



August 19 – August 25, 2012

STAR: Creating More Efficient and Scalable Computation for Astrophysics Research

A group of researchers at Louisiana State University's Center for Computation & Technology, or CCT, and LSU's Department of Physics & Astronomy have recently been awarded \$799,682 by the National Science Foundation to create a new model of computation that would radically benefit applications that support studies of the evolution and merger of close binary star systems. When scaled to reflect physically meaningful domain sizes and resolutions, the model could potentially transform the understanding of stellar evolution.

Today, whole classes of computational science and engineering applications are emerging as scaling-impaired. The main factors limiting scalability for these applications are: 1) *Starvation*--insufficient concurrent work to maintain high utilization of resources; 2) *Latencies*--delay of remote resource access and services; 3) *Overheads*--work for management of parallel actions and resources on critical path that is not necessary in a sequential variant; and 4) *Waiting for contention resolution*--delays due to lack of availability of oversubscribed shared resources. All of these factors (**SLOW**) are difficult to avoid using today's programming models. A new computational strategy, one that replaces CSP (Communicating Sequential Processes) is required to achieve dramatic increases in performance.

Hartmut Kaiser, team lead of CCT's STE||AR group, is the principal investigator for the grant to develop this new program, which he calls "INSPIRE: *STAR*: Scalable Toolkit for Transformative Astrophysics Research."

The *STAR* project proposes to provide transformative intellectual contributions that focus on achieving a deeper understanding and realizing an immediate impact on the field of astrophysics and computer science. The results of the research will explore and relate directly to one of the most commonly used algorithmic techniques in scientific applications, adaptive mesh refinement (AMR).

"The impact of this research isn't limited only to the advancement of astrophysics, computer science, and engineering, but also significantly affects the field of computer science as a whole by enhancing the understanding and capability of efficient realization of scalable computing of any size. This capability extends beyond the conventional means and practices in that it targets the difficult strong scaling problem in addition to supporting the traditional weak scaling regime so prevalently employed on the largest supercomputing platforms of today," said Kaiser.

"The broader impact of *STAR* extends even further. For example, many problems in physics and engineering require the simultaneous solution of coupled systems of

equations arising from different physical processes that are typically governed by equations of various types (hyperbolic, elliptical, and parabolic), and that require different discretizations and numerical strategies for their solution. Well-known examples of these problems in astrophysics are supernova explosions, star formation, galaxy formation, stellar mergers, and stellar evolution incorporating the effects of rotation and tidal forces. All of the above include fluid dynamics, dynamic gravity, thermal and radiative transport, particle transport, and nuclear energy generation in various combinations."

"In the broader arena of problems in physics and engineering that are relevant to national security, materials science and energy policy, one encounters similar multi-physics challenges in the stewardship of the nuclear weapons stockpile, ab-initio modeling of novel materials, nuclear energy generation, and the confinement of high temperature plasmas. All of these problem areas can greatly benefit from the results of *STAR*."

Other researchers on this project include LSU Department of Physics & Astronomy Ball Family Distinguished Professor Geoffrey Clayton and Professor Juhan Frank.

For more information on the STE||AR group, visit: <http://stellar.cct.lsu.edu/>.

Lectures This Week:

There will be a Frontiers of Scientific Computing lecture on, "[Five Trends in the Mathematical Foundation of Computational PDEs](#)" by Carsten Carstensen, Humboldt University of Berlin, Germany. This lecture will take place on Thursday, August 23 at 3:30 PM in 338 Johnston Hall.

Please Note:

- If you are planning on having any Major Events in the Fall 2012 or Spring 2013 (conferences, meetings, workshops, etc.), please contact Karen Jones so that it can get on the CCT Events Calendar.
- The *Sally Ride Science Festival for Girls*, hosted by ExxonMobil in partnership with The LSU Cain Center and Colleges of Science and Engineering, is coming back to Baton Rouge on September 22. The 2012 Festival will offer exciting, hands-on activities during the street fair, followed by a keynote address from an astronaut, and engaging, hands-on workshops for students and parents/teachers. They are expecting 600+ 5th-8th grade students, most of whom will be girls.

Kathy Traxler is asking for volunteers to help her with a demo of applications from the Alice in Computation Land Camp and a parent/teacher workshop to showcase some of the things she learned in the computational science workshops CCT hosted for high school teachers and faculty. She is asking for help from 9:00 AM until about 4:10 PM to help her with the laptops she will bring and to keep the students moving during the fair and to help out during the workshops. If you can help, please email Kathy (ktraxler@cct.lsu.edu).

- **SC12 Information:**

1) Please notify Karen Jones (kjones@lsu.edu) if you need lodging in the CCT block for SC12. She only has two rooms left, so don't delay.

2) As a reminder, submit your AS292 (Authorization to Travel Form) at your earliest for SC12. You don't want to get caught in a budget-freeze and not be able to go!

3) If you want to present a demo or submit information for a display poster for the CCT booth, please contact Karen Jones before Sept. 7th.

4) If you or your group are participating in the SC Conference by presenting a tutorial, as a committee member, lecturer, etc., please send that information to Karen.

- Please visit the new and updated Office of Research and Economic Development (ORED) web site (www.research.lsu.edu). Essential information is now part of the web site including research news, updates and calls for proposals and grants. The RFP information from different federal agencies are updated weekly.
- 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. Dine-in restaurant meals are not allowed on LaCarte credit cards. Please contact Susie McGlone (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 two weeks, so please plan accordingly.
- Please remember to send your news concerning grants, awards, conferences, or other pertinent information to CCT Event Coordinator Jennifer Fontenot at jennifer@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

Interest groups:

- **MAG (Mobile App-Art-Action Group):** Everyone interested in the potential for Mobile Apps is invited to come and add their vision for these revolutionary devices. Meetings are scheduled in 338 Johnston from 4:30- 6:00 PM on September 6th, October 4th and November 1st. For more information visit: <http://www.cct.lsu.edu/MAG>
 - Contact: Jesse Allison (jtallison@lsu.edu)
- **GPU:** meets weekly (Thursdays @ 12:30 pm in 338 Johnston) and encourages participation from anyone who would like to join in the discussions. Join the mailing list: lasigma-gpu@loni.org
 - Contact: Zhifeng Yun (zyun@cct.lsu.edu)

Upcoming events:

August 28: [Computational Mathematics Seminar Series Lecture by Nicholas Zbaras](#)

September 14: [LSU Fall Fest](#)

September 20: [Women in Technology Careers Forum](#)

October 19-20: [ACM ICPC South Central USA Regional Programming Contest](#)