CAESES: CAD for Automated Design Studies with Simulation Tools

For simulation engineers who need to improve and optimize the fluid flow or thermal performance, of their products or address structural issues, CAESES offers efficient CAD and process integration to automate simulations that optimize product shapes. As a result, engineers can run large design studies overnight or over the weekend with hundreds or even thousands of design variants, to ultimately pick the optimal design, which, for example, shows the best aerodynamic behavior, or the greatest robustness. Unlike traditional CAD tools, the geometry generation in CAESES can be fully automated and does not break, or fail to regenerate, during variation. Hence, CAESES is best-suited to large automated design studies that are run on powerful workstations or High-Performance Computing (HPC) clusters.

Fig. 3 - Parametric turbocharger turbine including parametric flow and structural domain for automated meshing

Fig. 1 - CAESES comes with specialized CAD, CFD automation, and an integrated optimization environment

APPLICATIONS

CAESES is most commonly used whenever flow-exposed products need to be optimized in an automated way. It is integrated into the design processes at leading companies worldwide, such as SIEMENS, Samsung, VW, Toyota, Rolls-Royce, Ebara, Caterpillar, Suzlon and VOITH. Another large customer base is in the marine industry where the Computational Fluid Dynamics (CFD)-driven optimization of ship hull-forms and propellers are key engineering tasks. For instance, CAESES is used to design and optimize large container vessels where an optimized hull-form can save more than $ 1-million of fuel costs – per year!

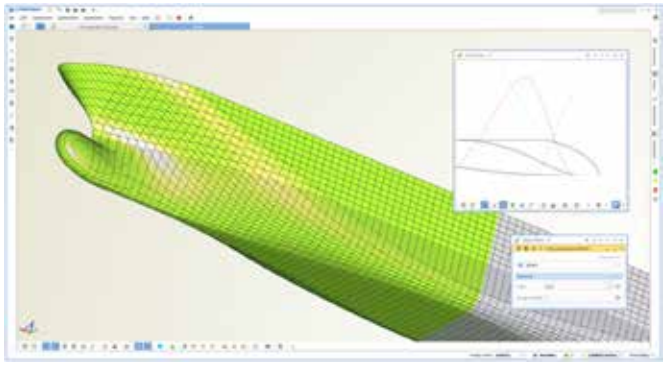

Fig. 2 - Parametric ship hull-form model in CAESES, variable and ready for shape optimization

Fig. 4 - Geometry modeling and automated variant creation of an intake port in CAESES

CAESES is also routinely used in the turbomachinery sector for the design of turbines, compressors, pumps, fans, and volutes. It has a dedicated turbo module, which allows users to design highly customized, 3D blades using, for example, meridional contours as well as camber- and thickness-based profile descriptions. These blade models are simulation-ready and optionally include the parametric fluid and solid domains for automated meshing.

Being able to define, control and optimize each detail of the blade is a major benefit compared to the use of standard black-box tools. The high customization and programming capabilities of CAESES provide users with a platform to incorporate all their expertise and innovative ideas, no matter which application is considered.

In the automotive industry, CAESES helps engineers to design and optimize the shape of critical components such as piston bowls, manifolds, intake ports, ducts and wings. These geometric models

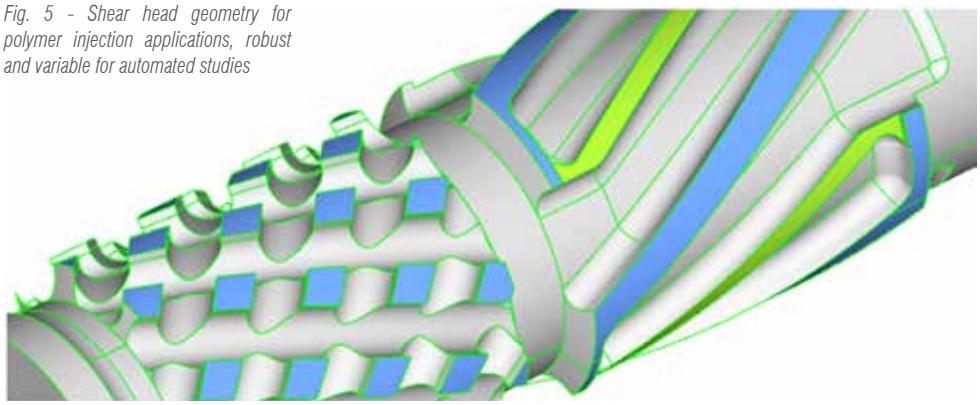

Fig. 5 - Shear head geometry for polymer injection applications, robust and variable for automated studies

are then also set up for automated processes and can incorporate geometric constraints such as space limitations, cross-sectional areas and target volumes. As a result, only feasible designs are created during the optimization process, which drastically reduces the overall computation time.

CAESES is also used in the medical sector for the design of blood pumps, and in process engineering to vary and optimize sophisticated free-form shapes (e.g. a shear head for polymer injection).

GEOMETRY MODELING

Traditional design and production CAD packages, although powerful, are rather detail-oriented and encompass features that are not relevant for simulation. CAESES can be considered a complementary tool in the pre-CAD stage, to optimize a product's

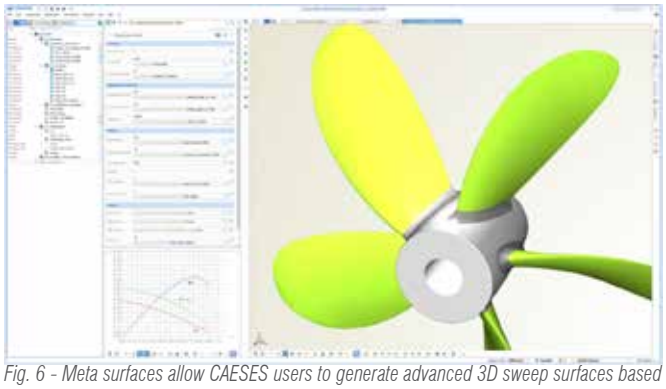

Fig. 6 - Meta surfaces allow CAESES users to generate advanced 3D sweep surfaces based on function graphs

performance using geometry models that are useful for simulation engineers. It focuses on complex surfaces that are difficult to parameterize with other tools and where the generation of an automated geometry is challenging and needs to be 100% robust. CAESES includes specialized modeling approaches for smarter surface design, such as the proprietary Meta surface technology, which allows users to create advanced sweep surfaces based on parametric 2D profiles. These surfaces can be controlled in the 3D space through user-defined function graphs. This intuitive and efficient technique can massively reduce the number of design parameters and at the same time generates extremely smooth shapes.

For rapid design studies of existing CAD geometries, users can import their data and apply shape changes such as free-form deformations and Radial Basis Functions (RBF) morphing.

OPTIMIZATION

Besides geometry modeling, CAESES comes with integrated capabilities for the automation of Computer-Aided Engineering (CAE) tools and with advanced optimization strategies. The user can create design variables with lower and upper bounds for all geometry and analysis parameters. These variables can then be accessed by the different integrated optimization strategies, such as sampling methods, genetic algorithms and efficient response surface techniques.

External third-party optimization tools can also be used to control and change the values of the design variables, as an alternative to CAESES' integrated optimization strategies. For this purpose, CAESES offers an easy-to-use batch mode option to enable it to be integrated into any workflow as a background CAD engine. For batch mode use on cluster systems, CAESES is also available in a Linux version.

THE COMPANY BEHIND CAESES

CAESES is developed by the German company, FRIENDSHIP SYSTEMS AG. With more than 15 years of expertise in parametric modeling and optimization, FRIENDSHIP SYSTEMS is one of the leading suppliers for parametric, simulation-driven shape optimization in the CAE industry.

For more information, visit:
www.CAESES.com

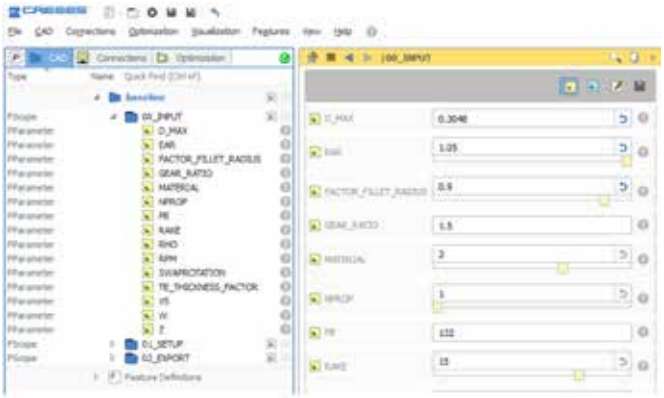

Fig. 7 - Design variables of a CAESES model with lower and upper bounds that can be changed manually or automatically