Optics Program Modified for Multithreaded Parallel Computing

A powerful high-performance computer program for simulating and analyzing adaptive and controlled optical systems has been developed by modifying the serial version of the Modeling and Analysis for Controlled Optical Systems (MACOS) program to impart capabilities for multithreaded parallel processing on computing systems ranging from supercomputers down to Symmetric Multiprocessing (SMP) personal computers. The modifications included the incorporation of OpenMP, a portable and widely supported application interface software, that can be used to explicitly add multithreaded parallelism to an application program under a shared-memory programming model. OpenMP was applied to parallelize ray-tracing calculations, one of the major computing components in MACOS. Multithreading is also used in the diffraction propagation of light in MACOS based on p-threads [POSIX Thread, (where "POSIX" signifies a portable operating system for UNIX)]. In tests of the parallelized version of MACOS, the speedup in ray-tracing calculations was found to be linear, or proportional to the number of processors, while the speedup in diffraction calculations ranged from 50 to 60 percent, depending on the type and number of processors. The parallelized version of MACOS is portable, and, to the user, its interface is basically the same as that of the original serial version of MACOS.

This program was written by John Lou, Dave Bedding, and Scott Basinger of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (818) 393-2827. Refer to NPO-40572.

Programs for Testing Processor-in-Memory Computing Systems

The Multithreaded Microbenchmarks for Processor-InMemory (PIM) Compilers, Simulators, and Hardware are computer programs arranged in a series for use in testing the performances of PIM computing systems, including compilers, simulators, and hardware. The programs at the beginning of the series test basic functionality; the programs at subsequent positions in the series test increasingly complex functionality. The programs are intended to be used while designing a PIM system, and can be used to verify that compilers, simulators, and hardware work correctly. The programs can also be used to enable designers of these system components to examine tradeoffs in implementation. Finally, these programs can be run on non-PIM hardware (either single-threaded or multithreaded) using the POSIX pthreads standard to verify that the benchmarks themselves operate correctly. [POSIX (Portable Operating System Interface for UNIX) is a set of standards that define how programs and operating systems interact with each other. pthreads is a library of pre-emptive thread routines that comply with one of the POSIX standards.]

These programs were written by Daniel S. Katz of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (818) 393-2827. Refer to NPO-41206.

PVM Enhancement for Beowulf Multiple-Processor Nodes

A recent version of the Parallel Virtual Machine (PVM) computer program has been enhanced to enable use of multiple processors in a single node of a Beowulf system (a cluster of personal computers that runs the Linux operating system). A previous version of PVM had been enhanced by addition of a software port, denoted BEOLIN, that enables the incorporation of a Beowulf system into a larger parallel processing system administered by PVM, as though the Beowulf system were a single computer in the larger system. BEOLIN spawns tasks on (that is, automatically assigns tasks to) individual nodes within the cluster. However, BEOLIN does not enable the use of multiple processors in a single node. The present enhancement adds support for a parameter in the PVM command line that enables the user to specify which Internet Protocol host address the code should use in communicating with other Beowulf nodes. This enhancement also provides for the case in which each node in a Beowulf system contains multiple processors. In this case, by making multiple references to a single node, the user can cause the software to spawn multiple tasks on the multiple processors in that node.

This work was done by Paul Springer of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (818) 393-2827. Refer to NPO-41706.