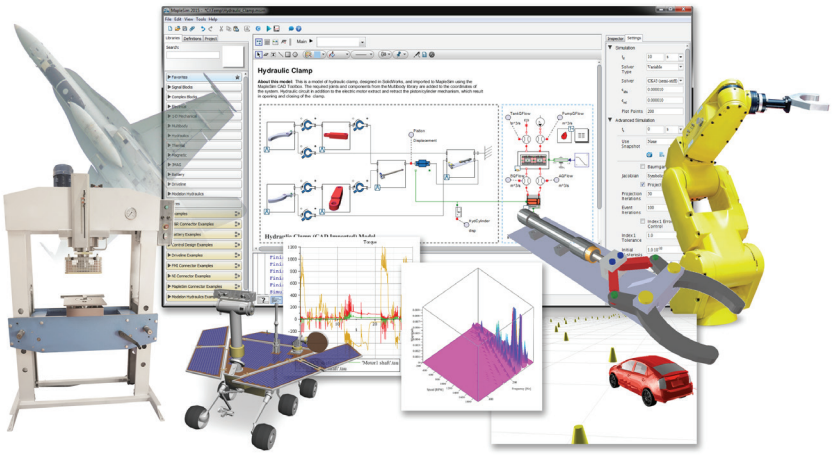
The modern approach to physical modeling

MapleSim™

MapleSim™ is an advanced system-level modeling and simulation tool that applies modern techniques to dramatically reduce model development time, provide greater insight into system behavior, and produce fast, high-fidelity simulations.



Reduce Development Time

By combining modern physical modeling techniques with the world's most advanced symbolic computation engine, MapleSim offers an environment in which you can develop high-fidelity system-level models significantly faster than with other tools.

- **Easily construct and validate models** using a model diagram that closely resembles the system diagram.
- **Create multidomain system-level models** by seamlessly combining components from different domains into a single model.
- **Take advantage of revolutionary multibody technology** that gives you unparalleled flexibility and control of your multibody models, making complex multibody models easier to develop and analyze.
- **Create custom components easily**, without programming, simply by specifying their representative equations.
- **Incorporate CAD models** in your system-level designs by importing CAD assemblies directly into MapleSim, automatically capturing the properties of the model components.
- **Customize and expand MapleSim's modeling capabilities** through the open standard Modelica® modeling language.

Develop Better Designs

MapleSim, coupled with Maple™, provides a powerful, open analysis environment, giving you all the tools and flexibility you need to refine and optimize your designs.

- **Take advantage of an extensive library of built-in analysis tools** for sensitivity analysis, Monte Carlo simulation, optimization, and more.
- **Leverage automatically generated model equations in full parametric form** for open access to your models for advanced applications and analysis.
- **Perform complicated operations at the click of a button or with a single command**, including symbolic differentiation, symbolic integration, order reduction, variable isolation, and analytical solving of sets of equations.
- **Easily script custom analyses** using a powerful programming language designed for working with mathematical concepts.
- **Access the underlying equations or Modelica code for components** for deeper insight into the behavior, and modify them if desired.
- **Capture all your project information into a single project file**, including models, simulation results, analyses, and reports, combining your reasoning with your results and fully capturing the engineering knowledge that goes into each project.

Get Extremely Fast Simulation Code

MapleSim's unique technology generates extremely fast, royalty-free model code for optimization and in-the-loop testing. With MapleSim, you can achieve real time the first time, without sacrificing fidelity in your system-level models.

- **Achieve a computationally simpler set of system equations without loss of fidelity** through symbolic simplification, including DAE index reduction, removing redundant operations, and eliminating algebraic loops.
- **Dramatically speed up execution times** with symbolic optimizations of generated code.
- Take advantage of **automatically generated simulation code that is always royalty-free**.
- **Easily integrate code into popular real-time toolchains and other applications**, including Simulink® and FMI-compatible tools.

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
- 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

MapleSim Add-ons

- MapleSim Control Design Toolbox
- MapleSim CAD Toolbox
- MapleSim Battery Library
- MapleSim Driveline Library
- MapleSim Tire Library
- MapleSim Hydraulics Library® from Modelon
- MapleSim Server
- Connectivity add-ons for Simulink®, FMI, and many more

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
- 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
- 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, 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, 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

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

Maplesoft

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