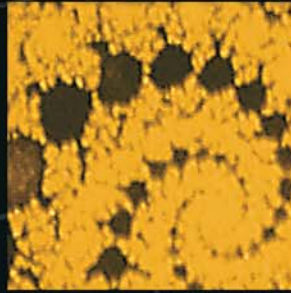


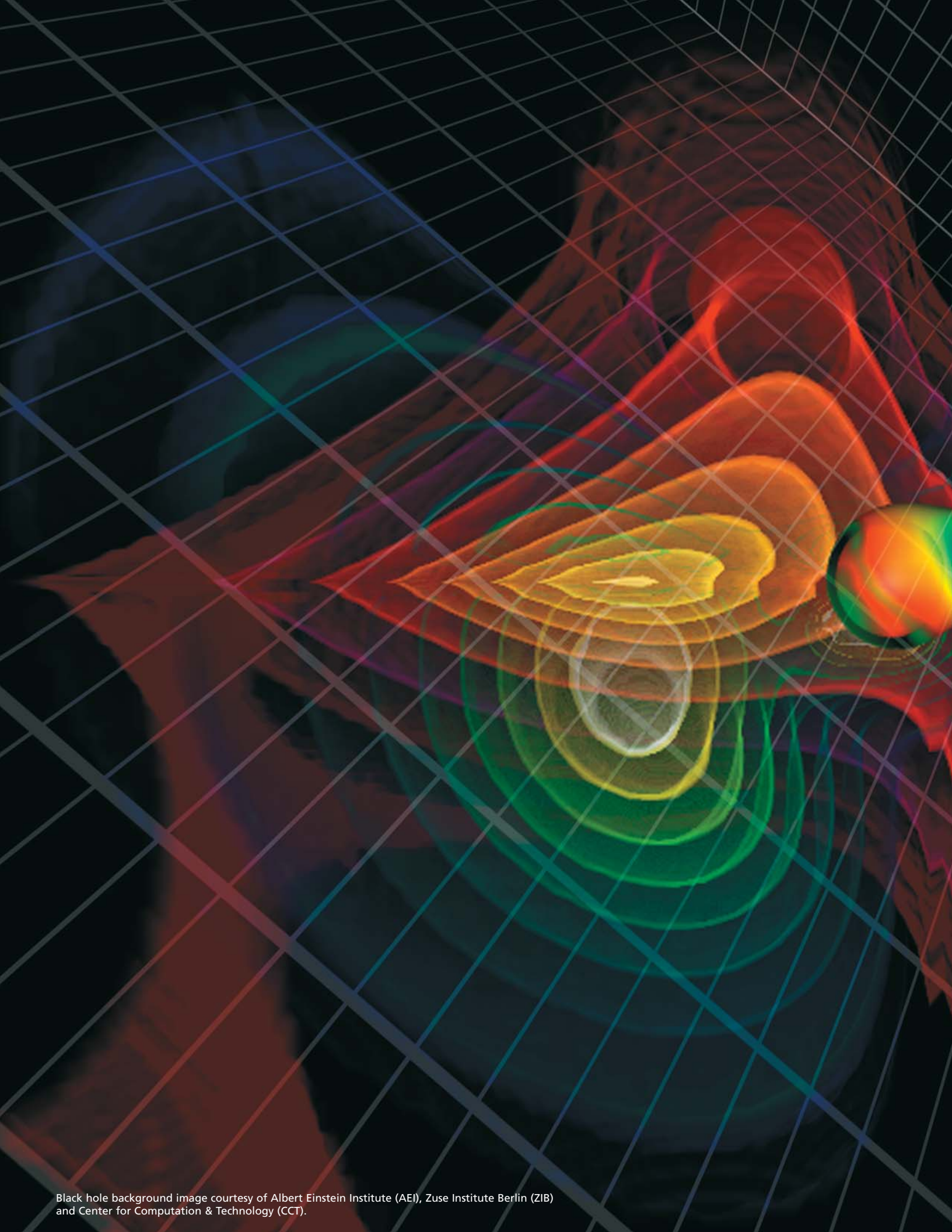
components VOLUME 1



Innovation through Collaboration



CENTER FOR COMPUTATION & TECHNOLOGY
at LOUISIANA STATE UNIVERSITY





“The center is developing interconnected focus areas spanning a number of research disciplines. Musicians and designers work alongside computer scientists, engineers, and physicists to develop new tools, create novel applications, and apply them to advance their research.”

Edward Seidel

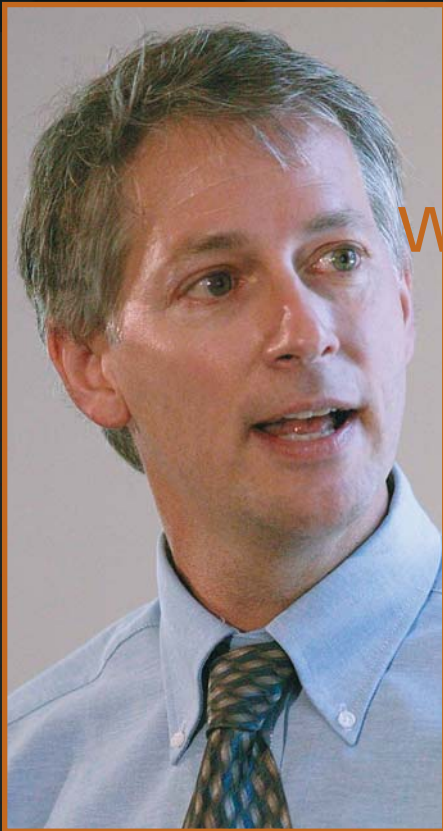
Director

Center for Computation & Technology



OUR MISSION

The Center for Computation & Technology is an innovative and interdisciplinary research environment for advancing computational sciences, technologies, and the disciplines they touch. Our efforts branch out from the center to serve Louisiana through international collaboration, promoting the progress in leading edge and revolutionary technologies in academia and industry.

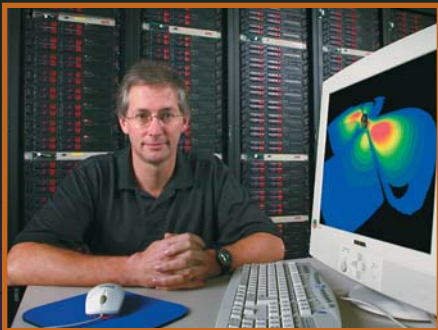
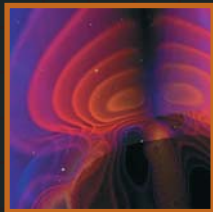


When I moved to Louisiana,

I was intrigued by the vast potential for the development of a world-class research center in an area seeking a new industry. This potential, coupled with exceptional support and commitment to realize it, and Louisiana's culture of Cajun food, jazz, and Spanish architecture, lured me and my colleagues to the LSU campus from all areas of the world. Our research group from Europe, South America, and Asia were welcomed in a state that embraces a mixture of diverse, creative people.

Just as you hear a variety of languages at LSU and within the Center for Computation & Technology, the center is also buzzing with a broad scope of disciplines and new applications for technology. My vision for the CCT is to create an innovative, enterprising, and interdisciplinary environment where computational sciences partner with various fields. Our focus areas include applied mathematics, business, computational fluid dynamics, collaborative environments, software frameworks, Grid computing, creative technologies, materials science, numerical relativity, and scientific visualization.

Although the CCT is relatively new, I am extremely pleased with the great strides we have accomplished in my first year as director. This report will showcase only a small sampling of our work. I am proud to present this compilation of the research and educational projects that were generated from our growing CCT team. In the last year we have successfully recruited outstanding students, researchers, and faculty from top institutions around the world. I am certain this will continue as we further strengthen and expand our center in the coming years.



Within this report you will learn about extraordinary developments in fields from Grid computing to animation. You will read about important medical research, like tracking the spread of disease, our state's new optical network, soon to be one of the most advanced in the world, and a promising economic development initiative. This compilation also offers an inside look into my own research in using supercomputers and Grids to solve Einstein's equations to predict gravitational waveform signals expected when black holes collide.

There are many people to whom this center owes sincere thanks. To Interim Director Joel Tohline and Jade Ethridge, who started us off, and to many more of you who energetically contribute to our budding center's development, I want to say how lucky I feel to work with you, and how excited I am about the future of our center and its impact on the state and beyond.

Sincerely,

Edward Seidel
Director
Center for Computation & Technology

It's all RELATIVE

Peter Diener (foreground), a native of Denmark and assistant professor of research in LSU's Department of Physics & Astronomy, is intent upon his research. Like other international CCT researchers from across the globe, Diener was drawn to LSU because of the collaborative, interdisciplinary work environment.



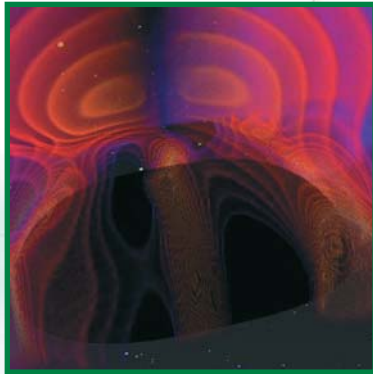
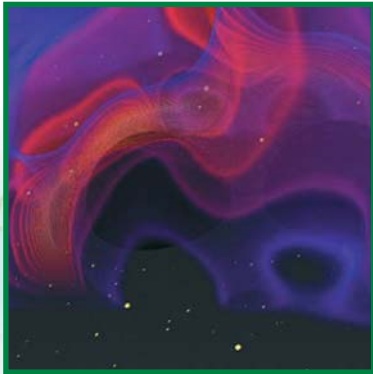
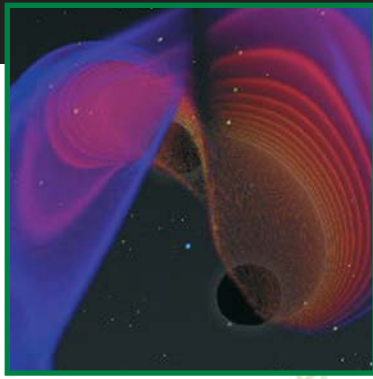
Louisiana's Laser Interferometer Gravitational Wave Observatory (LIGO) and other facilities of its kind around the globe record data from the inspiral and collision of black holes in space.

AT CCT, numerical relativists depend on the international networks, collaboration, and high-tech resources at their fingertips. These researchers are seeking to use Einstein's General Theory of Relativity to predict and understand the structure of gravitational waves resulting from the inspiral and collision of binary black holes in space. Their research has many implications for astronomy.

Currently, gravitational wave detectors around the world, like the Laser Interferometer Gravitational Wave Observatory (LIGO, part of which is located in Louisiana), the GEO facility in Germany, the Virgo facility in Italy, and others, are ready to record data from the inspiral and collision of black holes. During the inspiral phase, before collision, the orbit shrinks due to loss of energy carried away by gravitational waves. Competing with the weak gravitational waves from the cosmos is seismic background noise and a multitude of other signals on earth that may hide the waves. CCT's numerical relativists are working to help researchers distinguish the



L I G O
www.ligo-la.caltech.edu



real data from the noise with templates of gravitational waveforms that will act as a guide.

Peter Diener, LSU assistant professor of research in physics, is quick to give examples of the advantages that CCT brings to his research. The complexity of Einstein's equations, coupled with the need for high-resolution models, means that numerical relativists depend on large supercomputers like CCT's four-TeraFlop SuperMike supercomputer. "We work closely with CCT's computer science and high performance computing (HPC) groups, who provide us with a universal framework for our scientific codes," said Diener.

Computer scientists, such as CCT's assistant director for computing applications Gabrielle Allen and research associate Tom Goodale, developed a framework named "Cactus" to provide a worldwide numerical relativity community with a code for the cutting-edge computational and algorithmic techniques needed for their models. "The Cactus framework is unique because it's driven by the needs of the physicists, mathematicians, and engineers with whom we collaborate every day," said Allen. "Cactus is also extremely adaptable and portable. It's being used by researchers at many other universities."

Numerical relativists at CCT also work with the Grid computing and collaborative environments groups, which provide tools for researchers to share comput-

Supercomputers can be used to simulate gravitational waves that result from the collision of black holes.

Needs No Water



The Cactus framework enables scientists, researchers, and engineers to collaborate on solving large-scale problems and run in parallel on supercomputers or on several supercomputers at once.

"Several application communities around the world researching such subjects as climate modeling, biological computing, and chemical engineering, use Cactus," said CCT research associate Tom Goodale. "Cactus is also used for computing infrastructure projects in Grid computing," he said.

During its early stages, creators likened the framework to a cactus plant. The central core of the design is the "fleshy" part of the cactus, which connects to the "thorns," or application modules. These thorns describe and solve parts of larger problems; Cactus users combine sets of thorns developed by themselves, collaborators around the world, and the core Cactus team, to solve the scientific problem of interest to them. The framework is designed such that these problems may be solved on devices as small as personal digital assistants (PDAs) up to the largest supercomputers available, depending upon the size of the problem to be solved. Recently, the

ers, data, numerical simulations, ideas, and tools in a coordinated and integrated “virtual organization.”

“We are working with the LSU Department of Physics and Astronomy and with international partners such as the Albert Einstein Institute (AEI) and the Universidad Nacional Autónoma de México (UNAM) on different approaches to the study of gravitational waveforms,” said Diener. The European-based GridLab project facilitates such partnerships.

“There are many joint projects between CCT, AEI, and other international centers. Not only do we need to share information and resources for our research projects, we also have to set up a grid of computational resources between sites that cooperate so closely. This provides a unique laboratory for developing and testing collaborative grid software infrastructures,” said Edward Seidel, CCT director and previous head of the numerical relativity group at AEI.

Seidel points out that the partnership with the AEI has helped strengthen LSU’s gravitational wave research program to become an international center of expertise.

“Furthermore, we’re in a unique position because Louisiana is home to the gravitational wave detector, LIGO, and to LSU’s numerical relativists and physicists, who are collecting data and producing simulations,” said Seidel.



GRID COMPUTING, in the broadest sense, is a means of coordinating resources. Just as the electric power Grid is composed of more than generators and wires, so too is the

computational Grid composed of more than computers and optical fiber. A Grid is the collection of the computational resources at one’s disposal as well as the services needed to efficiently, securely, and dependably manage and use them. Researchers at the CCT are working hard to integrate these services to run on Louisiana’s world-class computational resources so scientists can focus less on computers and more on their research.

We Are Tool Builders!

The Grid Computing Group at CCT exists at the intersection of science and computing. Materials simulation, molecular fluid dynamics, bioinformatics, numerical relativity, animation, computational chemistry, are all dependent on the computational resources available to their scientists. When scientists cease concentrating on science and start struggling with the computers they need to run their applications, science as a whole suffers. CCT researchers are building tools that keep the focus of biologists on biology, chemists on chemistry, and physicists on physics. By allowing researchers to focus on their science rather than on their computing needs, the center facilitates the advancement of science and accelerates the discovery of knowledge. Two software technologies developed at CCT, along with collaborators in Europe, are prime examples of such enabling tools. The Grid Application Toolkit provides researchers with an easy way to use new Grid technologies with their simulation and other codes. The GridSphere portal framework provides application groups with a customizable, secure, and collaborative Web interface to use Grid resources and manage their simulations and data.

Cactus team exhibited the framework’s portability by running it on IBM’s BlueGene/L at the SC2004 Conference where BlueGene/L was named the fastest supercomputer in the world.

The framework was originally developed at the Albert Einstein Institute in Potsdam, Germany, with many contributions from colleagues around the world. In 2003 much of the Cactus development moved to the frameworks research group at the CCT.

The programming environment provides easy access to many cutting edge software technologies being developed in the academic research community. This characteristic of the program has direct economic implications for LSU and the state. The development of new technologies like Cactus draws industry to Louisiana, encourages new business development, and helps to solidify LSU’s reputation as a leading academic institution.

ROCKET MAN

CCT researcher and LSU student Florin Mingireanu was selected by the NASA Institute for Advanced Concepts to present his concept description of the Ramjet Statoreactor, a rocket engine that absorbs fuel from its surroundings (for example, interstellar media). Mingireanu's presentation for NASA's Student Visions of the Future Program (NSVFP) was one of four selected on a national level. His paper investigated how acceleration is related with speed for both relativistic (very high speeds) and non-relativistic cases (usual speeds). Mingireanu and CCT director Edward Seidel traveled to Washington, D.C., in March for the conference. Mingireanu went on to win the second round of the competition. As a result, the NASA Institute for Advanced Concepts awarded him a trip to Seattle where he made his presentation to the panel. Mingireanu, who hails from Romania and came to LSU to pursue an undergraduate degree in physics, works with CCT researcher Peter Diener in numerical relativity.



"I fly the rockets mostly for fun, but I've learned interesting things, such as the effect of engine size on the rocket's stability during flight. In one rocket, I modified the structure that holds the engine to accommodate a larger engine. This modified the position of the center of gravity, so I also needed to modify the size of the wings to maintain stability during the flight."



LOUISIANA OPTICAL NETWORK INITIATIVE

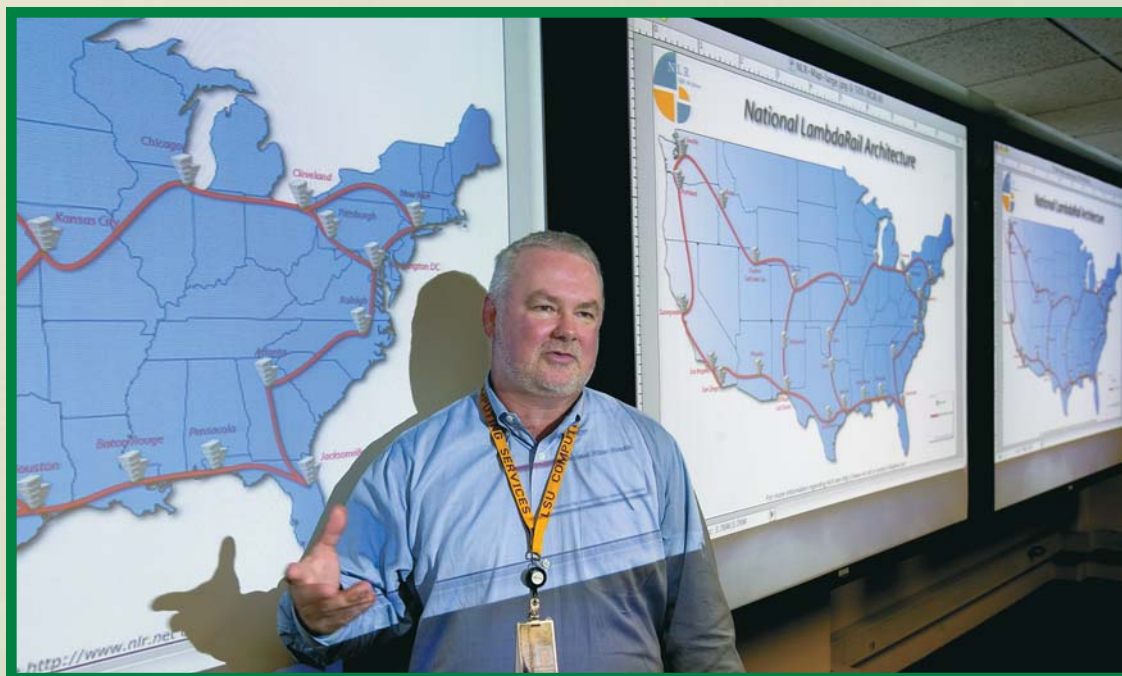
AS LOUISIANA refines its image to compete in the 21st century, dialogues and discussions have raged from the bayou to the Big Easy about how to invest the state's limited resources to assure the greatest returns.

One state initiative has already advanced Louisiana's technological, academic, economic, and cultural development—and all at the speed of lambda—light waves.

The CCT has worked with many partners across the state to secure Louisiana's inclusion on the National LambdaRail (NLR), the new generation of high-speed networking that uses light waves for data transmission, computation, and communication. The Louisiana Optical Network Initiative (LONI) is a \$40 million fiber network that grants NLR access to LSU, Louisiana Tech University, the LSU Medical Centers in Shreveport and New Orleans, the University of Louisiana at Lafayette, Southern University, the University of New Orleans, and Tulane University. With NLR access, universities have the opportunity to create a virtual high-speed, data-intensive academic community to share teaching and research resources.

Getting on Board

In 2001 the NLR was finalizing its designs to connect an exclusive cadre of member universities with superior super-computing capabilities in a high-speed network to access, process, transfer, and analyze data at 25,000 times the rate



“Before the NLR would change the design to come through Louisiana, we had to convince them we were serious players,”

Charles McMahon
Director
LSU Office of
Telecommunications

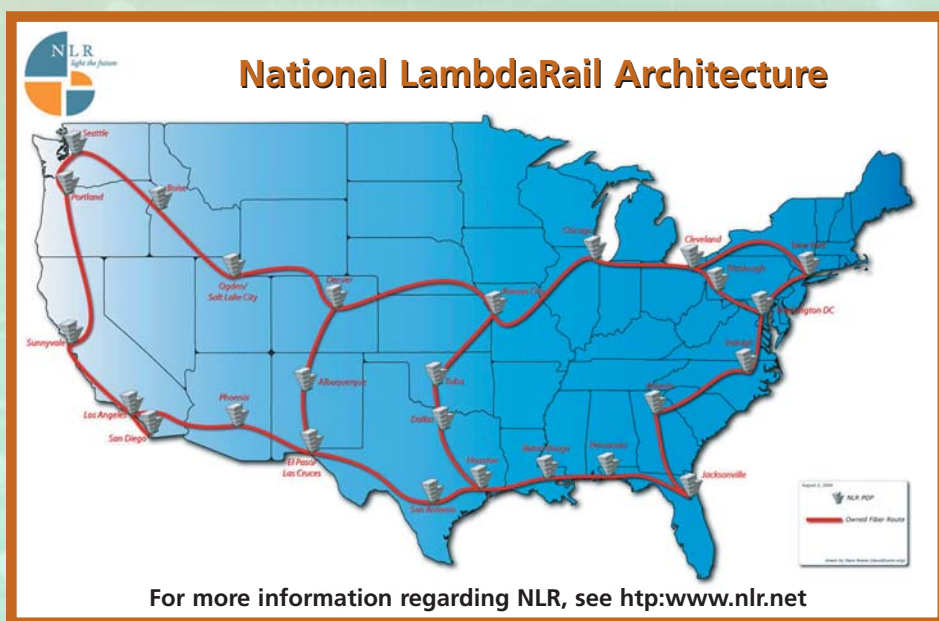
of the average cable modem. Realizing the importance of fiber optic technology, the Southeastern Universities Research Association, Inc. (SURA) began seeking access for its 60 universities located from Massachusetts to Texas.

When astrophysicist and supercomputing expert Edward Seidel agreed to move his international research team from Germany to Baton Rouge and

become the director of CCT, connecting Louisiana to the NLR became a priority. But the southernmost track of the NLR originated in Dallas and veered north-east to Atlanta. Louisiana wasn't even a whistle stop.

“It was the equivalent of watching the transcontinental railroad being built and not coming through your state,” said Charles McMahon, LSU's director of the Office of Telecommunications.

“Before the NLR would change the design to come through Louisiana, we had to convince them we were serious players,” McMahon said. While Seidel gave instant credibility on an international scale, the Louisiana consortium still had to demonstrate its ability to secure long-term funding. Louisiana needed a plan to avert a negative impact on NLR's balance sheet for the extra expenses the detour would accumulate.



From Underdog to Top Dog

By March of 2004, the Louisiana Board of Regents secured the \$5 million NLR membership fee by allocating \$700,000 from its own budget and receiving commitments from Tulane and LSU to contribute \$150,000 each per year, over five years. In addition to its contribution of \$3.5 million, SURA's two-year negotiations with AT&T yielded a donation of thousands of miles of fiber, which was instrumental in completing the NLR backbone, especially the Jacksonville to Houston link.

“As a result of these negotiations, support from the Board of Regents, and Grid expertise at the CCT, Louisiana was suddenly in a leadership position,” said Seidel.

Retouring the LambaRail: Before Louisiana gained membership into the NLR, the southernmost track originated in Dallas and veered northeast to Atlanta.

"We can distinguish Louisiana as a major player in high-performance computing and network technology and secure tremendous economic development gains in the future."

Kathleen Babineaux Blanco
Governor
State of Louisiana

That position was further enhanced when Louisiana Governor Kathleen Babineaux Blanco asserted her commitment to the LONI project in the State of the State address. "We will work with our higher education institutions to develop an in-state network that will take advantage of this National LambdaRail access," she announced. "Through these efforts, we can distinguish Louisiana as a major player in high-performance computing and network technology and secure tremendous economic development gains in the future." Moreover, at the beginning of the legislative session, \$1.1 million was approved for LONI in an amendment to the House appropriation's bill. With advocacy by the administration, the Senate finance appropriations committee increased the allocation to \$3.2 million. "Obviously, it was one of the priority items for the administration," said Donald J. Vandal, deputy commissioner for administration of the Louisiana Board of Regents.

Finally, during an open forum on LONI in September 2004, Governor Blanco surprised researchers from across the world by announcing her full support of the initiative and allocating \$40 million to create and maintain the network. At this forum international representatives from funding agencies, industry, and academia gathered to discuss use of LONI. Securing this fiber network and a spot on the NLR was made



possible by a broad range of support. And so it was that Louisiana went from being excluded to envied, technological underdog to top dog.

Science and Supercomputing

Supercomputers are used to simulate natural phenomena, analyze data, model scientific problems into three-dimensional images, and produce a variety of outcomes by simulating hypotheses in real time. Sophisticated animation, weather and economic forecasts, research and development of new pharmaceuticals and medical techniques generated from supercomputer models pervade daily life. Supercomputing has revolutionized science by allowing

researchers to probe, apply, and test theories. Researchers can use complex supercomputer models to make detailed predictions of real world processes.

While their data needs are exponentially greater than that of the average PC user, scientists and researchers experience the same frustration with integration of software systems and delays in processing. "Scientists have been restricted by the equipment they have had available and the length of run time and size of the computer capability. We are now working with bigger more complex models that use more data," said Gabrielle Allen, computer science faculty member, CCT's assistant director for computing applications, and Grid computing expert. "Even with supercomputers, you have to wait in a queue, and it may take up to a week for the program to run."

Although the current lower bandwidth available to academia is not saturated, the need to advance to improved technology is evident. Many applications



Grid technologies can improve medical research and help doctors transfer data more efficiently.

require access to large amounts of data distributed across the world. Research in high energy physics, the LIGO experiment, high definition video conferencing, and remote visualization of super-computer models are either difficult or impossible today, but will be routine with LONI.

LSU's technology experts have as much confidence in NLR's longevity as its speed and power. "Ten years ago, the case for the network wouldn't have been as clear. At some point, we have to get involved or be left behind. This is the start of a new phase of technology, a new provisioning of lambdas, and potentially unlimited bandwidth on demand," said Seidel.

Leveraging LONI

Louisiana's initiative with NLR has advanced the state's technological capabilities light years ahead. With the acquisition of the new infrastructure, CCT's faculty will harness that power to place the state's universities on a competitive edge in collaborative research and teaching capabilities.

The NLR is a hybrid of two proven technologies that have been both improved and used since the 1970s: fiber optics and ethernet. While the fiber optic cable's physical lifespan is between 10 to 20 years, the electronic components are expected to be upgraded every three years. Contracting with national and local information technology providers, LSU is installing and activating the fiber optic cable that will connect to the NLR as well as LONI. Downtown Baton Rouge will house the hardware hub with a smaller spur located in New Orleans.



"With international networks, collaboration, and high-tech resources, the world is at your fingertips."

Gabrielle Allen
Assistant Director for
Computing Applications
CCT

"The 20 other states in the NLR are providing exclusive access to their flagship supercomputing universities. In Louisiana, we want to leverage the computing power by giving direct access to everybody," said Brian Ropers-Huilman, CCT's assistant director of HPC and computation. All LONI sites will have international networking capability through the NLR. "With LONI, the supercomputers at the other Louisiana

universities will collectively run the same software, making one virtual statewide supercomputer," said Ropers-Huilman.

"Our universities that are geographicaly separated will collaborate on projects and address common issues," said Dan Henderson, director of information technology cluster development for the state's Department of Economic Development. "This is a big step forward for our state, to have cooperation by our researchers and sharing of resources."

"Because of LONI, Louisiana will be much more competitive for large-scale collaborative federal grants."

Edward Seidel

Academics and Economics on the Fast Track

"Because of LONI, Louisiana will be much more competitive for large-scale collaborative federal grants," said Seidel. These grants could result in more discoveries, innovations, and patents.

CCT scientists are already partnered with international research projects like GridLab to develop advanced tools that will enable Louisiana researchers to make use of LONI's advanced capabilities.

Research into coastal erosion could result in better barriers to shield the state from hurricanes. Satellite images of the nitrogen content of the soil yield

The Grid Application Toolkit,

developed by the EU GridLab

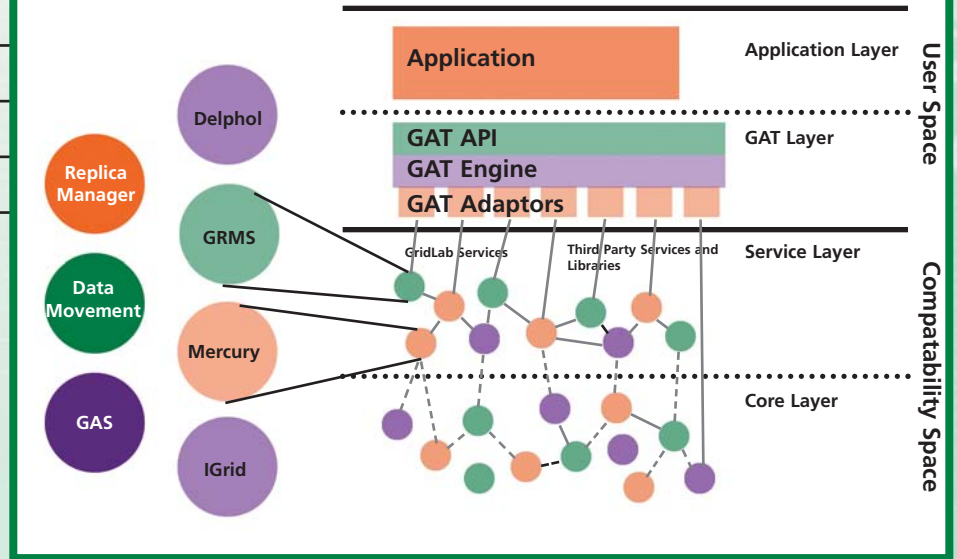
Project and CCT, is designed to

help applications easily use

grids such as LONI.



Grid Lab Services



information that inspires an entrepreneur to create a product that increases the production of sugar cane, rice, or cotton.

In addition, high-quality, high-definition videoconferencing allows faculty to participate in real-time urgent discussions on bioterrorism or public health crises as well as undergraduates to participate in courses taught on the

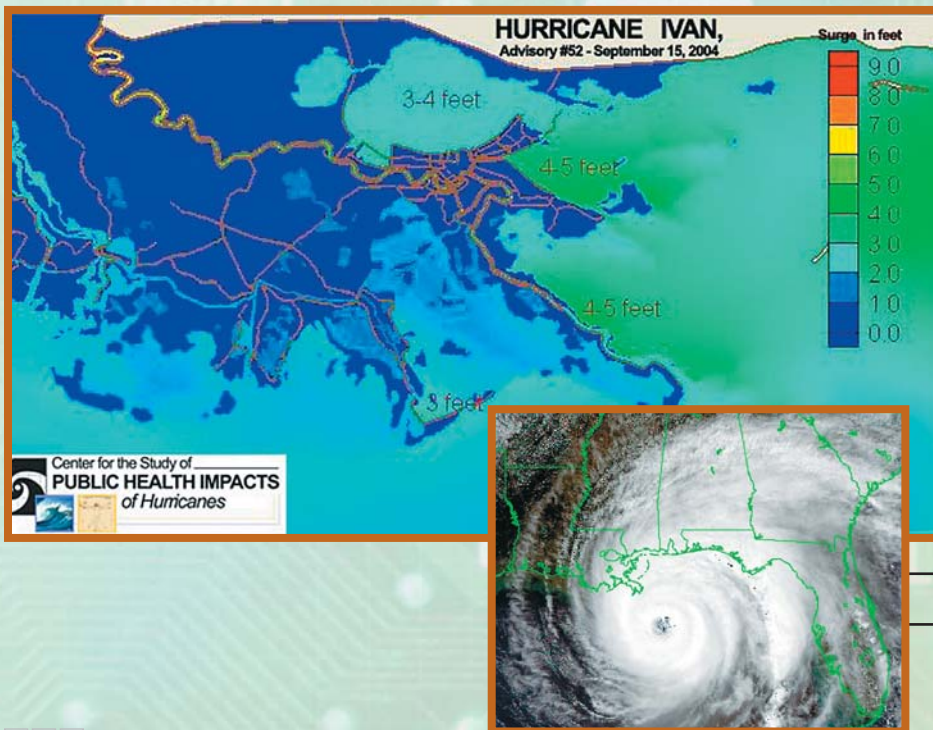
other side of the globe. "It's less important where people are located. With collaborative technology, the world is at your fingertips," said Allen.

With its application to research, and undergraduate and graduate programs, the technology can promote the creation of both a better-educated workforce and the kinds of jobs many Louisianians are currently seeking elsewhere.

LONI will attract researchers, faculty, technology experts and students. These skilled individuals will make Louisiana more attractive to businesses that may decide to locate in the state or develop partnerships with Louisiana universities.

"We recognize there is no more valuable economic development initiative than to have this kind of infrastructure available. It generates savings and maximizes use of capital expenditures, equipment, and facilities. It attracts the kinds of people and expertise that have a broad systematic view of Louisiana. All of which excel our quality of life," Henderson said. "And, that's what economic development is all about."

LONI is expected to be operational by December of 2005.



SuperMike is used to protect

Louisiana's coast from threats

such as Hurricane Ivan. Storm

surge modeling allows researchers

to predict flood patterns along the

Gulf Coast.

Creativity & Technology



ART AND SCIENCE work together to help scientists articulate their discoveries and develop new tools and methodologies for artists at CCT's Laboratory for Creative Arts & Technologies (LCAT). From planning Baton Rouge's first celebrity-stocked, high-tech animation festival to producing a multimedia show with live actors singing, computers buzzing, and film rolling, researchers at LCAT are reminiscent of Renaissance artists.



"We are focused on exploring the intersection of creativity, technology, and human expression."

Stephen David Beck
Director
LCAT

crowds from the LSU and Baton Rouge communities to LSU's HopKins Black Box Theater. "LCAT provided us with the support to integrate technology into art," said Suchy. "Like scientists, our students used video to collect data in a digital form."

LSU scientists are looking toward an artistic viewpoint to help provide alternative modes of communication within

"We are focused on exploring the intersection of creativity, technology, and human expression," said Stephen David Beck, director of LCAT and professor of composition and computer music. True to this mission, researchers from a myriad of disciplines at LSU are capitalizing on the new working relationships that LCAT has fostered to share ideas, enhance research, and reach students campus-wide.

LSU communications studies professor Trish Suchy and English professor Jim Catano, members of LCAT's Digital Video Working Group, have focused their talents on a cross-disciplinary approach to visual literacy while shar-

ing skills, talents, and tools. "Visual literacy unifies education in oral, written, and visual communication through the use of digital video production and editing," said Catano. "Instead of passively viewing digital media, students are taught to author projects. Our visual literacy class will teach how visual media creates cultural and aesthetic perceptions, constructs arguments, and persuades audiences."

A compelling example of visual literacy in action is the blend of theater, art, communications, and computer science that comes together in Suchy's *13 Ways to Kill a Mockingbird* multimedia production. The popular show drew large





their research projects. Chemistry professor Les Butler and systems manager of the Computer-Aided Design and Geographic Information Systems (CADGIS) Farrell Jones are relying on the graphic design principles provided by art and design assistant professor Wei He to bring an emotional, yet rational response to chemical-release information provided by a large sensor network.

"This real-time, sensor network could map a toxic release caused by a terrorist attack at an area industrial plant,"

said Butler. "The challenge is how to present the data in a way that the public can interface, navigate, and react to appropriately." Wei He is developing strategies that apply color, symbols, and other graphic elements to the tracking data in order to visually communicate with the public in an emergency. While the project is only at the early prototype stage, the project team has already discovered the inherent difficulties in visually representing data. Through a continuous loop of discussion, experimentation and analysis, the team hopes to ultimately devise a visual language that



can be used for chemical and other emergency response situations.

The benefits of LCAT have extended beyond interdisciplinary collaboration. A direct economic impact can be seen in projects like the Shaw Center for the Arts, where LCAT researchers, staff, and students will be contributing their skills and talents.

"LCAT is helping to develop a culture of creativity in Baton Rouge," said Beck. "We are collaborating with the LSU School of Art, the LSU Museum of Art, and the Arts Council of Greater Baton Rouge to build a digital arts studio at the Shaw Center. We also plan to use our facility there as a public interface, where visitors can explore new technologies and interact with digital media."

President/CEO of the Arts Council of Greater Baton Rouge Genny Nadler-Thomas agrees that LCAT is key in the revitalization of the arts, especially in the area of education. "LCAT will offer resources and technological support to the new Community School for the Arts at the Shaw Center," she said. The new school, which will also provide scholarships for those in need, will focus on middle and high school students who show an interest in the arts. "The school will expose students to innovative types of art forms and creativity," added Nadler-Thomas. "LCAT's involvement will be instrumental in making this possible."

ICAST

The Immersive Computer-controlled Audio Sound Theater (ICAST) at LSU's School of Music offers an immersive audio experience with a high-definition, 24-channel surround sound system. With applications in virtual reality, scientific visualization, computer games, and home theater, immersive environments such as ICAST create sensory experiences that transport the participant into the virtual world.

"Research tells us that realistic audio cues are the key to 'transporting' someone into a virtual environment," said Beck, director of LCAT and professor of composition and computer music. "We are using the ICAST Theater to study new ways of generating psychoacoustically correct sound environments in a controlled space, as well as designing new interfaces for controlling large speaker arrays."



RED STICK

INTERNATIONAL ANIMATION FESTIVAL



Children view a high-tech stop-motion animation machine at the 2004 Animex International Animation Festival.



In downtown Baton Rouge, April 21–23, 2005, LCAT is partnering with the Shaw Center for the Arts, the Louisiana Art and Science Museum, and the Old State Capitol to host the **Red Stick International Animation Festival**. The festival will highlight the convergence of the new set of technical skills that artists employ and the artistic vision that scientists are embracing through animation.

The festival will explore this intersection between art and technology, showing how computer animation can create movies like *Monster's Inc.*, map the human eye for medical researchers, and model colliding black holes for scientists. The event will also connect students with professionals from commercial studios, such as Pixar Studios and Sony Pictures Imageworks.

Modeled after the Animex International Festival of Animation in Middlesbrough, England, the event will feature animation and scientific visualization, student and professional competitions, and outreach programs for schools. Several famous animation experts, including those who worked on movies like *Toy Story 2*, *The Lion King*, and *Mars Attacks!* are slated to speak on their work.

"The festival will raise the awareness of Louisiana's animation assets and engage the Baton Rouge community," said CCT's assistant director for strategic advancement Stacey Simmons.

The Red Stick International Animation Festival will be one of the first events held in the new Shaw Center for the Arts.



Nemeaux

Nemeaux, a 48-processor, Apple Xserve computer cluster, is the newest addition to the CCT's collection of high performance computers. Alongside SuperMike and SuperHelix, Nemeaux will leverage its computational power for creative and research projects in the computational arts as well as in scientific computing. LCAT researchers will benefit from Nemeaux's ability to render high-definition animation, video compositing and digital audio, as well as its capacity to explore applications in Grid computing. As of January 2005, Nemeaux is fully operational.



Nemeaux will leverage several CCT software tools in its research. Triana, a data-flow programming environment, will be used to explore distributed audio rendering using multiple computers to analyze, process, and generate sound. The cluster will also serve as a test-bed for CCT's Cactus framework, a tool for facilitating simulations.

High-Tech

HEALTHCARE

Assistant professor Sonja Wiley-Patton's work with integrated clinical information systems improves the efficiency and accuracy of healthcare processes.



This tablet PC is an example of the types of digital devices that are currently being introduced into the clinical settings of Our Lady of the Lake Regional Medical Center.



LSU RESEARCHERS are making great strides in the improvement of healthcare and disease control by building on the interdisciplinary connections and high-tech resources provided by the CCT.

In close cooperation, the Department of Radiology at the LSU Health Sciences Center and the LSU Department of Computer Science have developed Digital Imaging and Communications in Medicine (DICOM), compatible software that provides a picture archiving and communications system (PACS) to store, display, and network medical images.

CCT provided support to the research and development of the new software, UniPACS, which has already received FDA approval. The software will be marketed through the private company, Universal PACS, Inc. "Our overall focus is to improve the quality of healthcare," said computer science professor John Tyler. He explains that the ongoing research includes automatic scanning of medical images to reveal areas that may have diseases. For

instance, the research could possibly be used with mammograms or brain scans.

With UniPACS, radiologists can work from remote locations, and patients can share their medical images via a secure, Universal PACS Web site with physicians around the world. Computer science graduate students play a key role in developing and sharing the data with a worldwide audience using high-resolution computers in the CCT-funded LSU Medical Imaging Laboratory.

Information systems and decision sciences assistant professor Sonja Wiley-Patton is also focusing her research on improving healthcare. Thanks to IT Initiative funding from CCT, she is using a cross-disciplinary approach to advance the adoption of integrated information systems among healthcare profession-

The UniPACS software package helps radiologists view and archive medical images, such as X-rays, MRIs, and CT scans.



als. "We are working with Our Lady of the Lake Regional Medical Center and LSU Health Sciences Center to improve the adoption and use of integrated clinical information systems," said Wiley-Patton. "We are also collaborating with information systems vendors and healthcare professionals in the development of secure, universal, computerized medical records."

Wiley-Patton's project is strengthened by the inclusion of LSU researchers from psychology, sociology, mechanical engineering, and medicine, who offer social network, persuasion and social influence tactics to foster adoption of the new technology. "I connected with researchers from other disciplines through CCT's workgroups," she said. "We expect the results of our study to be generalized and transferable to healthcare professionals nationwide."

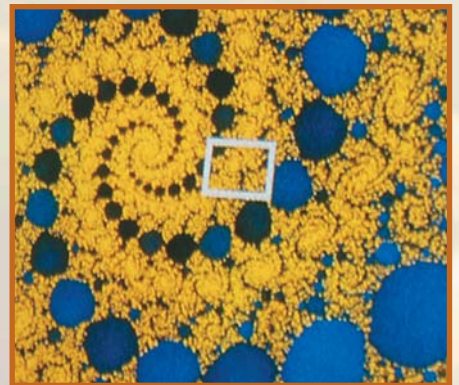
Mechanical engineering professor Sumanta Acharya is also contributing to medical research that has implications for the general population. CCT's SuperMike and SuperHelix computer

Nina Lam, professor of geography and anthropology, uses remote sensing images in her research on disease and the environment.



systems are providing the power behind Acharya's computer-intensive numerical simulations of ocular fluid dynamics and the mechanisms that lead to the development of glaucoma.

"We've developed a full geometrical model of the eye and are using numerical equations that govern eye-fluid flow and particle transport," explains Acharya. "This helps us understand where particles deposit in the eye and the sources of increased flow resistance that can lead to intra-ocular pressures (IOP), a precursor to glaucoma."



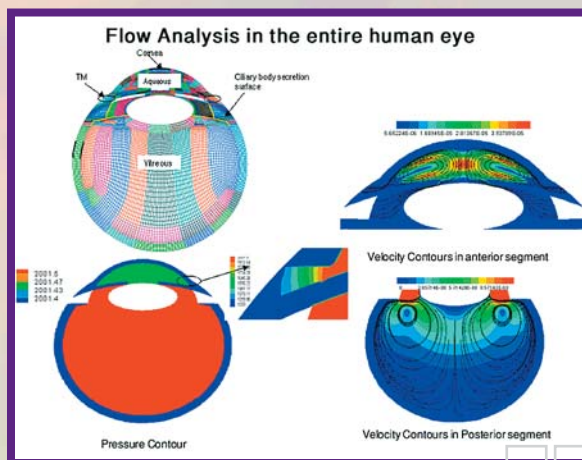
Acharya's research, in collaboration with the LSU Health Sciences Center, also explores ways to treat glaucoma by studying how drugs are transported to the eye's vitreous chamber and by using numerical simulations of surgical procedures. CCT is also providing funding for post-doctoral research on the project.

Using the lab, Lam and her students use NASA satellite images to study the environment, such as the temperature of different parts of an urban area. Remote sensing in Lam's research illuminates the influence of geographical elements on ozone and helps to find ways to save energy. "My classes will prepare students for competitive jobs in the information technology workforce," said Lam.

Geography professor Nina Lam studies geography and its impact on diseases such as cancer and AIDS. Her research is assisted by the Department of Geography and Anthropology's new Spatial Laboratory, which was funded by CCT.

"I connected with researchers from other disciplines through CCT's workgroups. We expect the results of our study to be generalized and transferable to healthcare professionals nationwide."

Sonja Wiley-Patton
Assistant Professor
Department of Information Systems and Decision Sciences



It's an All-New SuperMike



Ivor Van Heerden, deputy director of the LSU Hurricane Center, uses SuperMike to model storm surges and predict flooding due to the rising level of the Gulf of Mexico. The upgrade has reduced the compute time for this research from six hours down to two hours for a single model run.

"The upgrade on SuperMike has broadened our ability to produce accurate, high resolution hurricane storm surge predictions and animations that are used by emergency managers, industry, and law enforcement throughout our state and in adjacent states," said Van Heerden. "As a consequence we have dramatically improved our ability to lessen hurricane-caused injuries and deaths."

Other researchers also see the need for consistent upgrades. Randall Hall, professor of chemistry, is taking advantage of the machine's computing power. "The upgraded computer will be more stable and thus allow us to expedite our calculations of the properties of catalysts, nanoparticles, and biological materials," said Hall.

CCT's star supercomputer, **SuperMike**, is now almost twice as fast, due to all new hardware and software. These improvements were necessary for increasing computational capacity and decreasing processing time on a variety of research projects.

models or simulations by increasing the amount of data analyzed or by increasing the level of detail in their algorithms," said Brian Ropers-Huilman, assistant director for HPC and computing at the CCT.

The machine underwent a full hardware overhaul, including an upgrade to 3.06 GHz Intel Xeon processors, new Myricom network adapters, and new Tyan motherboards. A new Red Hat Linux operating system and new queuing software from Altair Engineering were also added. The entire software stack and libraries were updated as well.

"The increased computational capacity will allow researchers to improve their



In 2004, assistant director for HPC and computing Brian Ropers-Huilman (center) led a full hardware and software upgrade of the CCT's largest computing cluster, SuperMike.

Tom Goodale, a research associate at the CCT, commented on SuperMike's new capabilities: "The new processors will cut the time necessary for simulations, and increase the throughput for scientists." Goodale uses the machine for research in computational science, high performance computing, and Grid Computing.

SuperMike consists of 512 dual-processor nodes tied together with a high-speed network and open source software. Scientists at NASA were the first

to develop this principle of commodity-based cluster supercomputing. Using normal computers connected and working together as one machine can make for a more efficient supercomputer.

"The computing power is greater than the sum of its parts," said Ropers-Huilman. The CCT houses other clusters including SuperHelix, MiniMike, and Nemeaux.

SuperMike's upgrade was made possible by generous contributions from Intel, Myricom, and Tyan. Atipa Tech-

nologies performed the hardware upgrade, while TeamHPC performed the software upgrades and final systems integration.

The old system was shut down in the spring of 2004, and the upgrade was completed by midsummer. The new and improved SuperMike was available to select researchers in a "friendly user mode" through the summer and into the fall. The system was officially reopened on November 1, 2004.



As one of five universities to receive funding through Louisiana's Information Technology Initiative, LSU created the CCT to advance economic development, research, and education.

With the creative vision of its talented researchers and continued support from government and industry in the state and across the globe, the future of CCT—and Louisiana—promises to be nothing less than stellar.

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