SIEMENS
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Simcenter Amesim for detailed pump modeling

Create and optimize the design of hydraulic pumps and compressors to enhance performance

Benefits

- Automatically generate a sketch of a pump from CAD
- Choose from a variety of models, with precise geometrical representations for component design and functional descriptions based on system-level data sheets
- Optimize pump design and performance in terms of geometry, dynamic behavior, noise and vibrations
- Increase simulation flexibility with a one-click change of thermal-hydraulic simulation (isothermal, adiabatic for fast compression dynamics or full energy conservation)
- Predict the effects of aeration and cavitation on a pump's dynamics using several levels for air release and dissolution phenomenon

Summary

Simcenter Amesim™ software, part of the Simcenter™ portfolio, has exhaustive multiphysics modeling capabilities for pump design and optimization. Furthermore, it provides insights during the integration of pumps into the complete system, helping you evaluate the impact of design choices on system performance.

What are the challenges?

Pump efficiency/performance

- Control leaks: compensate for axial and radial clearances
- Proper chamber filling
- Customized inlet/outlet port shapes

Flow control

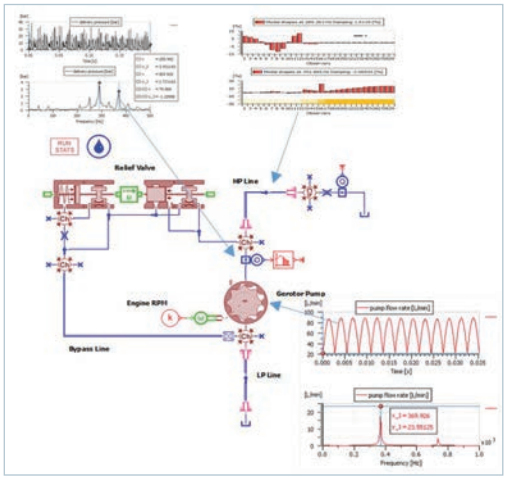
- Accurate control of the pump's displacement
- Stable behavior of pumps

Noise vibration and harshness

- Reduce fluid-borne and structure-borne noise induced by pressure and flow-rate fluctuations
- Limit pressure peaks, which are also affected by aeration and cavitation phenomena

Solve integration issues earlier in the development cycle

- Modal coupling between the pump and hydraulic components downstream (valves and actuators) through piping
- Control principles/strategies: load sensing, maximum pressure, maximum torque



NVH and frequency analysis for a gerotor pump.

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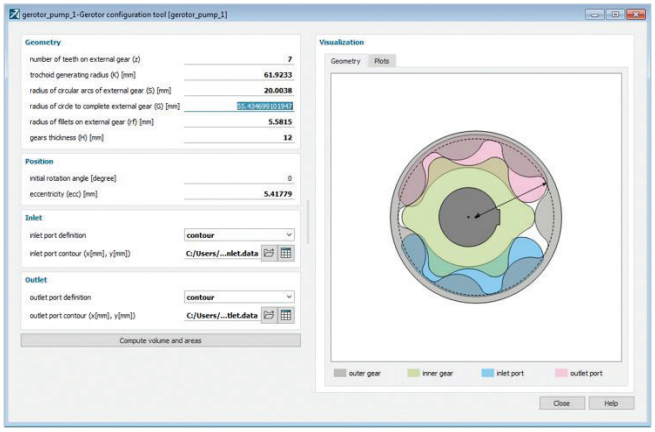
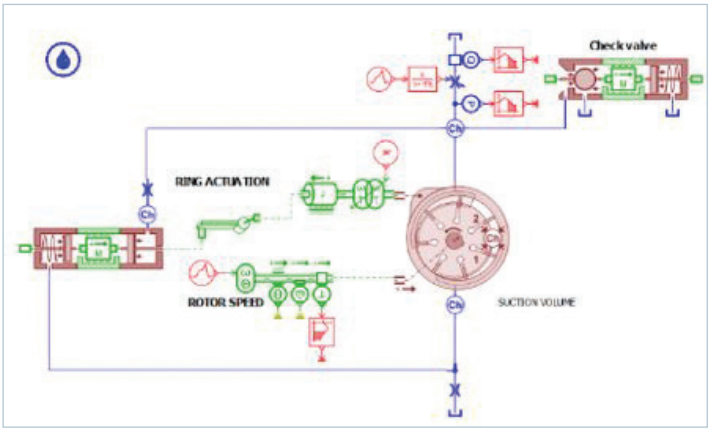


Pump setting tool for gerotor pump.



Integrated vane pump submodel.

Features

- Frequency analysis tools for modal couplings and NVH analysis
- Interfaces with 3D tools: CFD, 3D magnetics, FEA import
- Tool for creating cam profiles from scratch or from target curves: translating flat-faced or roller follower
- Extensive fluid database and fluid properties customization tool

Quick-setting tools for pumps

These setting tools enable you to easily and quickly parametrize the pump geometry and preprocess meaningful variables, allowing you to shorten the analysis time and check the pump design.

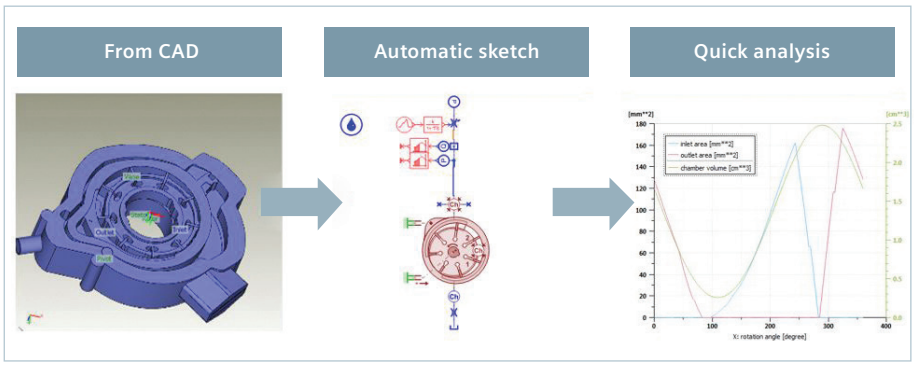
Detailed modeling of main pump technologies

- Vane pumps (hydraulic/pneumatic)
- Internal gear pumps (gerotor)
- External gear pumps
- Pistons pumps (axial/radial)

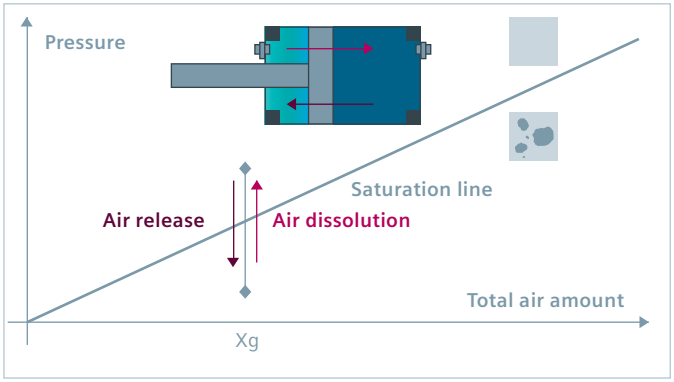
Detailed modeling of pumps can be done either by using the Simcenter Amesim Hydraulic Component Design library and the Simcenter Amesim Pneumatic Component Design library or the integrated submodels.

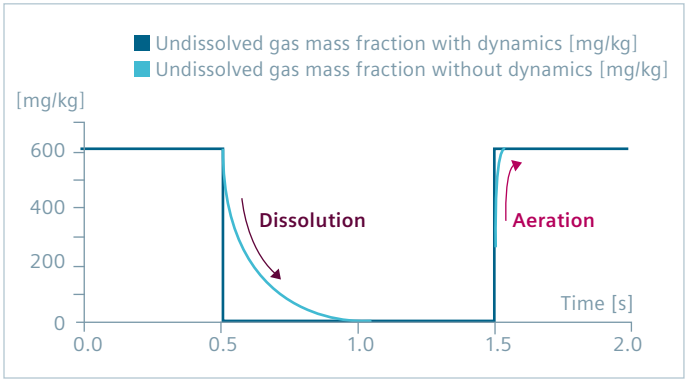
Providing a dedicated tool for pump sketch generation and CAD import

Simcenter Amesim includes an embedded computer-aided design (CAD) tool that automatically builds fully integrated pump submodules directly from a CAD file (sketch generation and parameters setting).



Workflow for an automatic pump sketch generation using CAD import.





Air dissolution and aeration dynamics.

The CAD import tool works with the following technologies:

- Fixed vane pumps
- Pivoting vane pumps
- Sliding vane pumps
- Gerotor

Advanced aeration models
New advanced aeration models allow you to represent:

- Filling, emptying and priming processes in hydraulic systems
- Pressure peaks, including vibrations, NVH and hysteresis cycles (actuation energy) in hydraulic components

Air dissolution dynamics affect the behavior of positive displacement pumps, particularly for vane pumps:

- Pressurization levels during compression phases (NVH)
- The result of internal pressure forces acting on the stator ring for variable displacement designs
- Stator ring position during the pump's displacement regulation

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