MapleSim™ 2

High-Performance Multi-Domain Modeling and Simulation

# Multi-Domain Modeling and Simulation

**MapleSim is a multi-domain physical modeling and control systems development tool. Physical components and signal-flow blocks can be connected to create model diagrams that intuitively map onto the real system. It features an integrated environment in which the system equations can be automatically generated and analyzed and new physical components created. It contains tools for optimized code generation for real-time applications, control systems analysis, and design documentation.**

## Block Library

MapleSim contains both signal-flow blocks (typically used to model control systems and filters) and physical components. The signal-flow blocks include:

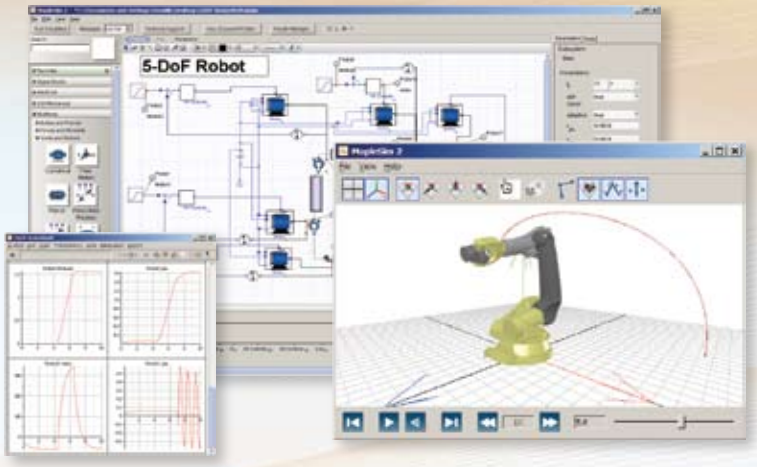
- Continuous and discrete blocks, such as integrators, Butterworth filters, and triggered samplers
- Logic and structural blocks, such as Boolean operators, switches, and mux/demux
- Arithmetic blocks, such integrators, gains, and feedback

The physical component blocks include functionality for many physical domains:

- Electrical, including resistors, op amps, and DC machines
- Thermal, including heat capacitors, conductors, convection, and radiation blocks
- Rotational and translational mechanics, including spring-mass dampers, gears, clutches, and joints
- Multibody dynamics, including flexible beams, rigid bodies, and spherical, planar, and universal joints

## Modeling

Blocks are dragged from a series of palettes onto a workspace and connected with bi-directional lines. "Through" properties such as flow, current, and force, and "across" properties such as voltage, pressure, and temperature are handled automatically with no interaction required from the user. Models created using physical components map onto the real system much more directly than those that only use signal-flow blocks.




Proprietary multibody technology generates high-speed models of demanding 2-D and 3-D mechanical systems.

# KEY FEATURES

## Interface and Modeling

- Drag-and-drop block diagram modeling environment
- Multi-model tabbed interface with customizable windows
- Signal-flow blocks and physical components models
- Ports on components allow connections only where appropriate
- Create masked subsystems to manage complex designs
- Subsystem browser to navigate model hierarchy
- Shareable custom block libraries
- Data import and export, and multidimensional lookup tables
- User-created favorites palette for commonly used blocks
- Units aware, including SI, US, and Imperial
- Library of models across multiple disciplines
- User-defined variables for component parameters

## Simulation

- Stiff/non-stiff and fixed/adaptive numerical solvers
- Index reduction method for high-index DAEs
- Analytic solution of algebraic loops without user intervention
- Detailed error analysis for simulation diagnosis
- Equation caching for multibody systems
- Compiled run-time mode for rapid execution
- Linear, nonlinear, continuous and discrete time, SISO, MIMO, and hybrid systems
- C code generation for real-time applications
- Batch simulation
- Results management and storage tools

## Analysis and Documentation

- Design documentation electronically linked to model
- Attach any file type to a MapleSim model
- Extract, view, and manipulate the system equations generated by a model
- Full access to Maple for simulation analysis, visualization, and design documentation
- Create custom component models without scripting
- Parameter optimization, parameter sweeps
- Frequency domain and controls analysis
- Fully integrated and hyperlinked help system
- Results management tools—recall of previously generated results for side-by-side comparison

## Visualization

- 3-D animations of multibody systems
- Automatic ball-and-stick rendering—custom geometry (springs, cylinders, boxes, force and torque arrows, path traces, etc.) and imported STL shapes can be added
- Full playback and camera control on 3-D plots
- 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

Connection ports only allow connections between blocks from the right physical domains or data type (preventing you from connecting a heat sink to a voltage source or connecting a floating point source to a block
that expects a Boolean input, for example).

Complex models can be grouped into hierarchical subsystems to make them more manageable. Parameters within a subsystem can be changed with a custom user interface. Annotations, block-alignment, and drawing tools improve the readability and organization of a model.

Variables can be defined and their scope restricted to hierarchical levels. Block parameters can be defined using variables, and a reporting tool lists defined variables and block parameters.

## Simulation Engine

MapleSim has a hybrid symbolic-numeric engine. When a simulation is run, MapleSim automatically generates the dynamic equations and simplifies them to a computationally efficient form without losing fidelity. It does this by eliminating redundant variables and expressions and reducing the index of high-index differential algebraic equations.

MapleSim has two numerical integration algorithms: Rosenbrock for stiff systems and Runge-Kutta-Fehlberg for non-stiff systems. Error tolerances can be modified.

The numerical solvers are flexible enough to simulate highly nonlinear systems, including those with discontinuities and hybrid continuous-discrete systems.

The underlying model description can also be automatically translated to C code and compiled; this results in much faster execution for large models.

## Analysis

MapleSim is fully integrated with Maple™, giving access to a broad range of analysis and visualization tools.

MapleSim comes with built-in Maple templates for control systems analysis, creating custom components, generating and manipulating symbolic system equations, Monte-Carlo simulation, sensitivity analysis, optimization, and data generation.

Maple includes a large selection of analytic and graphing tools for dynamic analysis, which is essential for control systems development. Maple's visualization tools include plots for time and frequency domain response, and root-locus and root-contour plots.

The Maple environment provides natural math notation, context-sensitive menus for mathematical operations, interactive analysis tools, and a full programming language.

## Visualization

MapleSim generates 2-D plots of selected simulation results. The plots are customizable and can be exported to external files.

MapleSim will automatically generate 3-D ball-and-stick animations of multibody systems. These can customized with a range of built-in 3-D shapes, including springs, cylinders, boxes, path traces, force and torque arrows, and more.

Additionally, 3-D animations can be further customized with imported STL shapes.

## Model Documentation

MapleSim is fully integrated with the Maple technical document environment. You can electronically attach live Maple documents (as well as any other file type) to a MapleSim model. You can then access any aspect of your MapleSim model from the Maple environment and add explanations, background information, and the analysis behind the design. These Maple documents can be shared and reused.

## MapleSim Documentation and Help System

MapleSim Documentation and Help System
A dedicated User Guide walks new users and experienced engineers through the interface. It contains several tutorials that help you learn as you model, and offers a guide to the fundamentals of physical modeling.

The MapleSim help system is electronically indexed and fully hyperlinked. The appropriate help page for any block is accessed through a right-click context-sensitive menu, and describes its functionality and connection ports.

# RESOURCES


### Web Site
http://www.maplesoft.com/products/maplesim

### User Community
http://www.mapleprimes.com/forums/maplesim

### Training and Demo Videos
http://www.maplesoft.com/support/training/videos.aspx

### Applications
http://www.maplesoft.com/applications/maplesim.aspx

### System Requirements
http://www.maplesoft.com/products/system_requirements.aspx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