The modern approach to modeling and simulation

MapleSim™ is an advanced system-leveling modeling and simulation tool that simplifies model development and provides greater insight into system behavior, making it ideal for education in addition to being a powerful research tool.

With MapleSim, you can:

- Bridge the gap between theory and practise
- Engage your students with complex, real-world examples
- Prepare your students for the challenges they will meet in industry
- Let students perform investigations without risking your equipment
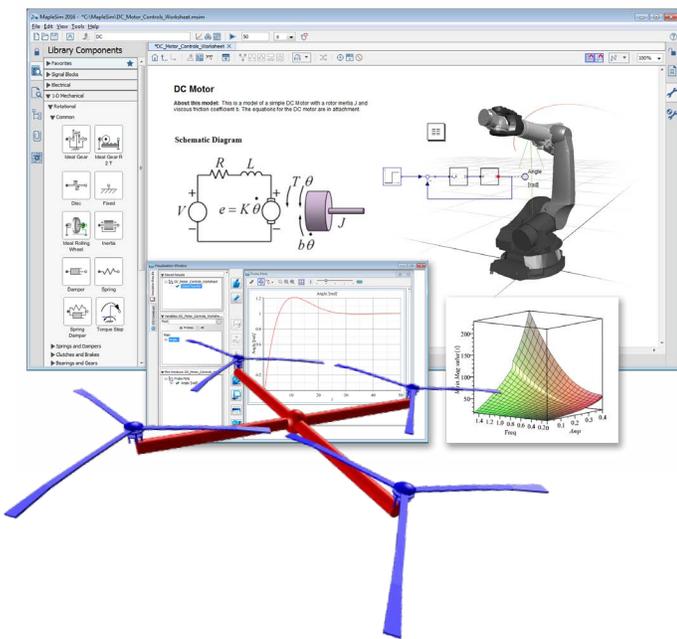
What Makes MapleSim Unique?

Multiple domains, one environment

The MapleSim modeling environment combines components from different engineering domains, including mechanical, electrical, and multibody, so that students in all engineering streams can build and explore realistic designs and study the system-level interactions.

Connect the concepts

With MapleSim you can easily access a model's system-level equations and use them to demonstrate concepts, such as parameter optimization, sensitivity analysis, and linearization. Conversely, you can use mathematical equations to define new components directly from first-principles, allowing students to immediately make the connection between the math and the model behavior.

Model systems, not equations

MapleSim lets you build system-level models simply by connecting physically meaningful components, such as motors and gears. Since model development is so much easier, you can incorporate significantly more complex examples into your courses.

Simulate virtually, validate physically

Simulation allows students to safely investigate a much larger range of conditions than is possible by testing with hardware alone, with no risk of damage to equipment and for much less cost. Once their design has been analyzed and optimized, the results can be exported to C code, Simulink®, LabVIEW™, and other tools, where it can be incorporated with a physical prototype.

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 libraries, 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.x standard library
- Import of models created in other FMI-compatible software using FMI 2.0 Model Exchange and Co-Simulation
- 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
- Library of prebuilt models across multiple disciplines
- Revision control tools

MapleSim Add-ons

- MapleSim Control Design Toolbox
- MapleSim CAD Toolbox
- MapleSim Battery Library
- MapleSim Driveline Library
- MapleSim Tire Library
- MapleSim Heat Transfer Library
- MapleSim Hydraulics Library® from Modelon
- MapleSim Pneumatics Library® from Modelon
- MapleSim Server
- Connectivity add-ons for B&R, Simulink®, FMI, and more
- MapleSim Engine Dynamics Library

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
- Live, interruptible simulations that show results as the simulation progresses
- Compiled run-time mode for rapid execution
- Batch simulation, including the ability to run batch simulations and optimizations in parallel
- Parameter sets management tools
- 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
- Deployment of simulation models to other engineers with the MapleSim Explorer
- 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, 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, parameter sweeps, sensitivity analysis, and Monte-Carlo simulation
- Data generation and signal generation tools
- Point-and-click access to powerful analysis and utility tools, for extracting both kinematic and dynamic equations from a multibody system, initialization diagnostics, motion profiles, vibration analysis, FMU generation, and more
- 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, including comparison of simulation runs on the same axes, instant plotting of both probed and unprobed variables, and easy creation of custom plots
- 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
- Supports development and deployment of easy-to-use custom applications based on the model, including web deployment using MapleSim Server

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

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