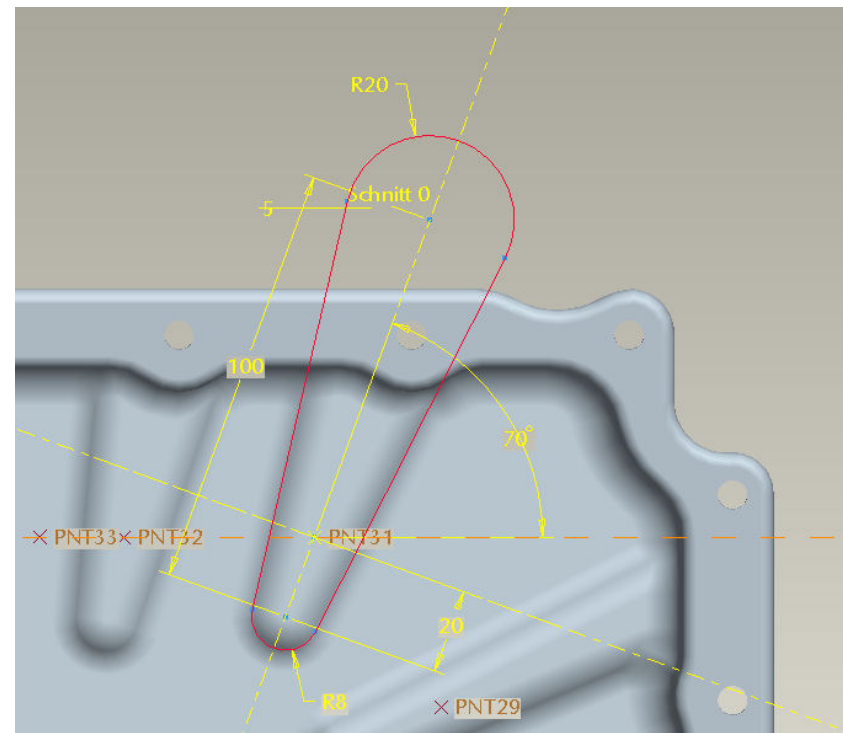
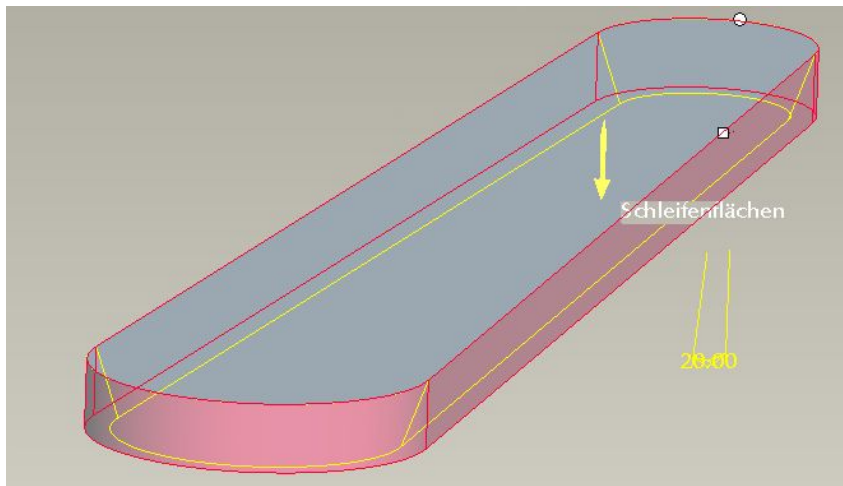
- Task:
These areas of failed designs are not very often determinable in that simple way

1. Direct interface to CAD parameters

- Summary of the direct interface to CAD parameters:
 - The direct connection of CAD parameters can sometimes cause instabilities during the geometry regeneration.
 - Determine the problematic parameter combinations by an analysis of the input parameters in anthill plots and histograms.
 - Insert suitable geometry constraints or reduce the variation space to stabilize the analysis.
- So, the direct interface works very efficient:
 - If the expected failure rate is already determined.
 - The number of analyzed parameters is rather small.
 - Failed designs can be avoided by inserting suitable constraints or by a reduction of the variation space.
 - If you need a CAD Model after the optimization process.

2. Simplification of the CAD model in the CAD system

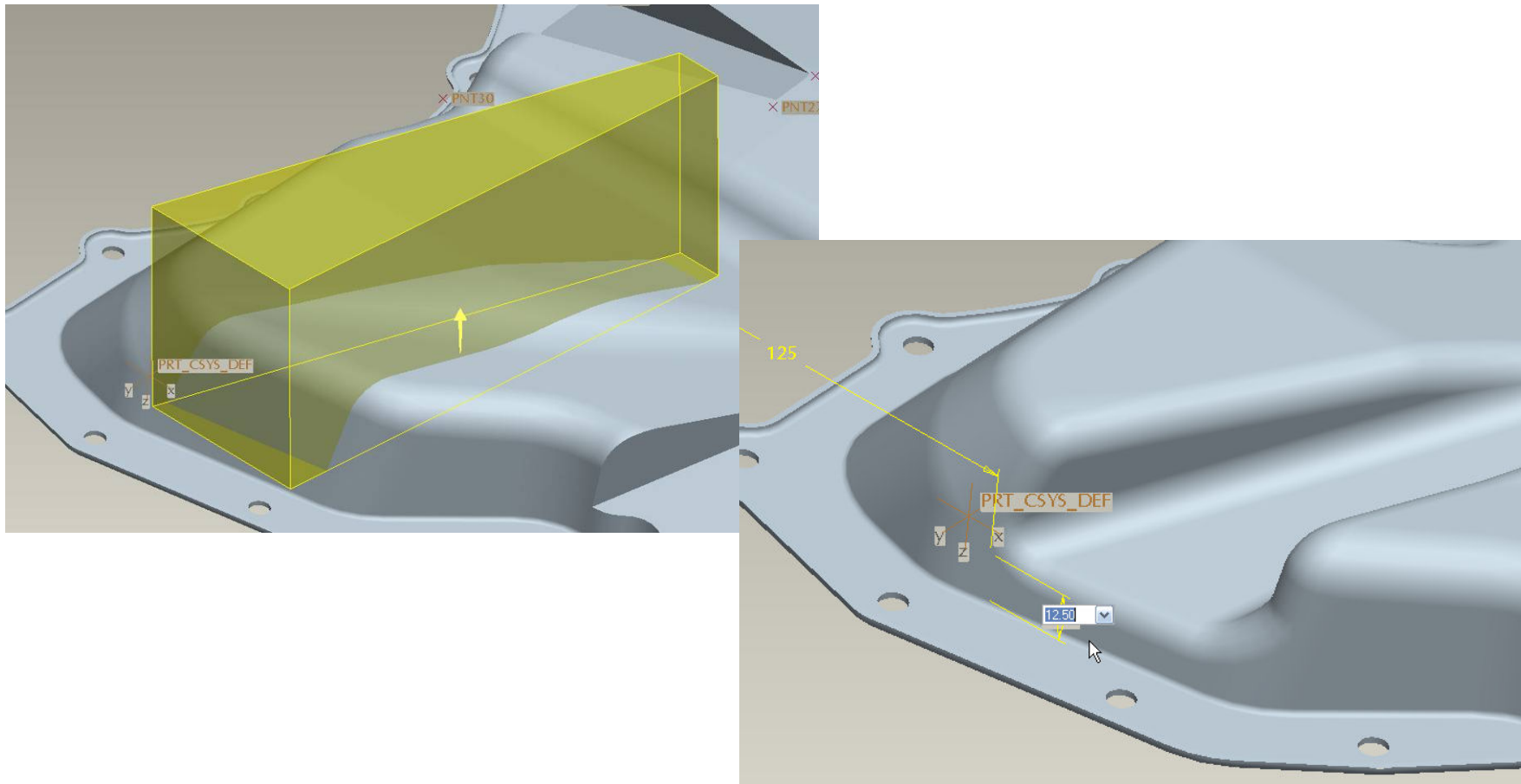
- Simplification of the CAD model are useful for complex geometries.
- Example of a complex plunger geometry of the Pro/E bead tool.
- Too fine details cause difficulties in the regeneration and meshing process.
- Due to a high number of parameters, overlaps can occur.



Process chain:
Pro/ENGINEER – ANSYS - optiSLang

2. Simplification of the CAD model in the CAD system

- Simplification by creating the geometry by four connected points
- This stabilized the geometry and a larger variation space was possible

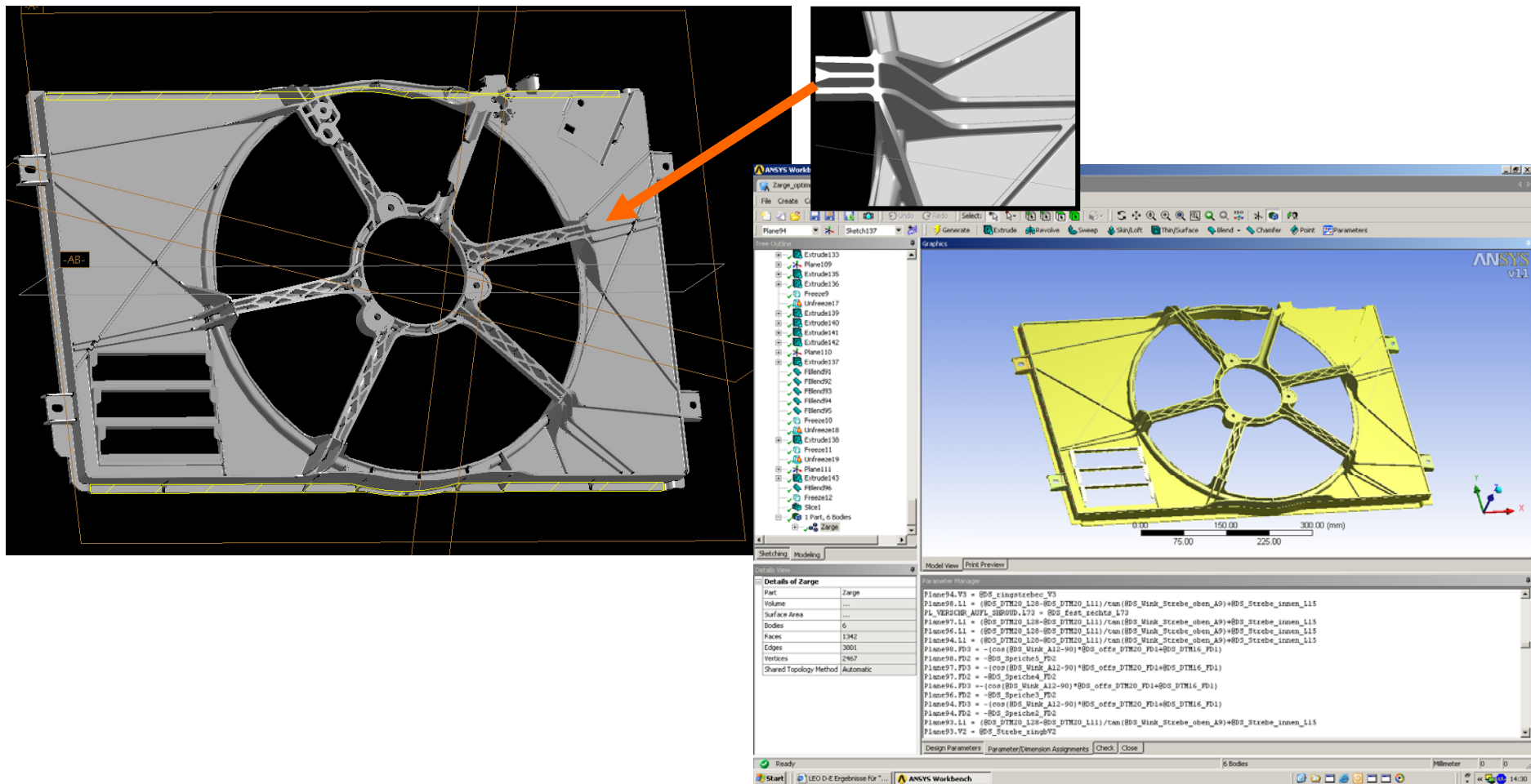


2. Simplification of the CAD model in the CAD system

- Summary, simplification of the CAD model:
 - Simplifications of complex CAD models can stabilize the whole simulation.
 - This simplification often allows a larger variation space than the more complicated structure.
 - If the direct interface of CAD to workbench is used for an optiSLang analysis, the potential of geometry simplification shall be regarded intensively.
 - Also using a simplified geometry, you get a direct CAD model after the optimization process.

3. Regeneration of the model in ANSYS Design modeler

- Highly complicated geometry often cause difficulties in geometry update and cause too fine meshes, so in this example, it was also recommended to redesign the structure in the ANSYS Design modeler.

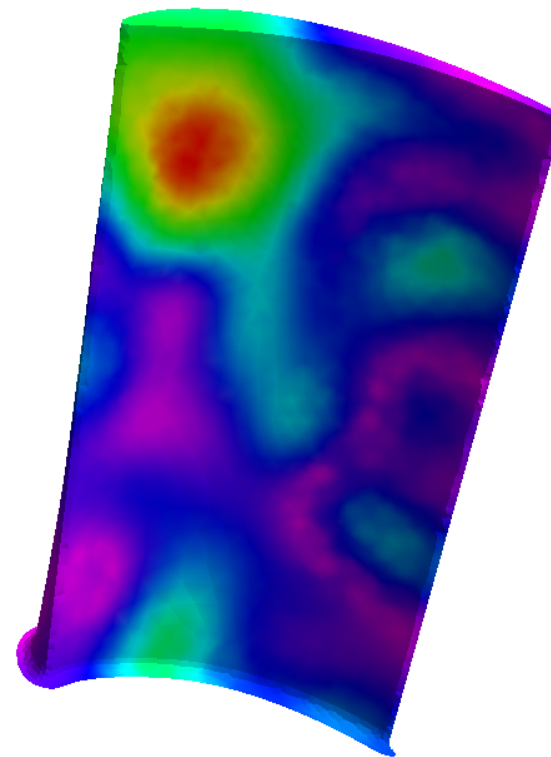
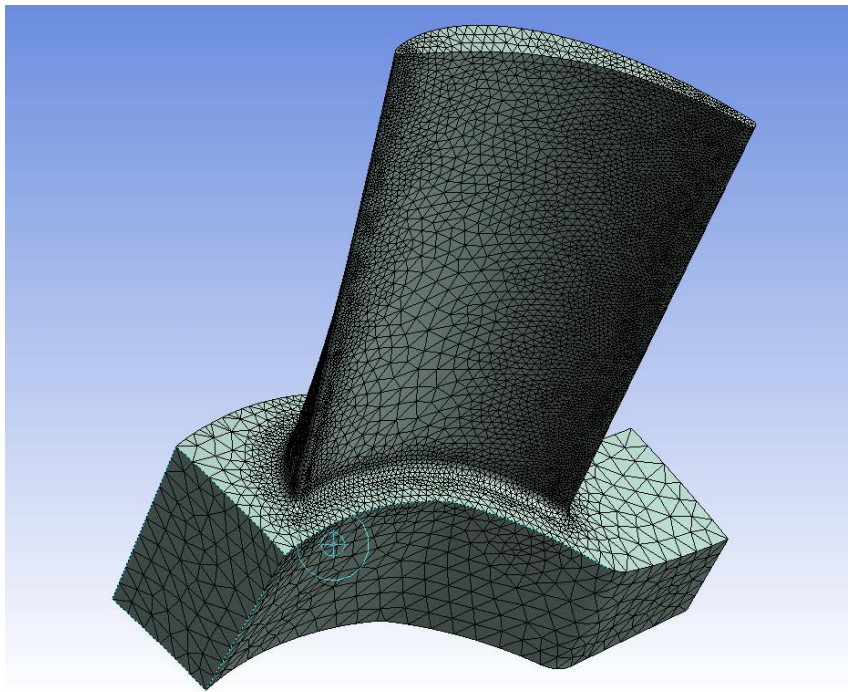


3. Regeneration of the model in ANSYS Design modeler

- Summary of regeneration the model in ANSYS Design modeler:
 - Redesign of the geometry in ANSYS Design modeler leads to a more simple and often more stable geometry.
 - Possibility of simplifications directly during the design process.
 - Therefore it is possible to avoid problematic geometries during the design process.
 - A CAD geometry can be exported out of the Design Modeler.
 - Note the double amount of work that has to be done – by creating two different models (CAD and ANSYS).

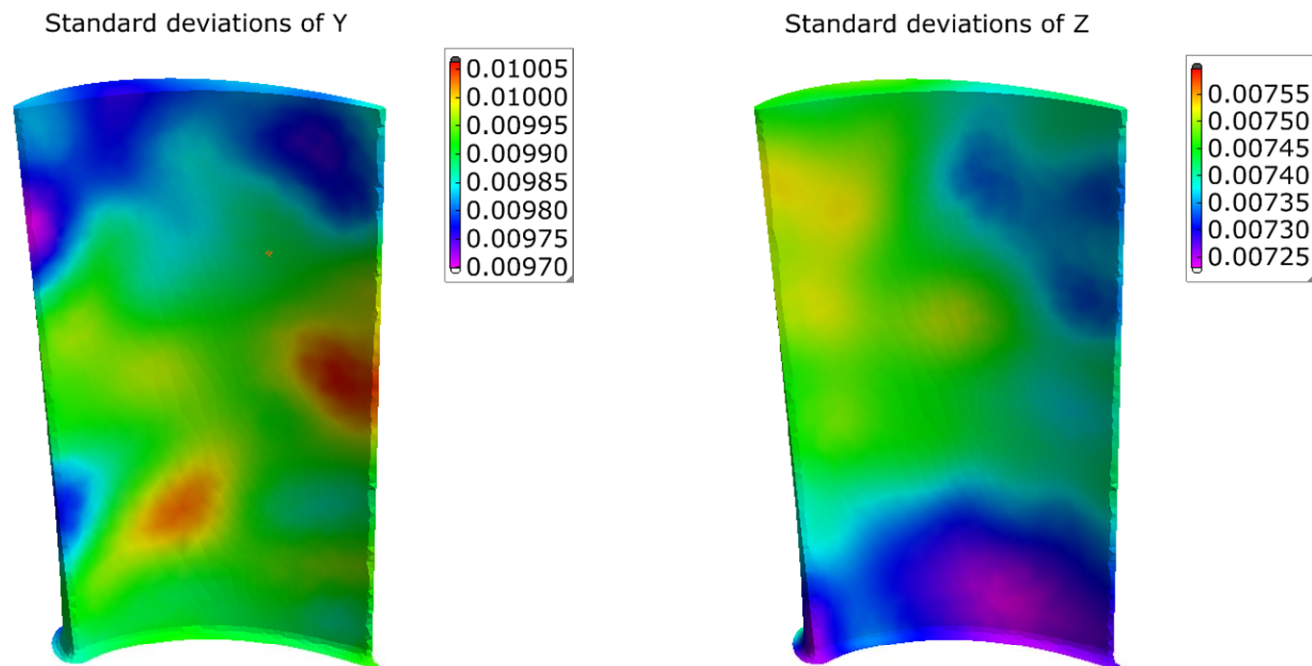
4. Small geometry variation by using random fields

- Axial Turbomachine: Robustness evaluation after optimization
- Random geometry, material and operation parameters
- Imperfect surface of turbine blade modeled as random field
- Robustness analysis controlled by optiSLang, CFD, thermal and structural analyses in ANSYS Workbench



4. Small geometry variation by using random fields

- Measurements:
- Geometry can be scanned on the surface of the blade
- Here, measures in y- and z-direction are taken (x: longitudinal direction)
- Mean values of imperfections are assumed zero



- (Standard deviations of measured imperfections)

4. Small geometry variation by using random fields

- Summary using random fields:
 - No geometry parameters have to be changed.
 - Small variations can be realized in a robust way.
 - Scatter on the surface structure represents tolerances quite well.
 - Variation space appropriate for robustness analysis.
 - No CAD model can be taken directly out of this models but this is usually not necessary during a robustness analysis.

5. Summary

- Finally, the following points shall be regarded working with geometries in Workbench and optiSLang:
 - The direct interface to a full CAD geometry shall be handled with care for complex geometries.
 - The first step is to simplify the model in the CAD system so that the regeneration can be done more easily and robust.
 - If it is not possible to realize a simplified CAD model, it is recommended to recreate the structure in ANSYS Design Modeler as simple and robust as it is possible.
 - Performing a robustness analysis, the random fields technology can be taken as an alternative for a stable model. Small variations will be handled here.