

Simcenter Amesim Base

Developing multi-domain system models with an innovative and open platform

LMS/IL-AME.01.1/16.001

Benefits

- Use an innovative and open platform for mechatronic system design and simulation
- Take advantage of a unique combination of ready-to-use validated physical libraries for a wide range of multi-domain applications
- Work with built-in scalable and energy-conserving models that can be fine-tuned for complexity
- Use powerful and simple analysis tools for the time and frequency domains
- Protect intellectual property and know-how while creating and sharing your components or libraries

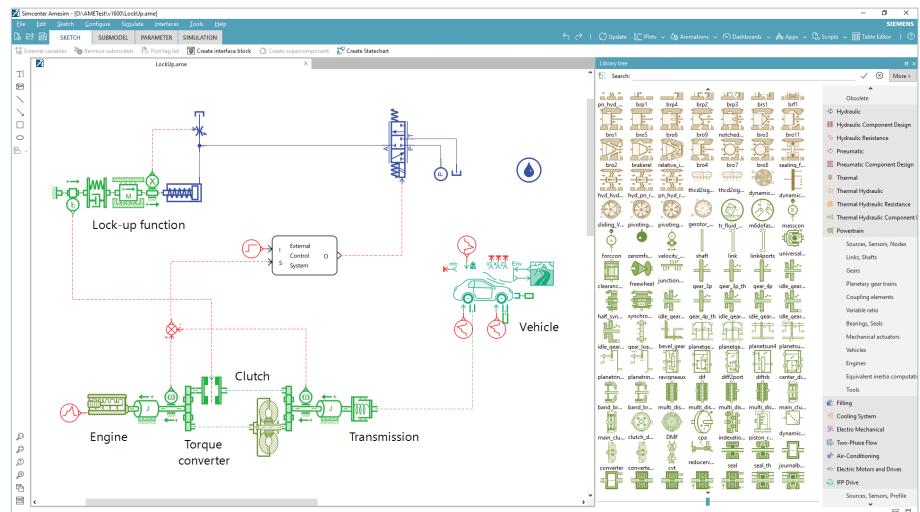
Features

- Simcenter Amesim modeling and simulation environment, including submodel editor, study manager, dashboard, animation and the LMS Virtual.Lab Motion interface
- CAD import

Summary

Simcenter Amesim Base is designed to help you develop and analyze multi-domain system models. In addition, Simcenter Amesim Base enables you to capitalize on know-how throughout the company, providing a comprehensive toolset that can easily extend the standard component libraries.

Using the easy and interactive graphical interface, you can build complex multi-domain system models in minutes by simply combining validated components from libraries covering different physical domains. The result is a straightforward system model representation that is easy to understand and investigate. You can create



Simcenter Amesim Base

models by connecting physics-based building blocks. This innovative concept allows you to avoid creating cumbersome numerical models and writing code. You are directly plunged into the critical aspects of design like analysis and optimization.

Based on the most advanced numerical techniques, the Simcenter Amesim™ software solver supports ordinary differential equations (ODE) and differential algebraic equations (DAE). The solver automatically and dynamically selects the best-adapted calculation method from 17 algorithms, depending on the system dynamics.

In addition to the core platform, Simcenter Amesim Base features component customization. This practical customization tool lets you tailor the software to specific applications, and internal or external processes. Moreover, it allows you to compile company-specific model databases with customized user interfaces and parameter sets. For security purposes, you can protect sensitive information via encryption before supplying models to third parties.

Submodel editor, the Simcenter Amesim submodel editing tool, is designed to help you write well-documented, standardized, re-usable and easily maintainable libraries. You can follow several simple rules to create fully compatible Simcenter Amesim component models that can be automatically used on the platform.

The study manager, a design investigation tool for exploring the design space, is an optimization software application that is used to capture and manage Simcenter Amesim engineering simulations. You can quickly and efficiently explore the design space with design-of-experiment (DOE) and response-surface modeling techniques to gain critical insight into possible design alternatives.

Numerical solvers

Simcenter Amesim is comprised of a set of variable time-step solvers that facilitate the integration of a wide range of physical problems, from the purely explicit to implicit. Based on the type of problem that needs to be integrated, Simcenter Amesim will choose the appropriate method and order and will switch dynamically between the most efficient methods for current system configuration.

Simcenter Amesim solvers have been tuned to achieve robustness in order to simulate multi-domain problems. The integration is based on a fine dialog between models and integrator, allowing rigorous discontinuity handling and providing linearization facilities.

Some numerical analysis tools (linear analysis, performance analyzer, etc.) provide the capability to gain a better understanding of the model, with the information being directly retrieved from the model integration.

For real-time applications, fixed step solvers are also provided in Simcenter Amesim, from Euler to Runge-Kutta methods, with variable orders.

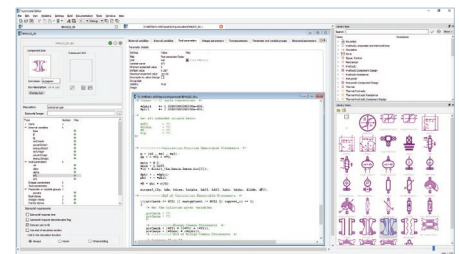
Component customization

Component customization is a customization tool that enables you to adapt applications to end-user requirements.

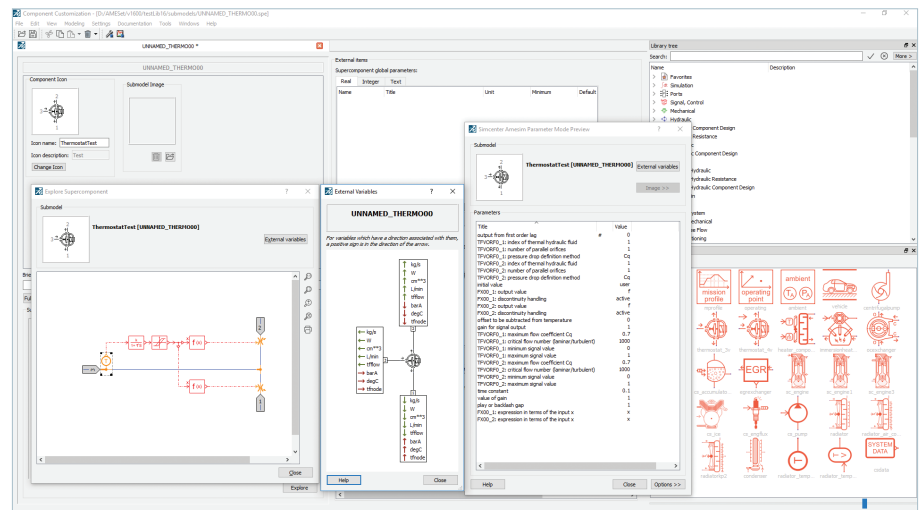
With component customization, company-specific model catalogs can be built with custom user interfaces and parameter sets. In addition, component customization enables you to protect sensitive information and intellectual property before supplying models through encryption facilities.

Submodel editor

Submodel editor provides a comprehensive graphical user interface (GUI), allowing you to extend Simcenter Amesim component libraries. Submodel editor is designed to assist you in writing well-documented, standardized, re-usable and easily maintainable libraries.



By following simple rules, you can create component models that are fully compatible with existing Simcenter Amesim models and are automatically usable on each supported platform. More than just a well-structured

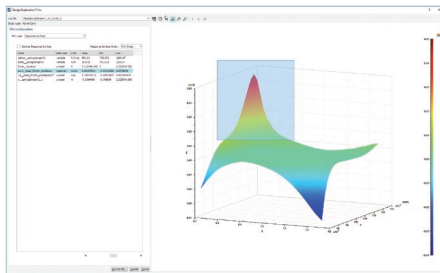


assistant for the development and management of user libraries, sub-model editor provides a tool that guides you toward high-quality models.

Study manager

Design exploration includes techniques for exploring the design space:

- Determine which parameters influence certain performance criteria
- Experiment with a collection of parameters in order to optimize certain criteria
- Find out how performance is affected by variation on a parameter due to production tolerances, different operating conditions or wear



Sensitivity analysis (DOE):

- Parameter study
- Full factorial analysis (main and interaction effects)
- Central composite
- Response surface generation, re-usable in Simcenter Amesim models

Optimization:

- Nonlinear programming by quadratic lagrangian (NLPQL)
- Genetic algorithm

Monte Carlo:

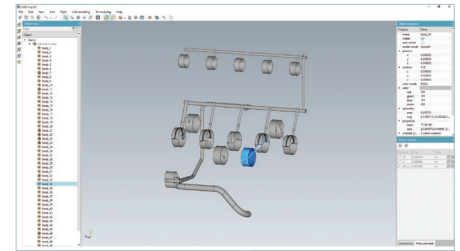
- Set distribution type for each parameter (uniform and Gaussian)
- Sampling method: Random, Latin hypercube and optimized Latin hypercube
- Posttreatment: Mean, standard deviation, skewness, kurtosis
- Sampling method

Plots:

- History plot
- Scatter plot
- Histogram
- Response surface

CAD import

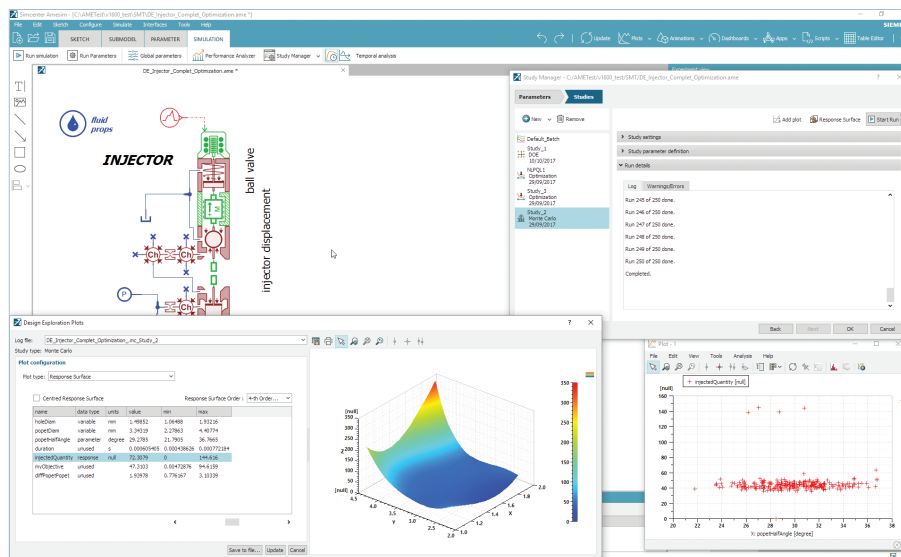
CAD import is a computer-aided design (CAD) viewer integrated into Simcenter Amesim, which can be used for creating, importing and analyzing 3D CAD files without having to rely on the original CAD software application.



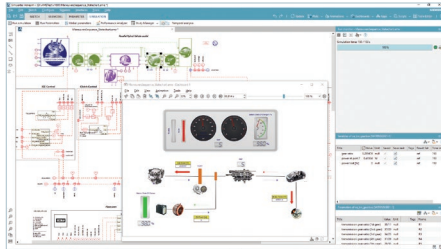
It is easy enough to be used by system engineers with limited or no CAD experience. Reduced sets of tools for modifying geometry or making measurements allow you to quickly retrieve geometric parameters for your Simcenter Amesim models.

Dashboard

The dashboard is a postprocessing capability that you can use to create 2D animations of simulation results in the form of gauges, sliders, buttons and switches.



Predefined generic sets of basic and fully customizable shapes are available and allow you to quickly generate a dashboard in the Simcenter Amesim or Simcenter Amesim Run environment.



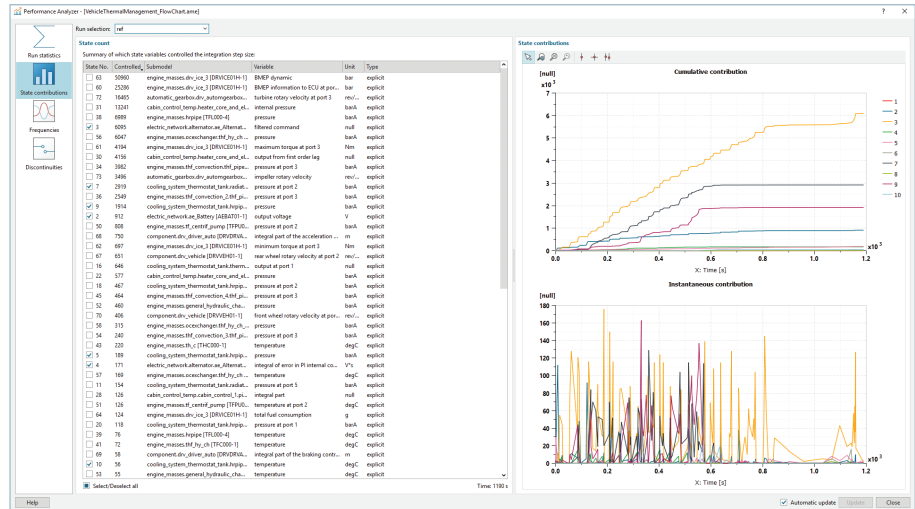
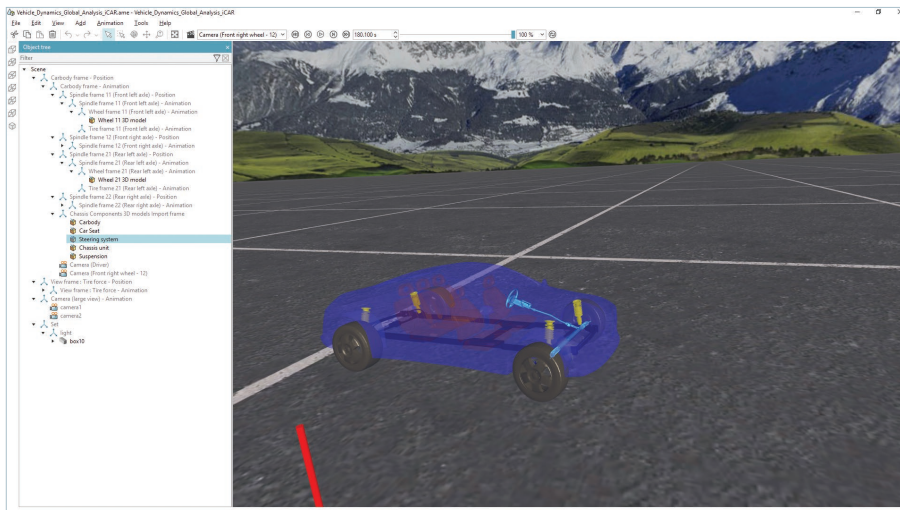
Predefined toolboxes are proposed by default with possible user toolbox extensions.

Animation [IL-TOL.50.2]

Animation is useful for visualizing the results of Simcenter Amesim simulations as a 3D animation scene.

You can develop animated representations of a Simcenter Amesim simulation by creating objects in animation and linking them to the results of the simulation.

Animated 3D scenes offer a higher level of demonstration and enable you to visualize the physical behavior of components according to the parameters you enter and the simulation results.



Performance analyzer

The performance analyzer offers a set of facilities for in-depth monitoring of the simulation performance. It provides valuable statistics on the simulation performance such as central processing unit (CPU) time, integration steps and number of Jacobians, function evaluations or discontinuities processed, etc.

It also allows you to clearly see which state variables can be used to speed up your simulation.

Application scripting and programming interfaces

Simcenter Amesim provides a comprehensive set of scripts to write short programs in higher abstraction level languages like Python, the MATLAB® environment, Scilab or Visual Basic for Applications (VBA), which automate interaction with models.

These tasks may be combined to build small or large applications in order to:

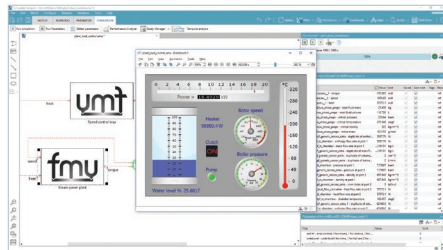
- Automate batch runs
- Perform complex and automated preprocessing
- Carry out parameter studies: simple sweep, Monte Carlo analysis, sensitivity analysis, etc.
- Perform complex postprocessing: creating 2D or 3D plots, animations, performing signal analysis such as fast Fourier transform (FFT), spectral estimation, etc.
- Build customized GUI for pre- or postprocessing
- Integrate a Simcenter Amesim model with an external application, read and write files with user-defined formats; connect to databases, communicate over networks, etc.

Circuit application programming interface

The circuit application programming interface (API) enables you to embed the power of Simcenter Amesim into your applications. Thus, you can easily create your own tools dedicated to your specific needs and powered by Simcenter Amesim. Three languages are available: C, Python and VBA.

Functional Mockup Interface: import and master

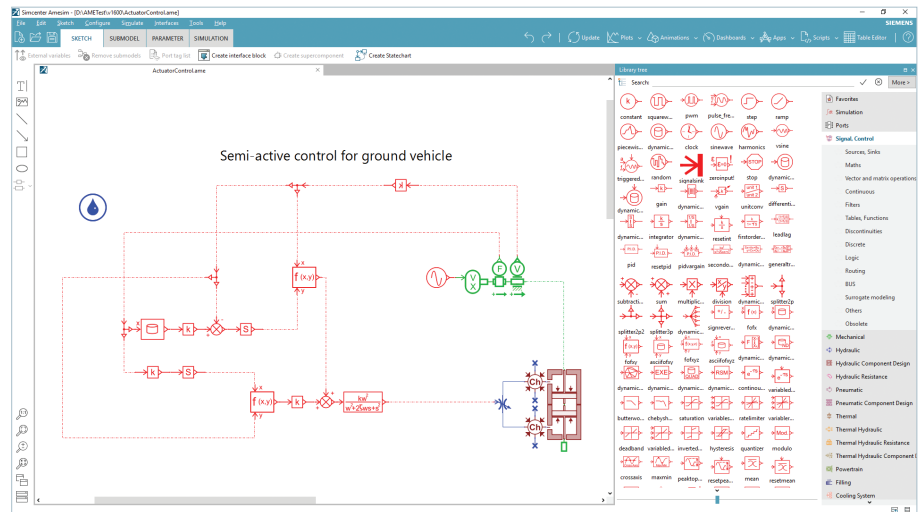
With Simcenter Amesim, you can import Functional Mockup Units (FMUs) coming from various Functional Mockup Interface (FMI) compliant tools in a simple and user-friendly way thanks to the built-in FMU import assistant. This functionality supports and transparently handles 1.0 FMUs for model exchange, 1.0 FMUs for co-simulation and 2.0 FMUs for co-simulation.



Simcenter Amesim Signal, Control and Observer library

The Simcenter Amesim Signal, Control and Observer library contains all required components to control, measure and observe multi-domain system models. Based on a block diagram approach, this library may be used to create linear, nonlinear, continuous-time, discrete-time, multi-rate, conditionally executed, mixed-signal and hybrid systems.

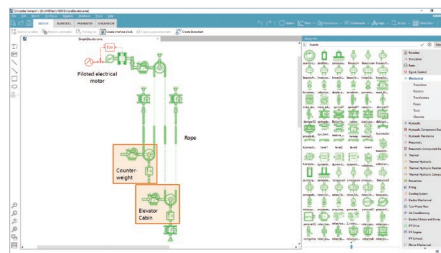
It is ideal for building control systems and implementing equation-based models.



Models are constructed graphically from predefined blocks, such as filters, dead zones, look-up tables or mathematical expressions. This library supports scalar and vector signals as well as real and Boolean data types.

Simcenter Amesim Mechanical library

The Simcenter Amesim Mechanical library contains components for modeling 1D translational and rotational mechanical systems, and can be used to simulate complete 1D mechanical systems.



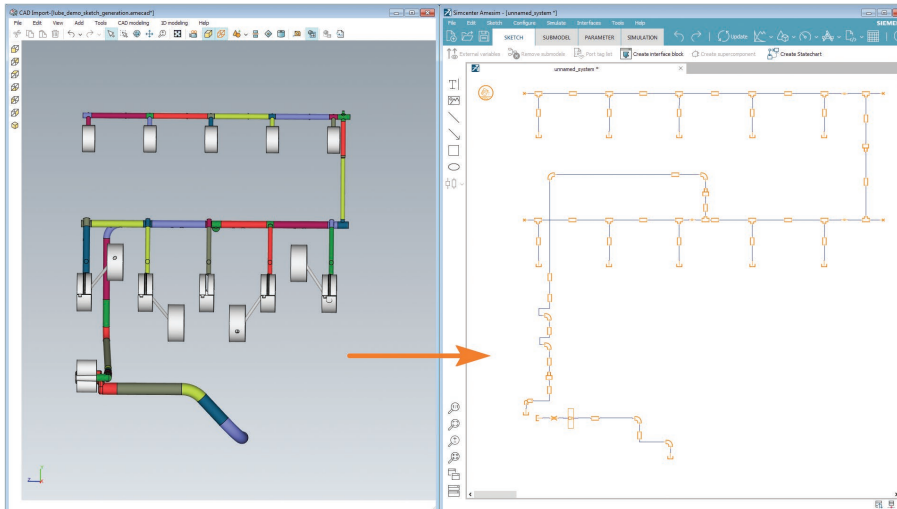
Since fluid, electromechanical and electrical power systems usually interact with some form of mechanical system (for example, actuators, pumps, motors, crankshafts and spools), these mechanical components are complementary to the other Simcenter Amesim libraries.

Options

Solutions

Simcenter Amesim provides you with direct access to multi-domain simulation solutions for powertrain, transmission and internal combustion engines, vehicle thermal management, fluid systems, ground loads and flight controls, vehicle system dynamics, energy and electromechanical systems.

Each of these solutions is comprised of a specific set of tools and application libraries, and focuses on delivering simulation capabilities to assess the behavior of specific subsystems. For example, engineering teams can analyze and optimize the noise, vibration and harshness (NVH) performance of transmission systems, or fine-tune air management and electronic control unit (ECU) calibration for combustion engines. With Simcenter Amesim, systems can be studied independently, but what makes Simcenter Amesim exceptional is the possibility to integrate subsystems into a unique environment to evaluate their interaction.



Simcenter Amesim CAD Import Advanced [IL-TOL.52.3]

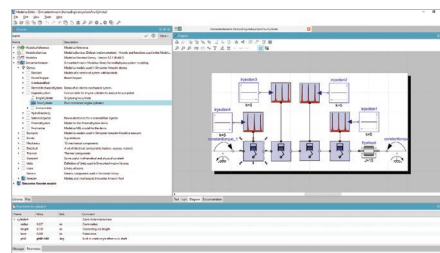
Simcenter Amesim CAD Import Advanced also offers you the possibility to create 1D Simcenter Amesim models from 3D CAD geometry of any fluid application. Thanks to a dedicated workflow, Simcenter Amesim CAD Import Advanced allows you to assign primitive components to CAD bodies and automatically retrieve lengths, radii, areas, volumes, etc., that are used to parameterize on-the-fly the components of the generated Simcenter Amesim sketch.

Software interfaces

- Simcenter Amesim Simulink interface [IL-INT.01.2]
- Simcenter Amesim NI LabVIEW interface [IL-INT.06.2],
- Simcenter Amesim NI VeriStand interface [IL-INT.07.2]
- Simcenter Amesim MSC.Adams interface [IL-INT.03.2]
- Simcenter Amesim FMI Export and Slave [IL-FMI.01.2]

Simcenter Amesim Environment for Modelica [IL-AME.13.2]

The Simcenter Amesim Environment for Modelica includes a bundle of products to support your Modelica related needs. The Modelica editor provides an integrated development environment for viewing and editing Modelica libraries, either graphically or directly through Modelica source code. The environment also includes the Modelica compiler to automatically transform your Modelica source code into C code, which can be simulated.



Simcenter Amesim parallel processing

- Simcenter Amesim Parallel Processing 4 Runtimes [IL-TOL.32.2]
- Simcenter Amesim Parallel Processing 8 Runtimes [IL-TOL.33.2]
- Simcenter Amesim Parallel Processing 16 Runtimes [IL-TOL.34.2]
- Simcenter Amesim Parallel Processing 128 Runtimes [IL-TOL.35.2]

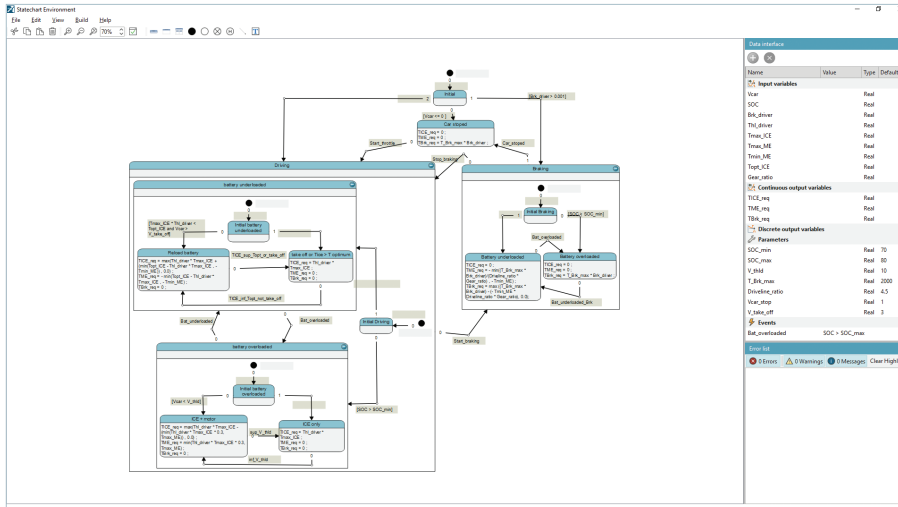
Model management

Simcenter Sysdm Integrated Client [IL-SDM.11.2]

- Simcenter™ Sysdm software allows you to manage mechatronic simulation models and data originating from Simcenter Amesim and other mechatronic simulation tools, and provides you with a collaborative environment for model lifecycle management in association with systems engineering. The integrated client gives you transparent and immersive access to your Simcenter Sysdm repositories directly from Simcenter Amesim, so you can manage your Simcenter Amesim models together with all their associated data.

Simcenter Sysdm Enterprise Model Management Client [IL-SDM.12.2]

Simcenter Sysdm Enterprise Model Management Client for Simcenter Amesim and Simcenter System Synthesis software is a solution to manage Simcenter Amesim system models in the enterprise product life-cycle management (PLM) context. It allows the user to create items using Simcenter Amesim models, check them out and revise those items in the Teamcenter® software repository. You can manage Simcenter Amesim models in the context of the PLM system, allowing the Teamcenter user to easily associate a given revision of a Simcenter Amesim model to a product, system or subsystem variant and configuration.



- A native American National Standards Institute (ANSI) C compiler. (GNU GCC or Intel® compiler on Linux)
- Properly functioning TCP/IP networking (for floating licenses)
- The Reprise License Manager 11.1.0 (supplied with Simcenter Amesim)
- Adobe Reader (8.0 or above) to read the PDF documentation

Simcenter Amesim Statechart Designer [IL-TOL.40.2]

Simcenter Amesim Statechart Designer is a dedicated application to graphically create a state chart with states and conditional transitions describing a complex logic. This tool allows you to create driving scenarios and control logics with inputs, outputs and parameters. The generated component appears in the Simcenter Amesim model and offers a graphical debugging capability after execution.

Supported hardware platforms and configurations

Windows Vista 7/8/10 platforms

- To compile:
 - GNU Compiler Collection (GCC)
 - Microsoft Visual C++ 2005, 2008, 2010, 2012 or 2013 standard or professional edition for 32 bit
 - Microsoft Visual C++ 2005, 2008, 2010, 2012 or 2013
- Express edition for 32 bit
 - Microsoft Visual C++ 2008, 2010, 2012 or 2013 standard or professional edition for 64 bit

- Properly functioning Transmission Control Protocol/Internet Protocol (TCP/IP) networking (for floating licenses)
- The Reprise License Manager (RLM) 11.1.0 (supplied with Simcenter Amesim)
- Adobe® Reader (8.0 or above) to read the PDF documentation
- Note: The Microsoft Visual C++ compiler is not supplied on DVD. If you do not want to use GCC, you have to buy the Microsoft Visual C++ compiler or download the free Microsoft Express edition compiler and install it independently

Linux platforms

- Minimum supported 64-bit Linux versions:
 - Red Hat EL6
 - SuSE 10.0
 - Ubuntu 14.04
- The Simcenter Amesim model can be compiled and executed on a 64-bit Linux platform. However, running the Simcenter Amesim GUI requires the 32-bit compatibility packages

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