Explore: an Algorithm Visualization Environment

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In order to provide a better understanding of various parallel algorithms, and in order to facilitate the creation of standard movies of array based algorithms, we have created an interactive visualization environment in which we can create test cases, watch the progression of an algorithm, and create an MPEG movie from the frames, or write individual frames in the popular "xpm" format. This environment, known as "explore", is supplied as a library to which users can link C code. We are particularly interested in using it to visualize *parallel* algorithms operating on matrices, though it can be used with any kind of matrix-based algorithm.

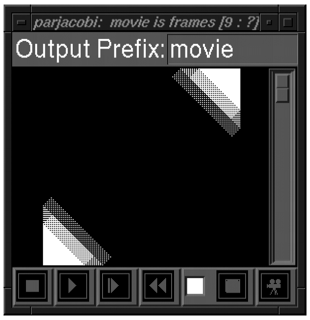

Figure 1: The Explore Utility.

Some years ago, Prof. Alan Edelman created animations from the Mobile Jacobi algorithm, and made slides from them. This visualizer updates this previous effort by adding MPEG animation, and by allowing users other than the programmer to interact with the simulation by changing initial elements of the matrix. An MPEG movie of Mobile Jacobi has been created, using *explore*, and is available for viewing from http://www.mit.edu:8001/afs/athena.mit.edu /user/p/j/pjg/www/jacobi.mpg, or via the link in http://www.mit.edu:8001/afs/athena.mit.edu /user/p/j/pjg/www/conference.html. Note that an MPEG viewer must be attached to your web browser to view this. For more information about Mobile Jacobi, consult Edelmans paper on the subject at url ftp://theory.lcs.mit.edu/pub/edelman/ gen-linear-algebra/snapshot.ps.

Explore is built using the popular tcl/tk toolkit, created by John Ousterhout. The algorithm is coded in C and is built into the tcl interpreter as an interpreted command. A graphical user interface is supplied which provides point-and-click access to start, stop, reset, single-frame, and mpeg-encoding. A picture of the running application is included in figure 1.

The *explore* system provides an open interface to users interested in adding their own algorithms to the package. It is available on most Unix platforms, and fairly easy to com-

*with the assistance of Prof. Alan Edelman

Figure 2: Initial State.

pile *if the system already has a tcl installation*. Otherwise, binary distributions of the kit should be available by late summer, 1995.

Future work in this area will include making the utility more robust and better featured, and adding support for other algorithms, as well as providing interfaces to useful mathematical packages, so that the algorithms can be designed in a mathematical rather than a programming language. Initial improvements will include a color editor, a better test case designer, and an automatic facility for incorporating new algorithms. Possibly the tcl auto-linker will prove useful in this endeavor for the addition of runtime loading of algorithms.

The *explore* environment attempts to tie together some difficult aspects of algorithm visualization. It enables easy experimentation, and output of the resulting movie in a standard format, and hopefully will serve not only as a research tool, but also as educational software, making it easier for students to understand parallel algorithms.

Shown below are frames from *Mobile Jacobi*, an animation created using *explore*.

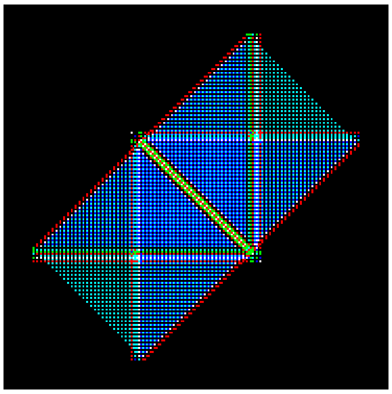

Figure 3: Frame 75.

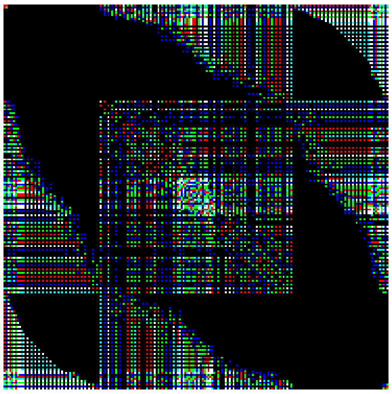

Figure 4: Frame 150.