Solutions for Every Aspect of Engineering Education
The Maplesoft Engineering Suite is based on Maplesoft’s core technologies, including the world’s most advanced symbolic computation engine and revolutionary physical modeling techniques. Together, they provide a new generation of engineering math and modeling tools that enrich your classroom and accelerate your research.

- Prepare students for the challenges they will face in industry by giving them experience with modern techniques and tools for system-level modeling
- Engage your students with complex, real-world examples without overwhelming them with derivations
- Show direct links between equations and design concepts to deepen student understanding and develop analysis skills
- Save wear and tear on expensive physical equipment through virtual prototyping and simulation, while allowing students to investigate a wider range of conditions
- Create lab reports, assignments, course notes, and research reports in a rich technical document environment
- Take advantage of e-learning solutions that include online testing and assessment and web-based learning tools designed for technical courses

Built on over 25 years of success and experience in high performance mathematical computing, Maplesoft’s engineering solutions are designed to face the challenges of modern engineering head on. Whether your interest is in the classroom experience, advanced theoretical research, practical realizations of designs, or even development of sophisticated models for consulting services to industry, the Maplesoft product line provides tools to satisfy all your needs.
Solutions for Every Aspect of Engineering Education

Maplesoft products are essential tools for researchers, educators, and students in any engineering discipline.

**Modeling and Simulation**
Create and simulate system-level models that incorporate elements from different engineering domains in a single environment, including electrical, mechanical, multibody, hydraulics, and more.

**Optimization and Analysis**
Perform numeric and symbolic computation with an extensive collection of powerful analysis tools, including parameter sweeps, optimization, sensitivity analysis, and more.

**Control Design**
Explore different control strategies, create parameterized controllers, and implement advanced control techniques.

**Statistics and Data Analysis**
Apply fundamental and advanced techniques for a wide range of common statistical tasks such as quantitative and graphical data analysis, simulation, and curve fitting.

**Mathematics**
Explore, visualize, and solve complex mathematical problems with the world’s most powerful mathematical computation engine.

**Assessment**
Deliver tests and assignments online, with free-form entry of mathematical equations and automatic, intelligent evaluation of the student response.

**Research**
Engineering researchers must not only develop models quickly, but they also require in-depth analytical tools to help them understand on a fundamental level the intricacies of their models. Fortunately, tools like MapleSim™ and Maple™ are available to researchers to aid in their model development and analysis. With Maplesoft solutions, researchers can quickly develop their models and can gain insight into their systems’ behaviors, accelerating their research and reducing model development time from months to days while producing high-fidelity, high-performance models.

**Education**
The advanced physical modeling and simulation solution from Maplesoft offers increased scope for educators, and is also easy and intuitive enough to be used by undergrads so they can gain greater insight into the nature of physical systems. Instructors can use MapleSim and Maple to quickly demonstrate the connection between theory and physical behavior, and students can spend more time working with design concepts rather than the mechanics of mathematical derivations.
Customer Stories

**MapleSim Revitalizes the Freshman Engineering Design Course at McMaster University**

*McMaster University*

During a recent initiative to enrich its cornerstone course, McMaster University introduced MapleSim into their engineering course curriculum. Dr. Thomas Doyle, Assistant Professor of Electrical and Computer Engineering at McMaster University, wanted to find a way to increase the engagement of these first year students by providing them with both practical knowledge and an understanding of the theory behind engineering design.

“Using MapleSim, students can visualize primary movements of an engineering system and identify design defects readily,” says Dr. Doyle. “The MapleSim software, although extremely powerful, has been presented in a way that is very easy to use, such that freshmen can design, operate, and build complex models. In my first year teaching the Cornerstone course using MapleSim, I witnessed better designs and true engineering insights in the final results of the students’ projects. As a result, MapleSim is now a mandatory component for every engineering freshman at McMaster University.”

**MapleSim and Maple Used in Advanced Research Projects at the Automation, Robotics, and Mechatronics Lab at SUNY Buffalo**

*SUNY Buffalo*

The Automation, Robotics and Mechatronics (ARM) Lab is a research laboratory in the Department of Mechanical & Aerospace Engineering at the School of Engineering & Applied Sciences in The State University of New York (SUNY) at Buffalo.

Since most of their projects start with an in-depth analysis of the underlying mathematics of the system, the ARM Lab requires tools for developing and analyzing mathematical equations. They have chosen Maple and MapleSim as key tools to complete these tasks. Dr. Venkat Krovi, director of the ARM Lab, finds using a symbolic approach invaluable to their work. “Performing these calculations symbolically allows for the development of exact, closed form expressions. We don’t need to worry about accumulating errors from numerical calculations. Perhaps even more importantly, with the exact mathematical equations, we can identify singularities, perform parametric design refinements, and improve the real-time model-based control strategies.”

**Controller Arm for World’s Largest Functional Brain Model Built Using MapleSim**

*University of Waterloo*

A group of neuroscientists and software engineers at the University of Waterloo’s Computational Neuroscience Research Group (CNRG) have built the world’s largest functional model of the human brain. Named Spaun, the simulated brain has a digital eye, which it uses for visual input, and a robotic arm that it uses to draw its responses.

Having a realistic arm that behaves similarly to an actual arm, with appropriate muscle responses and arm segment lengths and mass, is important to getting accurate results. Travis DeWolf, the University of Waterloo researcher who built the arm, attributes the success of the complex arm model to MapleSim’s symbolic computation power and model simplification capabilities.
“With MapleSim, we had access to the symbolic equations driving the system, which meant we could get very accurate descriptions and do extensive analysis of the model,” said DeWolf. “And the equations were automatically simplified in MapleSim, giving us a highly efficient simulation.”

Learning to Walk Faster with High Performance Modeling

University of Manchester • Italian Institute of Technology

A project using MapleSim at the University of Manchester is helping to perfect the process of humanoid walking in robots. Staff from the Centre for Interdisciplinary Computational and Dynamic Analysis (CICADA) have been working with Professor Darwin Caldwell at the Italian Institute of Technology, Genova, who has been developing a novel compliant humanoid robot (COMAN) based on the previously developed humanoid robot iCub at IIT.

One of the challenges facing the Manchester team, led by Dr. Martin Brown and Dr. Gustavo Medrano-Cerda, is visualising experiments quickly and effectively to avoid slowing down the process and to ensure that experimentation is valid and relevant. “The ability to visualise in MapleSim, without having to write our own programs, has been invaluable,” says Ph.D. student Houman Dallali. “What’s more, we can directly generate C++ code to interface with the hardware and speed up the controller implementation/debugging process.”

Advanced Teaching Benefits with Control Hardware and Modeling Software

Bristol University

At the Bristol Robotics Laboratory (BRL), the UK’s largest Robotics Laboratory based at Bristol University, postgraduates are using MapleSim to model robotic systems. Used in various projects, “MapleSim has enabled students to develop models far more quickly than would otherwise have been the case,” says Dr. Herrmann. “Highly intuitive, the software possesses a powerful mix of modeling and simulation tools to reduce the time and effort needed to realize projects whilst learning valuable techniques.”

University of Waterloo Improves Learning while Saving Money with Maple T.A.

University of Waterloo

The University of Waterloo chose Maple T.A. to automate the assessment tasks for many of their mathematics-based courses. Today, Maple T.A. is used to deliver tests and assignments to approximately 9000 students/year, spread over more than 40 courses. Students in the engineering, mathematics, and science faculties use Maple T.A. every day.

After adopting Maple T.A., the university reduced its budget for graders by one-third. Though the savings are substantial, and welcome, the university also views Maple T.A. as an important teaching tool that provides real benefits to the quality of the students’ education.

“Maple T.A. has made a huge difference to us, on many levels,” says Carrie Howells, Instructional Support Coordinator for the Mathematics Faculty Computing Facility. “We can offer an appropriate number of assignments to our students without being overwhelmed, and students appreciate the improved feedback on all their assignments. In addition, after moving to Maple T.A., we’ve found that we can save approximately $100,000 per year on our grading budget, which we can use to support activities and programs we couldn’t otherwise offer.”
The Modern Approach to Modeling and Simulation

MapleSim™
Advanced System-Level Modeling

With MapleSim, educators have an industry-proven tool to help bridge the gap between theory and practice. Built on the world-leading Maple mathematics engine, MapleSim gives you the ability to engage your students with complex, real-world examples and prepare them for the challenges they will face in industry.

Multiple domains, one environment
With industry increasingly turning toward system-level modeling to meet the demand for more efficient products at lower cost, there is a growing need to incorporate multidisciplinary concepts into the engineering curriculum. 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
Systems that would take hours or days to construct from first-principle equations can be created in a fraction of the time using MapleSim. Instead of building signal-flow diagrams based on abstract mathematical expressions, 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®, and other tools, where it can be incorporated with a physical prototype.

“The benefits of MapleSim compared to traditional tools are significant. The ability to see the model, to see the moving parts, is very important to a model developer. I am now moving to MapleSim in most of my projects.”
Dr. Amir Khajepour, Canada Research Chair in Mechatronic Vehicle Systems and Professor of Engineering in the Mechanical and Mechatronics Engineering department at the University of Waterloo.

“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.
MapleSim Add-ons

MapleSim Control Design Toolbox
Extend MapleSim’s plant modeling capabilities to support control design with tools for model linearization, PID tuning, development of state-space control strategies, and custom compensator design.

MapleSim Driveline Library
Covers all aspects of the powertrain, from the engine to the differential, wheels, and road loads.

MapleSim Tire Library
Industry standard tire force components for Fiala, Calspan, and Pacejka’s magic tire formula, in addition to linear and user-defined tire models.

MapleSim Hydraulics Library® from Modelon
Seamlessly incorporate industry-tested advanced hydraulics components into your MapleSim models.

Connectivity Add-ons
MapleSim can be seamlessly integrated with your existing toolchain. Connectivity add-ons, which make it easy to generate extremely efficient models for use in the target platform, are available for many different products, including Simulink.

Exploring Engineering Fundamentals

Enhance your classroom with free, professionally developed content designed to teach engineering fundamentals. Combining the strengths of MapleSim, Maple, and Maple T.A., this material helps students explore and reinforce concepts and provides instructors with content to supplement lectures and create labs and assignments. Topics include:

- Kinematics and Dynamics
- Introduction to Vibrations
- Introduction to Control Systems
- Robot Manipulators
- Electrical Circuits
Maple™

Maple is an essential tool for researchers, teachers, and students in any technical discipline. It lets you explore, visualize, and solve even the most complex mathematical problems, reducing errors and providing greater insight into the math.

**Most Powerful Math Engine**
- Over 5000 functions covering virtually every area of mathematics, including calculus, differential equations, statistics, linear algebra, and transforms
- Symbolic, numeric, and hybrid computation algorithms
- World-leading algorithms for solving problems that are beyond the reach of any other software system
- Efficient algorithms and tools for high performance computing and large-scale problem solving

**Smart Document Interface**
- Easy access to complicated operations, such as symbolic differentiation, symbolic integration, order reduction, variable isolation, and analytical solving of sets of equations, at the click of a button or a single command
- Sophisticated programming language
- 2-D and 3-D plotting and animation, with extensive annotation tools
- Extensive document creation and word-processing tools

**Extensive Connectivity**
- Code generation (C, C#, Fortran, Java™, MATLAB®, Perl, Python®, Visual Basic®)
- Connectivity to Excel®, MATLAB, MapleSim, Java, Fortran, CAD systems, C, databases, web sites, and more
- Extensive import and export capabilities for data, documents, math, and plots
- Web deployment through MapleNet™ and The Möbius Project

**Passionate User Community**
- MaplePrimes™, a web community dedicated to sharing experiences, techniques, and opinions
- The Möbius Project, the Maplesoft Application Center, and the MapleCloud™ Document Exchange, featuring thousands of examples and applications contributed by the Maple community
- Teacher and student resource centers, with classroom materials, training videos, social networking communities, tips and techniques, and more
Maple with MapleSim

MapleSim is based on Maple, the world’s most powerful symbolic and numeric math engine. Not only does the Maple computation engine provide many advantages other systems simply cannot match, from automatically generated system equations to real-time simulation code for complex systems, but Maple itself provides an ideal environment for design exploration, analysis, visualization, and documentation. Together, the two tightly integrated products provide a powerful, flexible platform for teaching, learning, and research.

- Automatically-generated model equations in full parametric form give you open access to your models for advanced applications, concept illustrations, and analysis, including optimization, sensitivity analysis, system identification, inverse kinematics, and more.

- Equation-based custom components take you from equations and concepts to final models quickly, without programming.

- Optimized code generation produces high-performance, royalty-free code suitable even for complex real-time simulations, including hardware-in-the-loop applications.

- An interactive analysis environment provides an extensive collection of powerful analysis tools and the ability to quickly customize and extend these tools to suit your project.

- Automated knowledge capture means you can easily integrate models, simulation results, analysis, reports, assignments, custom component descriptions, animations, data files, and more into a single project file, combining your reasoning with your results and fully capturing the engineering knowledge that goes into each project.

Maple Add-ons

Global Optimization

Powered by Optimus®

Using the Global Optimization Toolbox, you can formulate optimization models easily inside the powerful Maple numeric and symbolic system, and then use world-class optimization technology to return the best answer robustly and efficiently.

GRID Computing

With the Maple Grid Computing Toolbox, you can distribute computations across the nodes of a network of workstations, a supercomputer, or the CPUs of a multiprocessor computer. This allows you to handle problems that are not tractable on a single machine because of memory limitations or because it would simply take too long.

BlockImporter™

BlockImporter allows you to import a Simulink model into Maple and convert it to a set of mathematical equations. It can then be analyzed, optimized, simplified, turned into a MapleSim custom component for inclusion in MapleSim, and exported back to Simulink using the MapleSim Connector.
Why Choose 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, making it ideal for science, technology, engineering, and mathematics (STEM).

- Maple T.A. provides everything you would expect in an assessment system plus features designed specifically for technical courses involving engineering mathematics.
- Because Maple T.A. is powered by Maple, it offers features especially suited for assessment in technical courses.
- Maple T.A. has the easiest and most comprehensive content authoring tools available. Its advanced authoring environment lets you create custom engineering content quickly and easily.

Maple T.A. and Course Management Systems

Maple T.A. can be incorporated into virtually any course management system, making for a seamless experience for instructors and students.

- Connectors are available for Blackboard®, Moodle™, and Desire2Learn™ environments.
- A web services API allows you to build your own connector to integrate Maple T.A. into other systems, including custom-built solutions.

MapleNet™

Bring the Power of Maple to Your Web Sites and Applications

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.

- With MapleNet, you can easily share your Maple documents, calculators, and technical applications. Your colleagues and students can interact with your content, perform calculations, and visualize results, all from within a standard web browser. Maple provides the easiest interface available for creating web applications that rely on mathematical computations.
- MapleNet provides a standard web services application programming interface (API), making the computational power of Maple available no matter what language or infrastructure you use to create your web site, desktop applications, and mobile applications.
- MapleNet provides the tools you need to put mathematical power behind your web site. MapleNet supports web content written as Java Server Pages (JSP), Java applets, and Maplet™ applications. With MapleNet, you can design custom web applications that perform live calculations based on user input and display the results using standard mathematical notation and dynamic, interactive plots and animations.
Maplesoft Resources

Teacher Resource Center
Maplesoft has revolutionized how mathematics and engineering is taught and learned. This site is designed to ensure you get the most out of your teaching experience using Maplesoft products. The course content in the Teacher Resource Center is designed to provide you with all the materials you need to incorporate Maplesoft technology in your classroom.
Visit www.maplesoft.com/teacherresource

Student Help Center
The Student Help Center provides an unmatched online support system to students in their math and engineering studies. The site contains a dedicated student forum, online calculators, training videos, a homework resource guide, and much more.
Visit www.maplesoft.com/studentcenter

Application Center
The Application Center features over 2,000 applications and tutorials contributed by the Maplesoft user community. This growing collection shows how Maplesoft solutions are applied to solve technical problems.
Visit www.maplesoft.com/applications

MapleSim Model Gallery
The MapleSim Model Gallery contains a number of downloadable examples created using MapleSim. See for yourself the breadth and depth of MapleSim applications.
Visit www.maplesoft.com/products/maplesim/gallery

MaplePrimes
MaplePrimes is a web community dedicated to sharing experiences, techniques, and opinions about Maplesoft products, as well as general interest topics in mathematics and engineering.
Visit www.mapleprimes.com

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Online communities for Maplesoft enthusiasts are available through social networking sites Facebook® and LinkedIn®. You can also visit the Maplesoft channel on YouTube® to watch tutorials and other videos on mathematics, engineering, and related topics, or you can follow Maplesoft on Twitter™.

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Maplesoft’s monthly webinars provide an excellent opportunity to learn about interesting applications, new techniques, and products. Hosted live by senior Maplesoft representatives, these one-hour interactive sessions also offer the opportunity to ask questions and interact with the presenter.
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• Customized licensing programs

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