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TOSCA Fluid

Design and Optimization for Fluid Flow Systems

FE Design

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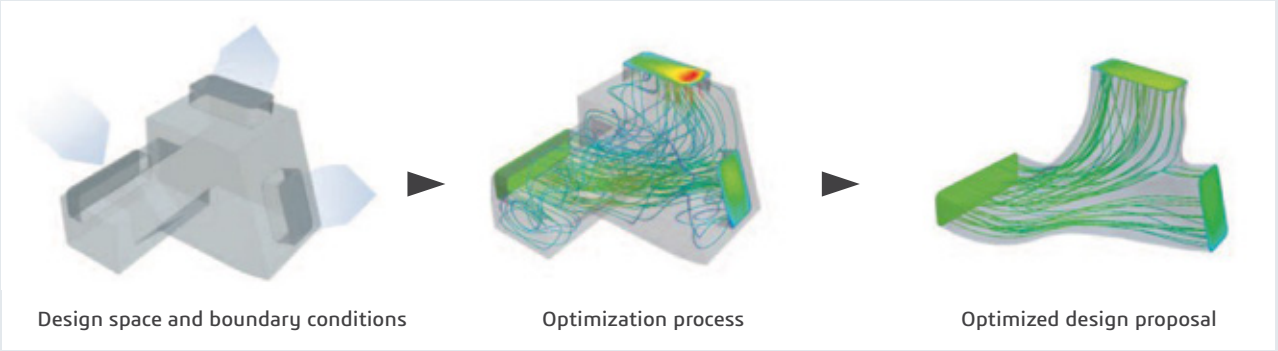
TOSCA Fluid is a unique, modular software system for non-parametric fluid flow optimization that enables topology optimization with industry-standard CFD solvers. The setup is simple. No model parameterization is necessary, and existing simulation files (even large scale CFD models) can be used for optimization. TOSCA Fluid offers state-of-the-art optimization technology that helps engineers to develop innovative product designs based solely on a given design space and a defined flow task. No initial design is necessary, and only one solver run is needed.

TOSCA Fluid Features

Innovative design concepts with reduced pressure drop and enhanced flow uniformity

Topology optimization – conceptual design to create fluid flow devices with reduced pressure drop and / or improved flow uniformity. Profit from full design flexibility to create a design proposal in the initial design phase. Achieve design goals using the available design space and achieve fast turnaround from analysis to design, with a single CFD solver run.

Create optimized product concepts with increased flow efficiency, which require less physical testing and fewer prototypes. Achieve a shorter time-to-market and improve your competitive position with state-of-the-art, eco-efficient designs.



Design space and boundary conditions | Optimization process | Optimized design proposal

Powerful graphical user interface

Intuitive and easy to use GUI which allows for fast setup and direct execution of optimization tasks. Monitoring of the optimization progress with real-time feedback, using industry-standard CFD solvers. Intuitive postprocessing and geometry generation for optimized design proposals.

TOSCA Fluid advanced capabilities*

Mass flow balancing

Flow balancing tasks - generate design concepts for a desired flow split ratio with multiple given outlets. Achieve an optimized flow distribution for maximum comfort and energy efficiency. Typical applications for flow balancing are HVAC components, flow splitters, and heat exchangers (among others).

Reduction of flow instabilities, induced noise and vibration

Flow acoustics optimization - achieve significant noise reduction by eliminating flow instabilities. Design products with enhanced flow efficiency. Achieve a balanced and noise reduced flow solution for increased efficiency and comfort. TOSCA Fluid has been successfully used for the design of noise and stability-sensitive components such as climate control components, hydraulic systems, pneumatic components and cooling ducts.

** for selected cases - depending on given technical and physical conditions*

TOSCA Fluid Key Benefits

Features and Benefits with TOSCA Fluid

TOSCA Fluid features unique design and optimization technology for fluid flow components. Utilize full design flexibility and create an innovative, optimized design concept for defined design spaces and flow tasks.

- Seamless integration with leading CFD solvers permits consistent reusability of existing CFD-models, as well as high quality results
- Full design flexibility without time-consuming parameterization, scripting and code coupling
- Innovative design ideas based on a defined flow task and available design space, no initial design is necessary
- Optimal utilization of the given design space
- Works for industrial large scale models with arbitrary complex design spaces
- A single CFD-solver run is sufficient for the optimization
- Uses CFD-analysis tools for automated design development with a focus on reduced pressure drop and improved flow uniformity
- High fidelity optimization to reduce noise level and improve flow split ratio
- Powerful graphical user interface for easy postprocessing and geometry generation of optimized design proposals
- Faster time-to-market for innovative designs
- Shorter development cycles by combining design and optimization of fluid flow tasks early in the design process
- Advanced designs with higher product performance and reduced energy consumption
- Automated design development leads to less physical testing and a reduction in the number of prototypes

Examples of the industrial use of TOSCA Fluid

Air outlet vent

The redesign of an air vent should result in a new device with lower pressure loss and improved flow distribution between driver's side and passenger's side.

With TOSCA Fluid topology optimization, a better design can be created. By reducing both pressure loss and noise at the same time, the result is an efficient and comfortable alternative to the original air vent. With TOSCA Fluid technology all performance objectives for the air vent were met. With less fan power needed, additional cost savings can be achieved.

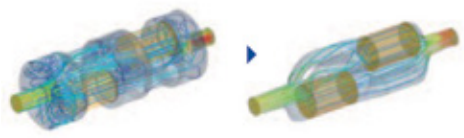
Final design

The use of TOSCA Fluid in the redesign process resulted in a pressure drop reduction of up to 50%, better flow efficiency, and overall cost savings. For an enhanced comfort, the flow distribution ratio between driver and passenger was improved from 40%/60% to almost equal.

Dual stream DOC design concept

Design of a dual stream Diesel Oxidation Catalyst concept that processes higher gas volumes without extensive pressure drop - still using conventional 5 2/3 inch monoliths.

To create a space-saving design for flow guiding components (like flow splitters, diverters, and collectors) a topology optimization driven design based on an initial design space was executed. After the optimization, the individually optimized components were assembled to create a new dual stream DOC design with significantly reduced pressure drop, enhanced flow split ratio and high flow uniformity across the catalytic sections. The resulting design has optimal performance and improved eco-efficiency.



Courtesy of Albonair GmbH

Using topology optimization, a new and promising DOC design was generated. The pressure drop has been reduced by 65% while the flow distribution ratio of the new design concept improved from 47/53 to almost equal. The entire design process took only two weeks.

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