SIEMENS
Ingenuity for life

# Simcenter Amesim Hydraulics library

## Designing hydraulic systems to achieve target performance

LMS/IL-DSS.10.2/16-001

### Benefits

- Efficiently simulate hydraulic systems by choosing from a wide range of functional components and fluid properties in the database
- Choose the best hydraulic configuration to achieve target performance
- Integrate and validate control strategies (MiL, SiL and HiL) early in the process using representative models of the piloted physical system

### Features

- Many standard components (pumps, valve actuators, etc.)
- Compressible fluid considerations with rigorous treatment of fluid properties and mass conservation
- Cavitation and aeration effects
- Functional valves with hysteresis and dynamics
- Water hammer transients with advanced pipe and hose models
- Computation of power, energy and activity in all components


### Summary

The Simcenter Amesim™ Hydraulics library is dedicated to the design of hydraulic systems for many applications. It is composed of a wide range of functional models with a variety of complexity levels based on the information available in manufacturers' data sheets.

This library is the design accelerator for hydraulic systems in industries such as automotive and off-highway vehicles (power steering, braking, suspension, fuel injection, hydraulic valvetrains, lubrication, powershift transmission actuators, etc.), aerospace (landing gear, braking, flight control systems, fuel and lubrication systems, etc.), industrial equipment (lifters, forging machines, packaging, etc.) and medical apparatus (dialysis machines, insulin pumps, etc.).

The Hydraulics library includes a variety of component groups (hydraulic lines and hoses, fluids, pumps/motors, control valves, linear actuators, etc.), allowing you to perform analysis in time and frequency domains and optimize both the steady-state and dynamic behavior of the system.

Hydraulic systems are known to be numerically stiff and present nonlinear problems with many discontinuities. Simcenter Amesim software is used to automatically and dynamically select the most adapted integration method based on system dynamics, enabling efficient best-in-class simulation of hydraulic systems.

# Simcenter Amesim Hydraulics library

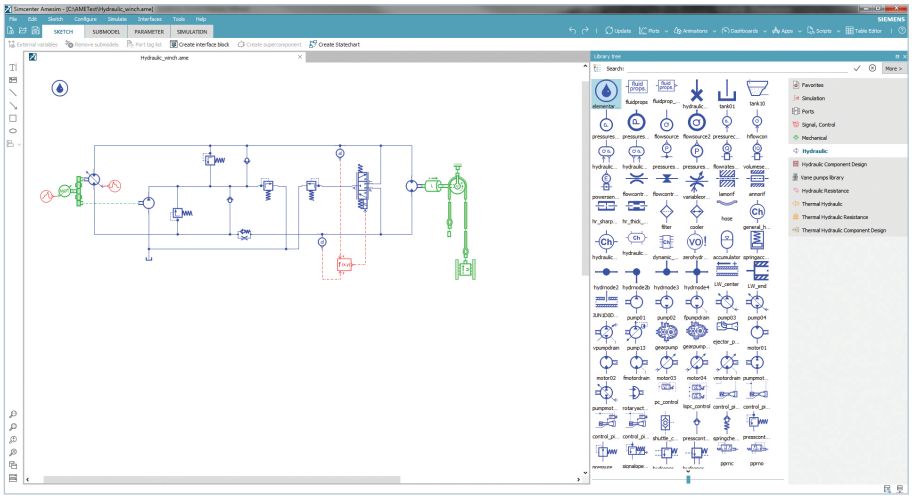
## Components

### Sources, sensors

- Sources: constant and variable pressure and flow rate
- Conversions between signal and hydraulic variables
- Sensors: pressure, volumetric and mass-flow rate, volume and mass, power and energy

### Fluids, nodes, volumes

- General hydraulic properties: simplest, elementary, advanced, using tables
- Fluid database:
  - Pure water, pure glycol, pure ethylene glycol, coolant simple, coolant EG20W80, coolant EG40W60, coolant EG50W50, coolant EG80W20, coolant EG60W40
  - 15W40 oil, 15W30 oil, International Organization for Standardization Viscosity Grade (ISOVG) 32 oil, ISOVG 46 oil, ISOVG 68 oil, transmission oil
  - Hexane, heptane, ethanol, methanol, unleaded gasoline premium, unleaded gasoline super plus, ethanol blend E24, D40 hydrocarbon
  - Skydrol 500B 4 hydraulic fluid, Skydrol LD 4, model-in-the-loop (MIL) H 5606, MIL H 8446, MIL H 27601, MIL H 83282, MIL H 87257
  - JetA, JetA1, JetB fuel
  - Jet propellant (JP) 4, JP-5, JP-7, JP-8, JP-TS fuel
  - Aviation gas (Avgas) jet fuel
  - TS-1, RT kerosenes
  - Adiabatic Robert Bosch diesel properties: Diethanolalamine (DEA) summer diesel, Princeton airport minibus, ISO4113, Swedish diesel, rapsoelmethylester biological diesel, 50 percent diesel 50 percent rapsoelmethylester, 80 percent diesel 20 percent rapsoelmethylester, soybean oil methyl ester (SME) 20 biodiesel (diesel 80 percent, SME 20 percent), high-density diesel fuel, SHELL HCU diesel, Japanese Industrial Standard (JIS) No. 2 diesel, JIS Special number 3 diesel
- Fluid properties calculations
- Data for complex hydraulic pipe/hose components
- Two, three and four port nodes
- Tank
- General hydraulic volume
- Zero hydraulic volume
- Pressurized tank with complex shape
- Gas-filled accumulator with ideal or real gas and spring accumulator



### Friction

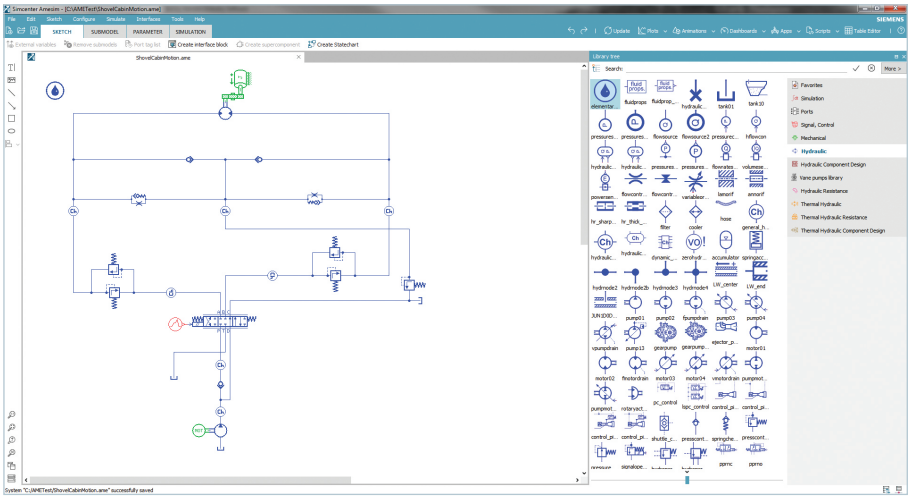
- Restrictor
- Variable restrictor
- Filter
- Cooler

### Directional control valves

- Shuttle valve
- Dual valves
- Flush valve
- Electrically-operated servovalves with up to six ports and three positions
- Valve builder: tool allowing the creation of new directional valves components

### Pressure control valves

- Pressure relief valves
- Pressure reducer
- Overcenter valve
- Counterbalance valve



### Flow control valves

- Flow regulator
- Local pressure compensator

### Pump displacement control valves

- Pressure control with load sensing and/or pressure compensator
- Piston actuator (single or dual) for pump control
- Pressure control shuttle valve

### Pumps, motors

- Fixed and variable displacement unidirectional and bi-directional pump, with 2D, 3D or 4D tables or expressions for efficiencies
- Pressure regulated pump
- External gear pumps with one or two mechanical ports
- Jet/ejector pump based on maps or geometry
- Fixed displacement unidirectional and bi-directional motor
- Variable displacement, unidirectional and bi-directional motor
- Rotary actuator

### Linear actuator

- Actuator with single/double hydraulic chambers and single/double rods
- Actuator with/without spring assistance

### Lines and hoses

- Lines: compressibility, steady-state friction, frequency-dependent friction wave equation, distributive pipe, distributive wave equation
- Computational fluid dynamics (CFD)1D hydraulic line (resolution of Navier-Stokes equation) using Lax-Wendroff method
- Frequency-dependent friction always included
- Hoses: simple compressibility, compressibility and friction, simple wave equation

### Prerequisites

The Hydraulics library requires the following:

- Simcenter Amesim Base [IL-AME.01.1]

### Extensions

- Simcenter Amesim Real-time option [IL-RTO.03.2]
- Simcenter Amesim Blackbox Export option [IL-BBO.03.2]

### Supported hardware platforms

For details on supported hardware, minimum/recommended physical configurations and operating systems, please refer to the Simcenter Amesim fact sheet.

**Siemens PLM Software**
**www.siemens.com/plm**

Americas +1 314 264 8499
Europe +44 (0) 1276 413200
Asia-Pacific +852 2230 3308


67679-A5 12/17 P