LSU Group Part of DARPA Project to Create Advanced Computing Systems

A CCT research group received two awards to provide fundamental technical contributions to the recently announced Defense Advanced Research Projects Agency, or DARPA, Ubiquitous High Performance Computing Program. Called UHPC, this program brings together researchers and scientists from universities, industry and national laboratories to develop new system architecture and software to prototype next-generation supercomputers. The first models will be completed prior to 2018.

LSU Department of Computer Science Arnaud & Edwards Professor Thomas Sterling and his research group at the CCT, where Sterling has a joint appointment, will lead LSU's contributions to this project, which include execution models, runtime system software, memory system architecture and symbolic applications. Under this project, Sterling received $1.2 million from DARPA for four years of work.

LSU is a key academic partner of the *X-caliber* project, a lead component of the UHPC program led by Sandia National Laboratories to develop advanced computing systems capable of running complex calculations a thousand times faster, using orders of magnitude more processors simultaneously, than today's most powerful supercomputers before the end of this decade.

National science and engineering organizations have identified developing new supercomputing systems as a top research priority because today's largest and most powerful supercomputers will be too slow and obsolete to run the kinds of applications needed to use computational science efficiently for military defense and other areas.

"Such systems will enable applications that require months of computation time today to take hours by the end of the decade and make possible real-time applications that cannot be done at all now," Sterling said.

Some research applications that scientists could address faster and more effectively with Exascale computing include astrophysics research to investigate black hole and neutron star collisions (a possible source of gravity waves and gamma ray bursts), studying RNA molecules passing through cell membranes to understand how viruses are transmitted and spread through the human body, and forecasting hurricane paths and their resulting damage among many others.

Sterling has spent the past several years working to address problems in developing Exascale-class supercomputer systems, which would be capable of running a million trillion calculations per second through the simultaneous application of up to a billion processor cores. Currently, the world's fastest supercomputers are at the Petascale level, running only 200,000 to 300,000 cores cooperatively.

"We are entering the next phase of computing and, essentially, everything has to change," Sterling said. "We are honored and excited to be selected as part of the national UHPC initiative that will, in the coming years, establish the future direction of American research, development, and application of supercomputer technology."

Sterling, who in the 1990s co-invented the Beowulf computing cluster that now serves as the archetype of many of the world's high performance computing systems with Penguin Chief Technology Officer Donald Becker, directs the CCT Systems Science and Engineering Focus Area. This group has spent the past four years working on the ParalleX project to devise and test the validity and potential of the ParalleX model of computation.

Parallel computing exploits the concurrency of operation to shorten the amount of time it takes researchers to run applications. Future supercomputers using multicore and accelerator technologies will require dramatic increases in computational parallelism if Exascale performance is to be achieved by the end of this decade. ParalleX replaces conventional practices such as MPI and OpenMP programming models to deliver the needed parallelism that is capable of running on Exascale-class machines combined with dynamic, adaptive resource management for increased efficiency, reliability, and programmability.

The experimental ParalleX execution model is a unique synthesis of several complementing research concepts, some first explored over previous decades, combined with important new ideas of dynamic computation composition and parallel control. ParalleX is embodied by the proof-of-concept HPX runtime system CCT researchers developed, which currently runs on conventional distributed-memory clusters and shared-memory symmetric multi-processors. ParalleX was developed through sponsorship from the National Science Foundation, Department of Defense, DARPA, and Department of Energy, along with major contributions of resources and expertise by CCT.

The DARPA UHPC work is one of several grant-funded research projects taking place at the CCT. During the past academic year, CCT faculty and staff brought in more than $10 million in new grant funding from leading scientific organizations including the National Science Foundation, Department of Energy, Louisiana Board of Regents' Experimental Program to Stimulate Competitive Research, and others. Last year LSU, through Sterling's participation, was invited to be part of the National Science Foundation's Exascale Point Design Study, a research group that held a series of collaborative meetings to determine what computational scientists and engineers must do to develop Exascale computing systems. Their findings will be incorporated into this and future research projects to build Exascale computing facilities.

"Exascale computing is at the forefront of the national science agenda, and it is exciting that research taking place here is establishing LSU as a leader in the next level of computational science research," Sterling said.

For more information:

Sandia National Laboratories *X-caliber* news release:
https://share.sandia.gov/news/resources/news_releases/supercomputer-prototype/

Exascale Point Design Study: http://exascale.cct.lsu.edu
ParalleX: http://px.cct.lsu.edu

CCT in the News:

Red Stick Animation Festival gets record number of entries
Source: Daily Report Aug. 19

150th celebration rescheduled for Homecoming Day
Source: The Daily Reveille

Lectures this Week:
- *FRIDAY*-James Nagy, Emory University, presents "Deblurring Images: Matrices, Spectra and Filtering (SIAM Chapter Talk)." The lecture will take place Friday, Aug. 27, in Johnston Hall Room 338 at 11 a.m.

Please Note:
- Prior approval is required for Special Meal Requests. Employees who make meal purchases without prior approvals may find that they must cover the cost of any monies spent for an unapproved event out of pocket, especially now that state funds are under a spending freeze. Please contact Susie Poskonka (susie@cct.lsu.edu) prior to any special meal with visitor(s) to file the appropriate request for approval. Prior approval could take up to one week, so please plan accordingly.

- LSU Day, a celebration of the University's sesquicentennial anniversary that highlights the various research and education accomplishments of different areas of campus, will take place on Saturday, Nov. 13 from 9 a.m. until 1 p.m., concurrent with LSU Homecoming. At LSU Day, CCT will host a "Visualize This!" exhibit showcasing student research projects and visualization work in the LSU Union computer laboratory. Additionally, the Red Stick International Animation Festival will provide a Best of the Fest reel to screen for audiences in the Union Theatre, and Professor Rudy Hirschheim will perform with Capital Gains, a band comprised of faculty from the E.J. Ourso College of Business. If you would like to participate, please contact CCT PR Manager Kristen Sunde at ksunde@cct.lsu.edu.

- The fall 2010 training schedule is available for you to view. Training will be held on

Wednesdays from 1-3 p.m. in 338 Johnston Hall and on the Access Grid this
semester. The first training will be Wednesday, Sept. 8: Introduction to HPC.
Account allocation and management. To register, visit:
http://www.hpc.lsu.edu/training/tutorials/index.php#fall2010-introhpc. The second
Fall 2010 training will be Wednesday, Sept. 15: Job Management with
PBS/LoadLeveler. To register, visit:
http://www.hpc.lsu.edu/training/tutorials/index.php#fall2010-jobmgmt. If you have
any questions or suggestions, e-mail Kathy Traxler at ktraxler@cct.lsu.edu.

- **Supercomputing Conference 2010 Information and Deadlines:**

  o NOTE: CCT has four rooms remaining in the center's SC10 reservation block
    at the Hampton Inn (Ernest N. Morial Convention Center). These rooms are
    $175/night. If you wish to reserve one of these rooms for your stay at SC10,
    please contact Karen Jones at kjones@cct.lsu.edu as soon as possible.

  o Follow SC10 with social media to get the latest news, information, and
    deadlines -- Twitter @ SuperComputing; Facebook group: SC10.

  o Applications for Student Volunteers for SC10 are now being accepted. The
    deadline to apply is Friday, Aug. 27. Undergraduate and graduate students are
    encouraged to apply as volunteers to help with the administration of the
    conference. In exchange, students will receive complimentary conference
    registration, housing (for out-of-town volunteers) and some meals. Volunteers
    will be expected to be available for a total of 4-5 hours of work per day during
    the week of the conference, which will take place Nov. 13-19 in New Orleans.
    Successful applicants will be notified of their acceptance by Sept. 30. If you
    have any questions please e-mail student-vols@info.supercomputing.org.

  o The 3rd Annual SC10 Student Job Fair will take place during the conference
    from 10:30 a.m. to 1:30 p.m. on Wednesday, Nov.17. Exhibitors should
    confirm participation in the SC10 Student Job Fair by Tuesday, Aug. 31.
    Please contact Yolanda Rankin at student-job-fair@info.supercomputing.org
    or yarankin@us.ibm.com with the name of your organization and your
    representative(s).

  o SC conference attendees are welcome to attend Broader Engagement and
    Education Program sessions and presentations, including attendees who only
    have exhibit badges. SC10 also is introducing new registration categories for
    conference attendees who would wish to participate in associated meals,
    catered events, or receive program logo merchandise. For more information or
    to sign up for these programs, please visit:

    Registration: http://sc10.supercomputing.org/?pg=registration.html
    Broader Engagement: http://sc10.supercomputing.org/?pg=broadeng.html
    Education: http://sc10.supercomputing.org/?pg=edprog.html

- Please remember to send your news concerning grants, awards, conferences, or other pertinent information to PR Manager Kristen Sunde at ksunde@cct.lsu.edu.

- Follow CCT with social media to access photos and see news, events or updated information. These pages are public; you do not need an account to view the information.
  - Facebook group : LSU Center for Computation & Technology
  - Twitter : LSUCCT
  - YouTube channel : LSUCCT

Upcoming Grant Deadlines:

Note: Please check the CCT deadline Web site, since it is updated daily.

Expeditions in Computing
September 10 2010 10:00 am
At Least $ 10,000,000.00 available

CISE Cross-Cutting Programs: FY 2011

December 17 2010 10:00 am

At Most $ 3,000,000.00 available