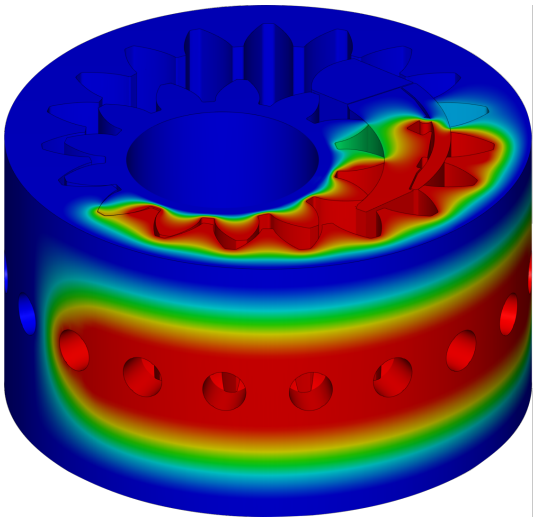
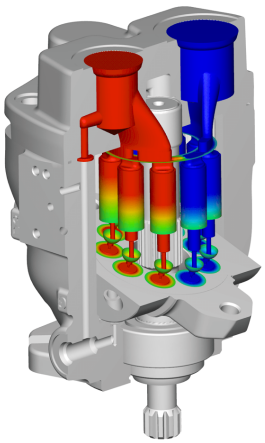
Advanced CFD Simulation for Positive Displacement Machines

Over the last 20 years, Simerics-MP+ has evolved from a specialized product into a trusted Solution and general-purpose solver utilized by the automotive, hydraulic, marine and academic sectors to solve a wide array of flow-related problems while maintaining and strengthening its unique core benefits. The software was developed specifically to address the inherent difficulties of simulating positive displacement machines. These challenges include geometric complexity, which requires the precise handling of rotating and deforming volumes as well as moving and sliding interfaces. Furthermore, the tool manages scale disparity by modeling extremely small clearances while simultaneously managing large pressure and density gradients. Finally, it addresses complex fluid phenomena by accurately predicting cavitation and providing robust handling of dissolved or undissolved gas, vapor, and compressibility.



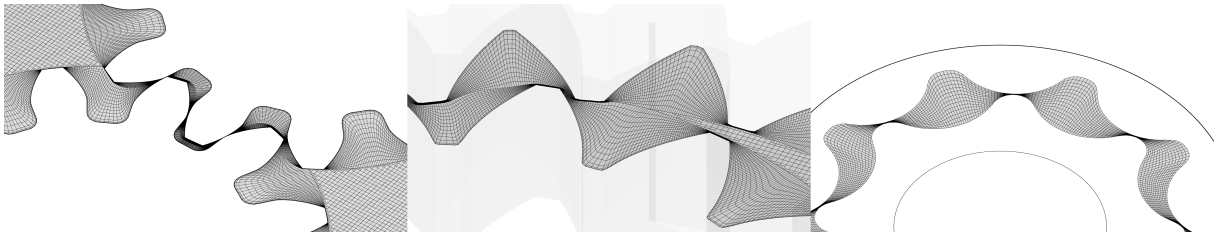


To provide a comprehensive overview of the capabilities of Simerics MP+, it is essential to highlight the extensive library of dedicated templates that allow for the rapid setup and simulation of various positive displacement machines. These templates can be categorized by the fundamental mechanical principles of the pumps/motors and compressors/expanders they represent.

Keep reading and find out how you can take advantage of the unique capabilities that Simerics-MP+ offers!

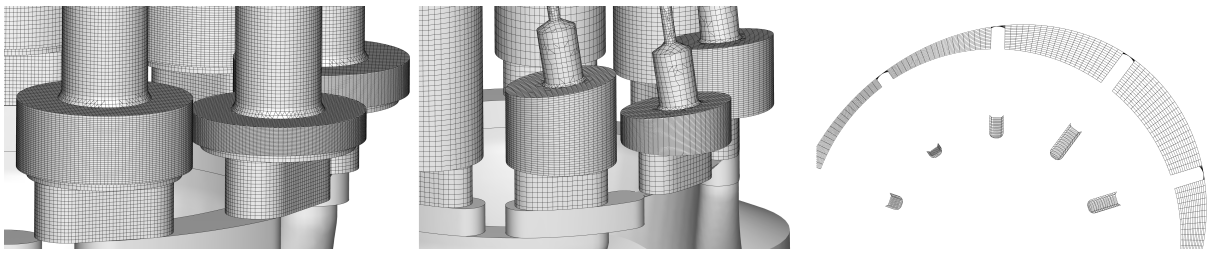
Templates for an Efficient Workflow

Gear-Based Machine Templates
The software includes a diverse range of templates for gear-driven systems, such as External Gear and Helical Gear configurations. For complex internal arrangements, the Crescent and Gerotor templates provide specialized mesh generation strategies to handle the deforming and rotating displacement-volume.

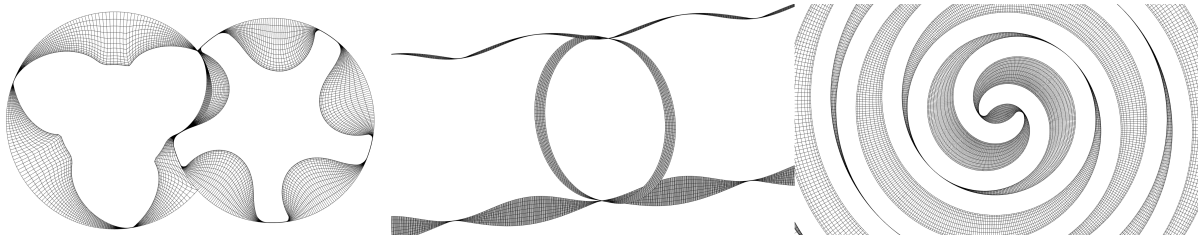


Additionally, a General Gear template is available to accommodate non-standard gear profiles that do not fit into traditional categories.

Piston and Vane Machine Templates
For reciprocating and rotary piston designs, Simerics MP+ offers high-fidelity templates for Swash Plate Piston, Bent Axis, Radial Piston and Vane-Type machines.



Screw and Scroll Machine Templates
The software provides robust solutions for screw-type machinery through the Twin Screw and Progressive cavity templates. For modern refrigeration and vacuum applications, the Scroll template is available to manage the intricate, orbiting motion of scroll compressors.



All these specialized templates ensure that even the most complex geometries can be transitioned from CAD to a running simulation in a fraction of the time required by traditional CFD methods.

Solving Challenging Problems

Engineers encounter critical design issues that are difficult to manage with traditional methods. Simerics-MP+ is engineered to provide precise analysis for the following areas.

Suction Capacity and Filling Efficiency
High rotational speeds often lead to incomplete chamber filling, causing a rapid drop in volumetric flow rate. The software accurately predicts self-priming speeds and allows for the optimization of inlet geometry and port plate timing to maximize performance.

Cavitation Damage
By utilizing derived outputs such as gas/vapor collapse rates and damage power, Simerics-MP+ helps predicting where material damage is likely to occur. This allows engineers to identify cavitation-critical areas, such as commutation grooves or cylinder barrels, even before physical testing.

NVH and Pressure Pulsations
The interaction between moving and stationary parts, trapped fluid or non-optimal port plates generate pulsations that can lead to noise. Simerics-MP+ accurately models these high-frequency transitions in pressure and flow. By coupling transient CFD with our computational acoustics capabilities, engineers can predict sound pressure spectra to design quieter machines.

Load Prediction
Simerics-MP+ can be used to predict dynamic loads - including forces, moments, and power consumption - acting on internal components such as bearings, cam rings, or compensation plates. This allows for the structural optimization of critical parts based on realistic operational data.

Leakage
Poor tolerances and hydraulic short circuits lead to wasted energy and unstable pressure maintenance. Simulating your displacement units allows you to identify these critical flow paths before prototyping. By addressing these issues in the design phase, you reduce unintended leakage and ensure predictable, high-performance system behavior.

System of Pumps and Valves
The software is capable of simulating a system of pumps and valves within a single environment. This allows users to study the complex interactions between components, leading to a much better understanding of overall system behavior and response. Utilizing our 1-DOF solver, the software predicts the real-world dynamics of moving parts like valve spools.

Why is Simerics Different?

In a market with various simulation solutions, Simerics-MP+ distinguishes itself through a specific approach that combines speed with the highest physical accuracy:

Automated, Template-Based Meshing
While other approaches often require time-consuming, labor-intense and tedious, manual meshing steps for complex geometries, Simerics-MP+ utilizes specialized templates for different pump types. This reduces the effort required to move from CAD geometry to a simulation-ready model to a minimum. Meshing the complex geometry of a gerotor, external gear, crescent, vane or axial-piston-pump is done with a few clicks in almost no time.

Modelling Cavitation and Aeration
Simerics-MP+ built in cavitation models offer various levels of complexity to suit specific simulation needs. By default, Simerics' cavitation model accounts for vapor generation, transport, and collapse, as well as undissolved gas and liquid compressibility. To address complex challenges, you can select more sophisticated models that incorporate dissolved gas dynamics, assuming instant equilibrium or factoring in the rates of absorption and desorption over time.

Fast, Robust and Accurate
Simerics delivers a robust numerical framework that thrives in challenging environments. While cavitation often causes competing solvers to fail, Simerics remains converged and reliable - even under conditions with severe cavitation. This high level of stability is paired with industry-leading efficiency - operating 5 to 10 times faster than standard alternatives - without compromising on accuracy, which remains within 5 percent of physical testing.

One Single User Interface
A major advantage of Simerics-MP+ is its single-interface architecture. Unlike complex "software zoos" that require multiple packages for meshing, solving, and post-processing, Simerics-MP+ provides an all-in-one environment. This significantly simplifies installation, maintenance, and staff training, allowing teams to focus on engineering rather than managing disparate software tools.

Knowledged Support Team
Our customers can expect premium support from a team with enormous experience in positive displacement pumps. We move beyond standard ticket systems; instead, we provide direct access to experts who understand your sector's specific challenges. Whether via phone, email, or live screensharing, we are always there to assist you in optimizing your models and interpreting complex results.

Conclusion

Simerics-MP+ is far more than just a tool; it is a critical asset for any organization that seriously develops positive displacement machines, valves, and hydraulic systems. By combining an intuitive, single-interface workflow and premium technical support with automated, template-based meshing and robust solvers, it provides the unique ability to accurately predict real-world performance under extreme rotational speeds and high pressures. The software empowers engineers to transition from traditional, reactive testing to a proactive, simulation-driven design philosophy. By accurately modeling high-frequency transitions in pressure and flow, predicting dynamic loads on internal components like bearings and compensation plates, and identifying critical leakage paths before a single prototype is built, Simerics-MP+ provides the clarity needed to make confident design decisions. Its industry-leading efficiency allows for rapid design iterations without compromising accuracy. **In a competitive landscape where efficiency, reliability, and noise mitigation are paramount, Simerics-MP+ serves as the strategic foundation for delivering high-performance hydraulic solutions to market faster.**

Let's solve your challenges together

Would you like to see how Simerics-MP+ can speed up your development process? You can contact us any time for a personalized demonstration or to discuss your specific challenge.

Do you want to talk to one of our experts?

Fabian Westrich will be happy to help you to find how you can benefit from the unique capabilities Simerics-MP+ offers.

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Simerics
TECHNOLOGY BY DESIGN

