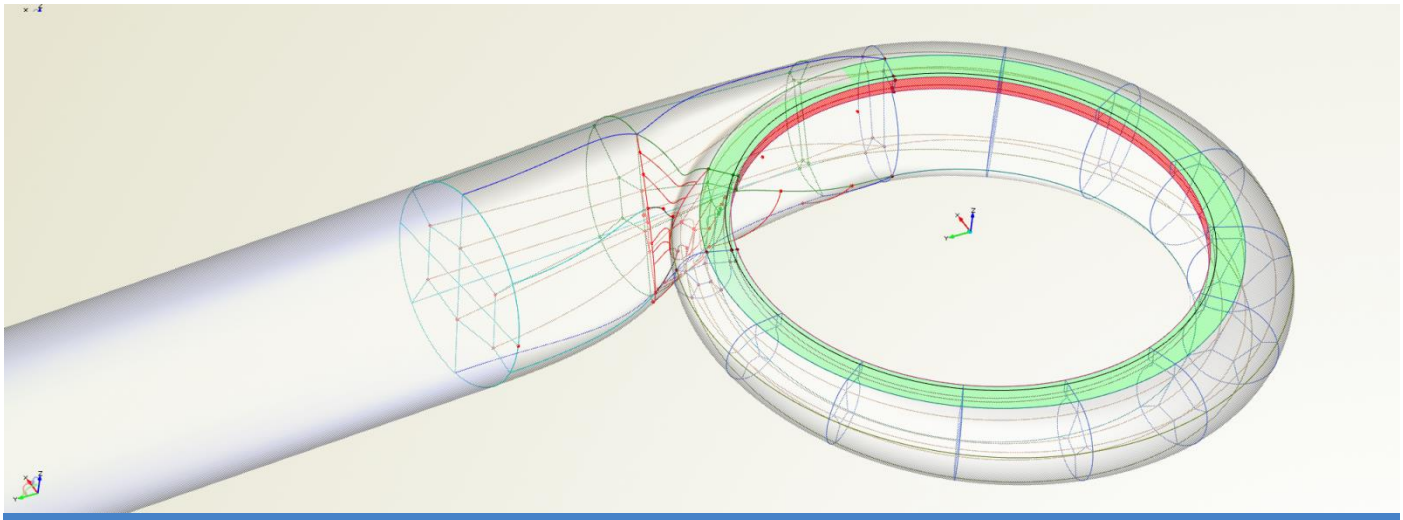


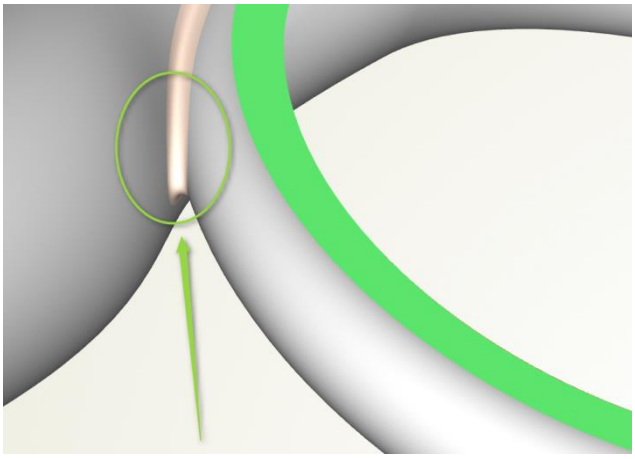
TECH BRIEF

AUTOMATE STRUCTURED MESHING WITH CAESES®

CAESES® optionally provides support geometry for structured meshing. For the fully-automated shape optimization with CFD, one key task is to robustly automate the geometry and mesh generation as well as the actual CFD analysis.
A very challenging task for complex geometries is the automation of structured mesh generation.

WHY STRUCTURED MESHES?

Compared to an unstructured mesh, structured meshes allow you to tremendously speed up the flow analysis, and they generally give you a better result accuracy.
Both are great when considering the investigation of large design sets with a high analysis quality. However, in the context of optimization, generating an unstructured mesh can be automated more easily – just hand over the geometry and off you go. This is typically not the case for structured meshes. Why?



Tongue area of turbocharger volute:
Difficult region for fully-automated meshing procedures

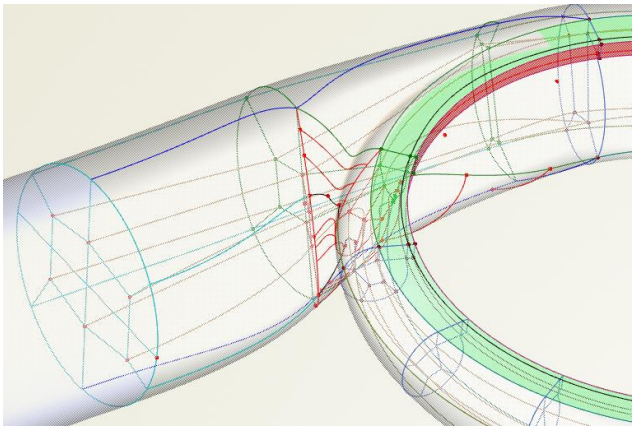
Well, the question is: How should your structured mesh actually look for an arbitrary shaped and feature-filled geometry? You have to somehow define it. When considering e.g. volutes for turbochargers, there is a small region in the geometry that makes it difficult to automate the process – the tongue area. Creating a block-structured mesh for this region automatically (!) for many different design candidates is typically a challenge and requires some smart techniques.

.

SUPPORT GEOMETRY

If you think about how to generate a structured mesh in such a flow volume, you quickly end up with the common idea of providing some helpful information to your meshing system. You simply cannot do it *automatically* in a generalized way for all types of complex geometries. Instead of only handing over a new design candidate to the meshing system, you can also set up and export a parametric support geometry in CAESES® that serves as a guide for the block structures. It inscribes some sort of logic how the mesh will be organized.

By means of this additional information, it is possible to automate the structured meshing process for a complex geometry. Since these inner curves are parametric objects and part of the geometry model itself, they also change when you modify the design variables of the design.

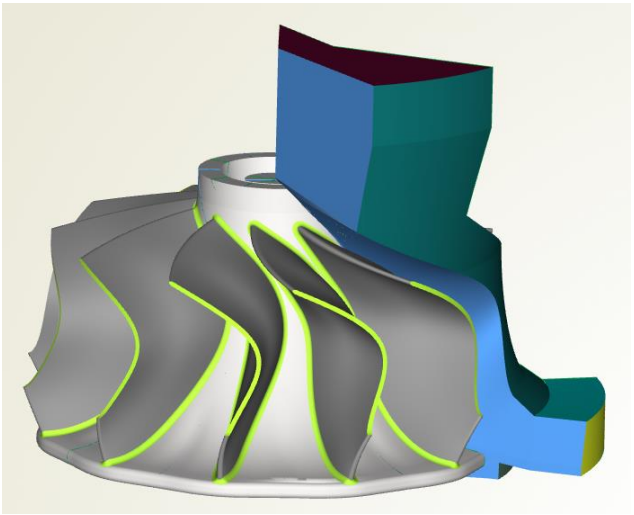


Support geometry that adjusts automatically to design changes and provides assistance for automated meshing

This is also possible for the non-GUI (batch) run where the geometry is created through a script within an optimization, e.g. controlled by external optimization tools. This makes it directly suitable for use in HPC environments so many designs can be investigated at the same time.

GENERALIZED SOLUTIONS FOR ANY GEOMETRIES

Setting up the support geometry is an additional task. The same counts for creating the automation script in the meshing tool that copes with it. However, if you do it in a flexible way for one class of geometries using the capabilities of CAESES®, then these setups can be applied for future projects with similar geometries.



Parametric flow domain in CAESES for automated meshing of turbines

A related example for such support geometry is the periodic flow volume of turbomachinery blades for compressors and turbines. This is an additional variable geometry the user sets up once, and re-uses it in all future projects.

CAESES® provides robust geometry operations that are required to create these support geometries. Boolean and trimming operations are fully-parametric, and dedicated to automated design studies and optimizations.