



Automation and Optimization - ANSA an Essential Aid

Marcus Christiansson

FS Dynamics Sweden AB

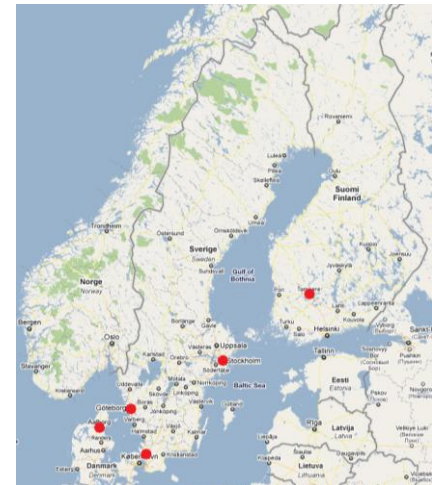
Mölnadalsvägen 24
SE-412 63 Göteborg
+46 (0)31-761 99 30
www.fsdynamics.se

Outline

- **FS Dynamics**
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 - Background
 - Overview
 - Example
- **Automated Optimization**
 - Background
 - Overview
 - ANSA Morphing
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- **Summary**

FS Dynamics

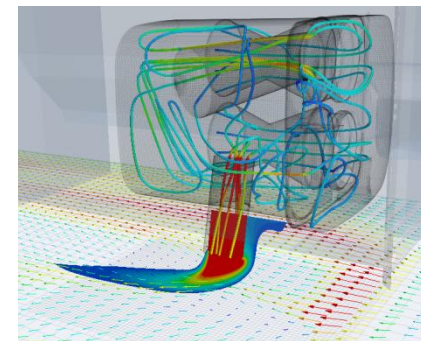
- **FS Dynamics is a consulting firm focused on CFD and FEM**
- **FS Dynamics was founded in 2004**
 - **Head office in Gothenburg, Sweden**
 - **Local offices in Helsingborg and Stockholm, Sweden**
 - **Local offices in Aalborg, Denmark and Tampere, Finland**
- **0-100 employees in 7.1 years**
- **Projects inhouse and at customer site**
- **Customers within various industries**
 - **Nuclear**
 - **Automotive**
 - **Marine**
 - **Process**
 - **Medical**



Automation with ANSA & STAR-CCM+

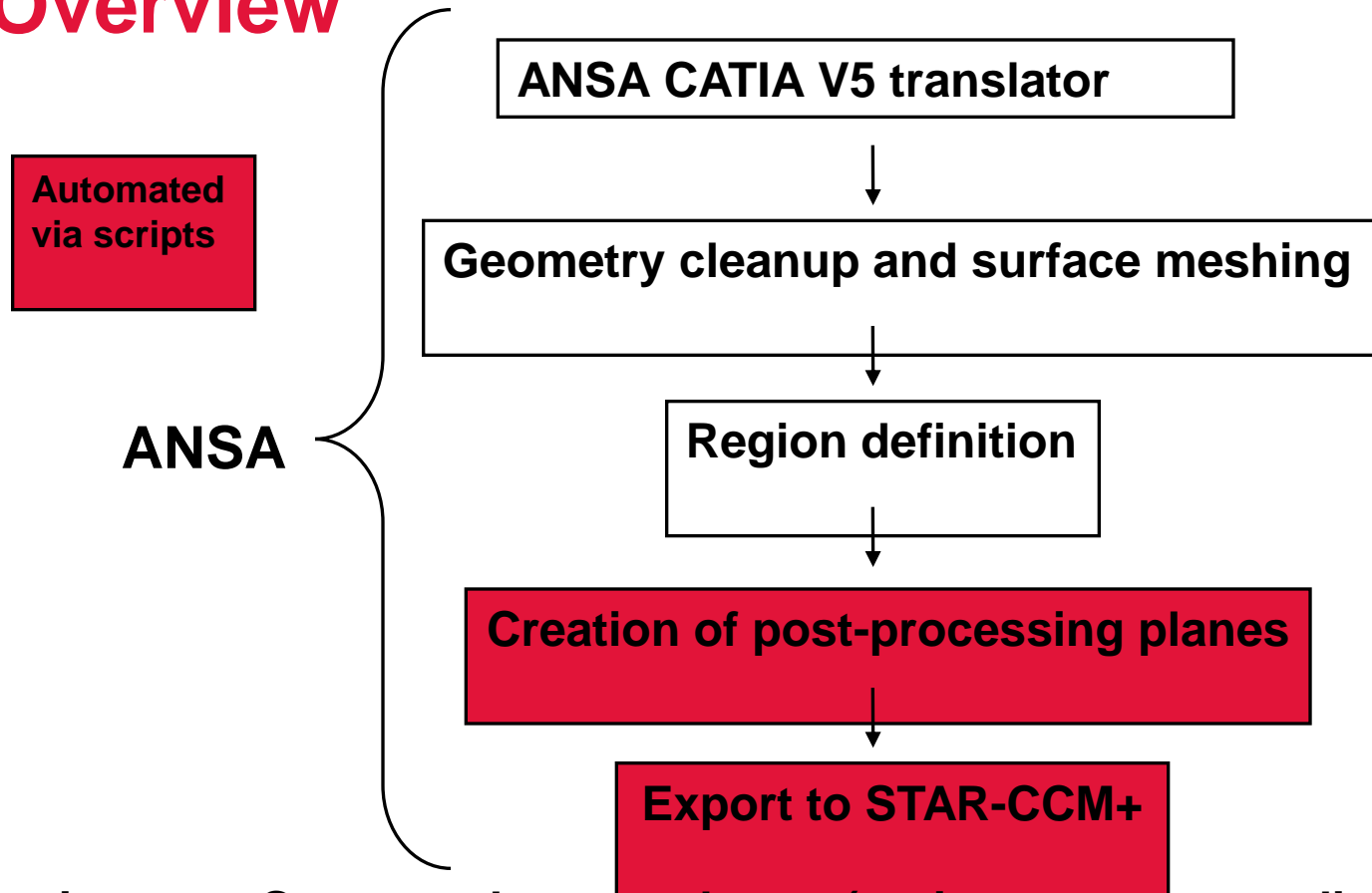
- Background

- On site CFD project at our customer Swenox AB
 - Exhaust aftertreatment systems for commercial vehicles
 - Pressure drop
 - Flow distribution in catalysts and filters
 - Outlet temperature
 - Urea spray
 - Surface temperature
- Change of software to ANSA and STAR-CCM+
- Main objectives with the new CFD process:
 - Automation
 - Robustness
 - Repeatability
- Higher quality of the results and cut lead time



Automation with ANSA & STAR-CCM+

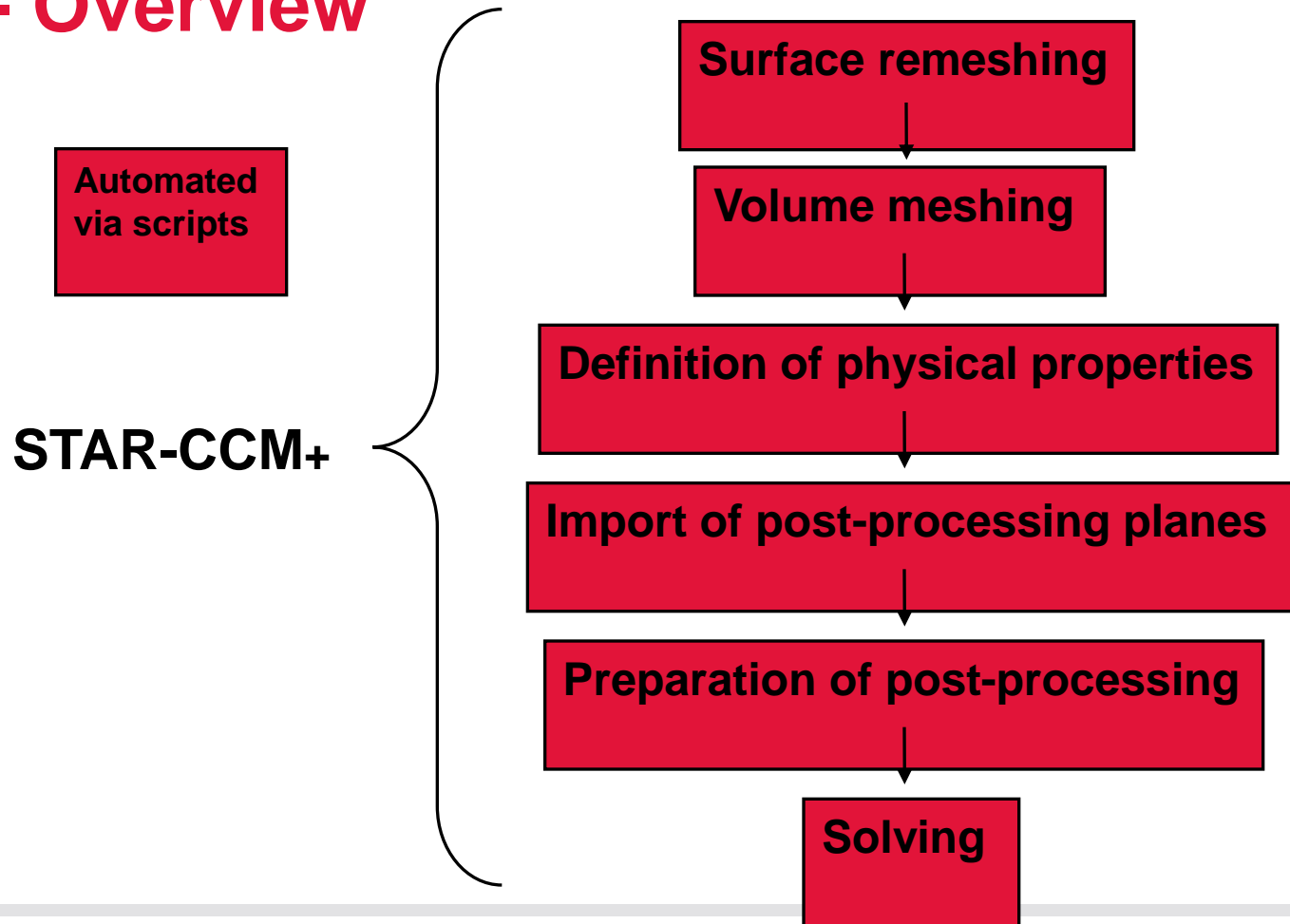
- Overview



- Requirement: Structured nomenclature (regions, porous medias, baffles etc.)

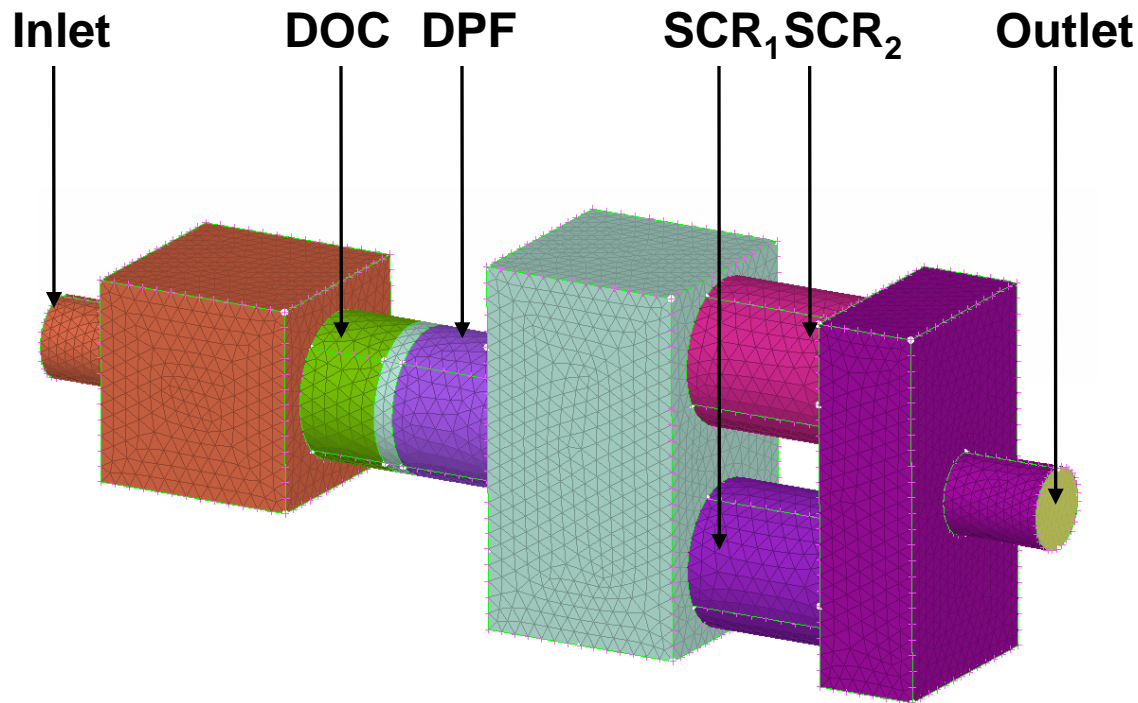
Automation with ANSA & STAR-CCM+

- Overview



Automation with ANSA & STAR-CCM+

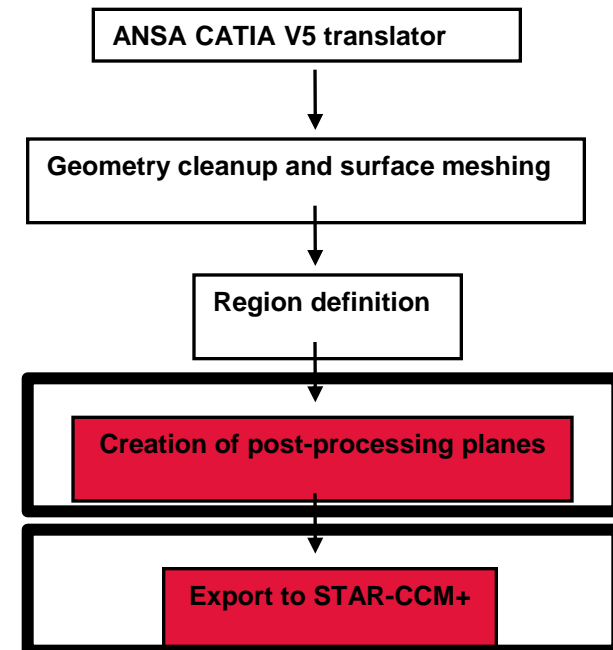
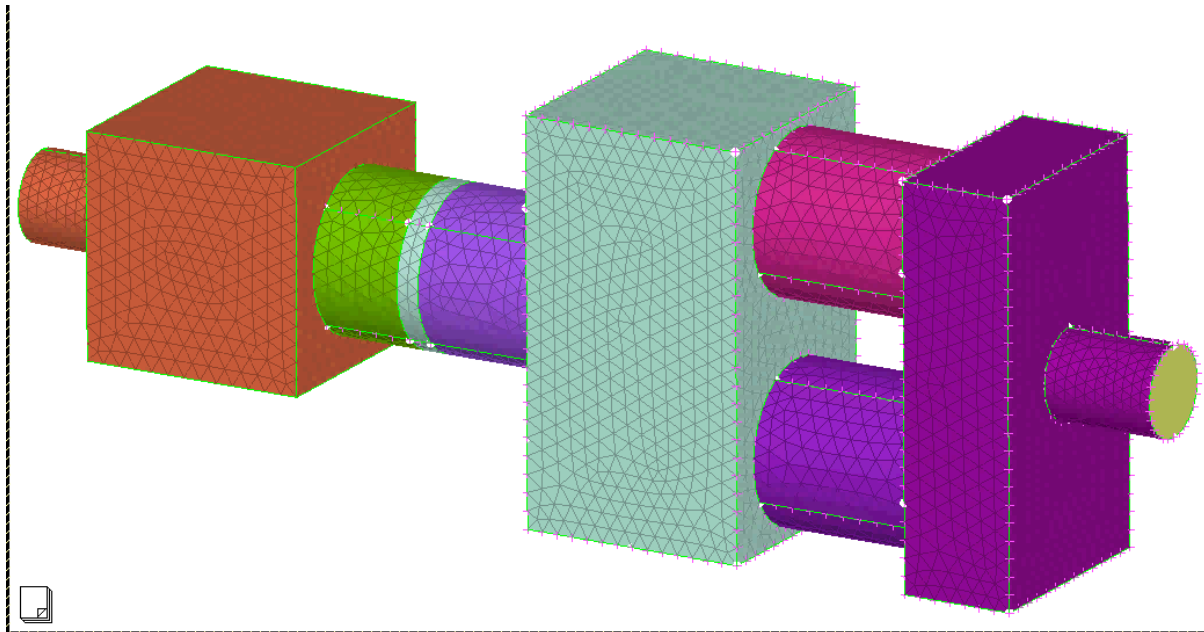
- Example



Overview of generalized Euro 6 exhaust aftertreatment system

Automation with ANSA & STAR-CCM+

- Example



Automated Optimization

- Background

- **Automated optimization:**
 - Screening and optimization with Design of Experiments
 - Single or multi objective optimization with global methods
 - Purpose: Optimization / robustness
- **FS Dynamics have carried out more than 15 automated optimization projects within CFD and FEM**
 - Incompressible / compressible flow
 - Combustion, Lagrangian particle tracking, strongly rotating flow
 - Geometry fitting within complex boundary geometry
- **Preferred method: ANSA, STAR-CCM+ and modeFRONTIER**
- **Requirement: Automated process**

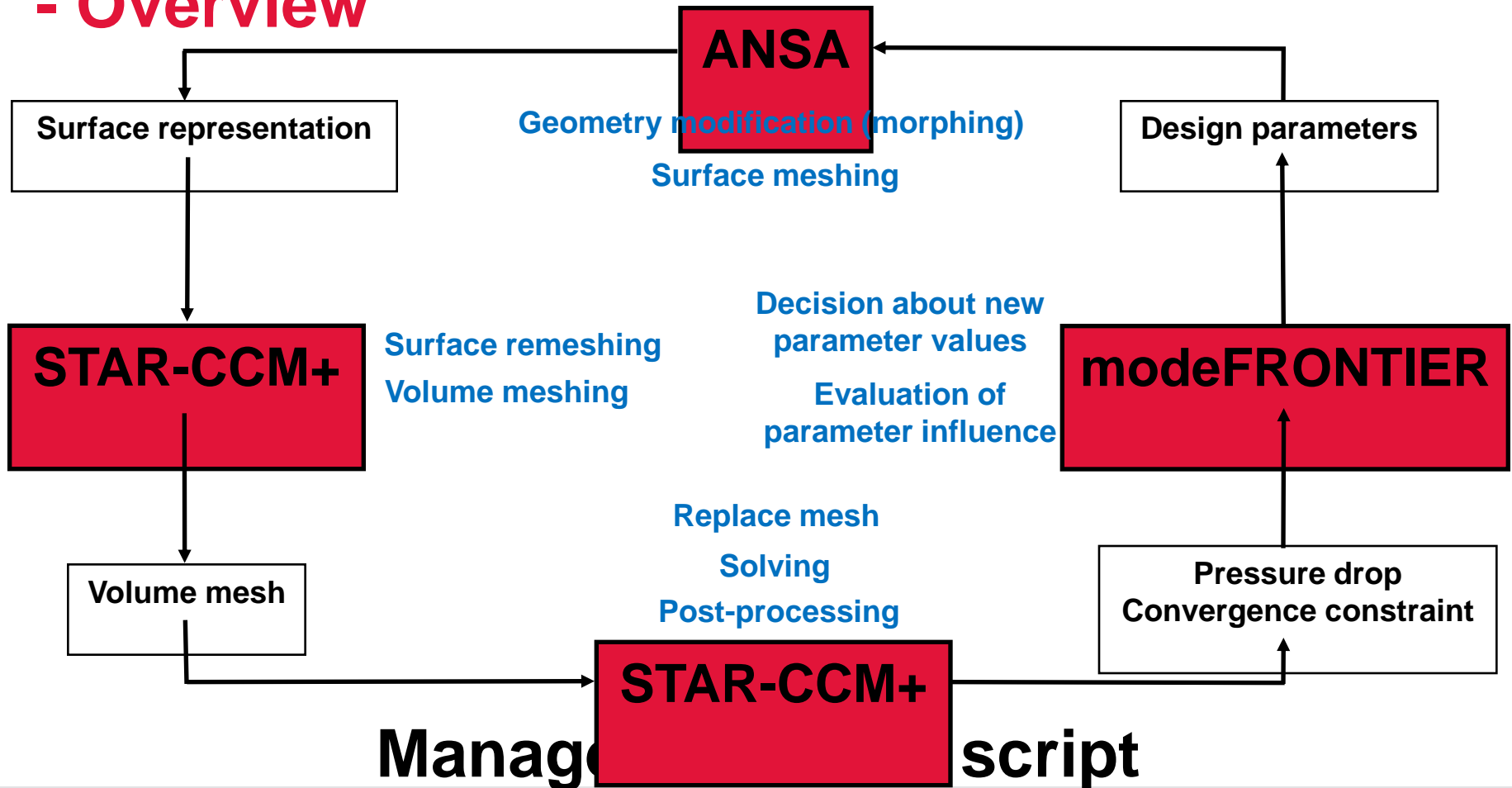
Automated Optimization

- Background

- **Specific optimization request in an ongoing CFD project**
 - **Goal: Minimize pressure drop**
 - **Much manual effort had already been spent**
 - **8 varying parameters**
 - **Significant constraints due to manufacturing and functional aspects**
- **ANSA, STAR-CCM+ and modeFRONTIER**
- **Presented geometries are from a generic model**

Automated Optimization

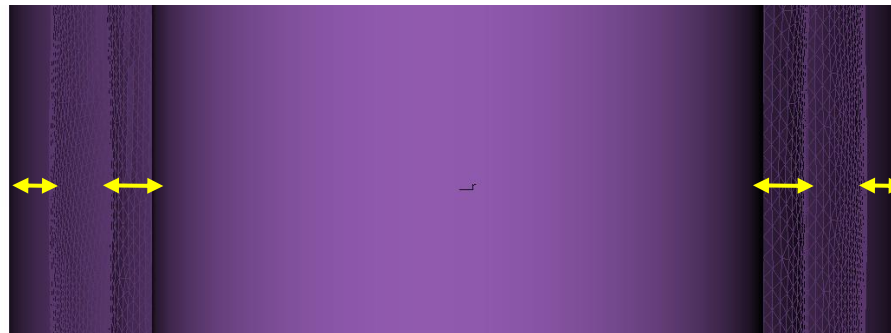
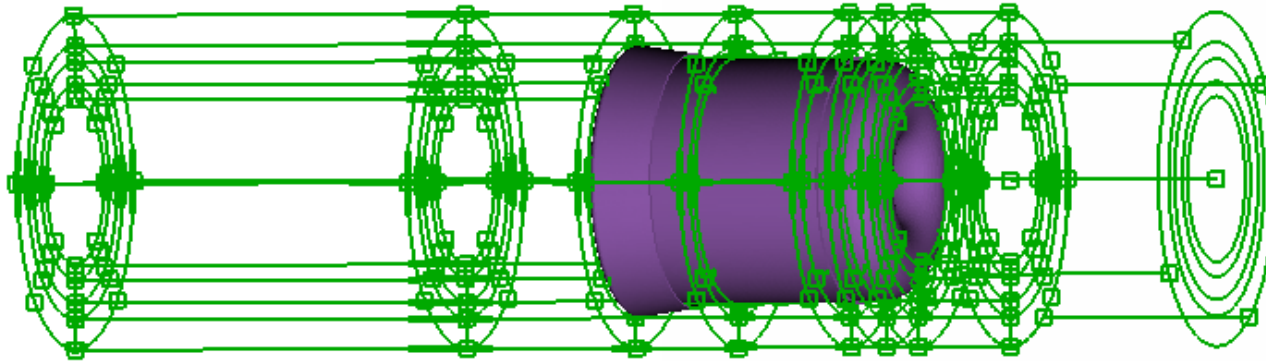
- Overview



Managed script

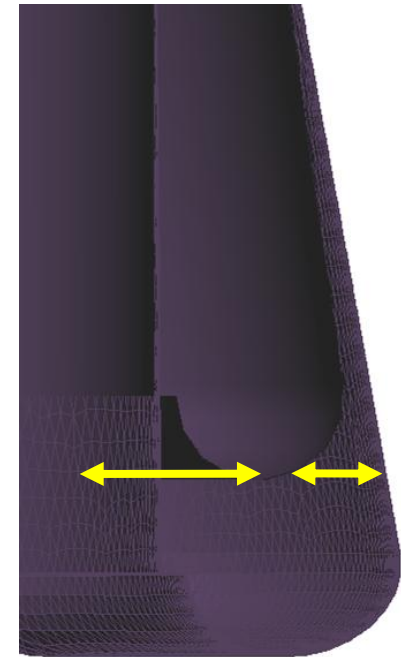
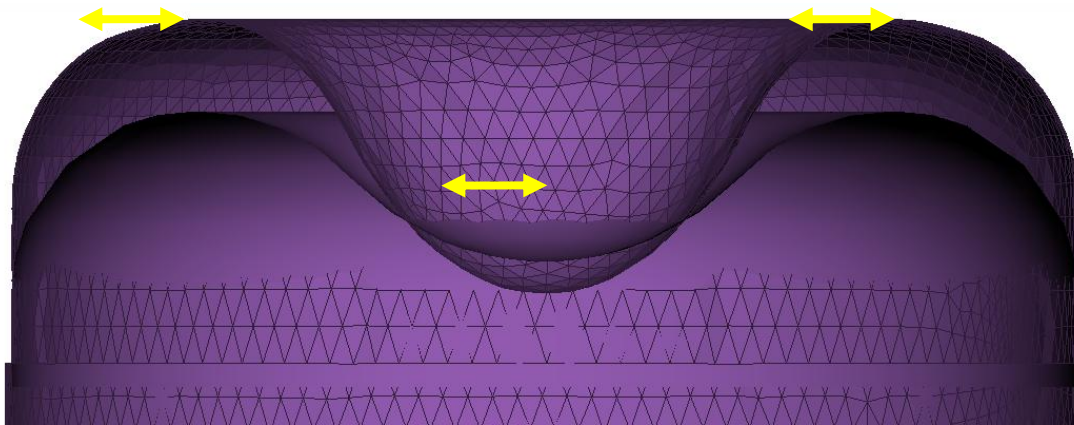
Automated Optimization

- ANSA Morphing



Automated Optimization

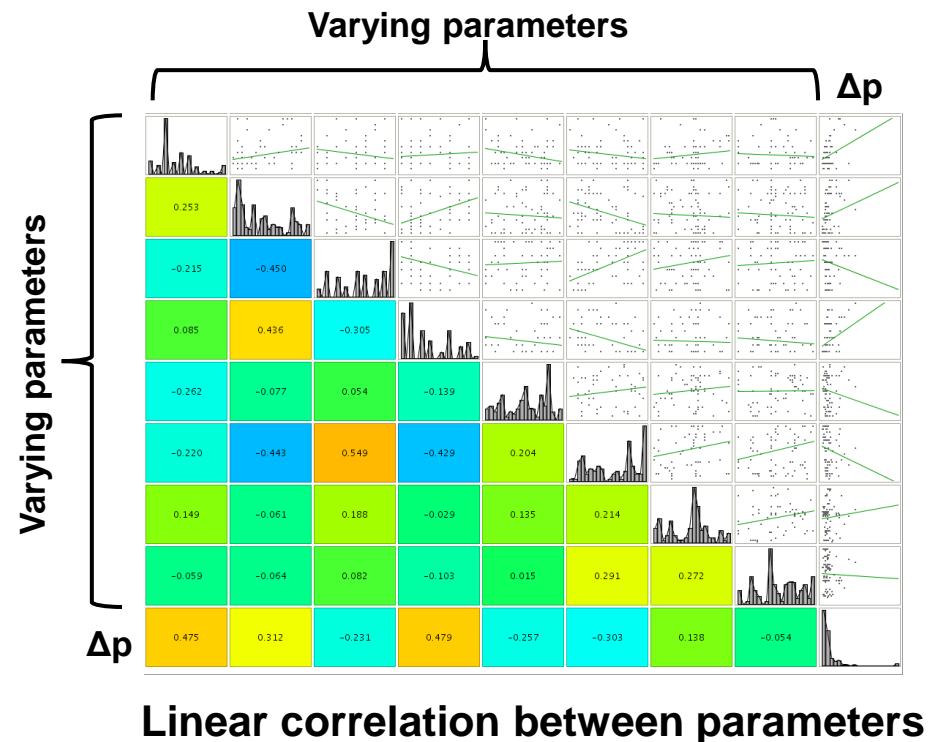
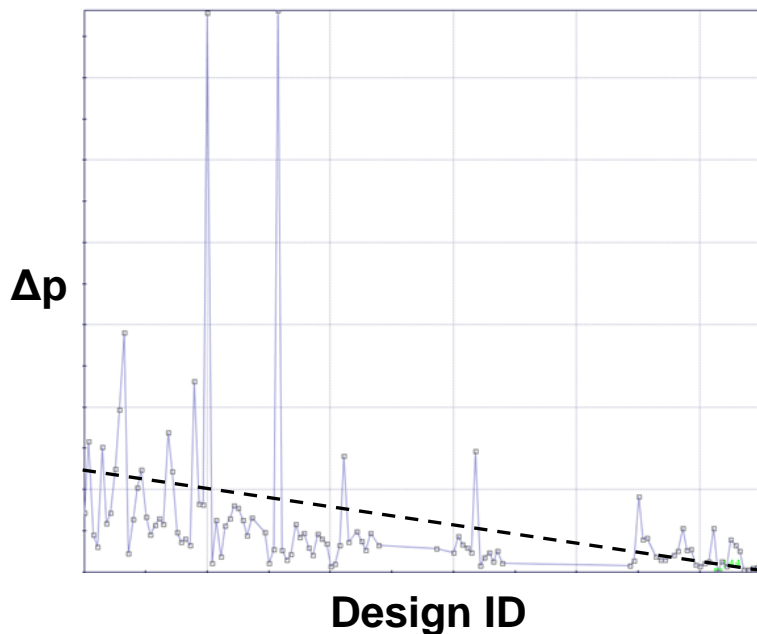
- ANSA Morphing



Automated Optimization

- Results

- The pressure drop was reduced 8 %, with the significant constraints fulfilled



Automated Optimization

- Results

- **The number of simulations performed were ~100, compared to $>10^{10}$ if evaluating all geometrical combinations**
- **Understanding about the robustness of the design was also obtained**
- **Most important: The project management was assured that the design was at its best level**

Summary

- Automation with ANSA and STAR-CCM+

- **Prioritized objects:**
 - Automation
 - Robustness
 - Repeatability
- Easy to introduce new CFD engineers
- **CFD results of higher quality in a shorter time**
- **Ultimately, cut costs and better products**

Summary

- Automated Optimization

- **Automated optimization yields better results and at a lower cost, compared with manual work**
- **Wider understanding of the potentials and robustness of the geometry is obtained**
- **The robust and repeatable process minimizes the risk of manmade errors**
- **Automated optimization in combination with CFD is well-established and with great future prospects in the industry**

Summary

- **ANSA is very suitable for both automation and optimization**
 - **Comprehensiveness**
 - **Scripting possibilities**
 - **Smooth interaction with other software**
- **Exceptional support at BETA CAE Systems!**

Automation and optimization

- ANSA and essential aid