LSU CCT Researchers Explore Enhanced Scalability for Accelerated ParalleX Computing

Over the next decade, scalability of many applications on current and future parallel computer architectures is critical to the fundamental advancement of science and exploitation of technology, both in the regime of strong scaling (the reduction of execution time for fixed size problems) and Exascale computing. Among the strategic challenges to dramatic extensions of scalability, important to future use of both multicore and GPU architectures, is the exposure and exploitation of new forms of parallelism and the concomitant reduction in overheads for effective finer-grained parallelism execution.

LSU IT Consultant Hartmut Kaiser, along with LSU Professor Thomas Sterling, both from the LSU Center for Computation & Technology (CCT), have been awarded funding from the National Science Foundation for the project, "Computer Systems Research: Small: Accelerated ParalleX for Enhanced Scaling Adaptive Mesh Refinement Based Science." The amount of $474, 024 was awarded for a three-year term.

This accelerated ParalleX project will be driven by a single application domain--numerical relativity. Numerical relativity exhibits the challenges to scaling and its advanced class of parallel algorithms--adaptive mesh refinement that provides superior execution properties with respect to uniform grid representations.

Accelerated ParalleX will explore the opportunity of employing field-programmable gate array technology in otherwise standard commodity clusters of SMP nodes to reduce key spruces of runtime overhead of the ParalleX HPX (or high-performance ParalleX) runtime system. Specific areas of pursuit include global address space and translation, thread instantiation and context switching, active message creation and processing, and atomic memory operations, among others.

The HPX runtime system represents a first attempt to develop a comprehensive application programming interface for the ParalleX execution model. This hardware support will augment optimized software services to improve efficiency in available parallelism.

"This research is motivated by the duel challenge of applications that through conventional practices either are presently unable to effectively exploit a relatively small number of cores in a multi-core system or that by the end of this decade will not be able to exploit Exascale computing systems likely to employ hundreds of millions of such cores," said Kaiser. "It will develop a deeper understanding of the interrelationship of system hardware and software for new execution models and will devise a new working system and a useful hybrid hardware/software prototype system performing real-world science and applications."

"Long term, future ASIC (application-specific integrated circuit) designers of processors and systems will be able to dramatically extend scalability of graph-based problems, including adaptive mesh refinement," said Kaiser.

For more information on this and other research at the LSU Center for Computation & Technology, visit: http://www.cct.lsu.edu.

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