

CSAM NEWSLETTER

College of Science and Mathematics

A Spectrum of Possibilities

E Pluribus Unum - Parallel Cluster Computing at MSU

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Imprinted on US coins, this Latin expression symbolizes the powerful nation created by the cooperation of thirteen weaker colonial governments. Likewise, “out of many, one” epitomizes the latest trend in supercomputing development where large, powerful machines are constructed from many small, weaker computers. The individual processors are assigned parts of a complex task and work on them in parallel.

Historically processing power of electronic computers has doubled about every eighteen months. But this trend, known as Moore’s law, is limited by physical factors and cannot continue indefinitely. Thus, unless computer scientists develop new exotic computing paradigms, such as quantum or chemical computing, parallelism is the primary way to sustain the growth of computer performance in the future.

The history of parallel computing at MSU dates back to the early 1990’s when the Computer Science faculty offered the first courses in this technology. Shortly after the Department of Computer Science came into existence in July 1998, a team of ten Computer Science students, supervised by the Department Chair, Dr. Dorothy Deremer, had assembled a working Beowulf cluster from five generic Compaq computers. Beowulf, an ancient Scandinavian mythological hero, was the name of this novel approach to high-performance computing. Instead of using proprietary “supercomputers” that are also “superexpensive”, use of many off-the-shelf components to build a comparable system at a significantly lower cost is the Beowulf mantra. The Beowulf initiative at Montclair culminated with a student presentation to the Board of Trustees on the speed-up results for several common mathematical problems. Although the Department still offered courses related to parallel processing after the original students were graduated, the Beowulf cluster was abandoned.

In the fall 2000, Dr. Roman Zaritski, a newly appointed CS faculty member, became interested in the MSU Beowulf cluster. He completely rebuilt and reconfigured the old cluster environment using a new Linux environment. While modernizing the old Beowulf, Dr. Zaritski began to investigate the possibility of moving his research in computer modeling to a cluster system. The acting CSAM Dean, Dr. Kenneth Wolff, and Dr. Deremer encouraged Dr. Zaritski’s interest and supported his initiative to assemble “something parallel.” The result was a new, 20-Pentium-CPU Linux cluster, named “GALAXY”. After its assembly and configuration in Richardson 110A completed in the summer of 2001, the “clusters.top500.org” international cluster database placed GALAXY in 93rd place among world clusters.

Assisted by the on-site availability of high-performance parallel resources, Dr. Zaritski developed a new, computationally intensive research project. This work, “Parallel Simulation of Spiral and Scroll Wave Interactions in Excitable Media”, is carried out in close collaboration with Dr. Arkady Pertsov of SUNY Upstate Medical University



Dorothy Deremer and Roman Zaritski in the new Parallel Computing Laboratory.

(UMU) in Syracuse, NY. Dr. Pertsov, one of the founders of a comprehensive spiral wave theory, was Dr. Zaritski's postdoctoral mentor. Among other applications, this research project is directly related to cardiac arrhythmias - the leading cause of death in industrialized nations. Because of the obvious difficulties with studying arrhythmias "in vivo", most experiments are done "in silico"; i.e., by modeling with a computer the evolution of electrical abnormalities in the human heart. Using clusters, simulation time has been cut from weeks to days and from days to hours opening new exciting possibilities for defibrillation research. Besides several journal publications, the joint work led to a long-term cluster consulting project between Dr. Zaritski and the Department of Pharmacology of SUNY UMU. Utilizing his expertise, Dr. Zaritski supervised the assembly and configuration of an off-site SUNY UMU \$100,000 cluster.

In the summer of 2003, the National Science Foundation (NSF), through its Major Research Instrumentation program, awarded Dr. Zaritski, along with his collaborators Dr. Lora Billings of CSAM's Department of Mathematical Sciences and Dr. Pertsov, \$100,000 to build a more powerful cluster at MSU. This new machine, a 64-Opteron-CPU Linux cluster, will be fully assembled, configured, and ready for number crunching in mid-spring of 2004. The primary function of the new cluster is numerical simulations of excitable media. Matching the NSF grant and as encouragement to the PI, CSAM has funded the construction of a new Parallel Processing Laboratory in Richardson 109. This space addresses the enormous electric power and air-conditioning requirements set by the clusters. The new laboratory now houses three parallel machines: the soon-to-be-retired old Beowulf cluster, the GALAXY cluster, and the new NSF sponsored cluster "Parallel Monster." This considerable on-site parallel computing resource is indispensable for the continued success of Dr. Zaritski's research project. The Parallel Processing Laboratory will also open new possibilities for several other auxiliary projects within CSAM. The MSU clusters have already been used in the teaching of several undergraduate and graduate parallel computing courses and in student research projects. The new laboratory will contribute to the positive image of CSAM, as a place where cutting edge technology research is carried out. It will create new learning and research opportunities for our students. For more information, visit the Parallel Laboratory homepage at <http://roman.montclair.edu/Research/Parallel/>.

Bristol-Myers Squibb Center for Science Teaching and Learning

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President Susan A. Cole announced the University's plans for opening a new center for science education in Blanton Hall. The center, which is the second of its kind in New Jersey, aims to improve the way teachers prepare their students in mathematics and science education. It will also house the University's Professional Resources in Science and Mathematics (PRISM) program, directed by Dr. Jacalyn Willis. Designed as an incubator for excellence in northern New Jersey, the Montclair center is made possible through a \$500,000 five-year capital grant from the Bristol-Myers Squibb Company (BMS). John L. McGoldrick, executive vice president BMS, noted the company's commitment through its partnership with academia and government, strives to give "teachers and their students the finest resources in order to enhance our talent pool and ensure that we continue to have the best scientists in the world."

The center will design, develop and deliver inquiry-centered program initiative by encouraging students to ask questions, formulate hypotheses, describe and record events and then communicate their conclusions. This approach differs from the lecture and rote memorization routines that prevail at most universities and schools in the country.