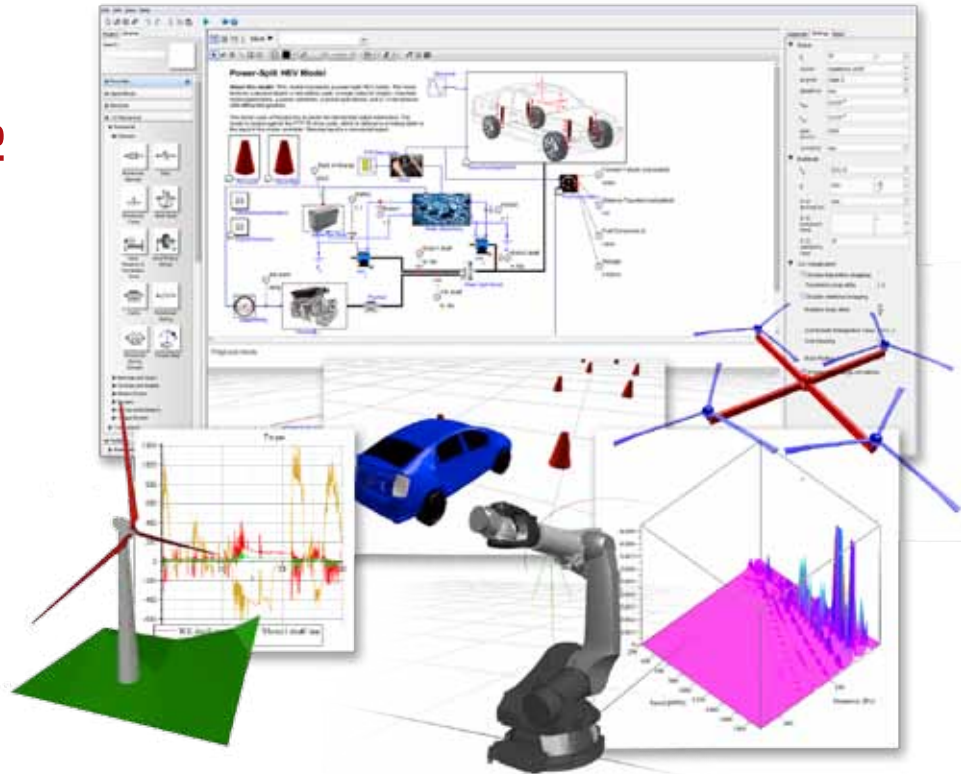


# The modern approach to physical modeling



Advanced projects require advanced tools for meeting and exceeding system-level requirements. By incorporating the most recent progress in engineering design technology, MapleSim™ offers a modern approach to physical modeling and simulation. It dramatically reduces model development and analysis time while producing fast, high-fidelity simulations. MapleSim is a “white-box” Modelica® platform, giving you complete flexibility and openness for complex multidomain models. With MapleSim, you create, analyze, and run system-level models in a fraction of the time it takes with other tools.



## What Makes MapleSim Unique?

### Maintain full control with “white-box” modeling and analysis

MapleSim, coupled with Maple™, is a completely open environment, meaning that you are never restricted to built-in components or analyses. With its complete programming and analysis environment, you can run simulations, customize analyses or script entirely new ones, perform optimizations, develop advanced symbolic control laws, and investigate models in ways not possible with other tools. You can even create custom components right from their unsimplified governing equations – our solution does all the work to incorporate them into your model.

- Create custom components directly from their equations
- Easily script custom analyses
- Take advantage of the world's most powerful symbolic and numeric math engine
- View and manipulate system-level equations, even for multibody and multidomain systems

### Get extremely fast auto-generated code for real-time and optimization

Whether you are running 100,000 simulations during an optimization or executing in real-time for hardware-and software-in-the-loop testing, your model code must be fast. MapleSim produces extremely fast auto-generated model code, and the code is completely royalty-free. You can achieve real-time the first time, without sacrificing fidelity in your system-level models. MapleSim's fast model code can be exported as S-functions, making MapleSim the best physical modeling solution for Simulink®.

- Best core symbolics generates extremely fast model code
- No more hand-coding: save time and eliminate errors with automatic code generation for custom components
- Pass your work down the toolchain: provide downstream engineers with fast and accurate exported models, including S-functions, C code, FMI, and more

### Give yourself a head-start on projects with a powerful Modelica platform

MapleSim is based on the open-standard Modelica modeling language, so you can leverage the growing collection of industry-tested Modelica components in your own projects. What's more, with Modelica, models and components are open and object-oriented, making them easy to reuse, customize, share, and extend to suit your exact needs. But MapleSim is more than just Modelica – it's Modelica “Plus”, consisting of an entire platform for modeling, simulation, and analysis, where Modelica provides the component and model description.

- Open, object-oriented system-level modeling language
- Custom components that automatically generate corresponding Modelica code
- Flexible Modelica multidomain framework

## Block Library

MapleSim contains both physical component and signal-flow blocks. The physical component blocks include functionality for many domains:

- Electrical, including passive and active components, semiconductors, and electromechanical machines
- Thermal, including heat capacitors, conductors, convection, and radiation blocks
- Rotational and translational mechanics, including spring-mass dampers, gears, clutches, and bearings
- Multibody dynamics, including flexible beams, rigid bodies, and constraints
- Magnetics, including data for magnetic materials, electromagnetic fields, permanent magnets, field shapes, sensors, leakage, and flux and potential sources
- Thermal fluids, including boundary conditions, constraints, heat flow, heat transfer, and thermal sensors
- Hydraulics, including hydraulic cylinders and motors, orifices, and non-circular pipes

The signal-flow blocks include:

- Continuous and discrete blocks, such as filters, delays, and triggered samplers
- Logic and structural blocks, such as Boolean operators, switches, and mux/demux
- Arithmetic blocks, such as integrators, gains, vectors, and feedback

The block library can be extended by creating and sharing custom components, through specialized add-on products, and by importing third-party Modelica libraries.

## Interface and Modeling

- Drag-and-drop block diagram modeling environment
- Model diagram maps directly to the physical system
- System equations generated automatically from the diagram and simplified using lossless symbolic techniques
- Components from different domains are seamlessly combined in the same diagram
- Shareable custom block libraries
- Import of Modelica libraries and models based on the Modelica 3.1 standard library
- Masked subsystems and scoped variables
- Control over parameters and initial conditions of a single instance of a shared component or subsystem
- Hierarchical model diagrams with easy model navigation
- User-defined variables for component parameters
- Block diagram and 3-D model construction of multibody systems
- Equation-based custom components, without scripting
- To/From blocks to facilitate clean routing
- Data import and export, and lookup tables
- Access to underlying Modelica code for any component or subsystem
- User-created favorites palette for commonly used blocks
- Units-aware, including SI, US, and Imperial
- Block details accessible through right-click context menus
- Library of prebuilt models across multiple disciplines

### MapleSim Toolboxes

- MapleSim Connector, for connectivity with Simulink®
- MapleSim Connector for LabVIEW™ and NI VeriStand™ Software
- MapleSim Connector for dSPACE® Systems
- MapleSim Connector for B&R Automation Studio
- MapleSim Connector for VI-CarRealTime™
- MapleSim Connector for JMAG®-RT
- MapleSim Connector for FMI
- MapleSim Control Design Toolbox
- MapleSim Tire Component Library
- MapleSim Driveline Component Library
- MapleSim Hydraulics Library® from Modelon

## Simulation

- Stiff/non-stiff/semi-stiff and fixed/adaptive numerical solvers (Rosenbrock, Cash-Karp, Runge-Kutta-Fehlberg, implicit Euler)
- Linear, nonlinear, continuous and discrete time, SISO, MIMO, and hybrid systems
- Lossless symbolic simplification of system equations produce efficient, high-fidelity models
- Index reduction method for high-index DAEs
- Analytic solution of algebraic loops without user intervention
- Detailed error analysis for model construction and simulation diagnosis
- Compiled run-time mode for rapid execution
- Equation caching for multibody systems
- Batch simulation, including the ability to run batch simulations and optimizations in parallel
- Parameter sets management tools
- Probe management tools, including ability to view results from newly added probes based on stored simulation data
- Ability to call on external code as part of a simulation
- Snapshots for starting experiments at any time-step, even if the model was modified after the snapshot was taken
- Efficient models and optimized C code generation for fast real-time execution, including hardware-in-the-loop (HIL) applications
- Deployment directly to popular platforms from MathWorks®, National Instruments™, B&R, VI-grade, dSPACE®, and more through connectivity add-ons

## Analysis and Documentation

- Extract, view, and manipulate the system equations for a model
- Parameter optimization and parameter sweeps
- Frequency domain and control analysis tools, including linear system analysis, sensitivity analysis, and Monte-Carlo simulation
- Data generation and signal generation tools
- Multibody analysis tools for extracting both kinematic and dynamic equations
- Full access to Maple for simulation analysis, visualization, and design documentation
- Scripting language for programmatic access to mathematical solvers, structures, and visualization tools for customized analysis
- API between MapleSim and Maple for programmatic analysis and testing
- Parameter management system for easily storing parameter sets, replacing groups of parameter values in a model, and comparing results
- Results management tools—recall of previously generated results for side-by-side comparison
- Live design documentation linked to model
- Include all related files in a MapleSim model for easy document management and sharing
- Natural math notation in analysis and design documents through Maple

## Visualization

- 3-D visualizations and animations of multibody systems
- Automatic ball-and-stick rendering—custom geometry (including springs, cylinders, boxes, force and torque arrows, and path traces) and imported STL shapes can be added for realistic rendering
- Full playback and camera control on 3-D visualizations and animations
- Export of 3-D visualizations as .mpeg movies
- Customizable 2-D plots
- Multiple y-axes, and phase plots
- Log, semi-log, and linear axis scaling
- Pan, zoom and scale, point probe, and plot export
- Windows with multiple plots
- Drag-and-drop traces from one plot to another
- Full range of Maple plots available

### For More Information

Visit [www.maplesim.com](http://www.maplesim.com) for product information, application stories, demo videos, a demo gallery, and more.

[www.maplesoft.com](http://www.maplesoft.com) | [info@maplesoft.com](mailto:info@maplesoft.com) • Toll-free: (US & Canada) 1-800-267-6583 | Direct: 1-519-747-2373

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