

INTRODUCING MATHEMATICA IN AERONAUTICS AND ASTRONAUTICS

WHY MATHEMATICA?

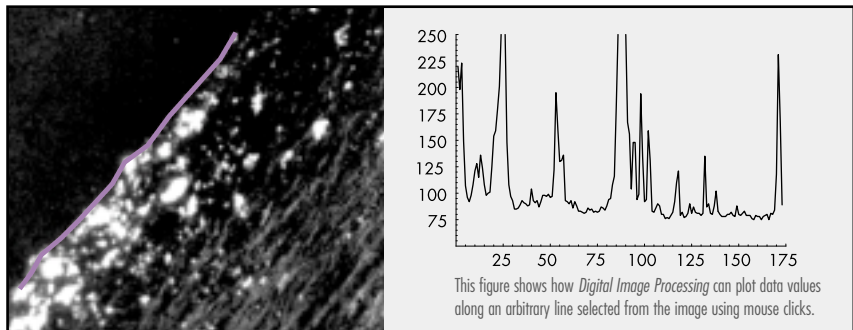
For over 12 years *Mathematica* has proven itself to be a leader in technical computing software. Now, an increasing number of companies consider it an indispensable tool for decreasing development time and speeding up communications. *Mathematica* allows consolidation of all calculations, graphics, code, and notes into one notebook that can be shared with other departments and partners, even if they don't have *Mathematica*. Additionally, *Mathematica* expressions can now be evaluated in real-time over the internet using *webMathematica*. This will give you the ability to build custom web sites that provide specialized calculations to employees and premium customers.

USE MATHEMATICA AS A PROTOTYPING TOOL

Mathematica's high-level programming language lets you build sophisticated programs more quickly and with less code than most other programming languages. Before wasting valuable time and computer resources on an intense computation, write a short application that lets you optimize the parameters. You can also easily link your C, C++, Java, Fortran, and other code to *Mathematica*. Dr. Kurt Thearling of Pilot Software states, "*Mathematica* is interactive and comprehensive. I can type something in and see the effects immediately. If I had to code it in C, it could take days to implement the algorithm and add the proper visualization routines to display the results. Prototyping in *Mathematica* saves me a lot of time."

MATHEMATICA HAS APPLICATION PACKAGES FOR ALL YOUR NEEDS

Wolfram Research offers several application packages that work with *Mathematica* to provide solutions in specialized fields. *Digital Image Processing*, *Optica*, *Signals and Systems*, *Control System Professional*, *Parallel Computing Toolkit*, and *Wavelet Explorer* are just some of the applications designed by experts in their respective fields. For a complete list, please visit our web site.



USER QUOTES

"The pattern-matching capabilities of *Mathematica* are great. There is no other language or package that allows me to look for certain kinds of patterns, find them, and then rewrite them in another way."

Bob Gore
Lockheed Martin Corporation

"*Mathematica* allows me to build substantial, elegant programs for analytical, numerical, and graphical analysis of complex problems with far less effort than conventional programming languages."

Ray Beausoleil
Hewlett-Packard Laboratories

MAJOR CORPORATIONS AMONG OUR ENGINEERING USERS ARE

The Boeing Company
Lockheed Martin Corporation
Loral Space and Communications
NASA
Raytheon Company

KEY FEATURES OF MATHEMATICA

- **ACCURACY**—no restrictions on the number size or degree of accuracy
- **SPEED**—extensive improvement in speed and memory efficiency for numerical calculations
- **CONVENIENCE**—store all your code, calculations, graphics, and notes in one notebook
- **FAST PROTOTYPING**—use fewer lines of code for your applications
- **VISUALIZATION**—quickly rendered, mathematically correct, and completely customizable graphics
- **SCALABILITY**—use *Parallel Computing Toolkit* to create a virtual supercomputer
- **RELIABILITY**—twelve years serving the world's most technologically sophisticated institutions

ABOUT MATHEMATICA

Mathematica is the world's only fully integrated technical computing system, combining unrivaled computational power with unprecedented ease of use. Used by over a million scientists, engineers, programmers, and students worldwide, *Mathematica* provides unmatched ease of computation (both symbolically or with unlimited numeric precision), 2D and 3D visualization, and programming. *Mathematica* creates fully customizable, publication-quality, cross-platform electronic and printed documents with professional mathematical typesetting quality, and it also generates web-ready documents.

MATHEMATICA®
The way the world calculates

HOW *MATHEMATICA* IS BEING USED IN AERONAUTICS AND ASTRONAUTICS

DR. MATTHEW M. THOMAS

The Boeing Company

Aerospace engineers at Boeing use *Mathematica* for computer-aided resistive taper (CART) technology, which is a process that allows precise application of a conductive coating to fighter aircraft. Sharp changes in conductivity from one area to another on an aircraft scatter incoming waves in a way enemy radar can detect, thus giving away the fighter's position. To avoid this problem, airframers in the past would spray a conductive surface coating of varying thickness onto the aircraft's surface, blending the edges so that no sudden transitions occur in surface resistance. Although the mathematical properties of the ideal blending pattern are known, applying the conductive coating properly still required a technician with a spray gun to gradually blend the areas.

Now Boeing has adapted *Mathematica* to precisely define the ideal coating pattern for a given surface. Using a very high-resolution PostScript printer, technicians print out a phototool, an optical mask, from *Mathematica*. The phototool is then used in a photochemical etching process to place the conductive coating exactly where it is needed and with exactly the right thickness.

DR. BOB GORE

Lockheed Martin Company

Photographs from LAN-satellites play a major role in the DEA's (Drug Enforcement Agency's) efforts to control the growth of illegal marijuana crops. However, the sweeping motion of the satellite causes distortion of the photographs, which necessitates some kind of postprocessing. Bob Gore, an engineer at Lockheed Martin, used *Mathematica* for this purpose.

"If you looked at the raw satellite image of a runway, it would look jagged. It was my job to investigate new ways of removing the jagged edges from the satellite images," said Gore, who also uses *Mathematica* at home as a hobbyist. "I started with old Fortran code, but I then used *Mathematica* to rewrite that code in 20:1 less lines of code. That kind of rapid prototyping was a valuable time-saver."

DR. FRANK KAMPAS

Lockheed Martin Astronautics Company

Frank Kampas, a senior staff engineer for the Lockheed Martin Astronautics Company, used *Mathematica* for probabilistic risk assessment. He was part of a five-person team that worked with NASA (National Aeronautics and Space Administration) on the Cassini Orbiter mission, which is en route to explore Saturn and its dark, cloud-laden moons. Kampas and his coworkers determined the risks associated with the Cassini spacecraft's RTGs (Radioisotope Thermoelectric Generators), which produce electricity from the heat generated by radioactive decay. Simulation programs and probability equations were essential to the work. Even though Kampas, who received a Ph.D. in physics from Stanford University, ran most final-version programs in Fortran, *Mathematica* played a crucial role.

"I used *Mathematica* mostly for postprocessing. It's a very compact, powerful programming language that lets me organize and plot my data before I convert to Fortran," Kampas said. *Mathematica* is a symbolic computer language that can manipulate a large number of technical computing functions using fewer programming lines. For example, Kampas sometimes needs to write a piece of program to calculate a sine of an array of numbers. In typical programs, the complete calculation would take five or six lines to operate, whereas *Mathematica* takes only one using a vector operation.