A Workstation Environment for Electrical Engineering Instruction and Research

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John Glover is currently using NeXT computers in undergraduate instruction in electrical engineering, as well as EE research at the graduate level.

NeXT in Electrical Engineering Instruction

Glover is currently Principal Investigator of National Science Foundation grant number ENG-8851973 entitled, "A Workstation Environment in a Computer Engineering Laboratory." The goal of the project is to develop a prototype of what would be the ideal laboratory environment for courses in computer engineering. As part of that project, a laboratory of 14 NeXT workstations has been established. In addition, there are an equal number of NeXT workstations in faculty offices and other labs.

To aid students in learning object-oriented programming (OOP) and the NeXTstep development environment, Glover developed a complete set of OOP course notes. These notes include slides that are shown by a NeXT computer using a video projector, along with program demos and examples to support the notes. There is also a set of laboratory exercises with solutions. (Interested users may obtain the **UHOOP-class.tar.Z** notes via FTP from **nova.cc.purdue.edu** in **/pub/next/docs.**)

Glover also developed a senior project design course called Computer Engineering Design. This course includes instruction in project planning, management, and implementation; oral presentations; and written reporting. Both hardware and software projects are provided. Students choosing software projects learn OOP and develop EE educational courseware. This courseware is then used in other electrical engineering courses. Examples include:

- ***PowerPlus!,*** a three-phase power system simulator that allows the user to test various wye and delta configurations
- ***ET,*** which allows the user to place charged shapes into an electrolytic tank and see the resulting field distribution
- ***Bounce!,*** which simulates a voltage pulse propagating down a transmission line, and draws the corresponding "bounce diagram" indicating reflections at discontinuities in the line
- ***LogicSim,*** a digital logic simulator. It is part of a larger project to develop a general icon-style discrete simulator
- ***Meter,*** a demonstration of an analog meter-type screen object

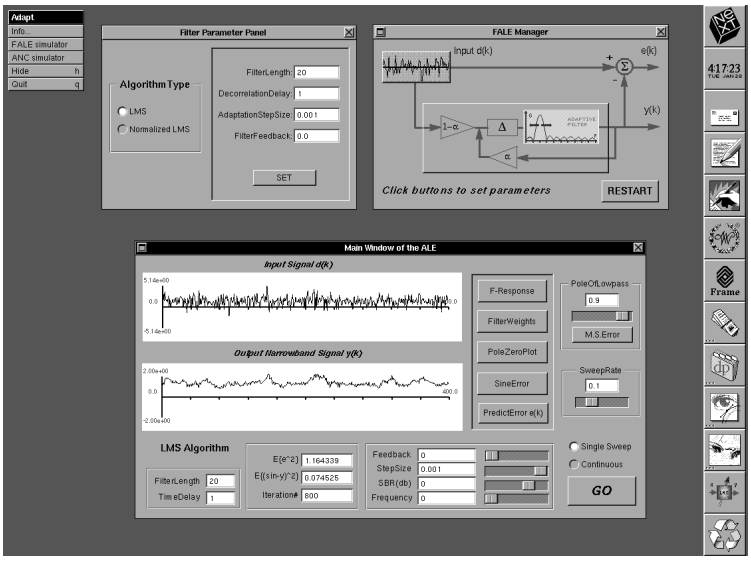

Figure 1 *Adapt, a student-developed application, is an adaptive field simulator. One can investigate input and output signals along with the instantaneous filter weights, frequency response, pole-zero distribution, and much more.*

- ***ArrayFactor,*** which demonstrates array antenna patterns, allowing the user to vary the spacing and phasing of elements and observe immediately the result on the antenna pattern
- ***Beam,*** an application designed by a civil engineer taking the design course, draws shear and bending moment diagrams for a loaded beam with three supports

NeXT in Electrical Engineering Research

Graduate students find NeXT computers equally useful in research. Here are three examples of custom applications written by graduate students in EE:

- ***Adapt,*** a program used for teaching and research in adaptive signal processing (see Figure 1 on previous page). It allows the user to choose various signal inputs, and then shows all relevant filter parameters and signals during the adaptation.
- ***Spiker,*** an expert-system for automated detection of sharp events ("spikes") in the electroencephalogram. It includes elements of a more general object-oriented system for signal analysis and interpretation.
- Screens are being developed for control and monitoring of the ***Wake Shield Facility***, a molecular beam epitaxy experiment to be deployed by the Space Shuttle in early 1993.

Benefits of NeXT Technology for Electrical Engineers

There are two principal reasons why the EE department at the University of Houston chose to purchase NeXT computers. First and foremost: for the first time, a development environment—NeXTstep—allows engineers to develop useful and usable programs. Engineers, as opposed to computer scientists, generally consider themselves "part-time" programmers—they spend time writing programs only as necessary to facilitate the engineering. NeXTstep simplifies program development so faculty and students can develop the educational and research software that is either unavailable or too expensive on the open market.

Second, we have discovered that only NeXT allows us to do essentially all of our tasks in an integrated environment on the same machine—and do it quickly, easily, and elegantly. At the same time, it is significantly less expensive than its competition. Although we will always have a mixed-vendor environment, NeXT computers have the potential of being the principal machines used in the classrooms, in the laboratories, and in the offices.

For more information on the use of NeXT computers in electrical engineering at University of Houston, please contact:

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John R. Glover is a Professor of Electrical Engineering at the University of Houston. He received his B.A. and M.E.E. degrees in Electrical Engineering from Rice University in 1967 and 1968, respectively, and a Ph.D. in Electrical Engineering from Stanford University in 1975. In 1975 he joined the Department of Electrical Engineering at the University of Houston, where he is now a professor and Director of Engineering Computing. In 1981 he received the Outstanding Transactions Paper Award from the IEEE Education Society for the paper, "Integrating Hardware and Software in a Computer Engineering Laboratory." His current research interests are in the areas of adaptive signal processing, knowledge-based systems, and bioengineering applications. His teaching interests include computer engineering, particularly object-oriented programming, and real-time laboratory programming. Glover is also president of the Houston Area NeXT Group (hAng).