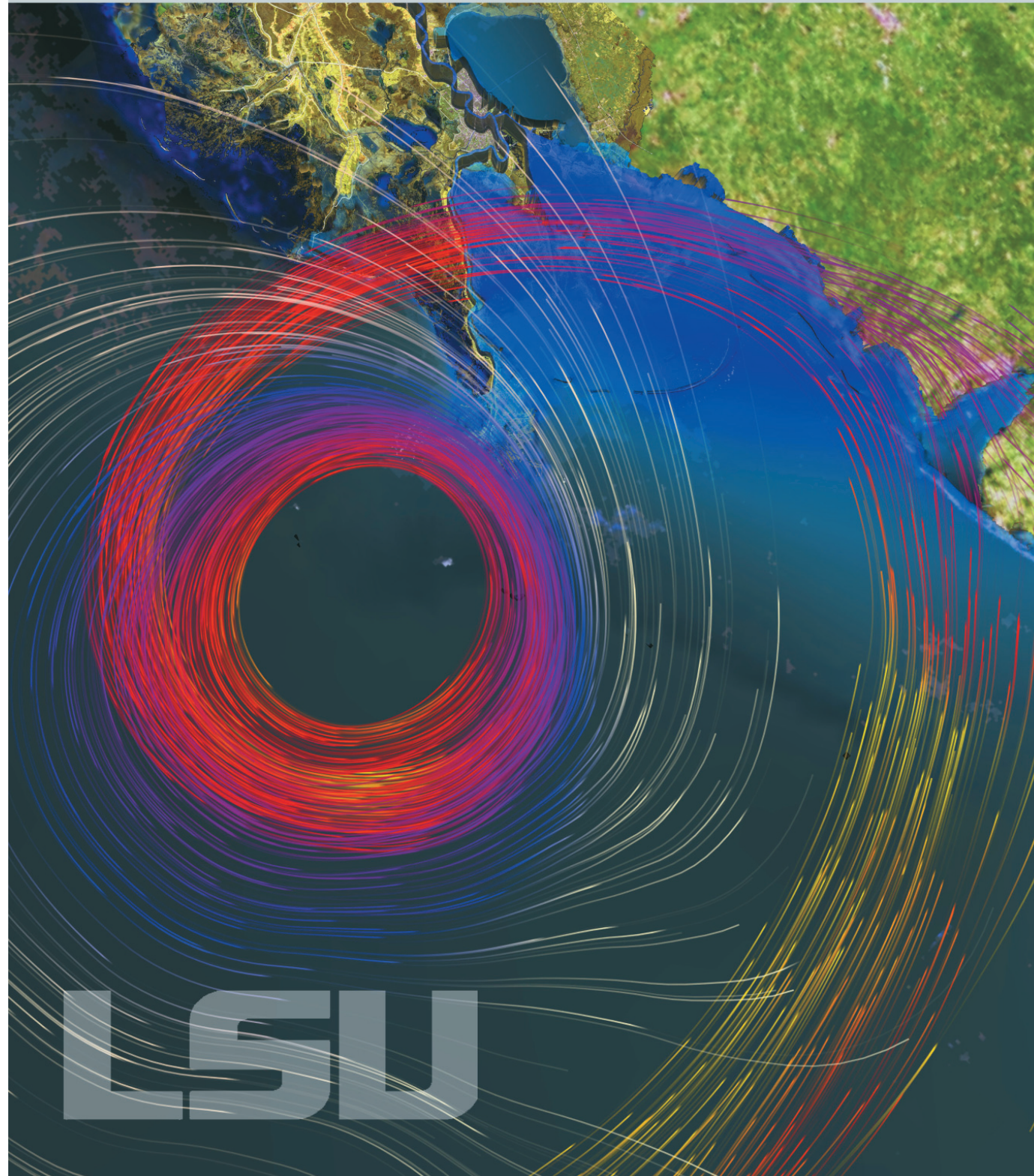




COMPONENTS

FALL 2006

CENTER FOR COMPUTATION & TECHNOLOGY
AT LOUISIANA STATE UNIVERSITY



LSU



Center for Computation & Technology
at Louisiana State University

COMPONENTS

2006-07 | Volume 2

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.

Center for Computation & Technology
Louisiana State University
216 Johnston Hall
Baton Rouge, LA 70803
225-578-4012
FAX 225-578-5362
info@cct.lsu.edu
www.cct.lsu.edu
www.lsu.edu

Director
Edward Seidel

Assistant Director for Special Projects
Stacey Simmons

Interim Deputy Director
Joel Williams

PR Manager
Kristen Meyer Sunde

Contributing Writers
Gina Palermo, LSU Center for Computation &
Technology
Sandra Stepongzi, LSU Office of Public Affairs
Sheri J. Thompson, LSU IT Communications

Art Director/Designer
Veni Harlan, Office of Public Affairs

Graphic Designer
David A. Gallop

Copy Editor
Tamara Mizell, Office of Public Affairs

Photographer
Jim Zietz, Office of Public Affairs

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Cover visualization by The Scviz Group at the CCT at LSU.

THREE YEARS AGO WE STARTED THE CCT with a mission to create a unique, interdisciplinary environment, where strong groups of computational and computer scientists would work side by side with mathematicians, scientists, engineers, and scholars in the arts, humanities, and business to create new IT approaches to research and economic development. The world of computing will have a profound and transformative effect on literally all disciplines, and we envision the CCT to be one of the places in the nation and the world with the breadth and depth to help drive such advances.

Beginning with a small handful of staff and researchers, CCT has undergone tremendous growth, with dozens of joint faculty and students in 12 departments across campus (more than 100 full-time employees in all), developing in line with an original plan that Gabrielle Allen, John Towns, Harold Silverman, and I produced in the spring of 2003. The original themes have evolved to a focus on *Complex Applications for Future Systems*, with complex discipline-specific applications exploiting advanced high-performance computing (HPC) architectures, software, data, networks, and sensors to solve problems in areas critical to Louisiana and the nation, such as coastal and environmental studies, geosciences, astrophysics, and business.

We have also deployed and developed large-scale computing facilities at LSU, spearheaded the development of the Louisiana Optical Network Initiative (LONI)—with optical networks spanning Louisiana and connecting six research campuses and two medical centers with 40Gbit/sec optical networks—and brought a National Lambda Rail connection (NLR) to Louisiana, connecting us to the nation's (and the world's) leading computational facilities. By the end of 2006, we will have deployed collectively more than 100TFlops/sec of computational capacity across this environment. Just as importantly, we have showcased our own technology and application developments at demonstrations across the world, such as iGrid, SC, and other events, prototyping a future of computing- and technology-based scientific applications that have drawn international attention to our work.

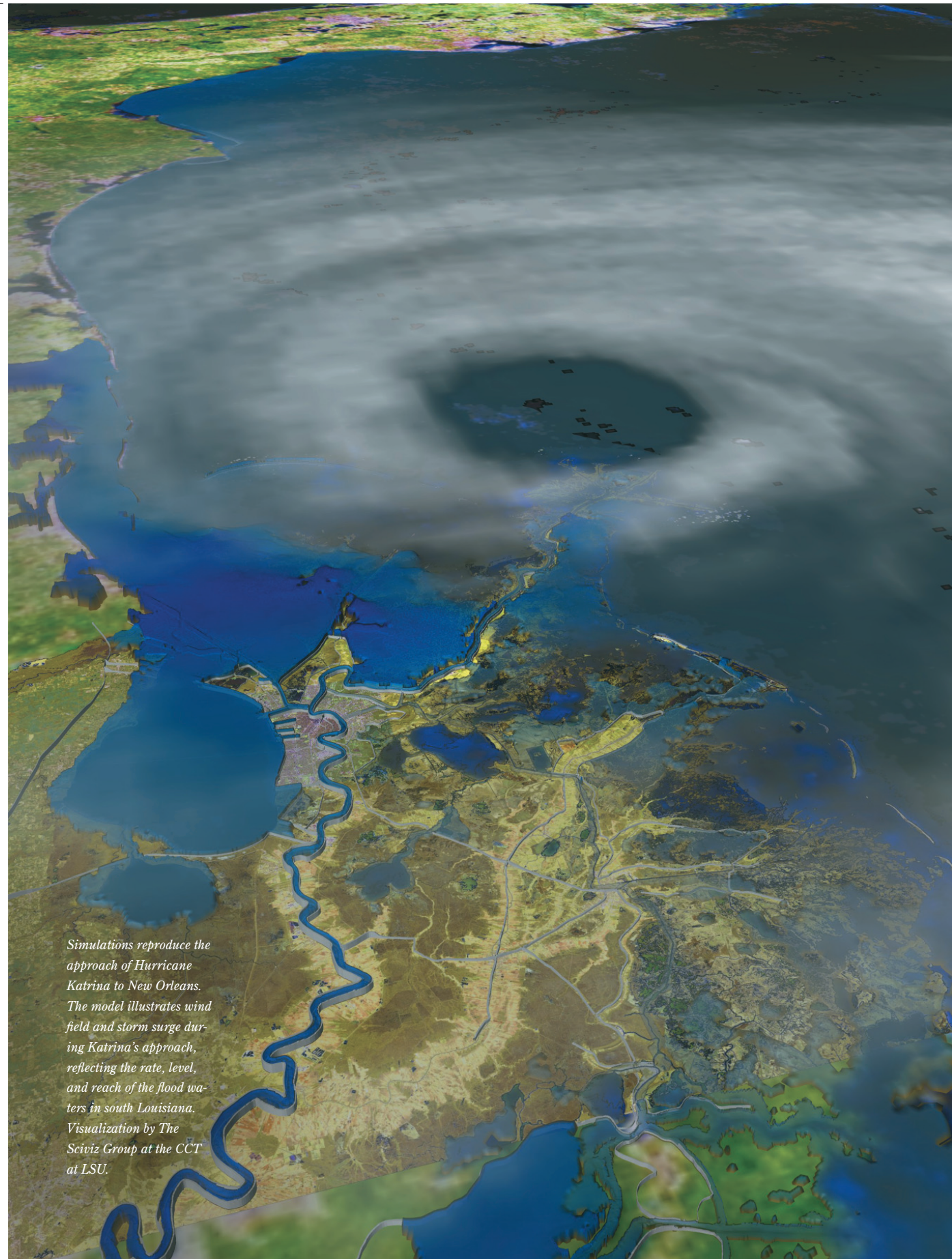
We expect CCT to continue to grow as a central component of LSU's academic development in the coming decades. It has aligned itself very strongly with the Presidential Information Technology Advisory Committee (PITAC) report and the National Science Foundation's newly created Office of Cyberinfrastructure, which is developing a strategic plan for 21st Century Discovery.

For such a breadth of activities, it is impossible to do justice to them all in a single magazine. Even a compendium of many articles and grant proposals written would not fairly represent the CCT. Instead, we have chosen to showcase five projects that provide a glimpse of our work, from visualizing Hurricane Katrina to the RedStick Animation Festival.

As we continue to develop the CCT, we expect to generate many more exciting projects; to attract additional faculty, researchers, and students in areas as diverse as computational science, astrophysics, and digital media; to build the state and regional research base; and to innovate on a world-leading scale. We look forward to working with you to create a new future of computational sciences and interdisciplinary applications to advance research and economic development in Louisiana and beyond.

Ed Seidel, Director
Center for Computation & Technology





Simulations reproduce the approach of Hurricane Katrina to New Orleans. The model illustrates wind field and storm surge during Katrina's approach, reflecting the rate, level, and reach of the flood waters in south Louisiana. Visualization by The Sciviz Group at the CCT at LSU.

Moving Beyond the Horizon

CCT Team Creates a Computer Visualization of Hurricane Katrina

BY SANDRA STEPONGZI, LSU OFFICE OF PUBLIC AFFAIRS

Can a three-dimensional visualization of Hurricane Katrina better educate scientists about the nature of hurricanes? LSU's Center for Computation & Technology (CCT), working with researchers across LSU and the nation, is betting on it. A team from CCT has created a visualization based on data from different sources. The team hopes that this data will help:

- scientists study and predict hurricanes;
- decision makers decide what is best for citizens of the Gulf Coast;
- citizens decide how to prepare for an approaching hurricane.

THE VISUALIZATION

The LSU Hurricane Center has used the ADvanced CIRCulation model (ADCIRC) to forecast hurricane storm surges since 2002. ADCIRC is a surface simulation formulated to predict storm surges based on projected hurricane paths. After wind velocity, atmospheric temperature, and pressure are entered, the ADCIRC simulation provides surge height and water flow direction data.

But if ADCIRC works so well, then why is the atmospheric visualization such a big deal?

"The ADCIRC simulation is a purely theoretical case demonstrating what happens, for example, when a hurricane directly hits New Orleans," said CCT staff member Werner Bengert. "In contrast, the atmospheric model stems from a simulation that was synchronized with observations. So the atmospheric model depicts the real path of Katrina, which was a little east of the city."

CCT and the LSU Hurricane Center discussed the concept of presenting hurricane data in a three-dimensional form in early 2005. "The onslaught of Katrina certainly accelerated our efforts. Just after Katrina hit, [CCT] was invited by the Supercomputing '05 steering committee to make a presentation on computational and visualization challenges for Katrina (and beyond)," LSU staff member Shalini Venkataraman said. "This was a good opportunity to make a case to the wider community about the challenges and opportunities of modeling our coast and to build up a national alliance of researchers. That's what gave us the impetus for our visualization efforts."

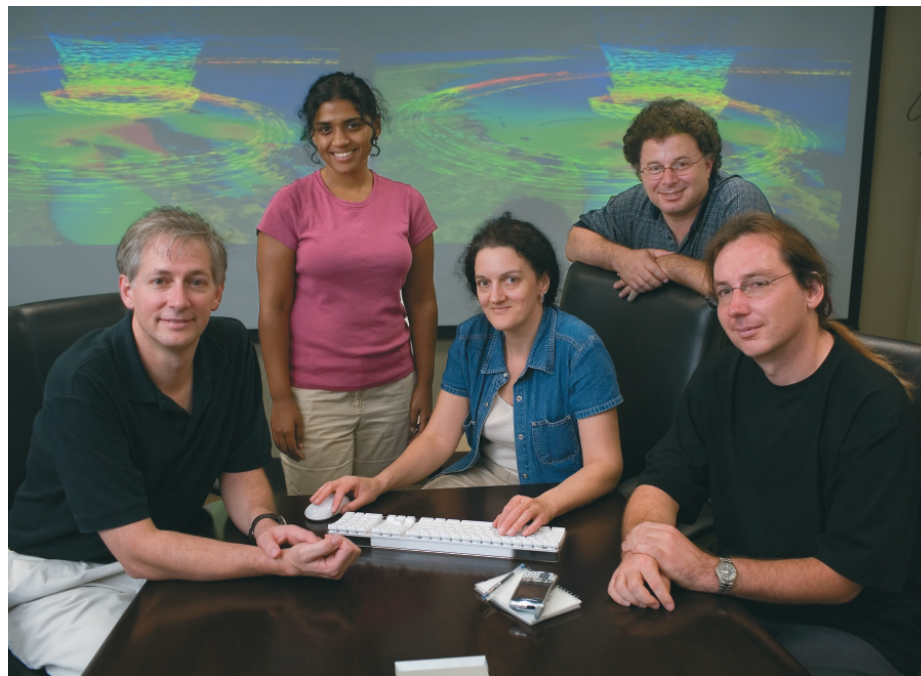
"The objective was to have a comprehensive presentation, pulling together models and visualizations showing the development of the hurricane's wind fields, the approach, the storm surges, wave models, [geographic] data, comparisons to what actually happened, and also post-Katrina studies of what went wrong."



She added that they are hoping for “new approaches to do a much more sophisticated job of forecasting in the future.”

The project began with CCT gathering basic hurricane data to present for the Supercomputing '05 conference in Seattle. The international conference is one in which organizations showcase innovations in high-performance computing, networking, storage, and analysis.

“The original plan [for the visualization] had been to just show data from the ADCIRC model, plus some photographs depicting the land,” said Bengner. “However, it became clear quite soon that just looking at a surface is visually boring and that we could not learn much from just visualizing an existing, single dataset.”



Left to right: Ed Seidel, Shalini Venkataraman, Gabrielle Allen, Stephen D. Beck, and Werner Bengner. Not pictured but part of the Katrina visualization team is Amanda Long.

To make the visualization more interesting and more educational, the team started to incorporate more data. “Most of the time [spent on this project] in autumn '05 was just communication efforts to find out where to get data and how to interpret it,” said Bengner. “Finally, we came up with an atmospheric dataset which encompasses the date Katrina hit New Orleans. Using this data set, we could show a three-dimensional visualization at Supercomputing '05.”

Supercomputing '05 took place in November. At the time, the visualization included “atmospheric wind and temperature outputs, ADCIRC storm surge [data], and some aerial photography maps,” Venkataraman explained.

Six months later, the team finished another, more detailed information sequence. The data in the March 2006 visualization includes that of the early visualization, as well as satellite images and

“Our main purpose is to educate people about the dangers of storms. Anything that makes the storm threat more real to people is beneficial.” —Paul Kemp, LSU Hurricane Center

elevation maps. Although it was no easy task for the team to coordinate time and position in space for all of this information, they put in the time and effort to make the visualization as accurate as possible.

Although each separate piece of data is not particularly innovative, scientists have never before seen the data presented together in a composite three-dimensional visualization. With this information, they can see how everything works together. This is a giant step toward better understanding hurricanes and the forces behind them. As Stephen D. Beck, director of CCT’s Laboratory for Creative Arts & Technologies explained, “We’re trying to give a sense of the inside of the storm.”

CONTINUING THE VISION

Although CCT has accomplished much in terms of hurricane simulations, their work is far from over.

“With each step of refining the visualizations, more details become visible, and with our current methods we do require consistent data to make meaningful visualizations,” explained Bengner.

The team has several goals:

- To include more hurricane data in the visualization
- To better synchronize the data that they have to form a picture that is as accurate as possible
- To build a workflow that can render a visualization that can be seen in a matter of hours rather than a matter of months

Another important aspect of the project is that the visualization program can be the foundation for making hurricane simulations. Hypothetical information can be entered to “create” a hurricane; this is important for studying and predicting hurricanes. According to Venkataraman, “The goal of this project is ... to aid in disaster forecasting, awareness, and management.”

The ability to accurately make hurricane predictions is especially important for the LSU Hurricane Center.

“Our focus is on forecasting. Our big problem is trying to get the forecast out as quickly as possible,” said Associate Professor Paul Kemp, who works at the LSU Hurricane Center. “Our main purpose is to educate people about the dangers of storms. Anything that makes the storm threat more real to people is beneficial.”



Professor Thomas Sterling, through innovative delivery methods, provides a practical treatment of the topics comprising the dynamic field of high-performance computing.

A Formula for Success

Professor to Offer High-performance Computing Course Via Real-time Internet Video Broadcasts

BY GINA PALERMO, LSU CENTER FOR COMPUTATION & TECHNOLOGY

An LSU professor is taking a huge step to fill what he calls a gap in high-performance computing (HPC) education on a national scale. In spring 2007, Thomas Sterling, professor of computer science and researcher of parallel computing architecture at LSU's Center for Computation & Technology, is launching an entirely new course unlike anything currently available in the country. The course will be a comprehensive introduction to the field of HPC to combat what Sterling calls the "graying of the HPC community."

Sterling describes HPC as an interdisciplinary field having important impact on many areas of science, technology, medicine, commerce, and national security; however, he and many of his colleagues believe it is a field that is not getting the attention it deserves on the collegiate level and that there are currently an inadequate number of new young participants educated in the field of HPC. "The HPC community is failing to get young folks excited and involved on many levels, including in academia, industry, and national institutions," Sterling said.

Through his new class "High-performance Computing: Concepts, Methods, and Means," Sterling hopes to jump-start a change to all that. His course will cover a broad range of HPC, including hardware architecture and design, system software, programming languages and tools, and parallel algorithms and computational techniques. He says while many universities offer graduate courses in one or more of these areas, none present a balanced treatment across all areas, and LSU will be unique in developing such an attempt.

The course will be available as a senior-year elective or a first-year graduate-level course. Sterling said the main goal of this new course is "to engender a new generation of computer and computational scientists expert in the development, operation, and application of high-performance computing systems prepared to address this nation's future challenges demanding capability and expertise in HPC."

Sterling described the course as having two crosscutting themes: hands-on experience to allow students to be engaged in the learning, and an emphasis on understanding and measuring the impact of computing performance.



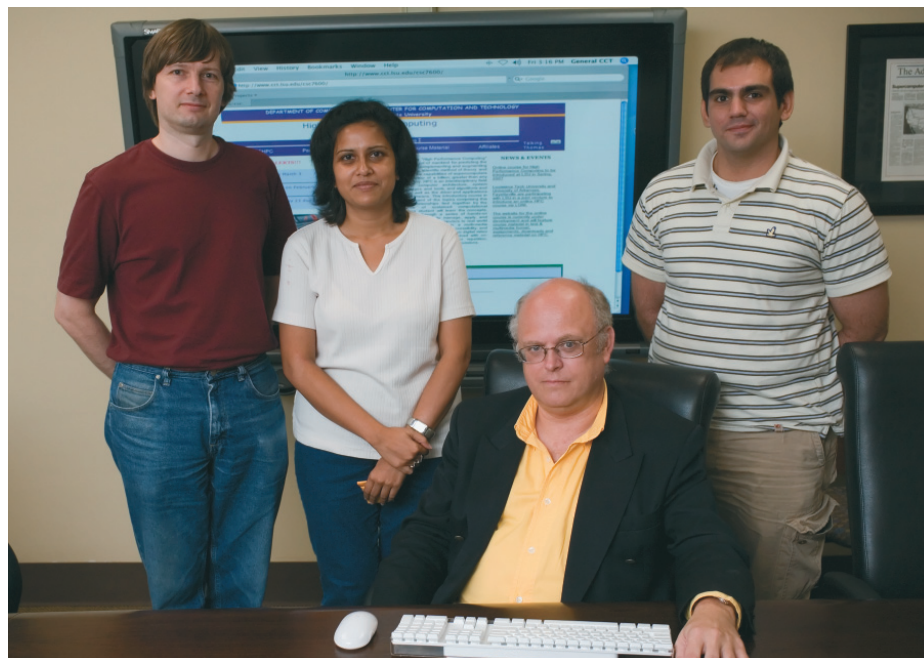


“Everyone who participates will be reminded that LSU is a leader in HPC education.” —Thomas Sterling, LSU Computer Science

Upon completion of the course, Sterling said students will be able to understand the field of HPC well enough to be able to go to any national laboratory and immediately know all the terminology and the basics of HPC. He also noted that this course will be useful to others deciding what topics they wish to pursue in graduate school.

Sterling aims to digitally record all lectures and have them available through real-time Internet video broadcasts, so that other universities who may or may not have experts in the field of HPC can offer the course. Louisiana Tech and the University of Arkansas have already agreed to offer the course, and the University of Oklahoma has shown interest as well.

“A project of this magnitude could have a very broad impact,” said Sterling. “The course and the textbook will be products of LSU. Everyone who participates will be reminded that LSU is a leader in HPC education. This is a big deal. It reflects on the course, CCT, the University, the entire state, and the reputation of the South in general.”



Left to right: Maciej Brodowicz, consultant for scientific computing; Damayanti Datta, computer science PhD student; Professor Thomas Sterling; and Richard Guidry, computer science PhD student.



LSU’s Center for Computation & Technology congratulates our director, Edward Seidel, who received the 2006 Sidney Fernbach Memorial Award for his outstanding contributions to innovative approaches in the application of high-performance computers.



“My vision for the CCT is to create an innovative, interdisciplinary environment, where complex problems in science, engineering, humanities, and business are solved on future systems integrating advanced computation, data, networks, and novel devices.” —Edward Seidel, Director of the Center for Computation & Technology



THE NEED FOR SPEED

LSU To Unleash One Of The World's Fastest Supercomputers

BY SHERI J. THOMPSON, LSU IT COMMUNICATIONS

LSU has announced its plans for a new supercomputer called Tezpur, which will advance the University's standing into the top-tier high-performance computing environment. It will be one of the most powerful supercomputers owned by any university in the nation and will be one of the top 50 most powerful supercomputers in the world. With more than 15 teraflops of capacity, Tezpur will outperform LSU's SuperMike and provide nearly three times SuperMike's computational speed.

The new commodity Linux cluster will be named Tezpur for one of the world's hottest peppers—and the platform will be true to its namesake. Tezpur will consist of a Linux Intel Cluster built by Dell Inc. that will deliver more than 11 million hours of computational resources and be capable of performing approximately 15 trillion numerical operations per second.

"Today, LSU steps further onto the forefront of the national stage, solidifying its place as a real supercomputing power," said LSU Chancellor Sean O'Keefe. "The presence of this kind of resource sets LSU into the rarest of company when it comes to the enablement of research and teaching using the latest and most powerful tools information technology has to offer. These are the kinds of resources available only at top, flagship-level research institutions—and LSU has them."

Tezpur marks only the beginning in LSU's efforts to create a top-tier high-performance computing environment, and stems from the recently announced partnership between the LSU Center for Computation & Technology, or CCT, and LSU Information Technology Services, or ITS. Tezpur should become operational in 2006.

"Tezpur will dramatically advance our ability to study complex systems of importance to the region and nation, such as coastal erosion or storm surges from hurricanes, as well as providing insight into mysteries of the universe, such as computing detailed signals from black holes and supernovae," said CCT Director Ed Seidel.

"The acquisition of Tezpur is part of a broader effort—in line with LSU's new Flagship Information Technology Strategy—to grow the array of high-performance computing resources available for researchers, and through the partnership between CCT, ITS, and campus researchers to build capacity in support of research endeavors," said LSU Chief Information Officer Brian Voss.



LOUISIANA TO CONSTRUCT ONE OF NATION'S MOST POWERFUL SUPERCOMPUTING ENVIRONMENTS WITH DELL SERVERS

Cluster to Aid Hurricane Tracking, Academic Research, and Economic Development

BY SHERI J. THOMPSON, LSU IT COMMUNICATIONS

The Louisiana Optical Network Initiative (LONI), a fiber-optics network connecting supercomputers at Louisiana's major research universities, has increased computing power with standards-based technology from Dell, making LONI's 85-teraflop grid one of the nation's largest.

LONI will install six clusters comprised of Dell PowerEdge™ 1950 servers at the six LONI member campuses: LSU, University of Louisiana at Lafayette, University of New Orleans, Southern University, Louisiana Tech University, and Tulane. Each 132-node cluster will feature five teraflops of storage. In addition, LONI will soon install a network that features a 50-teraflop Intel Linux Cluster to be housed at the state's Information Systems Building (ISB).

The new computers, along with additional system and hardware upgrades, will provide a significant increase in computational resources for academic research, including the ability to perform hurricane tracking and storm-surge modeling at much higher speeds and with greater accuracy than currently possible.

"These enhancements to LONI's computing power will make the network particularly attractive to the kinds of companies we need here to energize our state's high-tech economy," said Governor Kathleen Babineaux Blanco. "That's why we're leveraging the state's investment in LONI by reserving 10 percent of the grid's computational power for the creation and retention of high-tech jobs. Simply put, any businesses in the state able to connect to LONI can use access to the network as an inducement to recruit companies that would benefit from world-class computational capacity."

"These advances position LONI and Louisiana to become a world leader in supercomputing and emerging cyber technologies," said Charlie McMahon, LONI executive director.

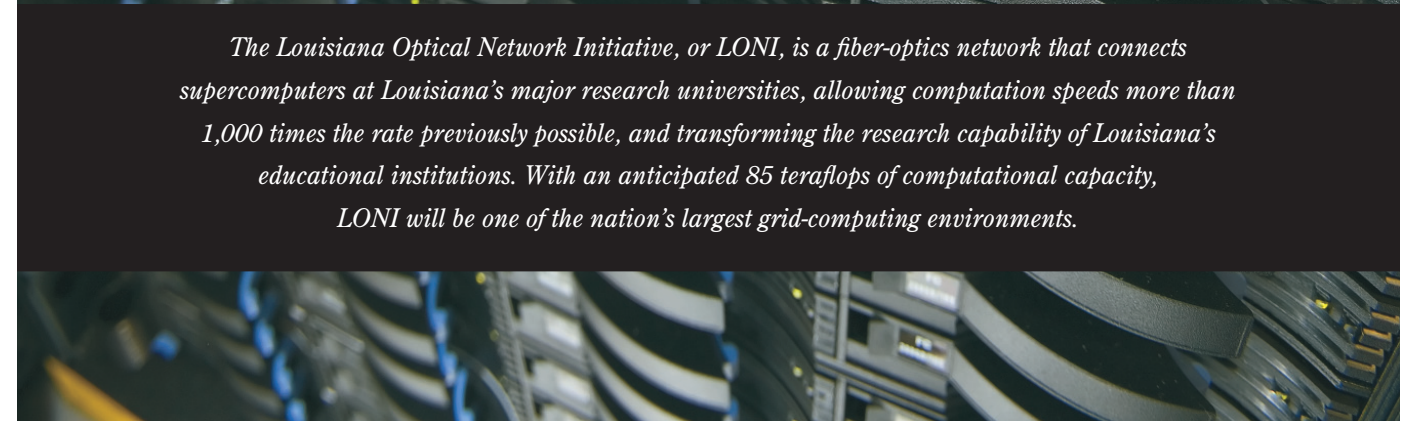
"LONI's impact on Louisiana's ability to attract federal research dollars was already being felt prior to last year's storms," said Commissioner of Higher Education E. Joseph Savoie. "Now, as we anticipate an extended recovery period, LONI's potential impact on academic research and economic development is more important than ever. This enhanced computing power is welcome news for our devastated education and research infrastructure."

"Now Louisiana researchers will not only have the most advanced optical network in the country, but will couple that with the most powerful distributed supercomputer resource available to any academic community," said Les Guice, Louisiana Tech University vice president for research and development and chair of the LONI Management Council. "This is a strong message to the rest of the world that Louisiana intends to be a leader in the knowledge economy."

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The Louisiana Optical Network Initiative, or LONI, is a fiber-optics network that connects supercomputers at Louisiana's major research universities, allowing computation speeds more than 1,000 times the rate previously possible, and transforming the research capability of Louisiana's educational institutions. With an anticipated 85 teraflops of computational capacity, LONI will be one of the nation's largest grid-computing environments.





'Toon town

The digital animation industry has a real chance of becoming a significant revenue generator for Baton Rouge, thanks in part to the city's Red Stick International Animation Festival.

BY STEVE CLARK, *Greater Baton Rouge Business Report*

MARCH 2006

Reprinted with permission from the *Greater Baton Rouge Business Report*.

This is not just about getting a bunch of people together to watch cartoons—not that there's anything wrong with that.

Baton Rouge's Red Stick International Animation Festival is about helping lay the foundation for a new kind of economic development based on digital animation.

It could fail, although a lot of people in high places feel it's a dream worth pursuing. The list of optimists includes Stephen Moret, CEO of the Baton Rouge Area Chamber, Mayor Kip Holden, LSU, and state economic development officials and, of course, those behind the festival itself.

While an animation festival sounds fun, cool, and creative, some might see it as "fluffy"—not exactly a no-nonsense engine for creating economic prosperity. But fluffy isn't what Stacey Simmons, director of Red Stick, has in mind. She envisions Baton Rouge becoming firmly established as one of a handful of places in the world that lures the best animators, directors, designers, and others—a place that matters to the industry.

Simmons believes if Red Stick can become that, it can become a funnel for the development of the digital animation industry in Baton Rouge. The effort to attract industry players here has already borne fruit: N Erjyzed Entertainment, a Dallas-based video game development and publishing company founded by a Southern University graduate, recently announced it would move its headquarters to Baton Rouge. The Baton Rouge Area Chamber had been working on N Erjyzed for about a year, while the Metro Council recently sweetened the pot by approving a \$500,000 workforce development grant for the company.

Simmons says attracting companies like N Erjyzed can create opportunities for Baton Rouge to compete in the larger entertainment sectors because the animation skills are the same, whether it's a video game or a blockbuster movie.

"The thing about the digital media industry is even though the individual jobs are very specialized, they're transferable," she said. "If you know how to do digital lighting, for example, you can go into a video game and light it. You can also do lighting for special effects on a film or on an animated feature. Those skills transfer very easily."

The Red Stick festival grew out of Simmons' conversations with Stephen D. Beck, director of LSU's creative arts and technologies lab, part of the University's Center for Computation & Technology.



RED STICK
INTERNATIONAL
ANIMATION
FESTIVAL
www.redstickfestival.org



The question was how to make people aware of what CCT was up to in terms of creativity, computing, and technology and why they should care.

An animation festival seemed appropriate: *Shrek* and *The Incredibles* are digital celebrities; creating such effects is a huge industry, and CCT has the computing power to play in that league. But they wanted to see what other people were doing.

“We went looking for an animation festival in the United States and couldn’t find one,” Simmons said. “The closest thing was the New York Animation Festival.”

Not close enough. That festival and others were either marketing events or screenings, mainly getting a bunch of people together to watch cartoons. Community/economic development engines they were not. Then Simmons found one: the Animex International Festival of Animation and Computer Games at Teesside University in Middlesbrough, England.

In its seventh year, Animex has grown into a serious event, drawing animation talent from around the world. It’s been an economic shot in the arm for a depressed part of England long since abandoned by steel-fabrication, shipbuilding, and the chemical industry.

Animex has helped draw students from the region into educational opportunities that otherwise would have passed them by. The festival has also spawned Middlesbrough’s Digital City project, a community regeneration effort credited with establishing a thriving digital corridor in the city.

Red Stick has modeled itself on Animex, whose creators have been more than willing to share speakers, give advice, etc. They’ve even traveled to Baton Rouge.

Chris Williams, director of the English festival, says the idea Teesside graduates can stay around and set up their own animation firms instead of drifting off to London or the United States is gaining traction. Digital City is also trying to lure larger animation companies to Middlesbrough.

Baton Rouge is dealing with similar issues, as far as getting young people to stay in the area after graduation and attracting outside business—preferably high-tech business. Those aren’t the only similarities: Middlesbrough and Baton Rouge both have chemical plants, universities, a major river, and roughly the same population. “The synergy between the two areas is quite frightening,” Williams said. “It’s uncanny. When I came there the first time I said, ‘Oh, I’m back in Teesside.’”

Though successful, Animex is still in its infancy. Williams says Baton Rouge appears to be moving faster toward its goal by being able to offer tax incentives, training, and such. England’s centralized government makes it impossible for Middlesbrough to offer such incentives.

“It takes people to just go for it,” he said. “It’s going to be a gamble, but all being well, this gamble is going to pay off.”

Moret says the gamble is worth it, particularly when it comes to video games. The video game industry is bigger and growing faster than the film industry and has the extra advantage of offering high-paying jobs that don’t evaporate once the filming is done.

Based on a chamber report indicating Baton Rouge stands a good chance of being a video industry player, the Legislature last general session passed a bill allowing video industry tax credits similar to those the state already has to attract film production. Moret says Baton Rouge needs at least a few animation firms to set things on fire, which is why the chamber has been aggressively courting prospects.

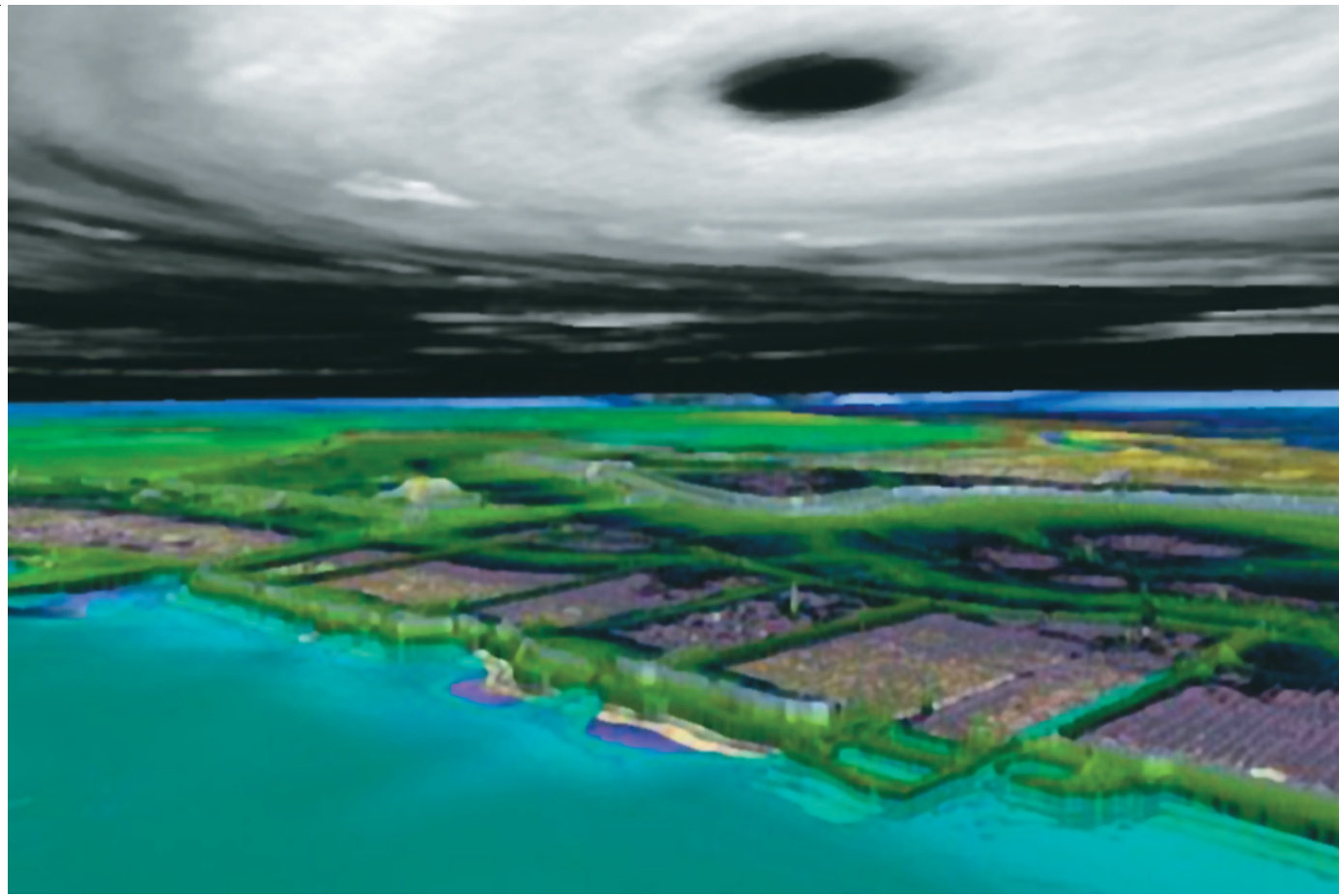
“It would be a success even if it was just a great festival. But if it actually helps catalyze economic growth, what a wonderful opportunity for Baton Rouge.”

—Stephen Moret, Baton Rouge Area Chamber

“We’re talking to one of the biggest video game development and publishing companies in the country,” he said. “One of the top 10 has approached us, really because of the Red Stick animation festival connection.”

Moret, instrumental in securing large amounts of private support for this year’s festival, has another reason to love Red Stick: It makes Baton Rouge seem cooler—a place young creative types might want to live. Nothing denotes coolness and creativity like an animation festival.

“This is right at the center of the bull’s-eye,” Moret said. “It would be a success even if it was just a great festival. But if it actually helps catalyze economic growth, what a wonderful opportunity for Baton Rouge.”



LSU CENTER FOR COMPUTATION & TECHNOLOGY

216 Johnson Hall
Baton Rouge, LA 70803
www.cct.lsu.edu

