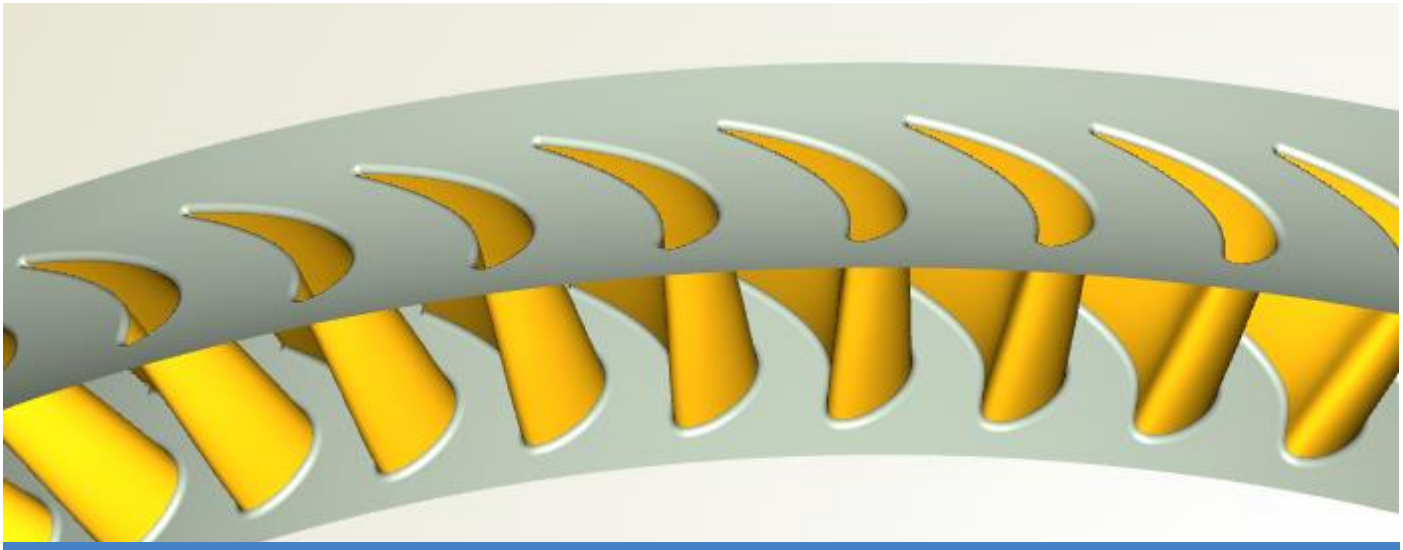


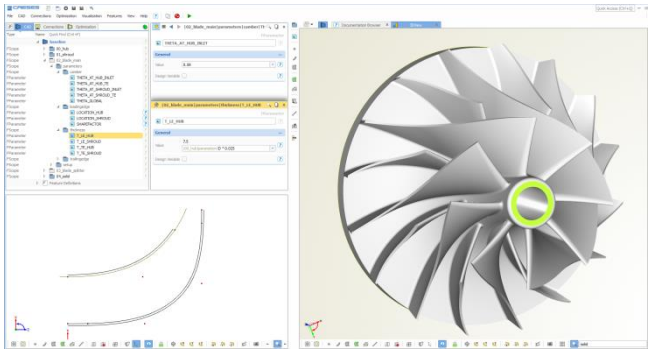
TECH BRIEF

ADVANCED DESIGN OF TURBOMACHINERY BLADES

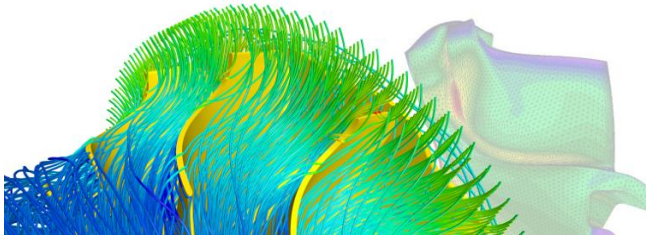
CAESES® is a powerful and flexible platform for the design of turbomachinery blades, including the optimization of advanced features such as endwall contouring. All parametric blade models can be robustly linked to any meshing and simulation tools to run automated design studies and optimizations with CFD. Example applications are turbochargers, gas turbines, fans and pumps – no matter whether they are axial, radial or mixed flow devices.
Leading companies such as SIEMENS, Toyota, MTU, KSB, Spencer Turbine and IHI are using CAESES® for the design of turbomachinery components.

WHY CAESES?

- Robustness and flexibility of parametric models
- High level of customization i.e. no black box models and full integration into existing workflows
- Integrated consideration of geometric/manufacturing constraints within model setups
- Intelligent reduction of the total number of parameters
- Comprehensive tuning possibilities of shape details, e.g. to better control local flow phenomena such as cavitation or swirl
- One-time preprocessing for all design variants
- Everything is geared towards automation, for the purpose of efficient shape optimization
- Incredibly fast support from the CAESES support team



Turbocharger compressor model in CAESES, fully-parametric and variable – ready to run automated design studies



Link the blade model to CFD and automate the analysis

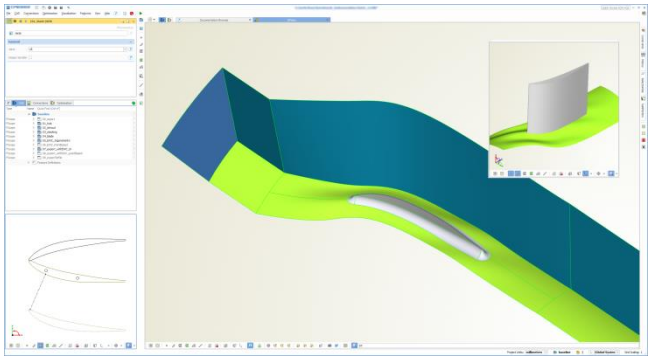
BLADE DESIGN – EFFICIENT AND FLEXIBLE

CAESES® blade models are ready for the fast manual and automated creation of new design candidates. Create single-blade and splitter blade models, and always have full access and customization possibilities such as:

- Any 2D profile parameterization including automated fitting procedures for using existing blades as a baseline
- Any meridional contours (imported data, parametric) for 3D mapping of 2D blade sections onto streamlines
- Any leading edge and trailing edge shapes including circular, elliptical, blunt, curved
- Any camber definitions based on beta or theta definition i.e. blade flow angle or wrap angle definition
- Any thickness distributions (imported data, parametric, mathematical)
- Full control for radii-based fillets (constant, variable) to consider stress and structural constraints
- Advanced 3D surface generation techniques to generate high-quality shapes and only feasible design candidates

PARAMETRIC SUPPORT GEOMETRIES

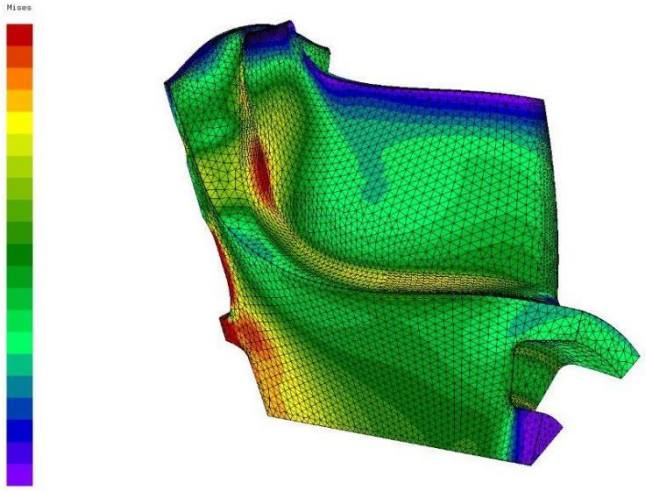
For the automated CFD analysis of new design candidates, CAESES® provides parametric support geometries such as the periodic flow domain. It adjusts to the shape of the blades and can be meshed automatically without any manual interaction.



Parametric stator model including endwall contouring and periodic flow domain for automated meshing

CFD AND STRESS ANALYSIS – IN ONE LOOP AND FULLY AUTOMATED!

The advanced and robust CAD capabilities of CAESES® allow you to also model the parametric solid domain of the blades including scallops for turbine wheels. As a result, the stress analysis can be also calculated in one loop together with the CFD analysis.
Having both disciplines in a single & automated loop can save you months of manual engineering work – thanks to the model representations in CAESES®.



Stress analysis based on the derived solid model from CAESES

> ***"We launched a pilot project to evaluate CAESES® in May, it helped us solve a time-critical task in July and it became a design tool by October. By then we had created flexible and robust parametric models for complex parts, enabling us to optimize in design spaces we had previously not been able to explore."***
>
> *— Tilmann auf dem Kampe, Head of Aerodynamics Techn. Dev., Large Gas Turbine Engineering*

SIEMENS