Mathematical Analysis and Custom Front Ends to *Mathematica*

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PhaseScope—A Custom Front End to the *Mathematica* Kernel

Michael J. Mezzino, Jr. developed *PhaseScope* with NeXTstep to be used as a pedagogical tool in a typical undergraduate course in ordinary differential equations. *PhaseScope* can be used to visualize solutions in both two and three dimensions, including phase plane and phase space orbits, as these solutions are used to qualitatively analyze the stability characteristics of the dynamical system.

PhaseScope is a custom front end to *Mathematica'*s kernel. It uses the kernel to compute the numerical integration of the dynamical system, locally linearize the system, compute spectra, and perform other typical calculations that arise with these problems. *PhaseScope* can be used to investigate arbitrary numerical integration algorithms, written in *Mathematica*'s programming language.

Recently, *PhaseScope* won the Impact Software Publishing's first national software contest, and it was also nominated and received honorable mention for a Computerworld Smithsonian Software Award in the category of Education and Academia.

PhaseScope is currently available through Impact Software Publishing; users may obtain a demonstration version of *PhaseScope* via FTP from **sonata.cc.purdue.edu** (in **/pub/next/2.0-release/demos**) or from **cs.orst.edu** (in **/pub/next/demos**). For more information on how to obtain *PhaseScope,* contact Impact at: **impact@impact.shaman.com.**

MathGraph—A New NeXTstep Object for Mathematical Graphing

Mezzino also recently developed a new mathematical graphing object called *MathGraph* (see Figure 2). As a loadable palette for Interface Builder, this object can produce a two-diminensional graph of several functions of one variable, or graph a single function of two variables as a three-dimensional surface or as a contour plot. The user may select linear, semi-log, or log-log options for any combination of axes; choose line, scatter, error, bar or polar displays; examine a variety of ruled surface views; zoom and vary the viewpoint; and elect to print, copy to the pasteboard or build a PostScript file.

In addition, this object has a "hook" to *Mathematica*'s kernel and therefore can be used to evaluate any valid *Mathematica* command or use *Mathematica* to generate the data for a graph. Finally, this object can easily be made into a Service provider within the NeXTstep environment, which allows the user with

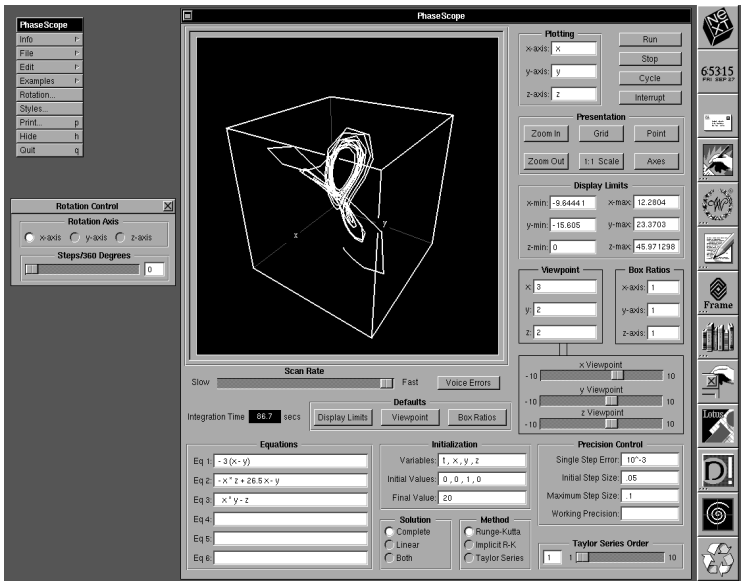

Figure 1 *PhaseScope is a comprehensive user interface and graphical display application for quantitatively analyzing the solution and the stability characteristics of systems of first order differential equations.*

data, say in a word processor, to message the graphing Service to produce a graph of the data in one simple step. Then, the user may paste the graph directly into the word processor or other application in a second easy, seamless operation.

The Benefits of NeXT Technology

As chairman of a small but demanding department, Mezzino no longer has the time to devote to complicated software development projects. Yet, through years of teaching he has accumulated many pedagogical concepts that, with modern technology, should enhance the learning experience and provide entertainment in the process. Until the NeXT's Interface Builder was introduced, he had no interest in pursuing software development because either the learning curve for development was too imposing, the task would clearly exceed the computer's performance, or the cost to obtain the necessary resources was prohibitive.

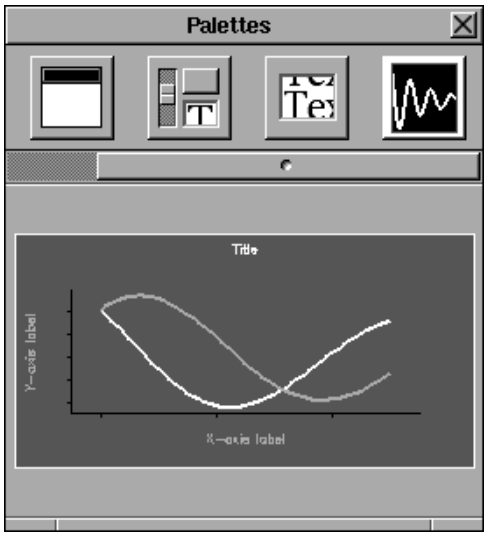

Figure 2 *MathGraph is a mathematical graphical display object in the form of a loadable palette for Interface Builder.*

With the NeXT platform, these projects are now feasible. Interface Builder inspires one to refine the design of a graphical user interface well beyond the limits of other platforms. One senses that artistic elegance and intuitive functionality now are achievable.

In price/performance nothing competes with NeXT computers! In particular, that the most sophisticated implementation of *Mathematica* is bundled made NeXT an easy choice for the department. Some say there is more software for the Macintosh, but the NeXT environment bundles the important packages that we as faculty/developers *must* have—such as an intuitive, object-oriented development environment, document preparation (TEX and TEXView), UNIX text editors, PostScript previewer, and much more.

With seamless integration of all these tools, one is easily convinced that the whole is much larger that the sum of its parts. In fact, it is easy to believe that you are using one large package and are simply moving from one feature to another in a smooth and natural way.

For more information on *PhaseScope, MathGraph* palette, and/or developing instructional tools for collegiate mathematics instruction, please contact:

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Michael J. Mezzino, Jr. is a charter faculty member of the University of Houston - Clear Lake where he currently serves as chairman of the department of mathematics. He received a B.A. in Mathematics and Physics from Austin College in 1962, an M.A. in Mathematics from Kansas State College in 1963, and a Ph.D. in Mathematics from the University of Texas at Austin in 1969. Although trained as a theoretical mathematician in point set topology, he has maintained an active interest in computers since 1963 when he wrote his first computer program—a machine language routine for an LPG-30 (the first of only two computers made by Royal Typewriter Corp.). His current research and teaching interests are to investigate ways in which modern technology can be used as a vehicle for enhancing the teaching of mathematics through new pedagogical concepts.