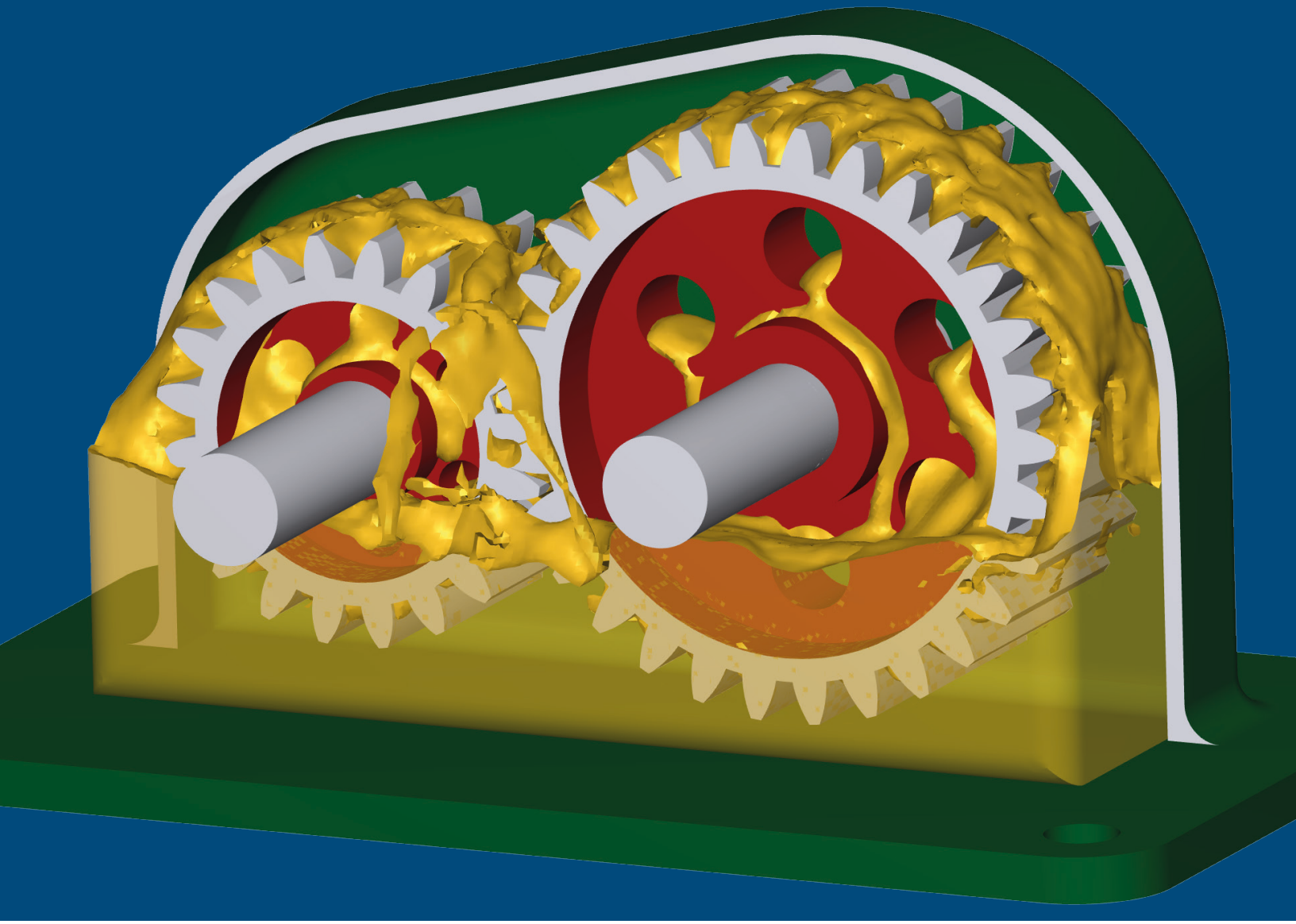
SPATIAL

Simerics
TECHNOLOGY BY DESIGN

SPATIAL SDKS ENABLE SIMERICS TO DEVELOP INNOVATIVE SOLUTIONS FOR COMPUTATIONAL FLUID DYNAMICS



DASSAULT SYSTEMES

Challenge:

There several issues that exist today with traditional CFD simulation workflows:

- CFD analysts are not CAD users
- No ability to update the CFD model when the CAD model changes
- Fundamental differences between CAD and CFD models

Solution:

Combination of custom, in-house algorithms, interacting via a rich API with a 3D modeling kernel, ACIS for analysis, plus 3D InterOp to handle model data translation.

Results:

- Tight coupling of CFD analysis with physical design without forcing CFD analysts to become CAD experts
- Greatly improved analysis cycle time
- Expanded CAD format support

The Bellevue, Washington based Simerics, Inc., is the leading developer of state-of-the art computational fluid dynamics (CFD) software. Simerics develops, markets, and supports CAE software for the virtual simulation and testing of fluid pumps, valves, compressors, motors, and even for boats moving through open water.

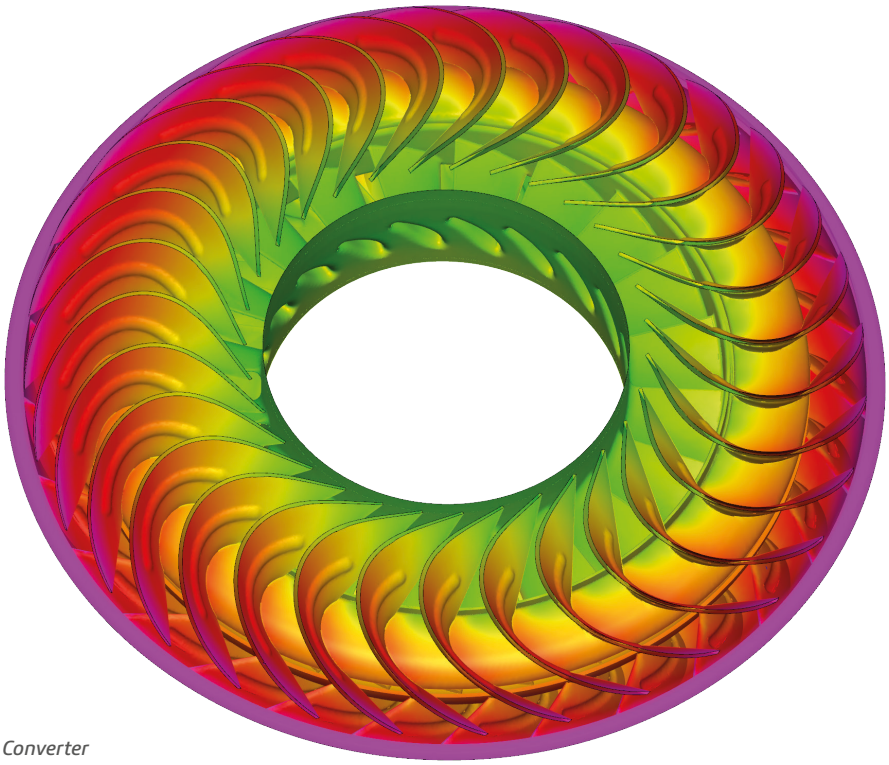
The dynamic team at Simerics is composed of scientists and engineers who were among the pioneers in the development and application of multipurpose computational physics since the early 1980s. This knowledge and experience is combined with new advances in computational physics, computational geometry, and software engineering to provide their clients with the next generation of fluid simulation tools.

COMPUTATIONAL FLUID DYNAMICS AND 3D MODELING

A branch of fluid mechanics, computational fluid dynamics (CFD) uses numerical analysis to analyze and solve fluid flow problems. The basis for this analysis involves solving the Navier–Stokes equations, which describe the motion of fluids.

CFD method was first developed to solve 2D inviscid flow around a cylinder and airfoils. With the help of computer power increase and the numerical method development, modern CFD allows engineering teams to model fluid effects during the design phase, dramatically reducing the need for physical tests. For example, when designing a next-generation torque converter, CFD enables an engineering teams to predict flows, torques and the dynamics of free-wheeling stators, even predicting areas of cavitation damage — all without having to build a single prototype.

Because modern CFD is performed with specialized CAE tools, it is natural to start from the 3D model developed by mechanical engineers. However, CFD does not use the 3D model directly, but must extract the volume within the model in which the fluid flows/is constrained. In other words, CFD must interact with the 3D model, rather than perform operations similar to structure analysis on a 3D model.



Fluid Analysis of a Torque Converter

THE ISSUES WITH THE CFD WORKFLOW TODAY

At the beginning of Simerics collaboration with Spatial, the team wanted to address several issues that exist with traditional CFD simulation workflows:

- Most CFD analysts are not CAD users, which translates to each discipline using different toolsets. CFD analysts cannot be expected to work within a CAD toolset.
- No ability to update the CFD model when the CAD model changes. For example, a mechanical engineer designs a pump using his/her CAD tool of choice, but does need to understand flow rate, pressure, temperature gradients, etc. The CFD analyst use a specialize tool to perform the analysis, but because there is no link between the CAD and CFD models, any changes to the CAD model invalidates the analysis, forcing the analyst to redo the initial setup (costing up to two weeks of effort) each time there is an update to the model.
- Fundamental differences in how CFD uses a model. A 3D CAD model used for manufacturing shows where material is, while CFD requires to see the volumes within that model — the empty spaces in-between where the fluids flow as well as the fluid-air boundary.

> "Without the technical help from Spatial, developing a solution from scratch would have taken a decade."
>
> — Rich Moore
> VP Strategy, OEMs, Partners
> Simerics

HOW SIMERICS SOLVED THESE ISSUES WITH SPATIAL SDKS

The software architects at Simerics decided the best approach was to build a solution around a 3D modeling kernel, one with excellent API support to allow for model interaction using their own algorithms for CFD analysis. The team architected a solution around ACIS, with its powerful set of functions and routines. Simerics then used their proprietary algorithms that can extract the model's volumetrics of inside the model where fluid will reside, as well as the outside model, where typically air resides. The resulting solution allows the analyst to see the unseeable — the fluid's volume model — while retaining the link to the 3D object model.

The second part of the solution required the ability to import model data from a range of third-party CAD systems. Simerics selected Spatial 3D InterOp, the world-class translation solution. With 3D InterOp, Simeric's solution can import a number of modelling formats, including all major CAD providers and associated formats. By adding support for the native formats of other CAD systems, Simerics can import the original design intent, bringing in not only the geometry data, but also the product structure and assembly, graphical representation, and PMI.

3D InterOp brings automatic healing on import to the solution. The goal is to create a model with high enough quality to be correctly interpreted by the modeling kernel while remaining true to the intent of the original model. This automatic healing occurs in three areas:

- Modification of the topology of a body by removing duplicate and overlapping vertices, and splitting edges having large discontinuities in their pcurves so that their continuities follow the rules of the modeling kernel.
- Refinement of the geometry which involves reconstruction of self-intersecting and irregular curve geometry of edges, co-edges, and surface geometry of faces, as well as the trimming and sub-setting of underlying surfaces of faces to conform to the rules of the target modeling kernel. 3D InterOp healing does not modify the geometry, ensuring that output conforms to the shape of the original.
- Repair of other invalid data in the body such as loop errors.

The third part of this solution relies on the persistent naming (pname) function within 3D InterOp to preserve the link between to original 3D CAD model and the CFD model within the Simerics solution. The design/analysis cycle is an iterative one where analysis reveals that a tweak to the design is required. The designer then makes the required modification, and the design/analysis loop starts again until an optimal solution is achieved. For this cycle to work efficiently, Simerics CFD analysis solution depends on pnames set on individual features (faces and edges) to correctly identify what has changed within the model, and preserve all previous setup work done on parts of the model which have not changed. This link between CAD and analysis greatly increases work efficiency.

CLASSIC MODEL OF COLLABORATION

As the leading computation fluid dynamics software company, Simerics are experts in fluid dynamics, but not in CAD modeling. By partnering with Spatial, Simerics gained access to the Spatial engineering team's years of experience in dealing with 3D modeling as well as translating CAD databases from various vendors while preserving design intent. For this engagement, a dedicated Spatial support engineer spent three weeks to help Simerics programmers understand the intricacies of how to marry CAD formats to their tool. As a result, Simerics could focus on their IP, spending valuable engineering time on integration, productization, and UI designs. The result is a vastly shortened development time of only six months.

BENEFITS OF A THIRD-PARTY SOLUTION

From a business perspective, collaborating with Spatial provides Simerics with a complimentary set of capabilities and highlights the benefits of productive working relationship between partners.

Focus on Simerics, Inc.

Simerics, Inc., develops, markets, and supports CAE software for the virtual simulation and testing of fluid pumps, valves, compressors, motors, and systems.

Products: Simerics is focused on providing tools that allow manufacturers to reduce expensive hardware testing and provide unique insight into their products..

Headquarters: Bellevue, Washington

For more information

www.simerics.com

From an engineering perspective, Simerics gains a robust solution tested on thousands of datasets from hundreds of customers as well as the Spatial engineering team's years of experience in 3D modeling.

As a result, the Simerics team does not have to deal with the usual issues when rolling out new code to customers. Moreover, due to the maturity and robustness of the solution set, the number of support issues is greatly reduced. Simerics' customers benefit from any code fixes and improvements needed by the Spatial community.

CFD ANALYST BENEFIT

Through their partnership with Spatial, Simerics has closed the gap between 3D mechanical and fluid models, allowing for a tight coupling of CFD analysis with physical design. This tight coupling saves weeks of setup time needed for each design iteration, helping Simerics customers deliver the best solution while achieving aggressive times to market.

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DASSAULT SYSTEMES | The **3D**EXPERIENCE® Company

U.S. Spatial Headquarters
310 Interlocken Parkway
Suite 200
Broomfield, CO 80021
USA

Spatial EMEA Headquarters
Altenkesseler Str. 17/B6
D-66115
Saarbrücken
Germany

Spatial Asia Headquarters
c/o Dassault Systèmes K.K.
ThinkPark Tower, 2-1-1 Osaki,
Shinagawa-ku, Tokyo 141-6020
Japan