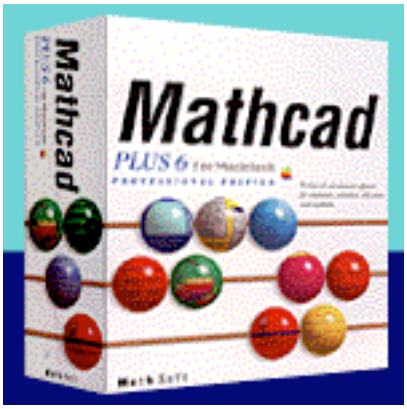
Mathcad PLUS 6 for Macintosh



Platform: Macintosh
Available on CD-ROM
Available for ground shipment

The first complete problem solving environment that lets you explore, analyze model, test, refine and document even the most complex technical problems. Mathcad's "live" interactive environment lets you change variables and watch results and graphs change instantly. You can perform numeric and symbolic calculations, statistical functions and matrix operations or solve a variety of differential equations. Then, produce presentation-quality output, export documents to Microsoft Word or email your work to colleagues. You can even write your own functional programs. And all your work can be done in familiar math notation. Once you experience the power of Mathcad, you'll never look at math the same way again.

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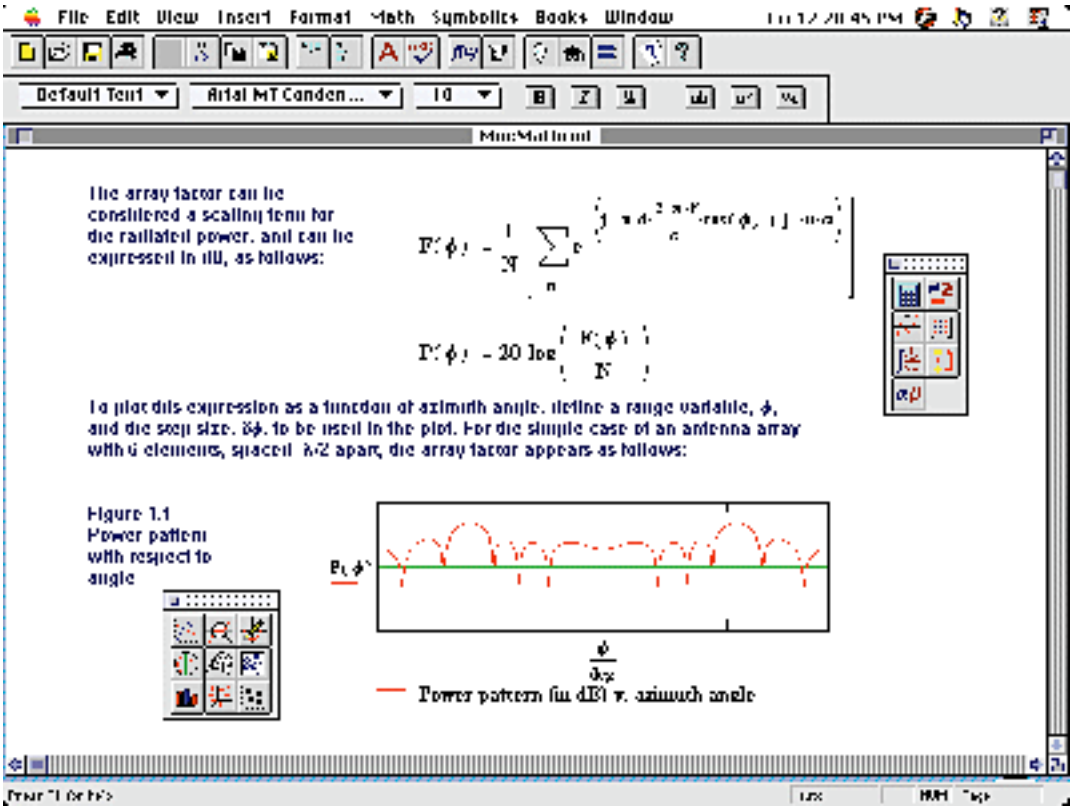

You can use a wide range of graphics capabilities -- including 3-D parametric plots -- to visualize your results. And when you change an equation, the graph changes, too

With Mathcad PLUS 6 for Macintosh you can define local variables, loops, branches, nested arrays and even write recursive functions. To extend your power, build libraries of frequently used Mathcad calculations or analysis and define hyperlinks to Mathcad documents over your local network or via the World Wide Web.

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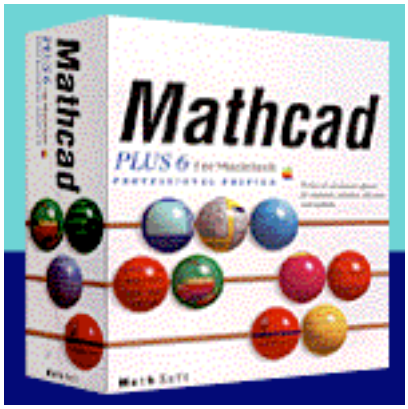

Mathcad PLUS 6 is packed with calculating power -- the kind engineers, scientists and educators need to solve and document even the most complex technical problems.

Mathcad's operators and built-in functions let you perform everything from numeric calculations to precise symbolic solutions. They give you the power to solve differential equations, as well as to perform derivatives and integrals, advanced vector and matrix operations, statistical analysis, Fast Fourier and wavelet transforms -- and more. And every step of the way, Mathcad automatically tracks and converts units of measurement.

You can even build your own functional programs in Mathcad. Just use the new set of "live" procedural operators built into Mathcad PLUS 6 to define local variables, loops, ranches, and recursive functions and to write functions that operate on scalars, vectors, matrices and nested arrays. Because these operators are integrated into Mathcad's interactive, visual environment, they're "live," which means they reflect the results of prior computation. And they can include or be part of any other Mathcad expression.

Mathcad's Live Interface Gives You Instant Feedback--Every Step of the Way

Mathcad turns your computer screen into a "live" worksheet, allowing you to perform numeric or symbolic calculations, add graphics and annotate with text wherever you want -- just like a pencil and scratchpad.

Enter your equations, using real math notation, anywhere on Mathcad's "live" worksheet. Or click on the palette and select from hundreds of math symbols, operators and Greek letters. If you wish, you can visualize functions or data by creating graphs and animation. You can even add text annotations above, below or next to your equations -- anywhere you want. Then, if you'd like to change a variable, go ahead - and see the new results calculated instantly.

And if you need help, new, online QuickSheets are there to take you through a wide variety of common tasks -- from graphing a function to solving simultaneous equations to analyzing variances. To help you visualize systems, solutions and data, you also get 2-D and 3-D graphing, multivariate curve fitting, data smoothing and animation capabilities.

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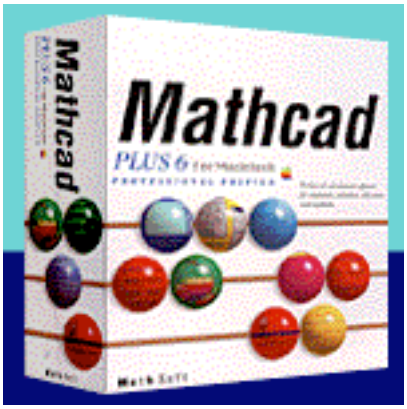

With Mathcad, documenting your work is a snap. What you see on screen is exactly what appears in print (WYSIWYG). So all you have to do is add some headers, run the technical spell checker, and print out your presentation-quality document.

Share Your Work with Unprecedented Ease

Mathcad PLUS 6 is the ideal environment for discussing and sharing technical information. Using its built-in electronic mail capabilities, you can easily send Mathcad worksheets to colleagues across the hall or across the globe. Through links with the World Wide Web, you can view and interact with live Mathcad worksheets on the Web -- using the international language of mathematics.

Working together, you can build libraries of Mathcad worksheets and organize them by task or discipline. Mathcad even provides automatic versioning of worksheets, so anyone can review the history of project decisions at any time. All of which means it's easier than ever to collaborate with co-workers and associates, as well as the worldwide community of technical professionals in business, government and academia.

Features At a Glance

Numeric Calculation Functions

Operators and built-in functions for manipulating numbers, vectors, matrices -- real and imaginary.
Built-in engineering units of measurement and dimension checking.
Solve polynomials.
Simultaneous equation solving.
Several forms of derivatives, integrals, summations, and products.
Built-in trigonometric, hyperbolic, exponential, and Bessel functions.
1D and 2D Fast Fourier and wavelet transforms.
decimal digit accuracy.

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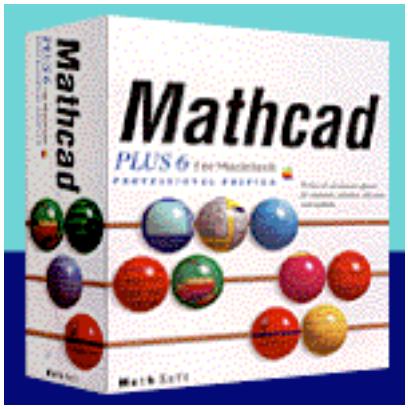

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Advanced Symbolics

"Live" symbolic solutions to individual equations or systems of equations.
Symbolic integration and differentiation.
Expand, simplify, and factor expressions.
Inverse, transpose, and determinant of a matrix.
Laplace, z and Fourier integral transforms and their inverses.

Graphics and Visualization Tools

2D rectangular, vector and polar plots.
3D scatter, bar, contour, surface, and parametric surface plots.
Log, linear, 3D axis options.
Trace and zoom.
Animation.
Image viewing and processing.
Cut and past graphics via clipboard.
QuickPlot for simplified plotting of graphs.

Statistics and Data Analysis

Linear regression
Statistical distributions: chi-square, F, t, uniform, normal, binomial, Poisson, beta, Cauchy, exponential, Gamma, geometric,
log-normal, logistic, negative binomial, and Weibull.
Standard methods of analysis, including parametric and non-parametric hypothesis testing, confidence interval construction, computing standard errors, analysis of variance, principal component analysis, and Monte Carlo techniques.
Linear and non-linear curve fitting and data smoothing.

Differential Equations

4th and 5th -Order Runge-Kutta method.
Bulirsch-Stoer fixed and adaptive step-size methods.
Bulirsch-Stoer methods for stiff systems.
Linear shooting and relaxation methods for boundary-value problems.

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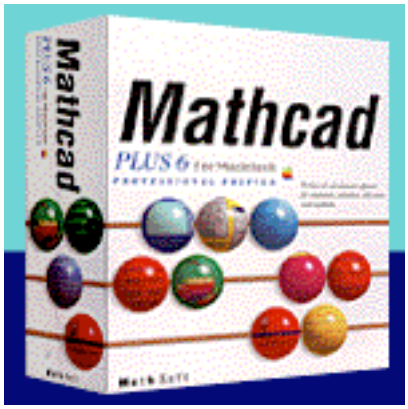

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Advanced Matrix Functions

Matrix operators including multiplication, inverse, transpose, determinant, eigenvalues, eigenvectors, dot and cross products.
Matrix decompositions such as QR, LU, and singular value.
Linear system solver.
Matrix analysis tools for row reduction, computing rank, and finding matrix norms and condition numbers.

Document Preparation Features

WYSIWYG presentation-quality output.
Print preview and technical spell checker.
Paragraph formatting and alignment.
Simplified equation editing.
Export worksheets.
Special characters including Greek letters, operators and common units.

On-line Learning Aids and Help

QuickSheets™ to take you through common tasks.
Online tutorial and context-sensitive help.

Programming Operators

Procedural operators let you build functional programs.
Define local variables, nested arrays, branches, loops, and recursive functions.
Create your own notation with live operators.

Communications Capabilities

Supports AppleScript™.
Link to worksheets on the World Wide Web or a local Web server.

Authoring

Create libraries of frequently used functions.
Create locked sections for algorithm security.
Define hyperlinks to Mathcad documents locally or on the World Wide Web.

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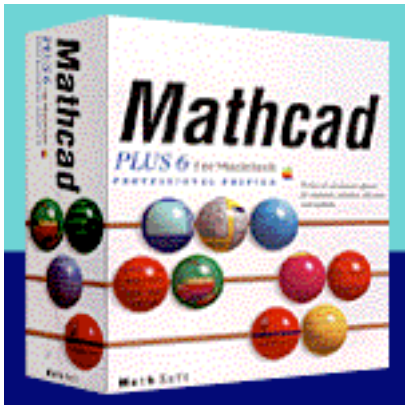

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System Requirements

Power Macintosh or a Macintosh running a 68030 or 68040 processor. A floating point unit (coprocessor) is required if your Macintosh has a 68030 or 68040 processor.
Macintosh System 7.1 or later. System 7.5 or later is recommended for a Power Macintosh.
At least 8 MB of RAM; 12 - 16 MB recommended.
Hard drive with at least 26 MB of free disk space.
CD-ROM drive.

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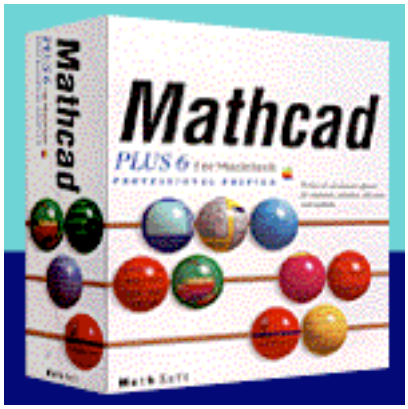

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Complex Solutions to Ordinary Differential Equations

The numerical differential equation solvers in **Mathcad PLUS 6.0** produce real numbers representing the values of real-valued functions which are solutions to ODEs. In some cases you may seek complex-valued solutions when the independent variable is real.

Consider the ODE

$$\frac{d}{dt}Z(t) - t \cdot Z(t) = \sin(Z(t)) \qquad Z(0) = -2 + i$$

where **t** is a real variable but we seek values for a complex-valued function **Z(t)**.

We can convert this into a system of equations in the real and imaginary parts of **Z(t)**.

Substitute $Z(t) = X(t) + i \cdot Y(t)$

where **X(t)** and **Y(t)** are real functions of **t**:

$$\frac{d}{dt}(X(t) + i \cdot Y(t)) - t \cdot (X(t) + i \cdot Y(t)) = \sin(X(t) + i \cdot Y(t))$$

If we expand both sides of this expression

$$\frac{d}{dt}(X(t) + i \cdot Y(t)) - t \cdot (X(t) + i \cdot Y(t))$$

expands to

$$\frac{d}{dt}X(t) + i \cdot \frac{d}{dt}Y(t) - t \cdot X(t) - i \cdot t \cdot Y(t)$$

expands to

$$\sin(X(t)) \cdot \cosh(Y(t)) + i \cdot \cos(X(t)) \cdot \sinh(Y(t))$$

and compare the real and imaginary parts, we get:

$$\frac{d}{dt}X(t) - t \cdot X(t) = \sin(X(t)) \cdot \cosh(Y(t))$$ real parts

$$\frac{d}{dt}Y(t) - t \cdot Y(t) = \cos(X(t)) \cdot \sinh(Y(t))$$ imaginary parts

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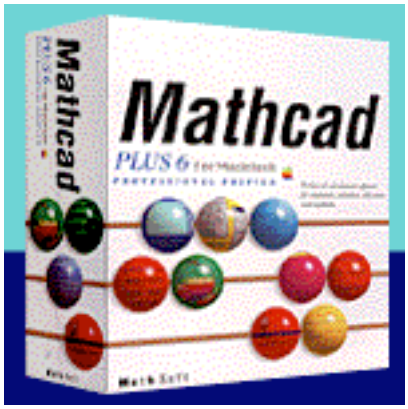

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This is a system in the real-valued functions **X(t)** and **Y(t)**. The initial condition

$$Z(0) := -2 + i$$

yields

$$X(0) := -2 \qquad Y(0) := 1$$

We may now solve this system in the usual manner using one of our built-in numerical DE solving functions. Define

$$IC := \begin{pmatrix} -2 \\ 1 \end{pmatrix} \qquad t0 := 0$$

$$t1 := 5 \qquad N := 500$$

$$D(t, Z) := \begin{pmatrix} \sin(Z_0) \cdot \cosh(Z_1) + t \cdot Z_0 \\ \cos(Z_0) \cdot \sinh(Z_1) + t \cdot Z_1 \end{pmatrix}$$

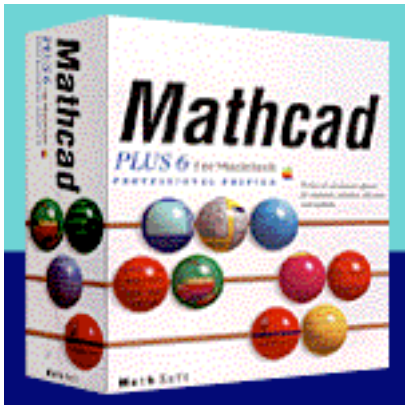
and solve using the adaptive Runge-Kutta routine **Rkadapt**:

$$C := \text{Rkadapt}(IC, t0, t1, N, D)$$

The columns of **C** now contain values for t along with **X(t)** and **Y(t)**, which determine the values of **Z**.

Define

$$t := C^{\langle 0 \rangle} \qquad Z := C^{\langle 1 \rangle} + i \cdot C^{\langle 2 \rangle} \qquad i := 0..N$$



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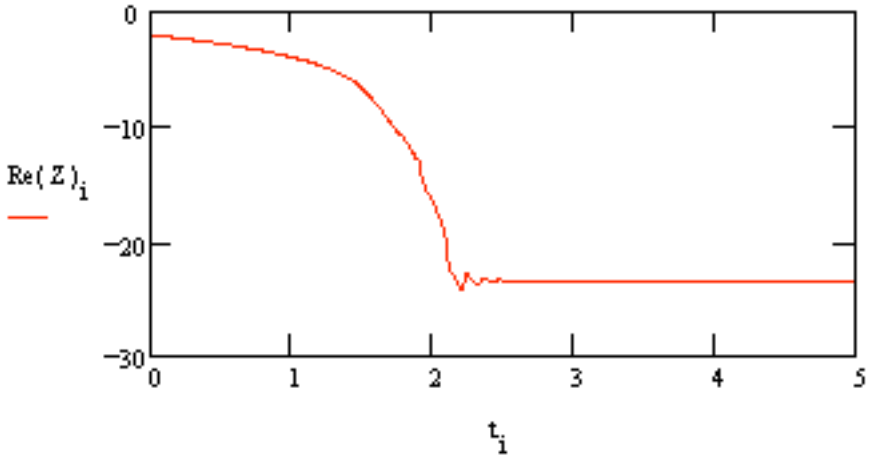
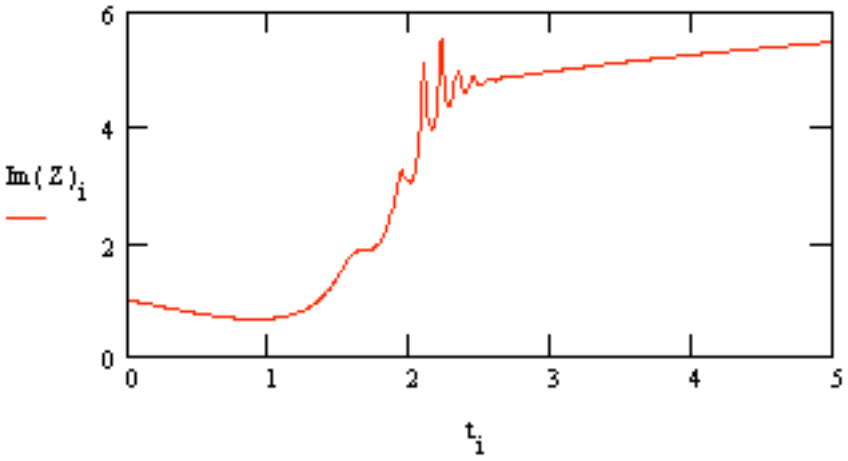
and we can view the real part over time,



and the imaginary part:



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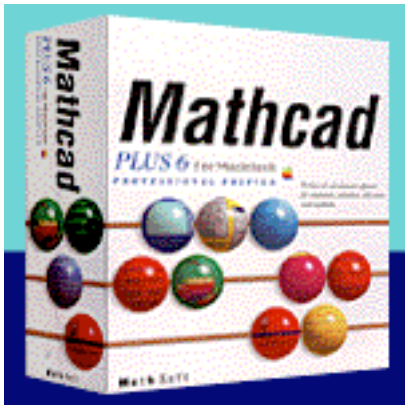

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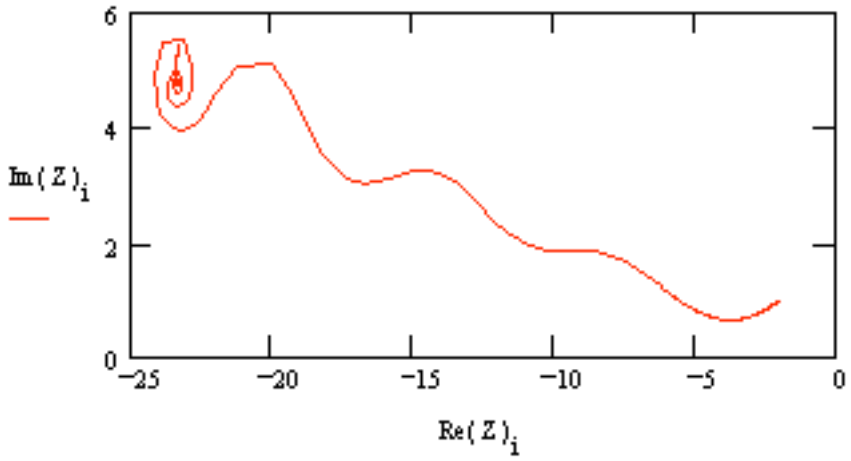
We can also look at the curve traced in the complex plane as **t** varies:



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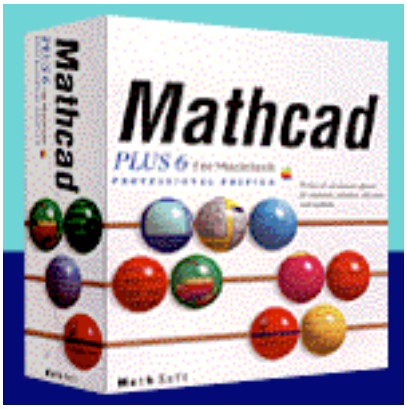

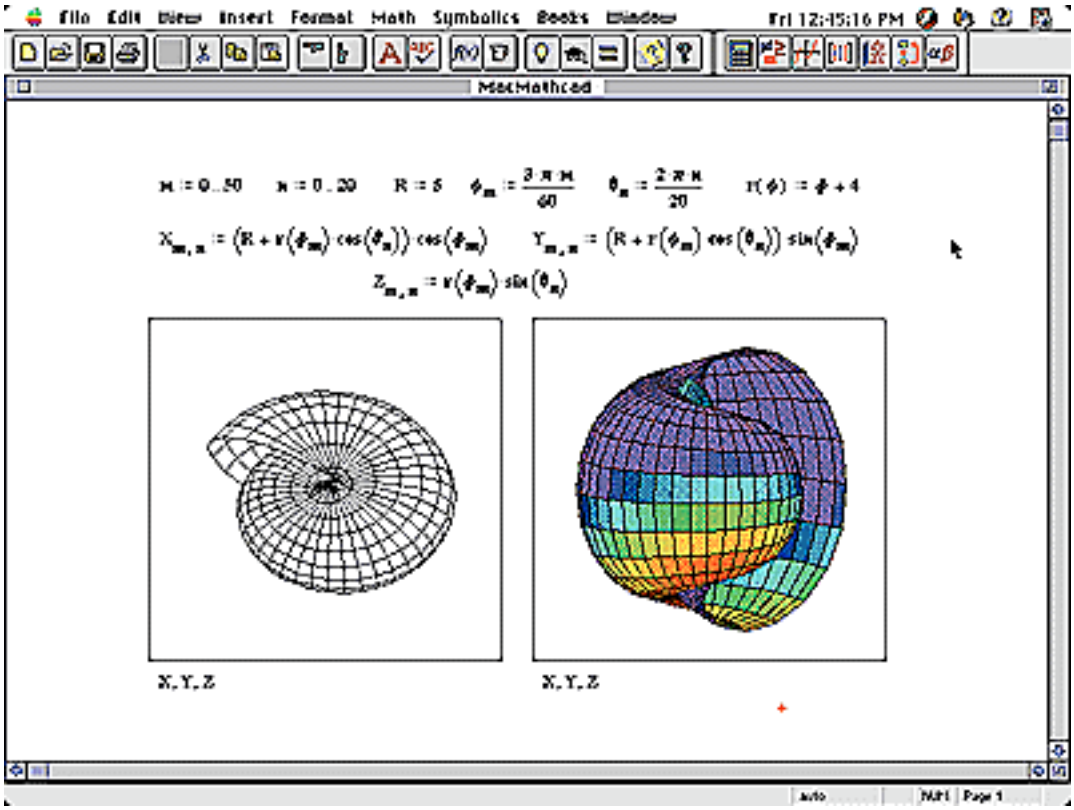

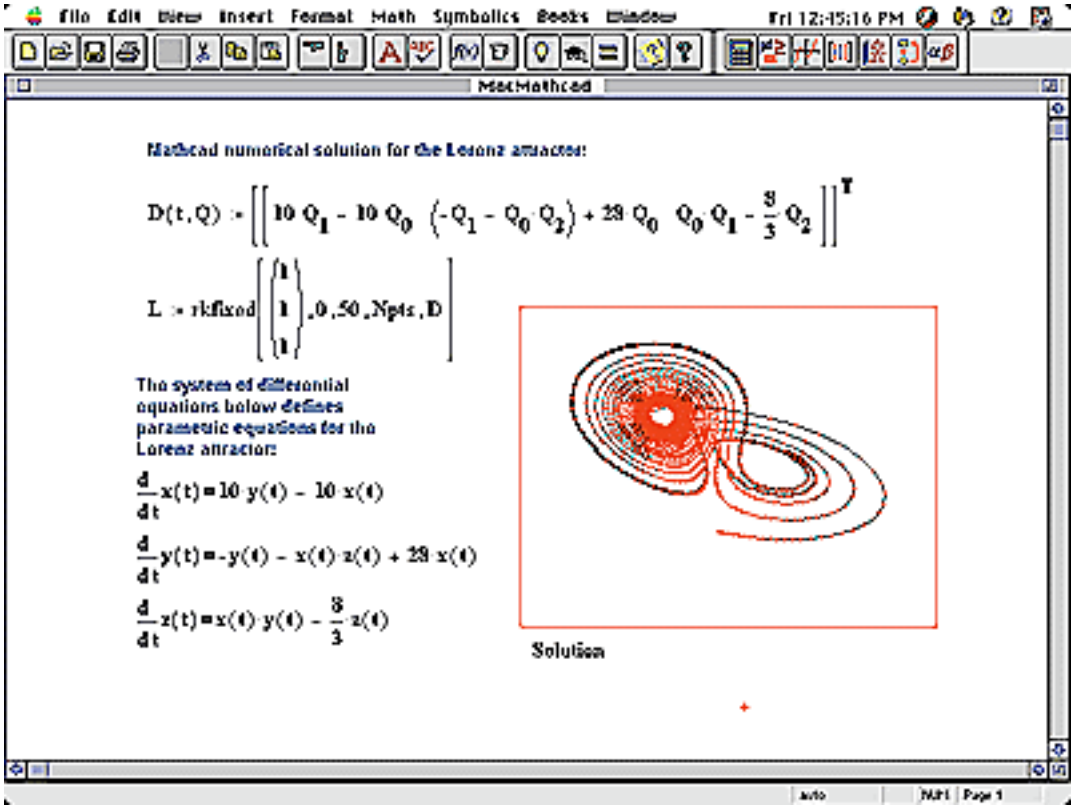

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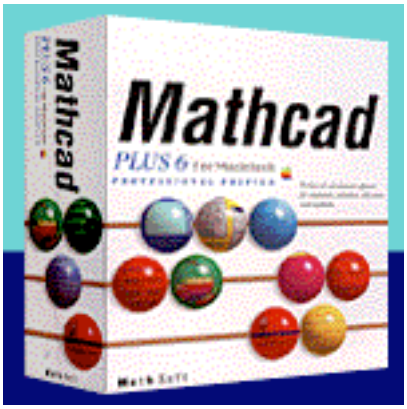
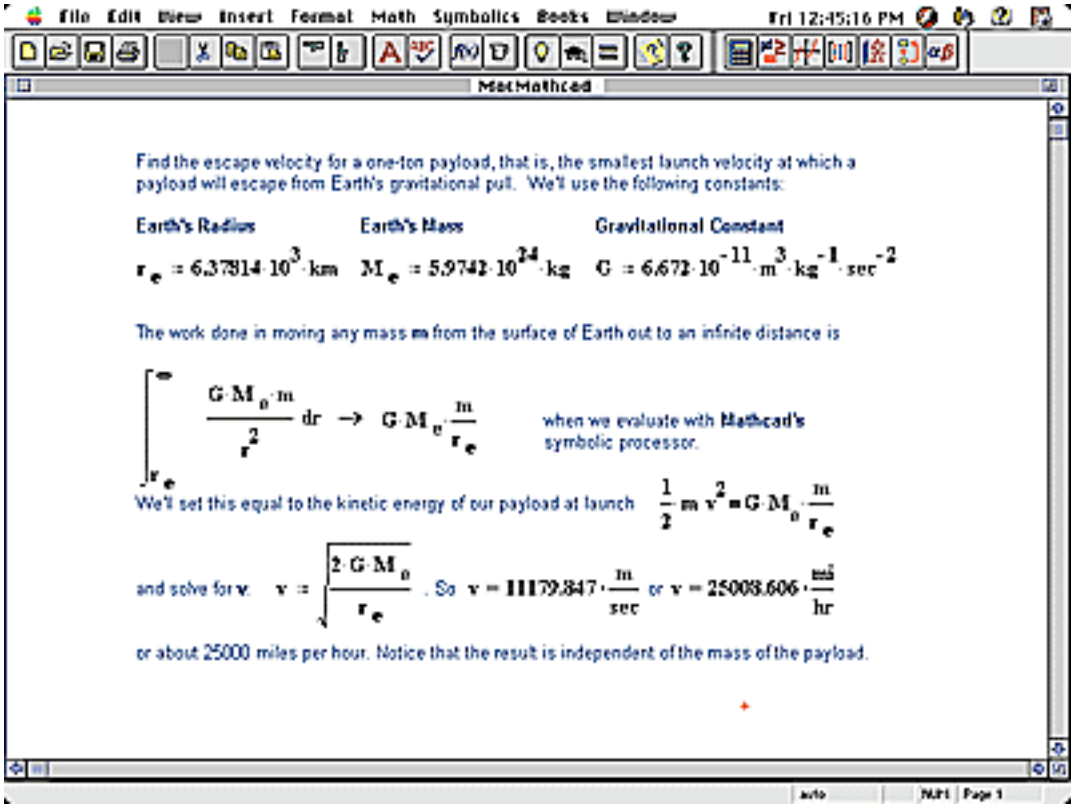




Find the escape velocity for a one-ton payload, that is, the smallest launch velocity at which a payload will escape from Earth's gravitational pull. We'll use the following constants:

Earth's Radius: $r_e = 6.37814 \cdot 10^3 \cdot km$ Earth's Mass: $M_e = 5.9742 \cdot 10^{24} \cdot kg$ Gravitational Constant: $G = 6.672 \cdot 10^{-11} \cdot m^3 \cdot kg^{-1} \cdot sec^{-2}$

The work done in moving any mass m from the surface of Earth out to an infinite distance is

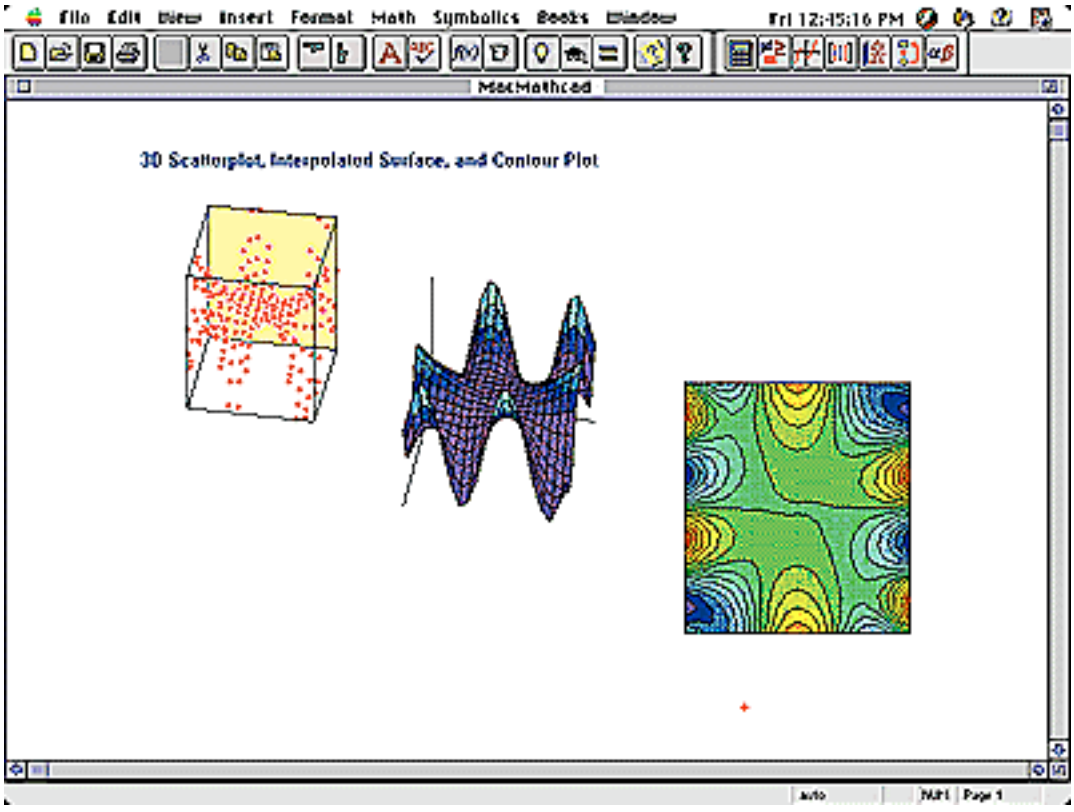
$$\int_{r_e}^{\infty} \frac{G \cdot M_e \cdot m}{r^2}\, dr \rightarrow G \cdot M_e \cdot \frac{m}{r_e}$$

when we evaluate with Mathcad's symbolic processor.

We'll set this equal to the kinetic energy of our payload at launch $\frac{1}{2} m v^2 = G \cdot M_e \cdot \frac{m}{r_e}$

and solve for v: $v := \sqrt{\frac{2 \cdot G \cdot M_e}{r_e}}$. So $v = 11179.847 \cdot \frac{m}{sec}$ or $v = 25008.606 \cdot \frac{mi}{hr}$

or about 25000 miles per hour. Notice that the result is independent of the mass of the payload.



3D Scatterplot, Interpolated Surface, and Contour Plot

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