

Maplesoft Engineering Suite

A new generation of engineering math and modeling tools that enrich your classroom and accelerate your research



Academic Engineering

High-Performance Physical Modeling



MapleSim™ 4

High-Performance Physical Modeling and Simulation

MapleSim™ is a physical modeling tool unlike any other. MapleSim is built on a foundation of symbolic computation technology, which efficiently manages all of the complex mathematics involved in the development of engineering system models, including multi-domain systems and plant models for control applications. With MapleSim, instructors can quickly demonstrate the connection between theory and physical behavior, preparing students to meet the challenges of modern industry. Students spend more time working with design concepts rather than the mechanics of mathematical derivations.

For researchers, MapleSim can reduce model development time from months to days while producing models of greater fidelity and higher performance.



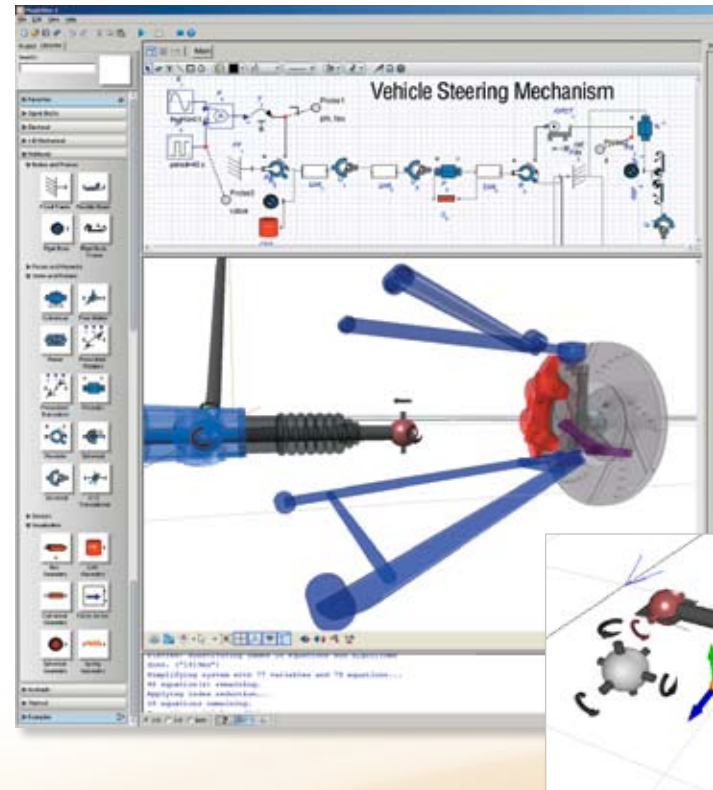
Who is Using MapleSim?

MapleSim helps engineers from around the world successfully meet the challenges of complex, modern engineering projects. Industries that are using MapleSim include:

- Automotive and ground transportation: vehicle dynamics; noise, vibration, and harshness (NVH); powertrain; hybrid-electric and electric vehicles (HEV/EV); rail; and industrial vehicles
- Aerospace: unmanned aerial vehicle (UAV), space robotics, aircraft dynamics, guidance and control
- Manufacturing: machine design and analysis, robotics
- Research and teaching: mechatronics, robotics, control
- Power (including wind and nuclear), electronics, and more

"Maple and MapleSim have opened new doors for my research and teaching in mechatronics, intelligent robotics, haptics, and other increasingly important fields in engineering. I am able to spend much more time in exploring ideas, concepts, and techniques at a high level."

Dr. Venkat Krovi, Mechanical and Aerospace Engineering
Director, Automation, Robotics and Mechatronics Laboratory
The State University of New York, Buffalo, New York, USA



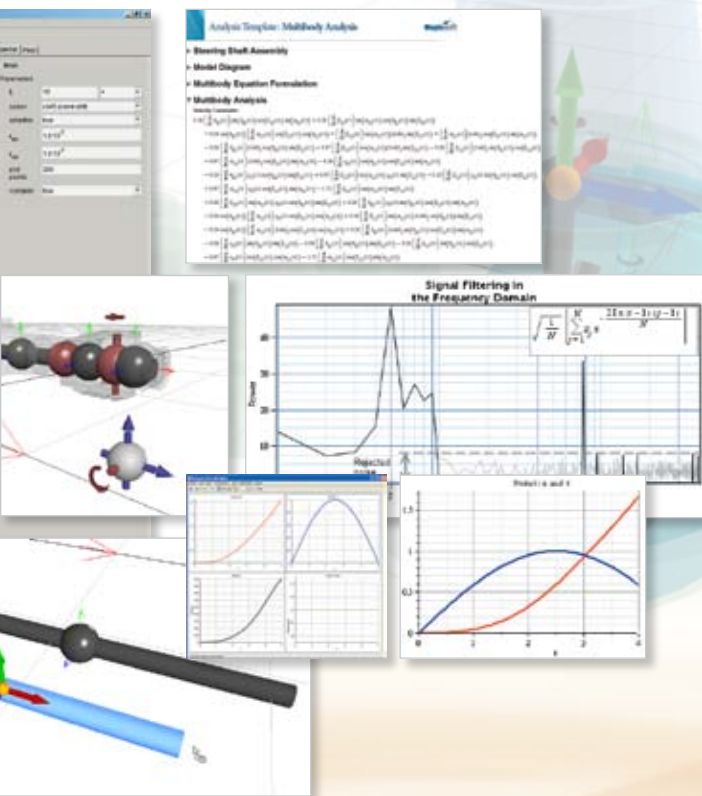
Quickly develop complex physical models

- MapleSim supports a wide variety of domains and includes fully validated Modelica components for modeling mechanical, electrical, hydraulic, thermal, and signal-flow systems.
- Model diagrams map directly to your physical systems, so they are easy to construct and validate.
- MapleSim lets you rapidly create custom components from first principles, by allowing you to specify the mathematical equations that define the dynamic behavior of your system.

Exceptional tools for multibody dynamics

- MapleSim helps you to meet the challenges inherent in modeling a 3-D physical system within a 2-D workspace by providing an interactive 3-D model construction environment. This environment can be used in conjunction with the block diagram environment, allowing you to leverage the benefits of both approaches when building your models.
- After your model is constructed, the MapleSim simulation engine automatically animates the model in 3-D, enabling you to visualize its behavior.
- State-of-the-art algorithms for multibody system handling automatically generate optimized model equations for your system. In MapleSim, powerful code generation routines can then convert these equations into compact and numerically efficient code, which can be quickly and easily exported to other applications in your toolchain.

g and Simulation



Extensive range of analysis tools

- Analysis and exploration tasks such as parameter optimization, sensitivity analysis, and unit management are easy to perform.
- MapleSim comes with components and routines designed to reduce the amount of work involved in performing signal and control analysis on your simulations.
- With its built-in symbolic scripting language, you can even extend your analysis beyond these tools to customize your models based on the needs of your project.

Realize more systems for HIL applications

- MapleSim's intuitive multi-domain modeling environment supports the rapid development of complex, high-fidelity plant models.
- The symbolic techniques that lie at the heart of MapleSim generate efficient system equations, eliminating the need to simplify the model manually to reduce its computational complexity.
- Powerful code generation tools produce fast executing code, which can be seamlessly incorporated into popular real-time toolchains.

Key Features of MapleSim

MapleSim is a drag-and-drop physical modeling tool that applies advanced symbolic computation techniques to produce high-performance simulation models of multi-domain systems. You can construct plant models using acausal connections between the components to represent their physical relationships, and then combine your plant models with signal flow-based control systems. MapleSim generates the representative system equations, reduces them to an optimal form while maintaining model fidelity, and runs a dynamic simulation of the resulting system, complete with a 3-D visual representation.

Key Features

- Using the drag-and-drop physical modeling environment, you can quickly create a **model diagram that maps directly to your physical system**.
- MapleSim comes with over 300 prebuilt components from **11 different domains**, including mechanical, electrical, thermal, signal, and hydraulic, that can be naturally combined in a model diagram.
- **Systems equations are automatically generated** from the system diagram and simplified using lossless symbolic techniques to produce an **optimal set of equations**. These equations can be viewed, manipulated, and analyzed using natural math notation.
- **Equation-based custom components** allow you to easily define custom components from first principles by specifying the representative mathematical equations.
- Advanced multibody system handling generates **optimized kinematic and dynamic equations** for multibody systems.
- A flexible model construction environment supports both **block diagram and 3-D model construction** for multibody systems. During system simulation, realistic **3-D animations** allow for full insight and understanding of the resulting dynamic behavior.
- **Built-in analysis** tools support parameter optimization, sensitivity analysis, equation extraction, multibody analysis, Monte Carlo simulation, and more.
- **Units management** removes potential conversion and consistency errors.
- **Live design documentation** allows you to analyze, fine tune, and document your project and store the information with your model diagram.
- Full-featured **symbolic scripting language** provides programmatic access to mathematical solvers, structures, and visualization tools.
- Symbolic techniques produce efficient, high-fidelity model equations and optimized code for **fast real-time execution, including hardware-in-the-loop (HIL) applications**.
- Models can be **deployed to other applications in your toolchain** using the built-in optimized code generation feature or more directly through connectivity add-ons for popular platforms from The MathWorks™ and National Instruments™.

The Essential Tool for Mathematics and Modeling

Maple™ 14

The Essential Tool for Mathematics and Modeling

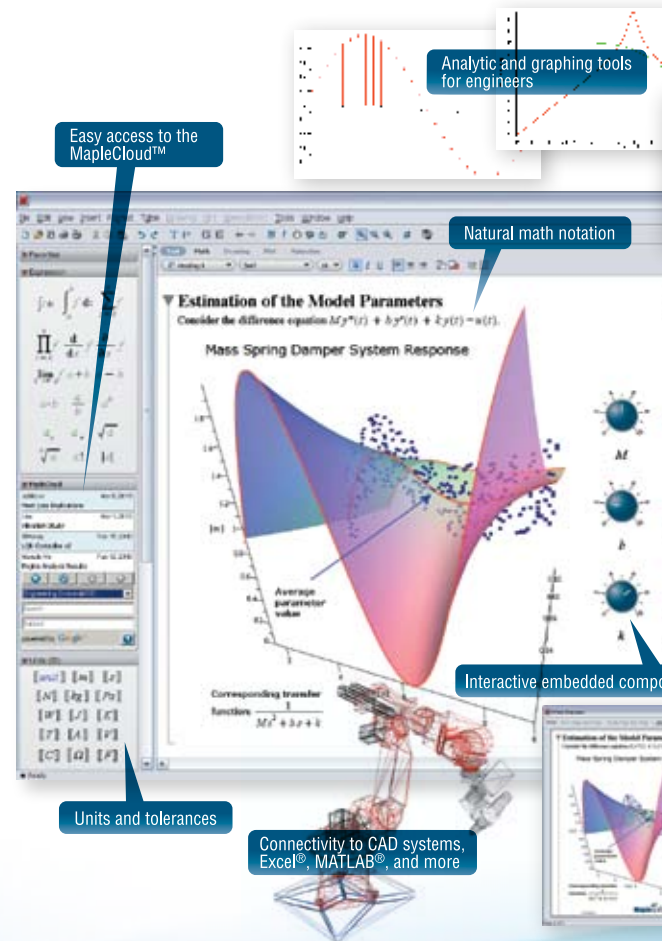
Maple™ is the essential technical computing software for today's engineers, mathematicians, and scientists. Whether you need to do quick calculations, develop design sheets, teach fundamental concepts, or produce sophisticated high-fidelity simulation models, Maple's world-leading computation engine offers the breadth, depth, and performance to handle every type of mathematics.

Maple combines the world's most powerful mathematical computation engine with an intuitive, "clickable" user interface. Its smart document environment automatically captures all of your technical knowledge in an electronic form that seamlessly integrates calculations, explanatory text and math, graphics, images, sound, and diagrams. Documents can easily be shared with colleagues, students, or the entire Maple community through the MapleCloud™.

Maple is a vital component of all your technical projects, including those in the automotive, aerospace, electronics, and financial industries. Maple provides the mathematical engine for MapleSim, a high-performance physical modeling and simulation tool. The full Maplesoft™ product line includes reference and self-study e-books, testing and assessment products, and more.

"My experience with Maplesoft technology has been extremely positive. Its computing and plotting capabilities make it an essential tool for conveying graphical ideas more efficiently, whether in the classroom or in design team meetings. It plays an invaluable role in the production of innovative designs."

Dr. Jorge Angeles
James McGill Professor, NSERC Design
Engineering Chair (2003-2008)
McGill University, Montreal, Quebec, Canada



Powerful Math Engine

The core math engine delivers a broad suite of symbolic and numeric solvers. This includes tools for matrix computation, differential equation solvers, code generation, data analysis, optimization, statistics, and much more.

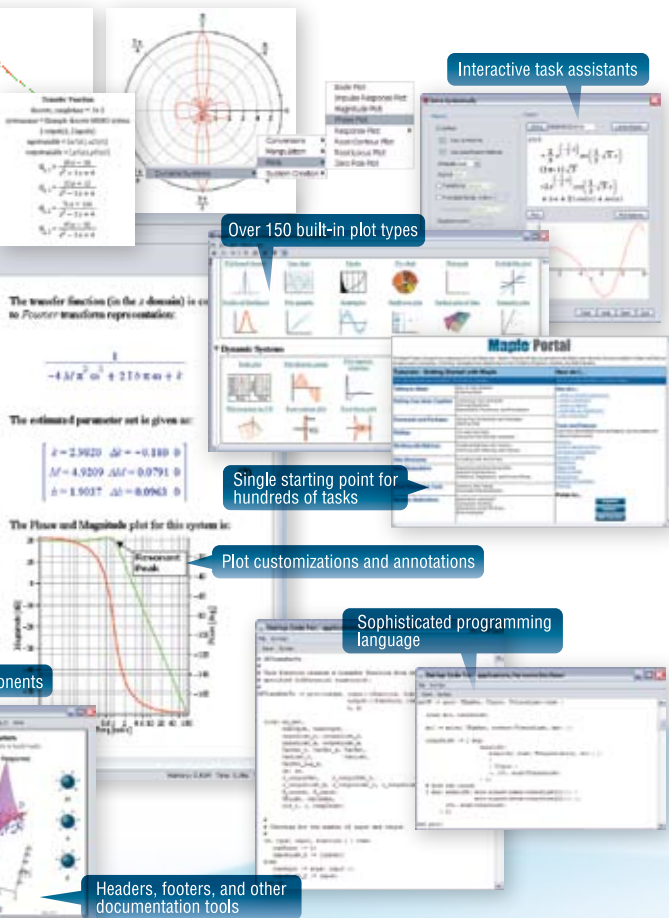
Ease of Use

Maple's remarkably intelligent interface minimizes the learning curve through context-sensitive menus, command completion, templates, palettes, and natural math notation. This makes Maple ideal for everything from quick calculations and design deliverables to full application development with custom interfaces.

High Performance

Efficient algorithms and tools for high performance computing (HPC) and large-scale problem solving include multi-threading, parallelization, and grid computing.

and Modeling



Compelling Visualization

Rapidly generate a broad range of customizable 2-D and 3-D plots, including plots for control analysis using context-sensitive and interactive plot builder menus. Exploit the programmatic interface for complete control over every aspect of your graphs.

Live Design Documentation

Maple offers a complete array of document layout and word processing tools that enable you to document as you design. You can do your calculations and produce a deliverable in a single environment.

Extensive Connectivity

Code generation, external calling, an open API, and CAD, MATLAB®, Excel®, database, and network connectivity mean that Maple amplifies the investment you made in other tools.

Key Features

- Coverage of virtually every area of mathematics, including calculus, algebra, differential equations, statistics, linear algebra, geometry, and transforms
- Intuitive smart document environment
- Advanced easy-to-use math equation editor
- Self-documenting context-sensitive menus
- Units, dimensions, and tolerances
- Task templates and interactive task assistants
- Point-and-click tutors for key topics in calculus, algebra, and more
- Interactive embedded components (sliders, buttons, dials, gauges, math entry boxes, etc.)
- 2-D and 3-D plotting and animation, with extensive annotation tools
- Extensive document creation tools
- Single integrated environment for creating, distributing, and receiving documents through the MapleCloud™
- Dictionary of technical terms
- Code generation (C, Fortran, Visual Basic®, Java™, MATLAB®)
- Connectivity to Excel, MATLAB®, CAD systems, C, Java, Fortran



Maplesoft Supports Both Teaching and Research

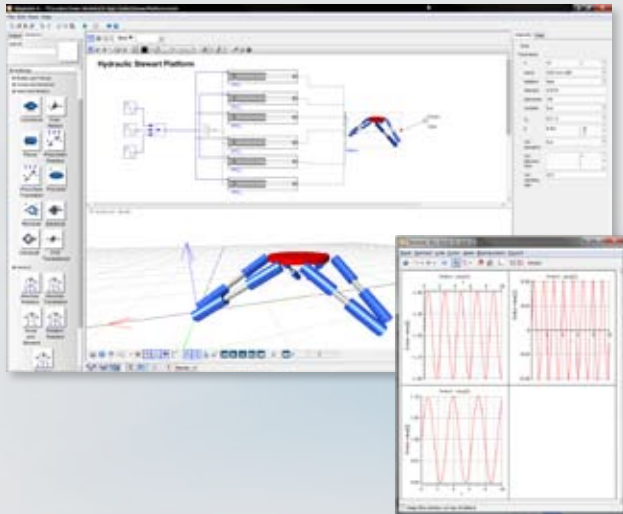
Case Study

Opening doors in research and teaching

Dr. Venkat Krovi, Mechanical and Aerospace Engineering
Director, Automation, Robotics and Mechatronics Laboratory
The State University of New York, Buffalo, New York, USA

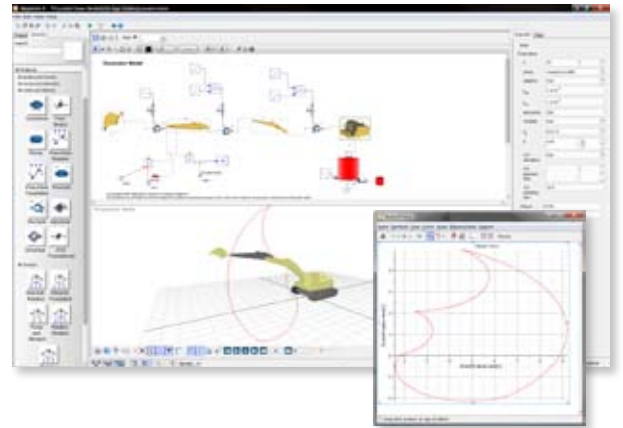
Dr. Krovi's Automation, Robotics and Mechatronics lab has been at the forefront of modeling, prototyping, and control of multibody mechanical and mechatronic systems. Over the years, he has used Maple's powerful symbolic capabilities to support the development of high-fidelity models for complex systems. Recently, his team used MapleSim to create high-performance models suitable for symbolic and numerical simulation studies, model-based controller development, and hardware-in-the-loop (HIL) testing.

He reports that the boost to his research has been clear – these tools accelerated the model development testing and validation cycle and allowed his team to spend more time exploring various concepts and techniques, in lieu of tedious algebraic manipulations. He also finds that MapleSim is a phenomenal computational and mathematical framework for bringing engineering modeling courses to life. Dr. Krovi has been at the leading edge of deploying MapleSim to support classroom educational activities.



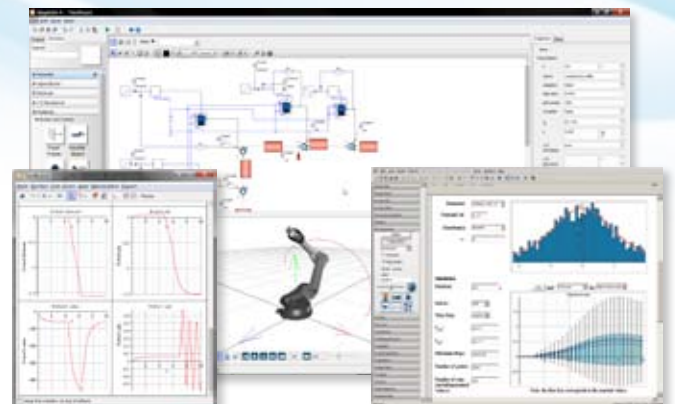
Enriching the Classroom

In many ways, the Maplesoft engineering suite is what engineering professors have always wished for: a platform where students can work confidently with everything from theoretical concepts to the subtleties of design, all within a rigorous framework. Maple has numerous fundamental tools that support applied topics such as dynamics, control, thermodynamics, circuits, and more. Through engaging classroom demonstrations, independent explorations, and labs, your students can focus on the concepts and application of theory and not the manual steps. In addition, with the growing importance of math-based design in industry, the Maplesoft product line keeps you and your students connected to emerging trends and helps ensure success in tomorrow's professional world.



Accelerating Research

With flexible modeling capabilities, powerful mathematical analysis tools, and an extensive programming language, you can rigorously manage your theoretical models and equations in a fraction of the time. Refining models for unique cases no longer incurs huge time penalties from manual derivations. In fact, with the Maplesoft product line, the path from your initial ideas to theoretical formulation, refinement, validation, proof of concept, and even the final report is a single, seamless process. The result is more research opportunities, more diverse research options, and increased opportunities to generate and enhance your intellectual property.



The Unique Advantages of Symbolic Technology

Maplesoft's core symbolic technology has evolved over a period of 25 years and is now considered the finest math functionality in the world. Technical professionals around the world have exploited tools in Maple for differential equations, matrix computation, optimization, and statistics, while eliminating round-off error, gaining unlimited precision, and taking advantage of symbolic parameters to better analyze their systems.

MapleSim is based on the same core technology. It is the only comprehensive modeling system built within a natively symbolic framework and, as such, it avoids some of the worst sources of error and computational inefficiencies generated by traditional, numeric-based modeling tools. Symbolic computation is quickly becoming one of the most important and defining technologies of next generation modeling techniques. It provides the flexibility to develop model equations quickly and it offers the flexibility to better manage models and get to the optimal results faster.

Symbolic computation provides:

- Model equations in natural mathematical form
- Equation-based custom component development
- Symbolic model simplification and DAE reduction
- Optimized code generation

Add-on Products and Toolboxes

MapleSim Connector

Using the MapleSim Connector, high-performance, high-fidelity MapleSim models are automatically converted to S-Function blocks for fast execution within Simulink® and real-time implementation in Real-Time Workshop®.

MapleSim Connector for LabVIEW™ and NI VeriStand™ Software

With the MapleSim Connector for LabVIEW™ and NI VeriStand™ Software, you can extend your NI LabVIEW and NI VeriStand applications by integrating MapleSim's high-performance, multi-domain environment into your existing toolchain.

MapleSim Control Design Toolbox

The MapleSim Control Design Toolbox provides a solid set of essential control design tools that extend MapleSim's exceptional plant modeling capabilities to support control design.

MapleSim Tire Component Library

The MapleSim Tire Component Library provides you with industry standard tire force model components such as Fiala, Calspan, and Pacejka's magic tire formula. In addition, linear tire models and user-defined tire models are available to provide flexibility for investigation and analysis.

Maple Global Optimization Toolbox

Formulate your optimization model easily inside the powerful Maple numeric and symbolic system, and then use world-class Maple numeric solvers to return the best answer, fast!

Maple T.A.™

Maple T.A.™ is an easy-to-use web-based system for creating tests and assignments, and automatically assessing student responses and performance. It supports complex, free-form entry of mathematical equations and intelligent evaluation of responses.

BLOCKImporter™

BlockImporter™ is a Maple add-on that allows you to import a Simulink® model into Maple and convert it to a set of mathematical equations. This conversion enables you to validate the mathematical integrity of the model, perform further analysis, document the system, eliminate algebraic loops, and increase Simulink® execution speed.

MapleNET

The MapleNet™ suite of mathematical services brings the power of Maple to your applications and web sites. With MapleNet, you can add mathematical computations and visualizations to your web and desktop applications, share solutions over the web through interactive Maple documents, and develop rich technical web content.

Maple Grid Computing Toolbox

The Maple Grid Computing Toolbox allows you to distribute computations across the nodes of a network of workstations, a supercomputer or across the CPUs of a multiprocessor machine.

Advanced Engineering Mathematics

Advanced Engineering Mathematics with Maple is the definitive reference software and textbook for engineering mathematics.

For more add-ons, visit www.maplesoft.com/products