Volume 5

COMPONENTS

Center for Computation & Technology

LSU

LSU Center for Computation & Technology

Components
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The LSU Center for Computation & Technology is an interdisciplinary research center that advances the University's Flagship Agenda and promotes economic development for the state by using computational science applications to aid research and develop solutions that benefit academia and industry. CCT is an innovative research environment, advancing computational sciences, technologies and the disciplines they touch. Researchers at the CCT use the advanced cyberinfrastructure – high-speed networks, high-performance computing, advanced data storage and analysis and hardware and software development – available on campus to enable research in many different fields. By uniting researchers from diverse disciplines, ideas and expertise are disseminated across LSU departments to foster knowledge and invention.

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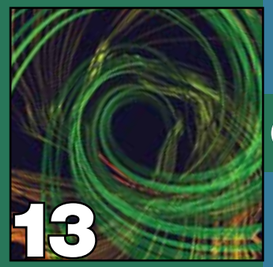


Message from CCT Interim Leadership


Stephen David Beck, Ph.D.


Jorge Pullin, Ph.D.

The LSU Center for Computation & Technology, and the University as a whole, have seen many changes since we agreed to jointly serve as the center's interim leadership team in September 2008. The economic situation nationwide and in our state produced numerous challenges that CCT had to meet to continue the progress that has flourished since its inception six years ago.

We are very proud to say that our talented researchers and faculty excelled in their work throughout the past year, maintaining momentum in their respective fields. Their commitment and dedication are what make CCT a recognized leader in applying 21st-century cyberinfrastructure to real-world problems in a variety of disciplines.

In 2008, CCT brought more than $11 million in external grant funding to the University. As of Spring 2009, CCT faculty and researchers had brought $9.2 million into LSU through external grant funding, and had more than $30.5 million in pending grant awards for the year.

Our faculty members have been instrumental in developing and leading research projects that span the campus, involving collaboration across departments. Some recent examples include work on CyberTools, a National Science Foundation-funded effort to build tools and applications that will allow researchers to use modern supercomputing power to its full potential; coastal modeling and data visualization work to develop better forecasting systems for hurricanes; a Virtual Worlds Research Group that examines how emerging social media, such as Second Life, can be used to advance academic research; PetaShare, an effort to build advanced data storage and management systems for effective computational science research; and ParalleX, which is developing next-generation supercomputer architecture.

While this edition of Components is too short to list the many remarkable accomplishments of our faculty, staff and students throughout the past year, the stories within showcase some of the innovative ways our center is enabling research breakthroughs with high-performance computing resources.

It has been our privilege to lead the CCT during this transformative period and to witness the scientific advancement, ingenuity and imagination underway here that benefit not only the state and the University, but contribute toward the worldwide research community's progress.

Stephen David Beck, Ph.D.
CCT Interim Director

Jorge Pullin, Ph.D.
CCT Interim co-Director

Research

Researcher Tackles Data Challenges Through Prestigious CAREER Award

Today's researchers have access to computational science technology that gives them faster, better and more effective methods to enable breakthroughs that would have been impossible just a few years ago. But, along with these great breakthroughs comes a massive amount of scientific data that must be efficiently stored, processed and analyzed. What tools and capabilities do scientists need to make sense of these great heaps of data they generate?

That question is central to the research of Tevfik Kosar, a professor in the LSU Department of Computer Science, who has a joint appointment with the CCT. Data storage and management is his specialty, and in Spring 2009, he received the National Science Foundation's CAREER Award for his efforts.

The CAREER Award is the National Science Foundation's, or NSF's, most prestigious award for junior faculty members. It is part of NSF's Faculty Early Career Development Program, which "recognizes and supports the early career-development activities of those teacher-scholars who are most likely to become the academic leaders of the 21st century."

CAREER Award recipients are selected on the basis of creative career-development plans that effectively integrate research and education within the context of the missions of their institutions.

Kosar is in esteemed company. LSU has 16 CAREER recipients, and four of them hold joint faculty positions within CCT – Juana Moreno, Q. Jim Chen, Bijaya Karki and now Kosar.

"NSF selectively awards CAREER grants to young researchers who demonstrate extraordinary promise and a commitment to advancing science, and I am very proud of Tevfik for receiving it," said CCT Interim Director Stephen David Beck. "I am confident his research will yield results that not only enhance his academic work, but will benefit the greater research community."

Kosar's CAREER-funded project is "Data-aware Distributed Computing for Enabling Large-scale Collaborative Science." NSF will fund this project for five years at $400,000.

Through his work on the CAREER grant, Kosar will develop new computing systems that manage data more effectively with automated processes, which enables scientists to spend more time focusing on their research and less time dealing with data.

"This project will not only impact computer science research by changing the way computing is performed, but it will also dramatically change how domain scientists perform their research by facilitating rapid analysis and sharing of raw data and results," Kosar said. "It will revolutionize science by bringing together computational, theoretical, and experimental researchers, who currently live in very different communities and often do not interact.

Kosar's integrated CAREER plan will impact computational science disciplines from science and engineering to emerging research in the arts, humanities, business and education, which also need to deal with increasingly large amounts of data.

The CAREER Award will allow Kosar to expand on research projects underway. In 2006, he received a $1 million grant from NSF to create advanced data archival, processing and visualization capabilities across the state through the PetaShare project (www.petashare.org). In December 2008, Kosar led a team of researchers who unveiled a new software package, called Stork Data Scheduler, which makes it easier and more efficient for researchers to access and transfer large data sets (www.storkproject.org).

In August 2009, Kosar received a half-million dollar grant through the National Science Foundation's Strategic Technologies for Cyberinfrastructure Program to support his work on Stork Data Scheduler. This grant allows Kosar to expand on models and algorithms created through his CAREER grant work, implementing them in a scheduling software program that will be available for production and distribution.

Kosar lets undergraduate and graduate students work alongside him on the project to gain valuable research experience and inspire them to pursue careers or further research in data management, as this will continue to be an urgent need for computational scientists in coming years.

This project also involves education and outreach to communities outside the University, as Kosar will incorporate the project into LSU's summer camp and outreach programs to students in the K-12 grades. He also plans to visit with students in Louisiana schools to discuss the project and encourage them to pursue careers in computational science.

Education and outreach is another area that has been central to Kosar's research interests. In 2007, he led a team of educators from LSU, Southern University and Southeastern Louisiana University, called the Pelican Educational Foundation (PEF), to develop the Abramson Science and Technology Charter School. Located in New Orleans East, the school was completely destroyed by Hurricane Katrina and reopened as part of the Recovery School District.

This charter school model integrates advanced computational science technology into traditional lesson plans, and provides more opportunities for students to work collaboratively with university-level researchers and be mentored by experienced scientists to enter into national and international science project competitions.

In its first year of operation, student performance scores at Abramson improved by more than 50 percent. In its second year of operation, they increased even more, by nearly 70 percent. Overall, test scores at Abramson have increased by 36 points in the past two years. Abramson students also enjoyed success at the 2009 Greater New Orleans Science & Engineering Fair, winning the most awards in the junior division, and the second-highest number of awards in the overall competition.

Abramson is one of two Recovery School District (RSD) charter schools operated by PEF. In March 2009, the Louisiana Board of Elementary and Secondary Education approved PEF's application to charter Kenilworth Middle, a low-performing school in East Baton Rouge Parish. After undergoing major renovations and getting almost all new teachers and staff, Kenilworth reopened this fall as a science and technology-focused, college preparatory charter school.

"I am so proud of the progress we have made in the community already, and I look forward to working alongside parents, teachers and students to create a high-quality learning environment at Kenilworth where science and technology will become vital tools that all our children can use for living, learning, and working," Kosar said.

For more information on Kosar's work with the Pelican Educational Foundation, please visit http://pelicanfoundation.org.

To see the complete LSU series profiling the 16 CAREER grant recipients at the University, including Dr. Kosar, please visit: http://www.lsu.edu/pa/mediacenter

Living in a Material World:

CCT Faculty Develop Ground-breaking Program in Physics Research

To advance modern technology and develop new applications, scientists need to understand the basic material properties that make up everything from airplanes to computer chips to improved solar cells. Computational modeling of condensed matter physics will play an essential role in helping scientists examine the basic elements and properties that make up materials. Breakthroughs in this area could give scientists the building blocks needed to develop newer, better and stronger materials.

Mark Jarrell and Juana Moreno, faculty with CCT who have joint appointments with the LSU Department of Physics & Astronomy, are developing a new materials science program to expand this research at LSU.

Both are part of the University's Multidisciplinary Hiring Initiative in materials science and engineering, which LSU announced in Fall 2007. In October 2008, E. Ward Plummer, a member of the National Academy of Sciences and a world-renowned physicist, came to LSU as a faculty member in Physics & Astronomy to expand the materials science program. As part of this expansion, eight new faculty, including Jarrell and Moreno, came to LSU, creating new curricula and projects for LSU students to be part of this ground-breaking effort.

"Mark Jarrell and I thought that our shared position between the physics department and CCT was a unique opportunity to grow our research group," Moreno said. "Our shared positions allow us to benefit from the challenging environment in physics and from the expertise of other computational science-focused faculty on campus through the CCT. We believe this will allow us to grow and progress in ways we could not achieve at other universities."

Their research focus is the physics of strongly correlated electronic materials, which include many nanostructures, high-temperature superconductors and heavy fermion systems. These systems are characterized by competing interactions and complicated phase diagrams, which make them ideal for creating devices since by tuning some parameters (e.g. applying pressure, magnetic field) scientists can completely change their properties.

Because the unexpected and changing properties of these compounds are too complex to study with conventional approaches, Jarrell and Moreno use high-performance computers to run simulations that can model these materials, which gives them insight to predict their properties. Computer simulations are an efficient way to study material properties, and often it is faster and cheaper to test ideas with computer simulations than to address them in the laboratory.

Jarrell and Moreno will be working to expand this research at the University, pairing CCT's cyberinfrastructure with the research background of faculty in physics and across campus.

"The recent, very rapid development of high-performance computer platforms together with a similar emergence of highly accurate algorithms allow us to model complex materials, which we were unable to do just a few years ago," Moreno said. "These materials form the basis of future high-tech devices and their proper theoretical understanding is paramount for technological progress."

In upcoming semesters, Jarrell and Moreno plan to push toward a more interdisciplinary approach to studying materials science by forming larger, collaborative teams of faculty with varying areas of expertise.

"By crossing traditional departmental boundaries and working together with experts in other areas, we expect to do transformative research and really make significant progress on the understanding of complex materials," Moreno said.

For more information on LSU's multidisciplinary hiring initiative in Materials Science & Engineering, in which Professors Jarrell and Moreno are participating, please visit http://www.mhi.lsu.edu/materialscience

Education

AVATAR Faculty Develop Digital Media Curricula at LSU

Faculty with the Arts, Visualization, Advanced Technologies and Research, or AVATAR Initiative, have spent the past year working to create an academic track for students to study digital media at LSU.

The AVATAR Committee worked during the 2008-2009 academic year to determine course requirements and develop new curricula for a minor in digital media through the LSU School of Art.

While students will enroll for the minor through LSU School of Art, the digital media curriculum encompasses many disciplines in departments across campus, including courses in video game design, electro-acoustic music composition, animation and digital art.

AVATAR received approval from the University Committee on Courses and Curriculum and began publishing the courses and program applicable to this minor in the University's registration materials for the Spring 2010 semester to begin attracting students.

The first students will take courses in the AVATAR digital media program beginning in the Spring 2010 semester.

For more information on this new academic program, please visit www.avatar.lsu.edu.

Video Game Design Class

Advances to the Next Level with More Collaboration, New Platforms

Imagine a college course where your assignments are to play, develop and test original video games.

This is an opportunity LSU has offered since the Fall 2007 semester, in collaboration with University of Illinois at Chicago, or UIC. In the class, which students attend via high-definition video streaming broadcast from Chicago to Baton Rouge, participants learn core concepts to develop and design video games, from storyline to character development to coding.

Working together in groups of three to four, the students form competing video game companies. As a final project, each group develops an original game, and for the final class, the students have a video game marathon in which a panel of faculty, former game class winners and video game industry professionals from both Baton Rouge and Chicago judge their work on several characteristics.

In previous semesters, there were many more UIC than LSU students, and Jason Leigh, a computer science professor at UIC and director of the university's Electronic Visualization Laboratory, taught the course with support from LSU faculty.

This year, the course achieved a more even balance between the two universities. Robert Kooima, Ph.D., who previously worked with Leigh at the Electronic Visualization Laboratory, came to LSU in the Fall 2008 semester to do research as part of the Arts, Visualization, Advanced Technologies and Research, or AVATAR, Initiative in digital media.

Kooima agreed to be the LSU instructor for the course, and worked directly with Leigh to make the teaching more interactive between the two locations than it had been previously.

This year, the course had such even enrollment that out of the eight groups that formed in the class, seven were equally split with team members from LSU and UIC. The video game design teams are interdisciplinary to emphasize links between art and technology. Art students work on animation and character design while computer science students work on the video game programming and code-writing components.

"The structure we were able to do, with the teams equally comprised of LSU and UIC students, really emphasized the collaborative skills that are an integral part of this field," Kooima said. "To complete their final video game projects, the students had to rely on video conferencing technology more heavily than previous classes, and they had to really assess each other's strengths and weaknesses to work effectively as a team between two campuses."

Another new feature of the Spring 2009 semester video game design course was an emphasis on creating games with multi-player, multi-touch capabilities.

"Multi-touch capabilities are becoming common for many kinds of technology, such as ATM machines and in gaming, with the emergence of the iPhone as a popular platform," Kooima said. "Multi-touch game design is a driving issue in the industry, and it is something students must be able to produce if they aspire to work in video game development."

To give the class a place to experiment with multi-touch gaming, Kooima built a 52-inch TacTile LCD touch table that students can use to play and display their video games. The students were challenged to create games that players could experience on the flat, multi-touch surface, without requiring hand-held controllers or other equipment.

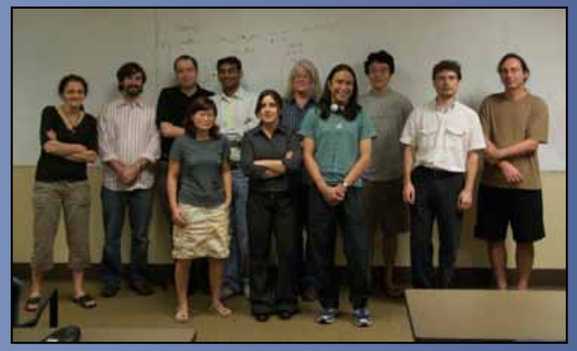
"In the future, you will likely see this technology expand beyond gaming into other applications, such as television sets or even computer screens," Kooima said. "The game table introduces the students to multi touch and gets them thinking about how to work it into the overall design of a program or art piece, which has useful implications for many areas."

In future offerings of the course, which is scheduled at LSU both as a computer science course (CSC 4700) and an arts course (FMA 4001), students will continue developing multi-touch games that use new platforms such as the LCD table.

For more information, visit:
http://www.evl.uic.edu/spiff/class/cs426/

Outreach

CCT's Black Hole Simulation Wins First Prize at International Scalable Computing Competition



A team of 13 LSU researchers and students, led by CCT faculty, conducted a presentation and demonstration that won first prize at the SCALE 2009 challenge at CCGrid09, a premier conference for cluster and Grid computing.

The SCALE 2009 competition, which took place in May 2009 in Shanghai, China, involved researchers demonstrating real-world problem solving using scalable computing, in which scientists use computer systems that can easily adapt, or scale up, to provide greater performance and computing power and give them greater capability to solve complex problems.

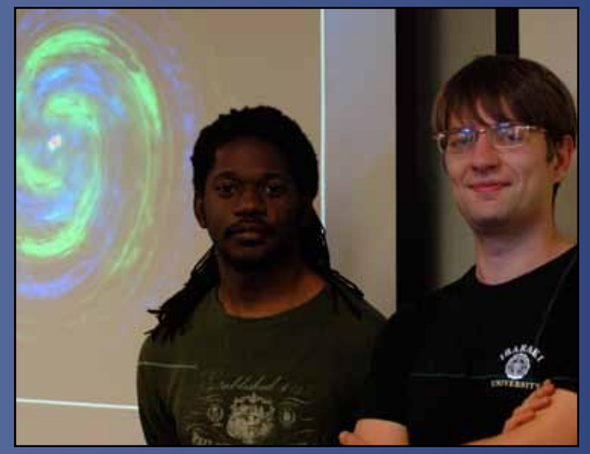
The CCT-led demonstration showcased a scalable, interactive system to simulate and visualize black holes to study the physics of gravitational waves. This complex process involves many challenges that scientists are only now able to address with modern cyberinfrastructure, including scalable computing systems.

"We were honored to receive first prize in this competition, particularly since we had many challenges leading up to our demonstration," said LSU Department of Computer Science and CCT Professor Gabrielle Allen, who led the demonstration team. "Travel restrictions prevented all but one member of our team from attending the competition in person, so we produced a video of our demonstration that was shown in Shanghai. The rest of our team communicated from LSU during the competition using Skype and live chat to describe the process and answer questions. The fact LSU's entry won first prize in spite of these obstacles is a good reflection on the quality of scientific research our group was able to demonstrate, and we are grateful for this recognition from our international peers and collaborators."

The CCT entry addressed the scalable computing challenges of the competition, including automatically generating simulation code, developing programs and software components to provide fast data transfer across the Louisiana Optical Network Initiative, or LONI, parallelize the rendering process that transforms scientific data into images and building interactive, tangible devices that allow observers to engage directly with the scientific data as it is visualized live.

The CCT demonstration also tested the team's ability to effectively use high-performance computing machines concurrently, running applications on thousands of computing cores at once while using multiple, distributed resources of different types(computation, storage, networks, graphics) for a single application.

Numerical simulations are the only practical way to study black hole systems, but this requires a complex system of mathematical equations describing effects that span a wide range of length- and time-scales. To address this challenge, the CCT demonstration used Cactus Software Framework, an open-source environment that allows teams of researchers from different fields in different locations to work together at modeling the black hole collisions, solving Einstein's Equations. Cactus allowed the researchers to automate a process that would be too time-consuming and error-prone for scientists to perform by hand.



The demonstration involved collaboration with LONI and the Texas Advanced Computing Center in Austin, where the black hole simulation was run on 2,048 cores of the Ranger machine.

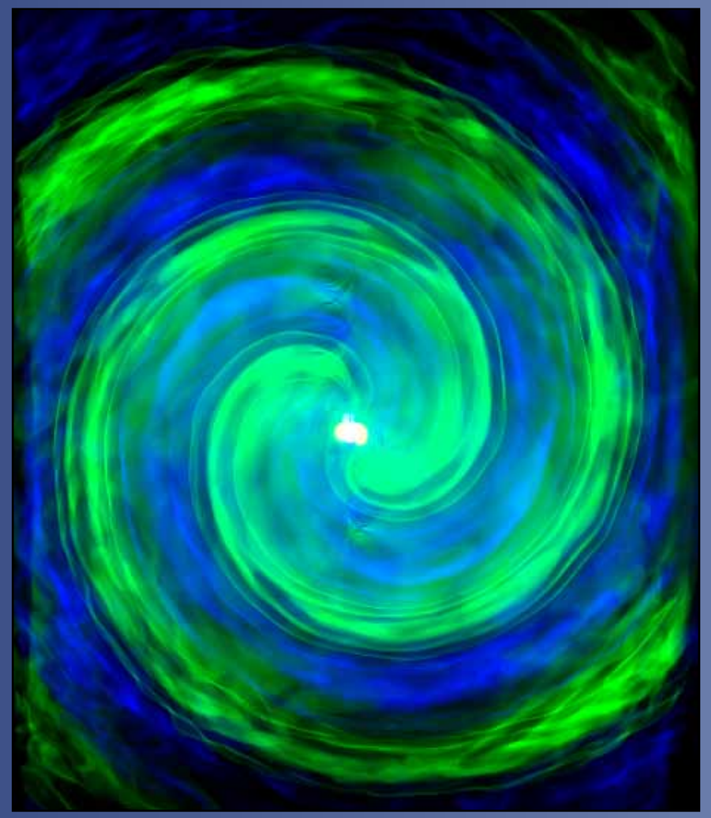
The CCT team was able to demonstrate live interaction with the simulation using a Web interface for application-level monitoring, debugging, and profiling.

The simulation integrated social networking sites into the scientific process, using a new Cactus application an LSU undergraduate student co-developed to announce runtime information to Twitter and provide real-time images of the gravitational field through Flickr.

The demonstration showed live, interactive images of the black hole data using a scientific visualization system distributed across LONI. The CCT group built tangible interaction devices, which they provided on the show floor in Shanghai, allowing observers to interact in real-time with the visualization process. The team came in first among the five international, short-listed entries for the competition.

"It was a great experience for us to be able to demonstrate University research to our international peers at a venue across the world, so we can show them the ground-breaking processes taking place through work at LSU that are advancing opportunities for the global scientific community," said CCT Interim Director Stephen David Beck, Ph.D.

To see the video of the CCT demonstration, please visit http://preview.cactuscode.org/media/videos/.



This visualization of a black hole and its resulting gravitational waves is the one resulting from data produced during CCT's SCALE 09 demo competition, which used scalable computing to model these phenomena.

Beowulf Boot Camp Drills High School Students in Supercomputing Basics

Beowulf Boot Camp might sound like a summer reading program featuring the Old English poem, but it actually is a summer education experience that gives Louisiana high-school students a unique opportunity to work hands-on with advanced computing technology that is not usually available in a typical classroom setting.

The camp is named after the Beowulf supercomputing cluster, which CCT and LSU Department of Computer Science Professor Thomas Sterling invented. Beowulf is now the building block of many of the world's supercomputers.

CCT hosted the first Beowulf Boot Camp in August 2007, with students and teachers from five Baton Rouge high schools participating. For the second offering of the camp, CCT included more participants, with 23 students and one teacher from 14 local high schools participating. CCT offered this camp at no cost to the students, and the activities took place in the high-performance computing center on LSU's campus.

During Beowulf Boot Camp, students work directly with LSU researchers to learn the basics of supercomputing and computational science research. They work in small groups to build computer clusters from scratch, then connect the clusters from each group together to form a mini supercomputer. The students develop and run basic applications on the clusters and learn simple programming exercises. At the end of the camp, they run performance benchmark tests to see how the mini supercomputer they build measures up against the largest and fastest supercomputers in the world.

"With the Beowulf Boot Camp, the students not only learn more about computational science, they learn more about themselves. This camp helps them realize they can interact with professors and university researchers, and exposes them to new interests and opportunities for their future careers or academic studies," Sterling said.

Sterling, a former NASA scientist who leads the CCT Systems Science and Engineering research focus area, developed the summer camp in collaboration with CCT faculty and staff.

In future years, Sterling hopes to work with other universities through the Louisiana Optical Network Initiative to offer the summer camp outreach to more students throughout the state. Sterling's research group will post videos of the lessons from Beowulf Boot Camp online to make the lessons broadly available to interested high schools throughout Louisiana and from other states.

"It is important that University professors focus not only on college-age students, but reach out to students in the K-12 grades, inspiring them to attend college and making them aware of the possibilities in a field many have not considered or been exposed to previously," Sterling said.

Cyberinfrastructure

LSU Visualization Lab Helps University Researchers See Their Data in New and Exciting Ways, from Underwater to Outer Space

A virtual underwater environment in Second Life. A new, high-resolution video of neutron stars colliding. A 3-D movie of Hurricane Gustav's wind field that impacted coastal Louisiana and Baton Rouge.

What do these seemingly unrelated projects have in common? They are all initiatives LSU faculty conducted using the University's Tier 2 Visualization Laboratory, located on the third floor of the Fred C. Frey Computing Services Center.

CCT operates this laboratory as a resource for faculty across the LSU campus who need advanced visualization assistance. The laboratory features a large-scale visualization wall to project images. Faculty from any discipline can use the laboratory to collaborate with researchers who have experience in advanced scientific visualization.

The CCT's Visualization Consultant, Jinghua Ge, assists faculty from disciplines including elementary education, physics, coastal studies and engineering with different projects.

"These services offer LSU faculty a new way to look at their data and develop solutions and models they could not do with traditional methods," Ge said.

One project Ge worked on was an initiative between CCT and the Department of Education to develop new ways of teaching science and technology to K-12 students. Using data from coastal studies, environmental engineering and basic sciences, Ge's student Kevin Kolz working in the Tier 2 Visualization Laboratory created an underwater environment in Second Life. LSU has an island in Second Life, and the underwater space allows students to go there and experience an immersive ocean area. The students can manipulate weather data in this environment to see how different elements affect ocean life.

LSU student Ashley Zebrowski, who works for Ge in the laboratory, is expanding on this work by creating a physics-based water flow animation using computer graphics techniques. This project could become a useful tool for coastal studies and engineering researchers who want to use realistic water simulations to study various coastal and environmental occurrences, such as tide changes or floods' effects on salinity levels.

Ge also worked with LSU Department of Physics & Astronomy Professor Joel Tohline to better visualize his data of merging binary stars. Tohline already had conducted a movie simulation of this violent merger, but by collaborating with Ge, whose programming skills significantly enhanced the capabilities of an open-source visualization tool called VisTrails, he was able to analyze complex aspects of the merger in considerably more quantitative detail than had previously been possible.

Jan Staff, Ph.D., a post-doctoral researcher working with Professor Tohline, wanted to create 3-D movies and images that show the jet streams produced in the Universe as stars or other stellar objects form and merge. The data set for just one of these streams can be up to terabytes. The output data contain multiple timesteps, with each step containing about 64 gigabytes of data, which is much too large to visualize using an office desktop computer.

Ge helped Staff visualize his data using Santaka, one of the LSU supercomputers, to create high-quality, realistic movies and still images that take density, velocity and degree of parallel activity in jet streams into account, which allows him to make direct comparisons between his simulations and actual observations of jet streams. Staff presents these images and videos as part of his research findings at conferences or in papers.

Professor Q. Jim Chen, from the Department of Civil and Environmental Engineering, used the laboratory to create a 3-D film of Hurricane Gustav, which hit Baton Rouge on Sept. 1, 2008. Chen's research group developed a wind dataset for a 51-hour period during Hurricane Gustav and used the wind field to drive their storm surge and wave models. Ge helped the group visualize these data to create a 3-D model that allows better and more in-depth analysis of the storm.

"Hurricanes are just one example of how scientific visualization is enabling breakthroughs that were not possible just a few years ago," Ge said. "Using these techniques, scientists can create more advanced models that take multiple elements into account, such as wind speed, storm surge, and ocean waves, as well as the resultant coastal erosion and sediment deposition. These models help them study hurricanes more effectively, and in the future, this could lead them to develop better and more accurate early warning systems."

In addition to the visualization and animation-based projects, another of Ge's students, Stephanie Beard, is providing movie editing and Java programming support to researchers who want to do longer-format animations of their work.

Ge provides high-performance computing visualization services to researchers throughout the state as part of her work with LONI, of which LSU is a part. She has conducted training and outreach sessions at LSU, Southern University and Tulane University in the past year to further LONI's goal of using the state's existing cyberinfrastructure to leverage more opportunities for visualization work and services.

For more information on the Tier 2 Visualization Laboratory, please visit http://avsl.cct.lsu.edu.

To reach LSU's virtual campus in Second Life and see some of the ongoing research taking place there, go to http://slurl.com/secondlife/LSU%20CCT/212/184/22.

Professor Thomas Sterling Part of National Science Foundation Workgroup Detailing Next-Generation Supercomputers

Currently, the world's fastest supercomputers are at the petascale level, meaning they are capable of running 1,000 trillion calculations per second. But, what will happen when supercomputers move from petascale to exascale and become even faster, capable of running a million trillion calculations per second? What architecture and interfaces will the research community need to use these next-generation machines effectively?

A new research group comprised of scientists and engineers from LSU, University of Southern California Information Sciences Institute, University of Illinois Urbana-Champaign, University of Delaware and Sandia National Laboratories is addressing those questions to prepare scientific research for exascale supercomputers.

The National Science Foundation, or NSF, has funded this group, called the Exascale Point Design Study, to have a series of collaborative meetings to determine what needs to happen to develop large-scale computing systems. NSF selected members of this group based on their accomplishments and expertise in various areas of computational science. Together, the group discusses programming, hardware, applications, systems design and other challenges researchers will need to overcome to use exascale machines effectively.

The lead researcher from LSU on this study is Thomas Sterling, a professor in the Department of Computer Science. Sterling is a former NASA and Cal Tech scientist who invented the Beowulf supercomputing cluster. At LSU, he leads the Systems Science and Engineering focus area within CCT.

Professor Sterling and his research team at the CCT have spent the past several years working on the ParalleX project to investigate how parallel computing environments can run effectively on large-scale machines. Their research and work on ParalleX will provide critical insight to the Exascale Point Design Study.

ParalleX is a next-generation model for parallel computing that eliminates constraints and programs petascale-class machines in ways that incorporate multiple elements effectively. ParalleX is designed make areas such as synchronization, scheduling, manual data layout and messaging more efficient for researchers.

Also, the ParalleX group is exploring how computing environments should be monitored as systems get bigger and are able to process more data rapidly. Sterling notes that historically, as computing systems get bigger, computer architecture has transformed.

"With ParalleX, we are preparing a computational model for petascale-class machines that will enable researchers to use high-performance computers and cyberinfrastructure to their full potential, and we can now expand on this research to contribute toward the scientific research community's preparation for exascale-class machines," Sterling said.

At the end of this series of meetings, the Exascale Point Design Study group will produce a report with their conclusions for NSF, which will serve as a prototype to build and design exascale machines for scientific research.

"We are about to enter a new era of scientific computing, and it is an exciting and rewarding challenge to work with distinguished researchers from institutions around the country to determine what the next supercomputers need to be," Sterling said.

For more information:

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

ParalleX: http://px.cct.lsu.edu

CCT Education and Research Highlights

Professor Tevfik Kosar received the National Science Foundation's prestigious CAREER Award in early 2009. Of the 16 LSU CAREER grantees, four of them hold joint faculty positions within CCT – Juana Moreno, Q. Jim Chen, Bijaya Karki and Tevfik Kosar.

Professor Shantenu Jha was invited to be the Program Chair of OGF-27, co-located with Grid 09 and the Cybera/CARANIE National Summit.

Professor Thomas Sterling again taught his "High-Performance Computing: Models, Methods and Means" course in the Spring 2009 semester, using the newly refurbished Coates 202 teleconference classroom. Sterling pioneered this teaching method in the Spring 2007 semester after working with a team of researchers from the CCT, MCNC in North Carolina and Masaryk University in the Czech Republic to develop HD streaming and Access Grid applications for educational purposes. This course was the first of its kind in the United States when it premiered in January 2007, and his course was an inspiration for the University to dedicate a sole classroom to teleconferenced courses.

Professor Susanne Brenner was appointed to the Scientific Committee for the International Centre for Pure and Applied Mathematics (CIMPA), a UNESCO center established in Nice, France in 1978. The aim of CIMPA is to promote international cooperation in higher education and research in mathematics and related subjects, particularly computer science, for the benefit of developing countries.

Professor Jorge Pullin was named to the General Council of American Physical Society, or APS, the country's leading professional organization of physicists. Professor Pullin also won a community prize in an inaugural essay contest for the Foundational Questions Institute, a physics and astronomy research organization.

Baton Rouge Business Report selected Professor Brygg Ullmer as one of its "40 Under 40" honorees. This annual contest acknowledges people in the Baton Rouge area who are making important contributions to advance education, economic development and industry. Brygg was nominated for his research expertise in tangible and embedded interaction, computational applications for biological science and also for his education and outreach efforts with local students in the K-12 grades as well as his own students at LSU.

CCT Interim Director Stephen David Beck, CCT Professor Susan Ryan and CCT post-doctoral researcher Robert Kooima all were featured speakers during SIGGRAPH 2009 in New Orleans.

Professor Susanne Brenner was reappointed to her second term as editor of the journal "Mathematics of Computation." She was appointed as an associate editor in 1993 and has served on this board continuously since then. Professor Brenner also accepted an invitation to join the editorial board of the journal "Advances in Numerical Analysis."

Professor Thomas Sterling was invited to give one of the formal presentations of the first meeting of the new High Performance Computing Task Force of the National Science Foundation in Chicago, and was invited to give the opening presentation at the final technical meeting informing the DARPA UHPC Program management team at Stanford University in Palo Alto, California.

Daniel S. Katz was one of 2 U.S. core members of the newly approved (UK) eSI theme: "The Influence and Impact of Web 2.0 on e-Research Infrastructure, Applications and Users."

Professor Jorge Pullin was selected by the International Society on General Relativity and Gravitation to chair the committee that chooses the winner of the Basilis Xanthopoulos prize, the most prestigious in gravitational physics for candidates younger than 40.

Ashley Zebrowski, an undergraduate student who works with Professor Shantenu Jha's group, received an undergraduate research award from the LSU College of Basic Sciences.

Professor Tevfik Kosar received the College Research Award at the LSU College of Basic Sciences Honors Convocation.

The Society for Industrial and Applied Mathematics (SIAM) nominated Professor Susanne Brenner to be the SIAM Vice President for Publications.

Professor Thomas Sterling was invited to attend the DOE workshop on Scientific Grand Challenges in Bethesda, Maryland. This meeting brought together national experts in the physics problem areas involved in future energy devices such as photovoltaic and energy storage among others, along with experts in relevant computational tools and techniques. Sterling was involved in a number of discussions during the workshop leading to possible conclusions.

CCT Interim Director Stephen David Beck and CCT faculty members Lance Porter and Susan Ryan received LSU Distinguished Faculty Awards for 2009.

Jintao Cui was a recipient of a student paper prize at the 2009 Society for Industrial and Applied Mathematics Southeast Atlantic Sectional (SIAM-SEAS) Meeting. His presentation was on "Nonconforming finite element methods for a two-dimensional curl-curl and grad-div problem." Jintao is a graduate student in mathematics working with Professor Susanne Brenner.

Professor Thomas Sterling was invited to participate in the second meeting of the International Exascale Software Project, which involves collaboration among world experts in high-performance computing from Europe, Asia, and the United States. This meeting took place in late June in Gif-sur-Yvette, France.

Professor Brygg Ullmer was invited to serve as Associate Chair for Papers/Notes at CHI (ACM Conference on Human Factors in Computing Systems) 2010, with responsibilities for papers on tangible interfaces. CHI is the premier international conference for the field of human-computer interaction; typical attendance is around 2,000 people from 38 countries. The Tangible, Embedded, and Embodied Interaction conference that Ullmer launched with the CCT Mardi Gras Conference in 2007 is now entering its fourth year.

Professor Susanne Brenner was selected to be an Overseas Visiting Professor at the State Key Laboratory of Scientific and Engineering Computing (LSEC) at the Chinese Academy of Science in Beijing.

CCT-Sponsored Conferences and Events 2008-09

CCT Faculty Retreat
Date: Jan. 30, 2009
Attendees: 35
Location: LSU campus

16th Annual Mardi Gras Conference
Virtual Worlds: New Realms for Culture, Creativity, Commerce, Computation and Communication
Dates: Feb. 19-21, 2009
Attendees: 78
Location: Sheraton Baton Rouge Hotel and Conference Center

5th High-End Visualization Workshop
Dates: March 18-21, 2009
Attendees: 48
Location: LSU campus

Exascale Point Design Study Meeting
Dates: March 19-20
Attendees: 20
Location: LSU campus

Distributed Organization for Scientific and Academic Research Workshop
Dates: April 2-3, 2009
Attendees: 12
Location: LSU campus

LONI Institute EPSCoR Proposal Planning Workshop
Date: April 4
Attendees: 30
Location: LSU campus

5th Gulf Coast Gravity Meeting
Dates: April 17-18, 2009
Attendees: 50
Location: LSU campus

5th Annual Red Stick International Animation Festival
Dates: April 22-25, 2009
Attendees: 5,000
Location: Downtown Baton Rouge Arts District

2nd LONI Institute EPSCoR Proposal Planning Workshop
Date: May 19
Attendees: 20
Location: LSU Campus

9th International Conference on Computational Science
Compute. Discover. Innovate.
Dates: May 25-27, 2009
Attendees: 257 attendees from 29 countries
Location: Hilton Baton Rouge Capitol Center

XiRel Workshop
Dates: May 28-29, 2009
Attendees: 12
Location: LSU campus

John Lennon Educational Tour Bus Visit
Dates: June 4-5, 2009
Attendees: 200
Location: LSU campus

Beowulf Boot Camp
Dates: June 15-19, 2009
Attendees: 23 students and one teacher from 14 area high schools
Location: LSU campus

SC 09 Summer Education Workshop
Parallel Programming and Cluster Computing
Dates: July 5-10, 2009
Attendees: 30
Location: LSU campus

Great Lakes Consortium Virtual Summer School
Scaling to Petascale Workshop
Dates: Aug. 3-7, 2009
Attendees: 24
Locations: LSU, National Center for Supercomputing Applications, University of Michigan and Oak Ridge National Laboratory

Lectures 2008-09

Sponsored by CCT and held on LSU campus
Speakers July 2008 -- June 2009: 51 total

CCT Colloquium Series: 17
CCT Distinguished Lecture Series: 1
Computational Mathematics Seminar Series: 5
Computing the Arts & Humanities Lecture Series: 1
Frontiers of Scientific Computing Lecture Series: 5
IT Eminent Lecture Series: 6
Sponsored in partnership with the LSU Department of Computer Science
Special Guest Lecture Series: 12
Other: 4

High-Performance Computing Tutorials

Hosted on the LSU campus
Organized by CCT and HPC @ LSU

Summer 2008

Introduction to the HPC Environment
Participants: 10

Introduction to Open MP
Participants: 12

Introduction to MPI
Participants: 8

Total trained for Summer 2008: 30 people in three tutorials

Fall 2008

Introduction to Linux and Vi
Participants:17

Welcome to HPC: accounts, allocations, Linux and Linux cluster environment
Participants:18

Introduction to MPI
Participants: 10

MPI Part 2
Participants: 5

Introduction to OpenMP
Participants: 7

OpenMP Part 2
Participants: 4

Introduction to Debugging and Profiling
Participants:15

Cluster Compilers and Optimization
Participants: 9
Introduction to Debugging with Totalview
Participants: 10

Practical MPI
Participants: 5

Total trained for Fall 2008: 100 people in 10 tutorials

Spring 2009

Introduction to Linux and Vi
Participants: 5

Welcome to HPC: accounts, allocations and the cluster environments
Participants: 15
Introduction to MPI
Participants: 5

Practical MPI
Participants: 7

Introduction to OpenMP
Participants: 11

OpenMP Part 2
Participants: 5

Introduction to MATLAB
Participants: 17

An introduction to the computational chemistry package, Gaussian 03
Participants: 18

Introduction to LAPACK
Participants: 22

Introduction to Hybrid MPI and OpenMP
Participants: 7

Introduction to Linux and Vi
Participants: 17

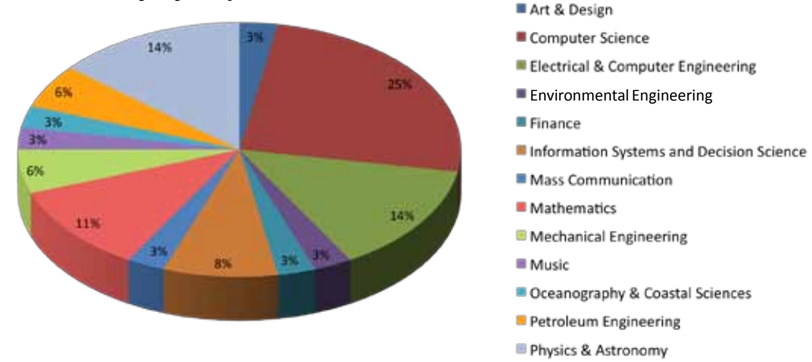
Introduction to Open Source Visualization Software
Participants: 13

PetaShare Environment and Client Tools
Participants: 47

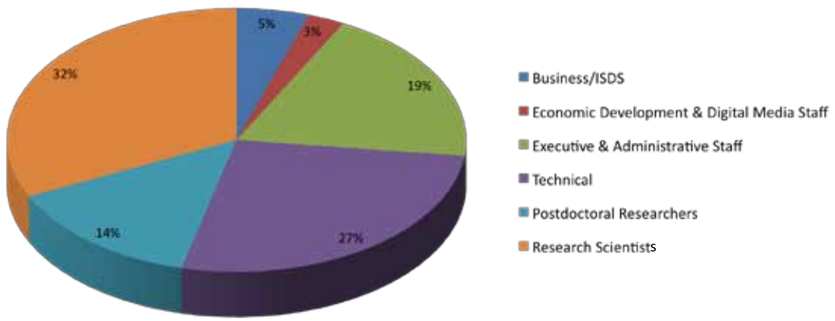
Total trained for Spring 2009: 189 people in 13 tutorials

CCT Annual Reports

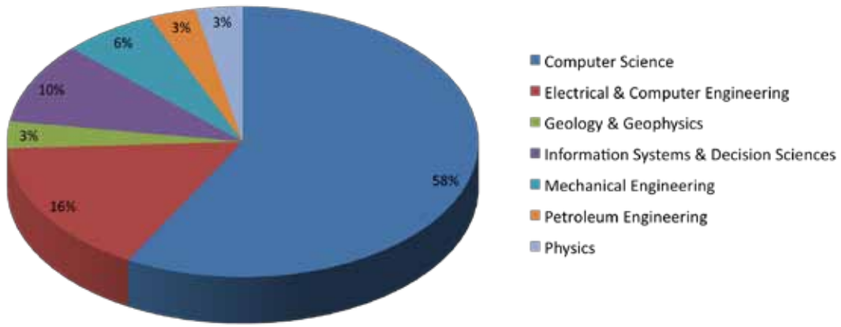
CCT Faculty by Department for 2009



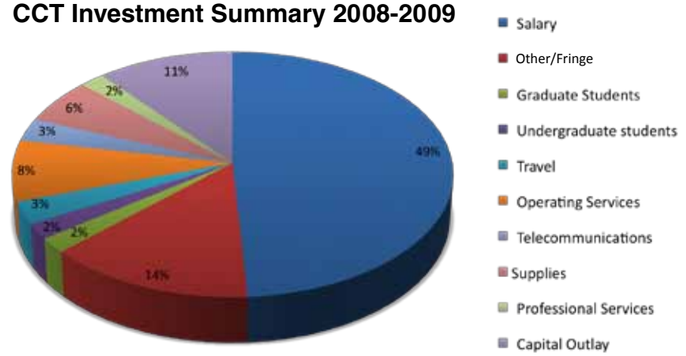
CCT Professional Staff for 2009



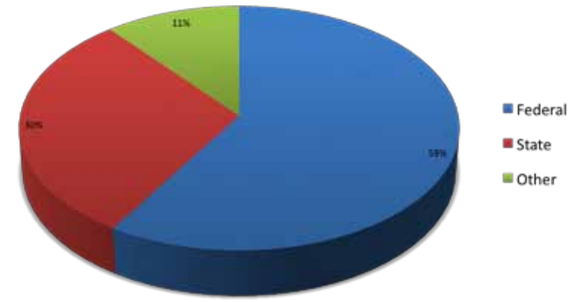
CCT Graduate Assistants by Department for 2009



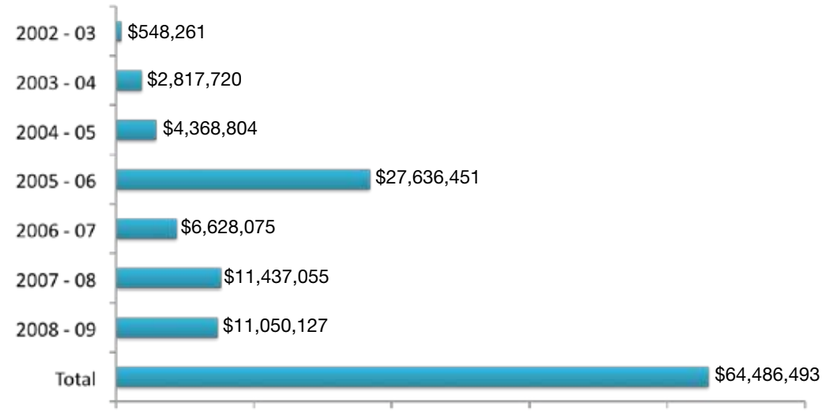
CCT Investment Summary 2008-2009



Cumulative External Funding by Source FY 2003-2009



External Funding FY 2003-2009



COMPONENTS Volume 5

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