

the optimization company



Aerospace



Appliance



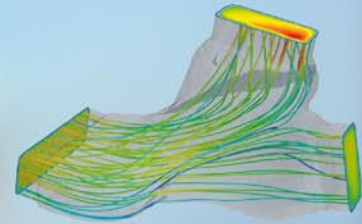
Energy & Power



HVAC



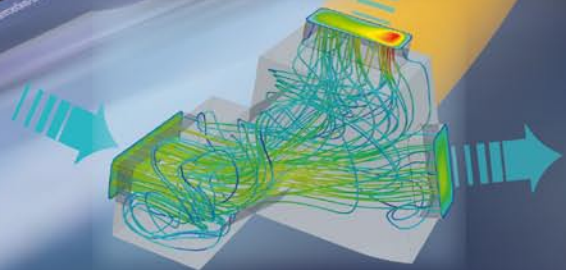
Process Industry



Final result



Optimization



Initial design

The Optimization Suite for Fluid Flow Systems



FE-DESIGN is a leading full-service optimization solution partner for numerical simulation, precise optimization and automation.

FE-DESIGN supports customers to develop products faster, better, more reliable and cost-saving by providing best-in-class optimization technology, software and services and integrating them into the virtual product development process.



TOSCA Fluid – The Optimization Suite for Fluid Flow Systems

Why

You are already applying powerful CAE techniques in the product development process to meet the growing and challenging demands of the market. Energy efficiency, quality requirements, environmental aspects and global competition lead to increasing demands and necessitate to exceed existing limits. Benefit from previous investments and leverage the output of your existing CAE environment by using automated optimization techniques without time consuming parametric setup. Extend the solution space for your specific design task dramatically and save time and efforts by reducing series of costly CFD analyses to one single optimization run.

Topology optimization with TOSCA Fluid helps you to find and speed up new optimized design proposals in a very early phase of the product development cycle. Simple input, low modelling effort, giant solution space and one single solver run.

What

TOSCA Fluid is mainly focused on industrial, internal turbulent flow systems in a conceptual design phase. It also supports the optimization process for existing designs with alternative design proposals.

Main optimization tasks are pressure drop reduction, noise diminution, flow homogenization and several other optimization challenges.

How

TOSCA Fluid uses your existing CAD/CAE design and simulation environment for enhanced CFD optimization tasks. A new optimized design proposal will be generated on a cell per cell basis in just one single CFD-run based upon the available meshed design space with given boundary conditions.

TOSCA Fluid is based on an unique non-parametric topology optimization scheme which combines straight forward operability, inspiring possibilities and unmatched efficiency. As a result the overall development costs and development time will be reduced significantly.

Pre

The users of TOSCA Fluid stay in their familiar pre-processing environment. Every CFD pre-processor that is able to generate respective TOSCA supported solver input files can be used for pre-processing of the design space for the optimization. Based on a "ready-to-run" CFD-case the optimization will be easily set up in the user friendly, interactive graphical optimization environment of TOSCA Fluid.

Optimization

TOSCA Fluid operates in conjunction with a standard CFD solver. The optimization is carried out directly during the CFD solver solution process. TOSCA Fluid uses an interface to the CFD solver for exchanging data during the runtime. Both, the CFD solution and the optimization process are executed simultaneously. Consequently only one single CFD solver run is necessary for the complete topology optimization.

The present approach of TOSCA Fluid allows for the first time topology optimization of industrial large scale flow applications.

Post

TOSCA Fluid is generating native mesh-based post-processing information with the relevant optimization output for visualization and evaluation of the optimization results. To extract the geometry proposal for a new channel design several extraction methods are available. Typical optimization results consist of a mesh-based design proposal.

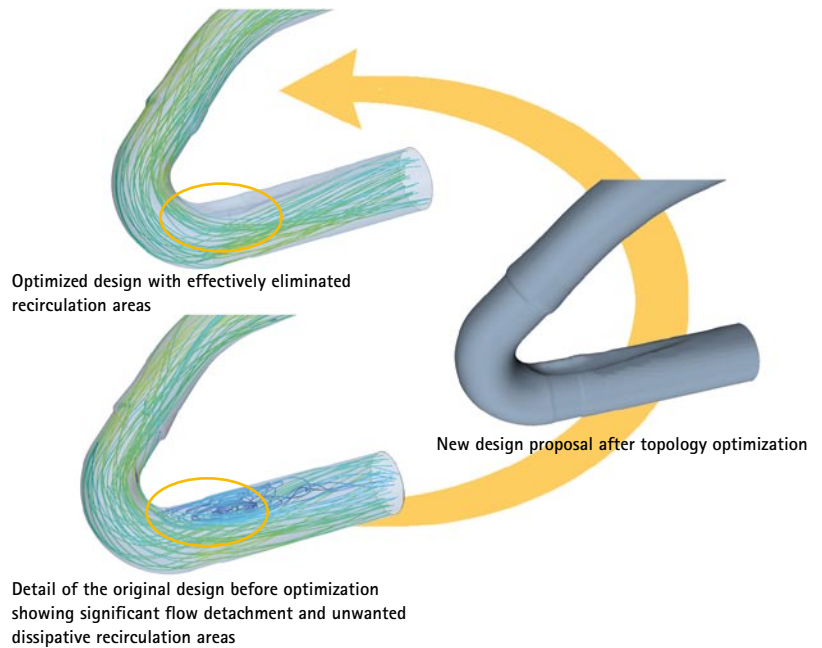
Results from topology optimization are smoothed and transferred to IGES and STL format for an import into standard CAD-systems or for generating meshes for subsequent verification analysis.

Examples of the Industrial Use of TOSCA Fluid

Pressure Drop Optimization of an Intercooler Intake Hose (with courtesy of Adam Opel GmbH)

After the principal layout of the underlying engine, additional components and their infrastructure have to be designed. Starting with a first design idea for the intercooler intake hose a subsequent optimization should lead to a preferably low total pressure drop. As an additional constraint, the new design must not exceed the space defined by the initial design due to geometrical limitations by other components. Conventional optimization techniques like CAD-parameter based schemes may be limited in this design case due to their extensive computing time, potentially time consuming pre-processing setup, difficulties in account for all design space restrictions as well as their inherent limitations in solution space. These disadvantages are eliminated using TOSCA Fluid for topology optimization.

TOSCA Fluid provides the designer with a design proposal in a given design space where TOSCA Fluid reduces the pressure drop by eliminating existing recirculation zones and backflow areas. A new design proposal is automatically generated by minor changes of the existing design volume. Due to the design space restriction the new design fits entirely into the installation space occupied by the original part. The achieved pressure drop reduction of the optimized design proposal is approx. 20% in this case while the total volumetric change of the design is less than 3%. The new design proposal shows a significant performance improvement and was achieved with only one single CFD-run.

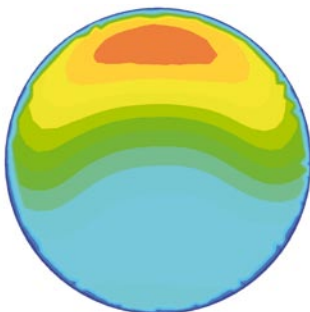


Optimization of the Flow Distribution in a Heat Exchanger

The design of exhaust gas recirculation coolers is often a difficult design task. From the fluidic side, an optimal design (like for almost any kind of heat exchangers) will consider not only small low pressure drop but also preferably homogeneous flow profiles through the heat exchanger matrix which may affect the exchanger efficiency dramatically. On the other hand, the available design space for the solution is complex geometrically constrained.

Starting with a generic design space of two regular cubes, a new design proposal is generated with a TOSCA Fluid topology optimization. The fixed diameter between the two regular cubes defines the location where the heat exchanger is mounted.

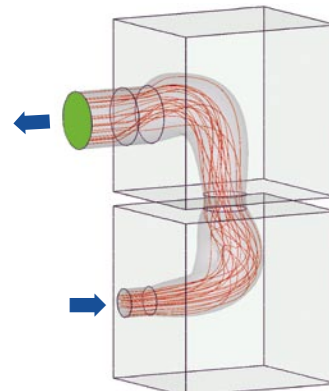
The optimization is performed within one single CFD-calculation. The fundamental design requirement for the solution is to provide a 180-degree flow pipe with low pressure drop. Additionally, a preferably homogeneous flow profile should be achieved at the outlet of the bend where the flow enters into the exchanger matrix. The optimization is resulting in an unconventional new design proposal with very promising performance. The achieved flow uniformity improvement of the new design results in a 10% heat exchanger efficiency enhancement. Additionally, the total pressure drop of the new design is decreased 20% compared to a traditional design.



Flow velocity Profile at outlet cross section area for the original 180-degree bend



Flow velocity Profile at outlet cross section area for the optimized 180-degree bend



New 180-degree bend within the given design space (resulting flow after the optimization is visualized using pathlines)

Key Notes of Optimization Solutions for TOSCA Fluid

Technology

- Unique technology for fast and efficient topology optimization by customer-focused development and joint strategic research projects
- Special focus on optimization of internal flow problems and large models

Integration

- Support of the workflow within your preferred CAE-environment
- Use of your favourite CFD-Solver guarantees high quality of calculated results
- Direct use of existing CFD-models in the optimization
- Pre- and post-processing in your familiar environment
- Strong partnership with the leading CAE software vendors

Performance

- Efficient and fast optimization by direct runtime coupling of the optimization to the CFD solver
- Parallel operation according to the supported CFD solvers
- One single CFD-run necessary for a complete optimization
- Unmatched efficiency for large industrial CFD-models

Training and Support

- Technical and support hotline by experienced CAE and optimization staff
- Training onsite at customers' location
- Basis and advanced training seminars at FE-DESIGN's sites

Handling

- Easy setup of optimization problems using the graphical user interface (GUI)
- A standard optimization problem is defined in 5-10 user clicks using the GUI
- No model parameterization is required
- Post-processing and data transfer of optimization results in your preferred CAD/CAE environment

Benefits of using TOSCA Fluid for the Product Development Process

- Fast and easy design optimization impacting the first development stage
- High innovative strength due to potentiality inspiring designs and large solution spaces
- Straight forward pressure drop reduction, noise diminution, flow homogenization and several other optimization tasks
- General reduction of development time and development cycles which saves your costs

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Typical Applications

- Aerospace
- Air intake system
- Appliance
- Automotive
- Biotechnology
- Chemicals
- Climate control
- Electronics
- Environmental
- Exhaust gas systems
- Healthcare
- Heat exchanger
- HVAC
- Medical equipment
- Oil & Gas
- Piping
- Power generation
- Powertrain
- Process industry
- Pumps
- Thermal cooling
- Turbo machinery
- Valves

