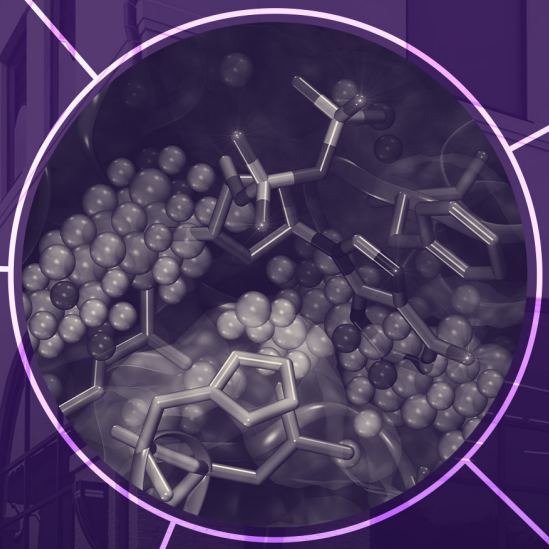
RESEARCH at CCT

Interdisciplinary | Innovative | Inventive

2019



LSU | Center for Computation & Technology

Message from the LSU CCT Director

Interdisciplinarity is the core of the Center for Computation & Technology's (CCT) innovative research environment. Enabling researchers and students to creatively combine the expertise of multiple fields leads to wholly new schools of thought and advanced applications. CCT facilitates these studies by providing access to cutting-edge cyberinfrastructure, high-speed networks, high-performance computing, advanced data storage and analysis, and software developed by its own globally recognized faculty and research scientists.

CCT researchers work on a variety of projects for state economic diversification and workforce development in global industries—like manufacturing, energy, data analytics, video game design, health and biomedical informatics, and cybersecurity—as well as academic endeavors to further understanding in both STEM and liberal arts. Many of these projects are conducted in partnership with national labs, governmental organizations, and industry leaders. The center's work directly touches roughly 20 different fields of study.

To foster interest in the opportunities available at the center, CCT hosts seminars, camps, and events throughout the year. This outreach facilitates recruitment of high-quality undergraduate and graduate students, contributing to LSU's vibrant academic community.

This issue of CCT Research highlights the research, education, outreach and other activities that CCT engaged in during the calendar years 2017 and 2018.

J. "Ram" Ramanujam
CCT Director

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Special thanks to Erica W. D'Spain (Assistant Director of Administration, CCT) and J. "Ram" Ramanujam (CCT Director)

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Cybersecurity & Forensics

CCT's Cybersecurity Group Growing to Fill Industry Workforce Gap

The global cybersecurity industry has almost 3 million open jobs with precious few people to fill them. The International Information System Security Certification Consortium ((ISC)2)–an international association of cybersecurity professionals–recently highlighted this substantial gap in a 2018 market study. The study also found that technological solutions, like AI and machine learning, aren't developing fast enough to be viable high-security solutions. (ISC)2 warned that the lack of qualified cybersecurity analysts left the U.S. open to coming waves of cyberattacks.

Recognizing the workforce needs, LSU hired Golden G. Richard III in 2017 as the new associate director of cybersecurity at CCT. Richard's extensive experience allowed him to obtain a $1.1 million grant from the National Science Foundation (NSF) and a $220,000 grant from the National Security Agency (NSA). The new program has had so much interest from students that Richard has had to turn talented applicants away because there are not enough faculty to supervise them. While he says the growing interest is exciting, the field and industry are still notorious for high burnout rates–a problem also noted by the (ISC)2.

"The one thing that is really clear is that there needs to be more cybersecurity education," claimed Richard. "But I caution people that are barely interested and just trying to milk it somehow because they are going to be driven out of their minds. Out of 30 students, maybe five are going to end up being good reverse engineers because they have the aptitude and don't get frustrated."

Through his current NSA grant, Richard is researching teaching techniques and ways to use existing tools to help mitigate some of the frustration that contributes to student burnout, hopefully increasing retention rates. He said the first tool he tells all his students to utilize is Twitter. The social media platform is a hotbed of real-time malware tracking. The popular hashtag, #DFIR (Digital Forensics Incident Response), for example, tracks new malware and reverse engineering efforts across the industry. Richard said Twitter keeps students informed, so they are not stymied by the rapid changes in the field, and introduces them to new techniques they might not learn in a classroom.

Richard praised his current students as dedicated and passionate. Three of his students were even accepted, pending successful security clearance, to the prestigious NSA internship program in 2019. During the 12-week paid internship, students receive training through real NSA missions. It can be a real boost to students' careers as nearly 80 percent of interns are offered full-time positions with the agency upon graduation. In the future, Richard, an NSA-certified instructor, hopes to grow the LSU cybersecurity program into an NSA-certified program, and to find other opportunities to help those students determined to beat the burnout and enter the cybersecurity workforce.

Credit: Golden Richard III

“The one thing that is really clear is that there needs to be more cybersecurity education.”

GOLDEN RICHARD III

Students of the CCT Cybersecurity Lab

The Cybersecurity Program started in 2017 and now sponsors around 13 graduate students under the supervision of the associate director of cybersecurity at the Center for Computation & Technology, Golden G. Richard III. Students come from various academic backgrounds and countries of origin, creating a diverse working environment. They all, however, share a passion for topics like malware analysis, reverse engineering, and machine learning.

Modhuparna "Modhu" Manna (India), Arian Shahmirza (Iran), and Md. Firoz-Ul-Amin (Bangladesh) agreed to share how they came to the program and how their experiences have impacted their interests in cybersecurity.

It is with great sadness that we acknowledge the death of Md. Firoz-Ul-Amin. Firoz's life ended abruptly on September 7, 2019. In addition to being intelligent and hard-working, Firoz was "amazingly sweet and just a beautiful person" in the words of his major professor Golden G. Richard, III.

Q: Why did you decide to pursue cybersecurity at LSU?

Modhu: I got the teaching assistantship under Dr. Golden, and the first thing that came to my mind was that I won't be able to do it because I wasn't familiar with cybersecurity and reverse engineering. I had never done this before. When I went to the chair to say that I won't be able to do it, he said to at least try. So I was attending the class along with the other students, and the first malware he showed was so awesome! When he described it, I was like WOW! That's when I decided that this was the thing I wanted to do.

Arian: When I came here, I was looking for someone working in cybersecurity. There was no one here at the time. During the program's first semester, I found Golden and decided to work with him. I already had some experience working in reverse engineering and doing security research.

Firoz: From childhood, I heard about the hacking stuff, and it seemed very interesting. They were trying to do it not only for bad reasons, but good people were also using it to intentionally attack or target some machines to look for information. After coming here, I saw Golden doing some work in this area and in machine learning. I had also been interested in machine learning, so it was a way to combine these two interests.

Q: Do you think machine learning is going to be the next trend in cybersecurity?

Firoz: Machine learning is very big right now. We have a lot of data, and to get the information out of that data, we need machine learning. Right now, however, memory forensics (a type of cybersecurity analysis that looks at live data, temporarily stored on a computer's RAM) is mostly a human labor job. We need experts for analyzing. We have the data, but to make any decision, we need human intervention, expert opinion. Maybe machine learning though could make it a little more automated, especially with big data.

Q: What is the biggest challenge in cybersecurity analysis?

Arian: I think reading the hacker's mind.

Modhu: I feel it is difficult to keep up with new trends. The trend is changing again and again. A few years back, we were doing digital forensics, and now the trend has changed to memory forensics.

Firoz: My opinion is that the most difficult part is to keep up with the changes. The people that are making the malware are making something new every day; so, we have to keep our tools updated to be able to fight against it.

Q: What do you want to do after completing the program?

Modhu: I want to work with Mac malware. It was a common notion that Mac malware was not very common, and until 2014 it was like that, but now there is a lot of Mac malware on the rise.

Arian: I am working towards securing memory forensics frameworks—the tools that we use for doing memory forensics. I am working to make them more secure. The hackers and all of the hacking can also try to target the forensics tools, and the forensics tools should ideally not be affected by a hacker; so, I am working towards that.

Modhu, Arian, and Firoz are currently performing work related to Dr. Richard's NSA and NSF grants. Some of their projects include: developing a machine learning program to catalog over 30 million live malware samples, improving memory forensics tools, and developing reverse engineering teaching methods. These projects will help them develop the skills they need to continue their careers upon graduation.

Reconstructing and Restoring the Past and Present

Some technological advancements lay the foundation for a plethora of applications; teaching a computer to solve a jigsaw puzzle is one of them. Xin "Shane" Li, faculty with the Center for Computation & Technology and the Oskar R. Menton Professor of Electrical Engineering at the LSU School of Electrical Engineering & Computer Science, describes the jigsaw challenge as a classic artificial intelligence computational problem that has stymied computer scientists for years. Previous solutions were only able to reliably solve small, simple puzzles. However, Li and the LSU Geometrical and Visual Computing (GVC) Lab have now developed state-of-the-art algorithms that are able to solve complex puzzles with up to 400 pieces.

"We trained the machine to recognize textures of images so that it could recognize and group together potential neighboring pieces, which often have similar or related textures," explained Li. "We also developed a new hierarchical model to search for the optimal composition between fragments that maximized the mutual consistency of local alignments. In other words, it picks the correct stitching between fragments by analyzing how well they make them fit with all their neighbors. With this new design, our algorithms can greatly outperform existing designs and can now solve puzzles that are four or five times more complex."

This computational advancement is quickly finding root in a variety of applicable projects. Li originally conducted the research as part of an NSF grant in collaboration with forensic anthropologists to automate skull and facial reconstruction and restoration. He has since collaborated on several related projects in the engineering and medical fields.

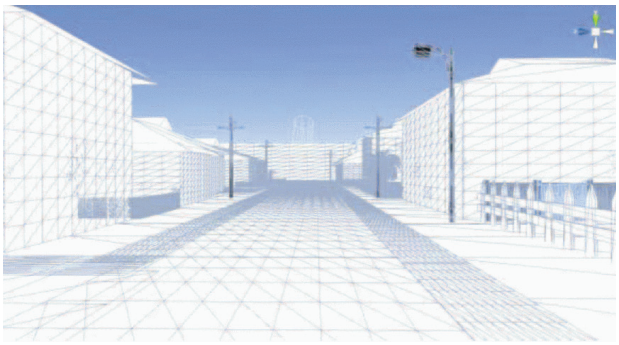
Forensic Imaging

Despite the portrayal of advanced technology on popular crime shows, forensic scientists do not currently have the capability of digitally creating skull and facial reconstructions. Most of the work is still done by hand. This process can take weeks, and it is open to the scientists' subjectivity.

Li's team created a three-point pipeline to automate and digitize the reconstruction and restoration process. Their first program scans each individual skull fragment and reassembles them like the aforementioned jigsaw puzzle. The second program uses self-symmetry and a database of 3D skull models to fill-in missing pieces. The final program takes the finished skull and generates possible facial reconstructions using a database of 50,000 3D models, scans, and portrait photographs. The program is able to structure its search by automatically identifying factors like race and gender.

"Forensic scientists usually put some (tissue depth) markers on the skull and sculpt clay to fit those landmarks. This is where the subjectivity comes in," said Li. "Traditionally they only apply normal tissue depth, meaning the standard. It's hard to infer any possible tissue variations from the skull itself. . . . We use our facial reconstruction algorithm to generate multiple 3D faces from our database of images. It's more like trying to match a skull with many, many faces

Credit: Colby Sterling



N. Urella, J. Hughes, E. Conrad, J. Zhang, and X. Li, "A VR Scene Modelling Platform for PTSD Treatment," Proc. IEEE 12th International Conference on Computer Science and Education, Houston, Texas, USA, pp. 257-262, 2017

and report which one has the highest probability of being a match."

In addition to digitally generated faces, the database itself incorporates the national missing persons database so the program can automatically look for matches amongst real people.

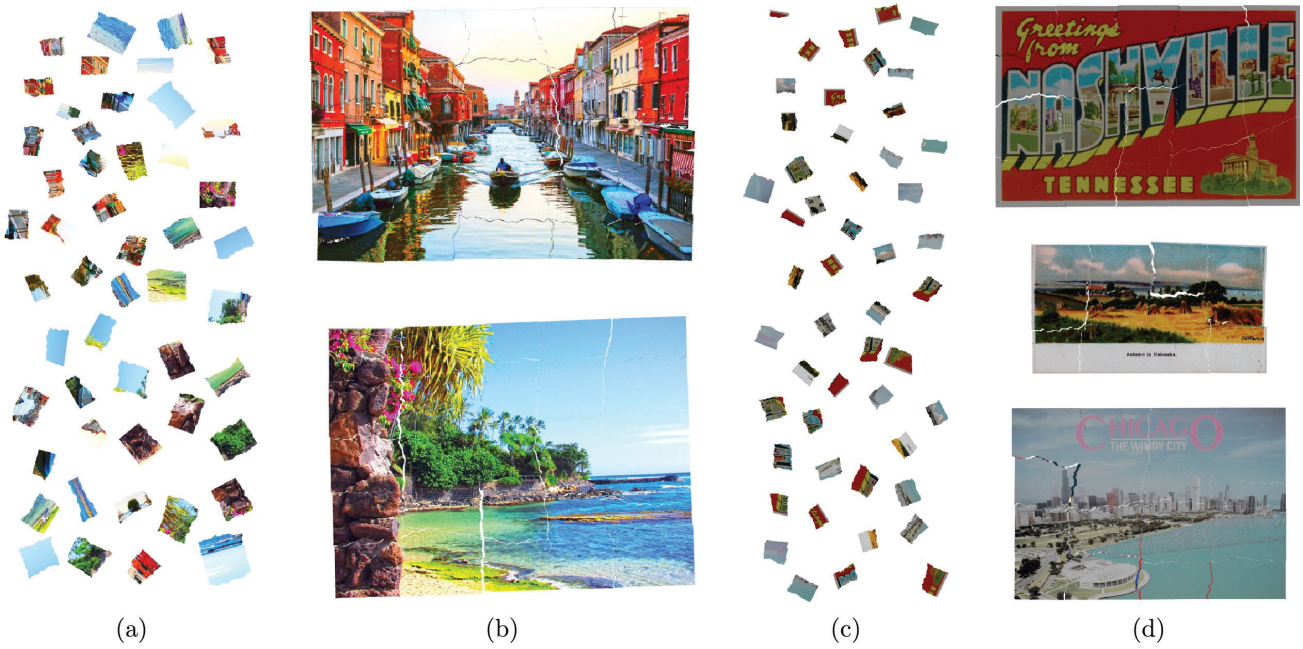
In a March 2018 TED Talk, Li shared, "We are excited. What we have developed here could potentially save forensics specialists days and weeks from their work time, and this may lead to a faster path to answers for people in the wake of disaster or tragedy. . . . This research is laying the foundation to make the fully computerized facial reconstruction a reality."

He added that the same technology is also being applied to document and image restoration as a "de-shredder," making it a very powerful tool for forensic scientists and anthropologists.

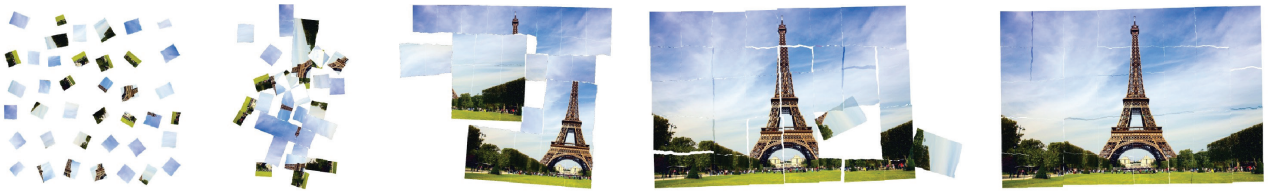
Virtual Environments

In 2017, Li collaborated with doctors from the University Medical Center (UMC) in New Orleans on a one-year project studying Virtual Reality Exposure Therapy (VRET) for PTSD patients. The therapy aims to safely recreate the environment where the trauma occurred.

"The current approach is the patient keeps repeating the scene by talking to the doctor until he or she gets used to it. It can be hard to imagine (the scene) just by saying it. The idea of VRET is that we can put the patient into a virtual reality environment so they can get stronger in a more realistic way," explained Li.



(a) (b) (c) (d)



(a) 40-pcs (b) $\epsilon_p = 35.9\%$ (c) $\epsilon_p = 87.1\%$ (d) BOP $\epsilon_p = 94.9\%$ (e) BOSP $\epsilon_p = 100\%$

(f) 60-pcs (g) $\epsilon_p = 31\%$ (h) $\epsilon_p = 70\%$ BOSP $\epsilon_p = 100\%$

X. Li, K. Xie, W. Hong, C. Liu, "Hierarchical Fragmented Image Reassembly using a Bundle-of-Superpixel Representation," *Computer-Aided Geometric Design (CAGD)*, in press, doi.org/10.1016/j.cagd.2019.04.015, 2019.

Manually building virtual reality scenes through animation is neither time- nor cost-effective, so Li's team developed a program that could reconstruct live scenes using photographs. Li compared it to a 3D version of GoogleMaps. The user, however, is fully able to interact with the environment, exploring areas like shadowed corners or alleyways.

Unfortunately, the program was not fully automated by the end of the project. Li hopes to continue with program development after UMC completes the initial study.

For a similar project, Li partnered with the LSU Construction Management Department to develop a virtual reality program that can reconstruct live, collaborative environments for remote communications. The resulting program would allow virtual workspaces for businesses with multiple locations. In addition to reconstructing the surrounding environment, the program will also be able to accurately reconstruct human facial expressions for a more life-like user experience and better interpersonal communication.

"The scene is more static. We can reconstruct that from camera images, but the reconstruction of the human body and their expressions, their emotions, are more difficult. It's highly dynamic," said Li. "Our human eyes and our brains are very sensitive to artifacts of human expression. We may not easily be able to tell apart the raw components of a chair, but we are very sensitive to the expression and the synchronization of words with their emotions."

Existing programs use multiple cameras that require ample bandwidth to transport the large amounts of data. This setup causes delays that make real-time synchronization impossible. The GVC Lab is trying to develop a system that only uses one camera and fills-in any missing data in the images with algorithms similar to the restoration program.

Body Scanning

In a previous project with Pennington Biomedical Research Center, the GVC Lab developed body scanning technology that only requires one Kinect camera (a gaming camera developed by Microsoft for the Xbox system). The program is able to accurately reconstruct a geometric model of the scanned subject. Pennington originally used it in obesity management studies to track changes in participants' shape, but the project continues to grow with new features like thermal scanning. Li believes the program, or one similar, could possibly be adapted for projects with virtual environments.

Overall, everything from ancient art restorations to modern self-driving cars relies on the ability to construct accurate image composites and effectively fill-in any data gaps. Li's research is at the forefront of this foundational technology. Forensic imaging was just the first piece of the larger puzzle.

Arts

LSU Promotes the Animation Arts with International 19th Annual Animation Show of Shows

Marc Aubanel, director of the LSU Digital Media Arts & Engineering (DMAE) program, said he was delighted to have the DMAE program selected as a host of the 19th Annual Animation Show of Shows tour. The nonprofit Show of Shows was founded by Film Producer Ron Diamond to promote awareness and preservation of the often overlooked animated-short films. Every year, Diamond curates a collection of animated shorts to tour around the U.S., mostly at colleges and industry events.

Show of Shows contacted Aubanel after the DMAE program received recognition and ranking in several animation and special effects industry publications. The event was a natural fit for DMAE–reminiscent of the DMAE Film Series, which paired works of animation or special effects with creator interviews. Aubanel noted that inclusion in the tour was a wonderful mark of recognition from industry leaders, and it was an opportunity to expose DMAE students to lesser known works.

“Animation shorts have always had a harder time finding a viewing audience,” explained Aubanel. “In the ‘50s-‘70s, often it was what played before the movie started; this was before they played commercials and previews, and that was where animators had well-attended public forums for their animations. Today, only major companies like Pixar can afford to do that.”

The 19th Annual collection featured 16 animated shorts from eight countries. They included a variety of animation techniques like traditional 2D drawing, stop motion, computer generated animation, and a short called *Casino* (Canada, 2017) by Steven Woloshen in his signature style of drawing directly on film. Charles Solomon of the Los Angeles Times described it as a “welcome reminder that an animated film can be as intimate and personal as a signature.”

Among the films were several award-winning pieces like the Oscar-winning short *Dear Basketball* (U.S., 2017) by Glen Keane and the Grand Prix winner *The Burden* (Sweden, 2017) by Niki Lindroth von Bahr. Since its inaugural year, Show of Show participants have garnered 38 Academy Award nominations with 11 wins.

Show of Shows is also an industry leader in animation restoration and preservation. They are currently funded through grants from the International Animated Film Association (ASIFA)–Hollywood and The National Film Preservation Foundation. This year’s collection included two restored works, *Next Door* (U.S., 1990)–by Pete Doctor director of the Disney Oscar winner *Up*–and *The Hangman* (U.S., 1964) by Paul Julian and Les Goldman.

Following the event, DMAE faculty led several small groups in discussions about the different animation techniques and story presentations. They also discussed animation job opportunities and challenges. It is a difficult field to break into, but Aubanel said, “The more exposure we have, the more works we watch, the more likely we are to succeed.”

Credit: The Animation Show of Shows

Shows used different animation styles as pictured here: (clockwise) *The Burden* (Sweden, 2017), *The Hangman* (U.S., 1964), and *Dear Basketball* (U.S., 2017).

Cultural Computing Turns Collaboration into an Art Form

Cultural computing pushes the boundaries of traditional methods for creating, producing, and delivering various art forms and social sciences to the public. Derick Ostrenko, LSU associate professor with a joint appointment at the Center for Computation & Technology (CCT) and the LSU School of Art & Design, described cultural computing as a mass collaboration among multiple academic disciplines—a perfect example of the CCT vision for interdisciplinarity on LSU's campus.

"A lot of what makes cultural computing unique is the ability to have someone from art history work with someone from computer science or someone from music work with someone from engineering," explained Ostrenko. "They all come together at CCT to create new ways of how we experience the world around us."

Due to its broad nature, cultural computing is the largest focus area at CCT, incorporating disciplines like art and design, digital media, mass communication, music, and dramatic arts. The heart of cultural computing, however, still lies in the arts. In 2018, CCT artists and musicians had a particularly busy year, with local installations that gained national attention as well as international performances in Paris and Edinburgh. The following is a sampling of the many works produced by the CCT Cultural Computing Group. These works are best experienced in their visual and audio formats, so more information is available at the links listed below the project titles.

Credit: Tricia Towey

The Time Machine attempted to capture a visual representation of New Orleans, Louisiana 300 years in the future.

DREAM LOGOS

Dream Logos . . . or the Divine Logic of Dreams was a physical theatre and experimental music production conceived by Jesse Allison, associate professor of the Experimental Music & Digital Media (EMDM) Program at the LSU School of Music, and Nick Erickson, LSU associate professor of theatre. The show toured in Paris, France, and at the Edinburgh Fringe Festival in Scotland—the world's largest performance arts festival.

Show runners created a visually dynamic set by programming cameras to track performers and props across consecutive frames, and then combined it with a digital map of the stage to create visual projections that performers interacted with on stage. To ensure proper timing and effect, Allison and Erickson used live music and live technology sequencing behind the scenes.

"It's as much a performance with the technology behind the stage as it is with the performers on the stage," said Allison.

For more information visit dreamlogos.org.

TIME MACHINE

Marc Aubanel, director of the Digital Media Arts & Engineering (DMAE) program at CCT was approached by Tricia Towey, a New Orleans based filmmaker, in late 2017 for help producing an art installation piece for the 2018 New Orleans Luna Fête. As part of New Orleans Luna Fête's tricentennial celebration, Towey wanted to create a display that showcased both the city's history and its possible future. She proposed a series of interactive poster panels that used a phone app to play animations of what New Orleans could look like in the future. Aubanel enlisted the help of Ostrenko and LSU undergraduate digital arts students, Shei Jae Gothico, Avery Canevari, and Tatyana Lee to bring Towey's vision to life.

"This is a natural frontier for art," said Ostrenko. "As a culture, we're at a state where we rely on technology quite a bit. For us to experience art on devices like our cell phones only makes sense. You don't have to travel to a museum anymore. Technology is helping to democratize the art world."

For more information visit vimeo.com/301484817.

Credit: LSU Theatre

Dream Logos combined traditional theatrical components with cutting-edge technology for a more dynamic performance.

"A lot of what makes cultural computing unique is the ability to have someone from art history work with someone from computer science or someone from music work with someone from engineering. They all come together at CCT to create new ways of how we experience the world around us."

DERICK OSTRENKO

COASTAL VOICES

In 2018, Allison accepted the challenge of recreating the cinematic experience of the documentary *Coastal Voices*. The film, produced by Michael Pasquier, associate professor in the LSU Department of Religious Studies, is a beautiful collection of autobiographical stories told by lifelong residents of the endangered Louisiana coast. Wanting to extend the impact of the film, Pasquier asked Allison to develop a way to make the film accessible to the public, something that would last longer than a screening and retain the film's ability to connect the audience with the coastal residents.

Allison explained, "A lot of times you have an event, like a concert, that happens once and then it's gone. Maybe we've recorded it, but you never get the same experience or context of the original event. We're working on a way to preserve the emotion of a past event for present day spectators."

To effectively preserve the full experience of *Coastal Voices*, Allison conceptualized an instrument created with large images printed on solvent materials like wood, aluminum, and canvas that were then connected to tactile transducers, turning the images into speakers. Motion sensors attached to the speakers activate recordings of the documentary interviews and recordings from the coastal soundscapes. Allison also used lighting cues to guide spectators from image to image for a fluid storytelling experience.

"They call it experimental music for a reason," said Allison. "Every piece is new and unique. Instrument creation can get really muddy, and I love it. It doesn't have to be a clarinet or a harmonica. If it makes sound, then we can figure out how to use that sound to generate music or a performance."

The *Coastal Voices* instrument will be available for public viewing again in 2019.

For more information visit coastalvoices.lsu.edu.

SMART CITIES

The Smart City project consists of a multidisciplinary team of community stakeholders and academic researchers working on the utilization of new Smart, Safe & Connected (SC&C) technologies, many developed at CCT. These technologies address major economic and social issues in Baton Rouge (i.e., crime, housing, transportation). The project is funded by an NSF Development Stage Grant with Seung-Jong "Jay" Park, LSU professor of computer science and engineering with a joint appointment at CCT, serving as the principal investigator (PI). Park collaborated with Ostrenko and Hye Yeon Nam, LSU assistant professor of digital art and adjunct faculty at CCT, to research the most effective way to communicate the live data from SC&C technologies to local communities.

Their findings resulted in two art installation pieces that were showcased at the Smart City meeting on The Water Campus in Baton Rouge. For the website, Ostrenko and Nam, with the help of a CCT REU student Jacob Shelton, created visualizations of area crime statistics spatialized on 2D maps and a 3D visualization of area crime across time. These were then used to create art installation pieces, presented atop a piece of high-density foam carved into the topology of Baton Rouge. Viewers could interact with the piece by touching different locations on the model. The other installation piece was a model of

Credit: Hye Yeon Nam

Observers interact with an installation piece showing the crime rates in Baton Rouge neighborhoods.

the Mississippi River that used programmed LED lighting to visualize currents, waterway traffic, and water depth.

“Emerging technology, the more untested and more sophisticated technologies, is where a lot of us in cultural computing are interested in working, particularly in regard to tangible and interactive media art. It allows us to develop ways of experiencing culture not just through a phone or computer, but through new types of interfaces,” said Ostrenko.

For more information visit smartcity.lsu.edu.

DMAE Bridges Art and Technology for Rare Glimpse Behind the Curtain

Credit: Sahar Rahimi

These works by DMAE graduate student, Sahar Rahimi, demonstrate some of the advanced computer animation techniques taught over the course of the program. The top image is an original 3D setting for a larger project, and the bottom image is an original interpretation of the popular cartoon character Toothless from *How to Train Your Dragon*.

The Digital Media Arts & Engineering program (DMAE) began in the fall of 2015 at the LSU Center for Computation & Technology (CCT). The program combines technology and art to teach the theories and professional tools necessary to succeed in modern interactive media and entertainment industries. Marc Aubanel, director of the DMAE program and a former video game developer himself, said the industry has quickly grown more technical and collaborative since he first entered the field.

“If we go back 30 years, we had four completely different fields: video game development, animation, feature film, and television. There was very little crossover, so all of these art forms developed on their own,” explained Aubanel. “In the late ‘80s and early ‘90s, the walls around each art form started to come down. Each industry digitized more and more of their pipelines, and the software for each art form started to amalgamate. Where we previously had dozens of software tools, we are now down to a handful that we are all sharing. This allows for more mobility between fields.”

These industry changes were the result of advancements in computer science and due to ever-increasing graphical and sound capabilities of modern computers. New technology allowed the digitization of pictures and sound, making software that was once only used by video game developers applicable to animators or film special effects crews. While old techniques are still sometimes used for artistic purposes, modern technology continues to be the heart of digital media and entertainment. The visual

Credit: LSU DMAE

Students work on a variety of original projects developed to teach animation skills that utilize techniques from multiple disciplines.

effects, animation, and design industries are moving toward real-time development processes that used to be the exclusive domain of the video game industry. This real-time development offers advantages to iterate more efficiently, especially in Virtual Reality (VR) and Augmented Reality (AR) environments.

Aubanel said, "I always encourage children who are interested in digital media to look into computer science as computational thinking is critical in all fields, whether artistic or technical. Also, the average salary for computer science graduates in the game and animation industry is higher than other positions. Even if you don't end up becoming a programmer, it's an applicable skill that can be translated to other disciplines."

Media professionals, like Aubanel, are the greatest source of information in this industry.

"It's an industry without really visible heroes. They're behind the scenes. They receive the technical awards that aren't televised. Most professionals aren't recognized and known outside of their field," said Aubanel.

One of DMAE's goals has been to give students the opportunity to meet industry experts and gain exposure to the high industry standards. In past events like the International Red Stick Digital Media Arts Festival, special effects artists that worked on sets of award-winning movies, like Star Wars, and video game developers from popular games, like Fortnite, shared their career experiences and answered student questions. Some of these visiting guests have even gone on to mentor promising students.

Moving forward, Aubanel hopes to continue building DMAE into one of the nation's leading graduate-level digital media programs. It is currently one of over 40 programs in the U.S., and ranked the #1 Game Design School in Louisiana by Animation Career Review.

"The digital age is bringing in large systemic changes, and digital media arts is at the forefront of this revolution," said Aubanel. "We expect DMAE graduates to become highly sought after employees who are able to flank both the technical and creative sides."

The Coast

Coastal Modeling and Alerts in a Hurricane Prone Future

The 2017 and 2018 hurricane seasons brought historic destruction to the Southeastern United States. The National Oceanic and Atmospheric Administration (NOAA) Office for Coastal Management estimated the 2017 season alone caused $306.2 billion in damages, making it the most expensive season on record. Hurricane Maria, in September 2017, became one of the deadliest hurricanes in U.S. history. New death tolls published by the New England Journal of Medicine contribute nearly 5,000 deaths to the storm and its immediate aftermath. Scientists are worried that future hurricane seasons will be even more destructive and costly.

"The impact of tropical events in recent years, especially on the Gulf Coast, really brought a new awareness to the vulnerabilities of these regions. It prompted local, state, and federal agencies to improve their efforts," said Carola Kaiser, IT Consultant with the LSU Center for Computation & Technology (CCT).

Government agencies and research organizations are now seeking to improve models that can predict how climate change and rising sea levels will affect the U.S. in coming hurricane seasons. This has become a massively collaborative, national effort. Because of the center's previous work with computational storm surge models, LSU and CCT are right at the center of several important research projects.

Coastal Dynamics of Sea Level Rise (CDSLR)

Scott C. Hagen, the Louisiana Sea Grant Laborde Chair, civil engineering professor with a joint appointment at CCT, and director of the LSU Center for Coastal Resiliency, along with his former student and current colleague, Matthew Bilskie, started work on their current sea level rise and storm surge model in 2010 under a $3 million, six-year NOAA grant with the NOAA Ecological Effects of Sea Level Rise Program. He brought the project and its preliminary results to LSU when he began working for the university in 2015. NOAA, the U.S. Army Corps of Engineers, the U.S. Fish & Wildlife Service, and the Department of Homeland Security have since provided more than $2M to continue related efforts through 2020.

"What we've done since 2010 is to really shift the paradigm of how sea level rises, in particular, and climate change, in general, are assessed at the coastal land margin," said Hagen. "We've really changed the way that people do this type of research—from static models to dynamic models that account for changes to coastal morphology, marshes, etc."

The project resulted in an unprecedented, high-definition computer model of the coastal land margin in the Northern Gulf of Mexico. Hagen and Bilskie employ the tightly coupled ADvanced CIRCulation (ADCIRC) and Simulating Waves Nearshore (SWAN) Model (ADCIRC+SWAN) to simulate tides, wind-waves, and hurricane storm surge. The model mesh that describes the intricate details of the region includes approximately 5.5 million computational

points. Various versions of the model mesh take into account how the changing climate will affect the area over time and simulate tide and storm surge effects under different climate change scenarios.

The American Geophysical Union (AGU) featured 10 articles on the ADCIRC+SWAN project in a January 2017 special edition of the publication Earth's Future. Hagen, his students and his NOAA project colleagues have published nearly 50 peer-reviewed articles on the coastal dynamics of sea level rise to date. Hagen said the model wouldn't be possible without LSU and CCT's high performance computing (HPC) resources.

"Since I've been at LSU, I've never wanted for computing power. That's not a small statement to make in my field," he said.

Coastal Emergency Risks Assessment (CERA)

The ADCIRC+SWAN model is also applied in real time to forecast tides and surge for the Coastal Emergency Risks Assessment (CERA) storm surge visualization tool. Developed by Robert Twilley, executive director of the Louisiana Sea Grant College Program, CERA generates storm surge and wave predictions for tropical events in the Gulf of Mexico and along the U.S. Atlantic coastline.

Twilley and his team have worked for over a decade on consolidating hurricane statistical data into a concise visual presentation. Kaiser even dated CERA's origins back to a small 2006 CCT project that arose in the aftermath of Hurricane Katrina. She said her personal experiences during that time greatly influenced the choices she made when developing CERA's design.

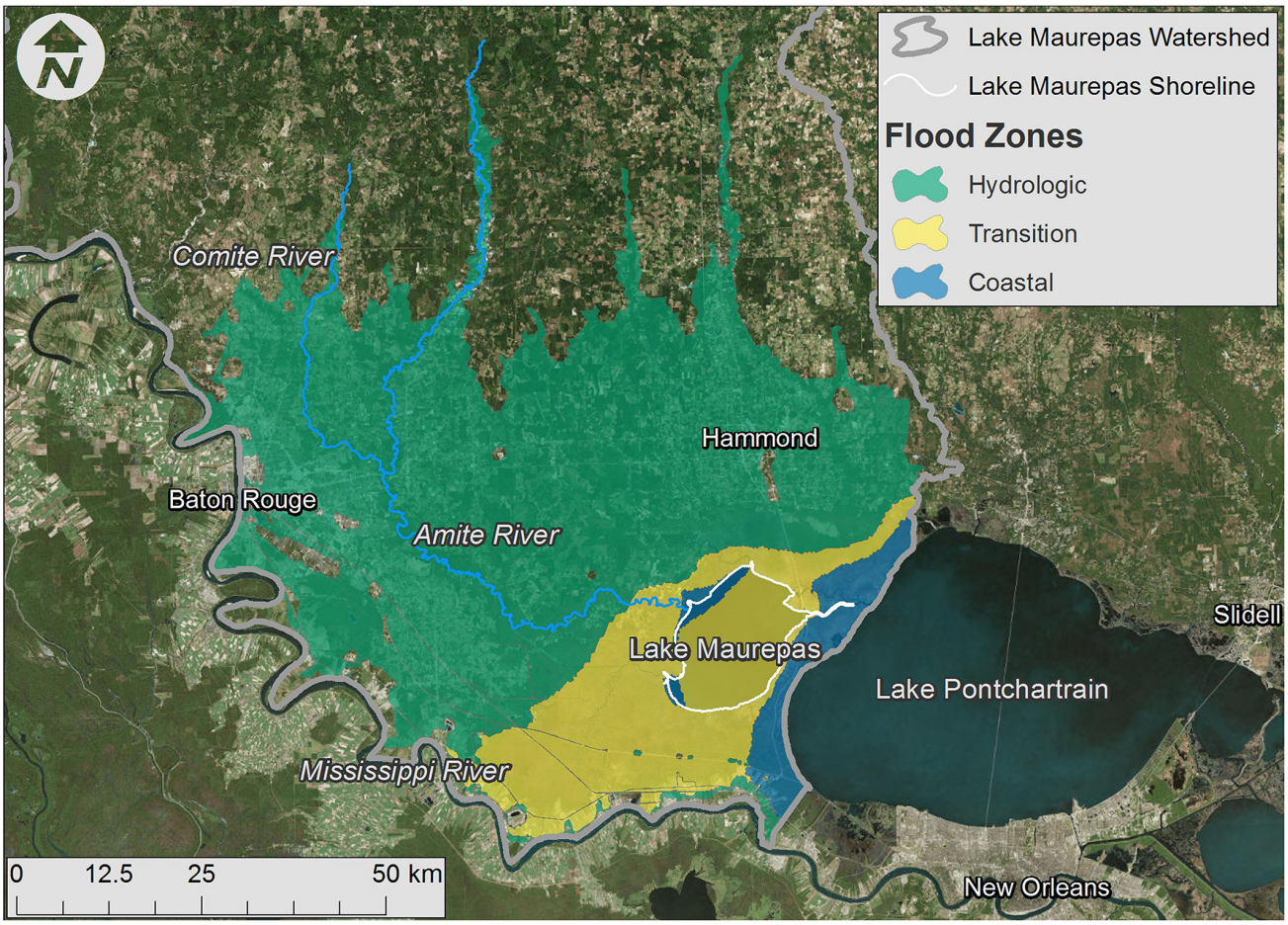
"You need to have a very powerful, easy-to-use interface and visualization tools so that people can look at it and know what it means, what the model is telling them," she explained. "In an emergency, it needs to be as clear as possible."

The model pulls data from the National Hurricane Center (NHC), water level stations and related agencies to generate real-time reports of the current coastal situation. The CERA group also provides predictions based on the NHC landfall projections in order to better prepare local communities for possible impacts.

The 2017 and 2018 hurricane seasons pushed CERA's hardware to its limits, as emergency officials and weather stations used the system to help with impact and response analysis. Its widespread use generated a buzz of public and media attention. In response, CCT Director J. "Ram" Ramanujam invested in new hardware for the CERA Group. The CERA group is hoping to generate more investments and expand its staff in the near future.

To view CERA, visit cera.coastalrisk.live.

The Louisiana coastline and waterways, in particular, are highly vulnerable to even low-grade tropical systems. Its low-gradient coastal landscape and expansive land loss exacerbate the effects of sea level rise and storm surge causing the area to be flood



Credit: Scott C. Hagen

Flood zones in the Lake Maurepas watershed resulting from the 2016 Louisiana flood followed by a Hurricane Gustav-like storm. The Lake Maurepas shoreline is shown in white.

Bilskie, M.V. and Hagen S.C., "Defining Flood Zone Transitions in Low-Gradient Coastal Regions." *Geophysical Research Letters*, 45(6), pp. 2761-2770, 2018. doi.org/10.1002/2018GL077524

Louisiana Waterway Defense

prone. Over the years, engineers have developed a complex system of levees, dikes, tide gates, storm surge gates, and pump stations to help alleviate some of the area's natural, destructive forces.

"You have to appreciate how complicated our defense structures are in coastal Louisiana," said Hagen. "There are many moving parts that have to be managed, and each part affects the others."

A grant from the Coastal Protection & Restoration Authority (CPRA) supports the LSU Center for Coastal Resiliency and the CERA group to continually update the tide and surge model, reflecting the changing waterway infrastructure, and employ it in real-time forecasts. Officials use these simulations to help with waterway management and policy decisions.

Hagen explained, "Our real-time forecasting model and CERA helps (officials) to make the decisions on when the gates should be opened and when they should be closed. It helps them make decisions on when pumps should be pumping and when they should not. It can also help officials decide when and where to add new levees."

While the CPRA model is not the only factor in operational and policy decisions, it is a vital part of that decision process. To create the model, they updated the existing ADCIRC+SWAN model and CERA visualization tools to include information like levee heights and locations, topography, and water-depth imagery. CPRA used the model during the 2018 hurricane season.

Compound Flooding

In the wake of The Great Flood of 2016, Louisiana public officials became concerned with the threatening approach of Tropical Storm Hermine. They posed the question, "What if the storm makes landfall in Louisiana and the surge comes in on top of already flooded regions?" While Hermine ended up turning to the east and making landfall in Florida, the challenging question led Hagen and Bilskie to a new line of research, namely compound flooding.

"We're trying to develop the capability where we model both the hurricane storm surge and the rainfall and runoff to simulate interactions between the two flooding mechanisms," explained Hagen. "It's becoming a very important area of research for flood-prone areas like Louisiana, Texas, and other low-gradient coastal land margins. Hurricane Harvey was unfortunately an excellent example."

The 2012 RESTORE Act awarded Hagen, Bilskie, and their colleagues a grant through the Louisiana Center of Excellence to begin examining the process of coupling hydrologic, tide, and surge dynamics. It is hoped that the increased capability can improve flood risk assessments for the Louisiana Coastal Master Plan.

LSU PhD student Felix Santiago-Collazo believes that combining the surge and hydrology models will result in more accurate and timely alert systems.

"It will save time, it will be more computationally efficient, and it will represent a more realistic flooding zone that can help prevent disasters to property. It could help save lives and avoid losses," said Santiago-Collazo.

“We’re trying to develop the capability where we model both the hurricane storm surge and the rainfall and runoff to simulate interactions between the two flooding mechanisms. It’s becoming a very important area of research for flood-prone areas like Louisiana, Texas, and other low-gradient coastal land margins. Hurricane Harvey was unfortunately an excellent example.”

SCOTT C. HAGEN

In 2017, Santiago-Collazo successfully obtained a prestigious Graduate Research Fellowship from the National Science Foundation (NSF) to further this important work on compound flood modeling.

Moving Forward

With its many projects, LSU and CCT are poised to make significant contributions to future hurricane and climate change studies. Hagen believes his own success and the university’s achievements are, in large part, due to the many opportunities for collaborative research at LSU. He also praised LSU’s and CCT’s commitment to maintaining and growing campus HPC resources, citing it as one of the reasons he chose to move to LSU himself.

“LSU is going to be leading the way on storm-surge model development for Louisiana, Mississippi, Alabama, the Florida panhandle, and the entire west coast of Florida,” said Hagen. “All the work that we do, whether it’s in the Mississippi Delta Flood Plain or if it’s in the Northern Gulf of Mexico, translates to other parts of the world. When we make advancements, it helps our counterparts and vice versa.”

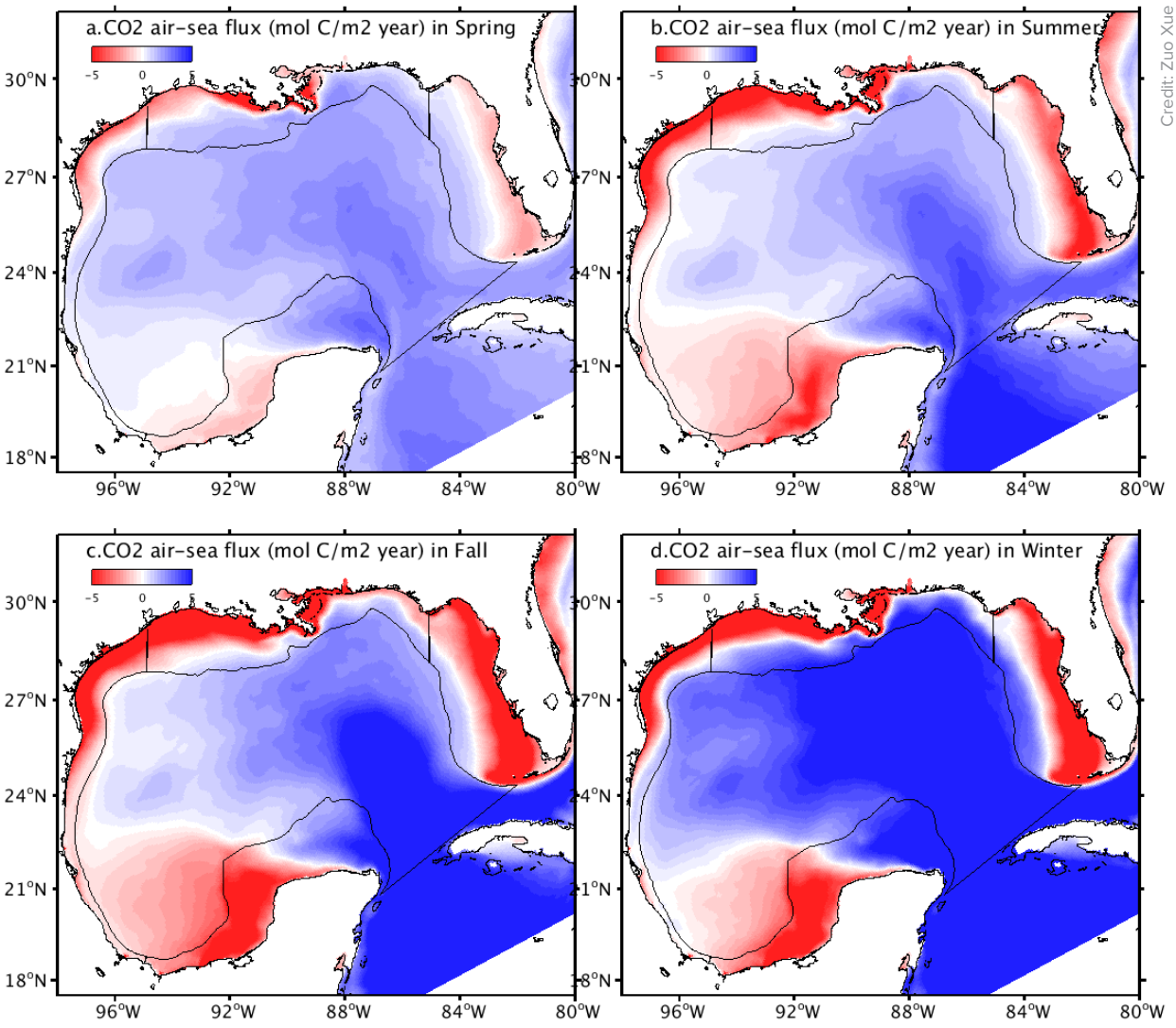
Carbon Exportation in Deltaic Systems

Credit: Kanchan Maiti

LSU graduate student, Michelle Anderson, works with field researchers along the Louisiana Delta.

The 2018 NASA Established Program to Stimulate Competitive Research (EPSCoR) awarded LSU Assistant Professor Zuo "George" Xue a $1.38 million grant to develop a model of carbon exportation along the Mississippi River Delta system. In his previous studies, Xue found evidence that carbon from land loss along the system created oversaturated coastal waters causing the gas to efflux into the atmosphere. For this project, Xue has assembled a team of experts in oceanography, ecology, satellite technology, and high-performance computing (HPC) in order to verify these observations and develop a model capable of application on a global scale. Dr. Xue will use supercomputing resources from the Center for Computation & Technology (CCT) along with CCT support for data storage, analysis, and algorithm improvement.

"Without CCT this would be impossible," said Xue. "The water is very complicated. Each site has very unique settings in terms of moisture, water vapor, etc. There is no one algorithm that is applicable to the entire gulf coast. We need access to the HPC technology in order to compute the massive amounts of data in a reasonable amount of time."



Credit: Zuo Xue

Six-year (2005-2010) model (control run) mean air-sea CO2 flux in the Gulf of Mexico during (a) spring, (b) summer, (c) fall, and (d) winter. Blue color indicates where the ocean is a sink for CO2; red color indicates where the ocean is a source.

Xue, Z., He, R., Fennel, K., Cai, W.-J., Lohrenz, S., Huang, W.-J., Tian, H., Ren, W., and Zang, Z., "Modeling pCO2 variability in the Gulf of Mexico." *Biogeosciences*, 13, pp. 4359-4377, 2016. doi.org/10.5194/bg-13-4359-2016

Supercomputers at LSU, QB2 and SuperMike-II, are HPC clusters capable of processing 1,474 TFLOPS (QB2) and 146 TFLOPS (SuperMike-II), respectively, at peak performance. This tremendous processing power allows Xue and his team to conduct parallel computations using the Regional Ocean Modeling System (ROMS). ROMS is an open-source ocean modeling and tracking program. Xue will use the field data gathered by his team to develop better algorithms, through the use of machine learning techniques, to create a more accurate model of water cycles, including carbon cycling.

“Via collaboration with other faculty, we will have a better idea of what needs to be improved and what cannot be reproduced by ROMS so far. Once we have confidence that the model is capable of accurately reproducing what happened in the past, then [sic] we can let it project what will happen in the future,” explained Xue.

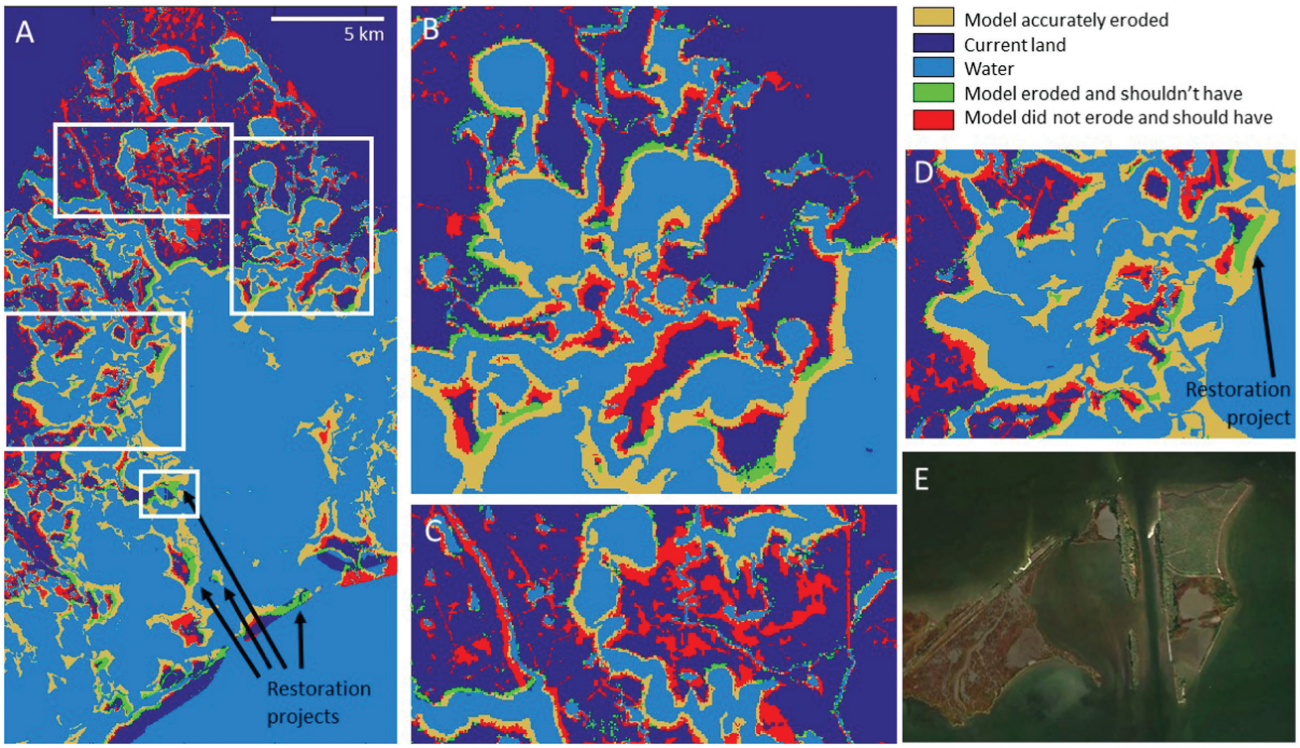
Co-Principal Investigators, Eurico D’Sa, Kanchan Maiti, and Victor Hugo Rivera-Monroy from the LSU College of the Coast & Environment will optimize data by examining carbon export into two contrasting study sites in the delta plain: the Wax Lake Delta, which is prograding (or building land), and the Barataria Bay, which is eroding (or losing land). Additionally, a team from Southern University will collaborate on the project by conducting terrestrial studies to compare their soil samples with the water exportation samples of the LSU teams.

“Within that soil we have a lot of organic matter. Our assumption is that this organic matter will be exported, in either inorganic or organic carbon components, to the coastal ocean,” said Xue. “By using both eroding and prograding sites, we can scale this up to a global scale to transfer the information and techniques to other delta systems.”

While the scope of the NASA EPSCoR grant is limited to his work in Louisiana, Xue will explore funding through agencies like the National Science Foundation (NSF) to continue model development along the Mekong River Delta in Southeast Vietnam.

Xue stated, “If we see that land loss contributes to oversaturation in the oceans, then we will have better justification to protect our coast not only for the prevention of land loss, but also for our climate health.”

Marsh Model of the Past Points to the Future



Credit: Giulio Mariotti

Modeled land-loss results for 1877–2017 with wind-direction (anisotropic) correction. Yellow indicates land that was correctly eroded by the model, green indicates areas eroded by the model but not in reality, and red indicates areas that eroded in reality. (A) Entire Model Domain (B) Microbays (C) Areas of Ponding (D) Enclosed Bays (E) Restoration Site

Louisiana has over three million acres of coastal wetlands. These vital ecosystems are home to a plethora of flora and fauna, they serve the local communities through flood control and fishery production, and they are a major mechanism for carbon storage. Unfortunately, recent U.S. Geological Survey reports show that Louisiana is losing a football field worth of coastal land every 100 minutes. Protecting these vulnerable environments is a top priority for local, state, and national officials.

Giulio Mariotti, assistant professor with the LSU Department of Oceanography & Coastal Sciences and the Center for Computation & Technology (CCT), approaches the erosion problem with a focus on marshland. His recent work produced a historical model capable of simulating how waves eroded the Louisiana marshlands. The model covers over a century of data.

"Some of the oldest maps are from the 1880s, but they are incredibly accurate, even at that time. Louisiana, especially New Orleans, at that time was very rich so they had money to pay good surveyors to map the marshes all around the Delta," said Mariotti.

The model simulates how crashing waves from the neighboring bays affect the fragile marshlands, accounting for the dynamically changing landforms. Mariotti's goal was to both replicate and explain the erosion process. Once completed, it produced some surprising results.

"Normally you would think that the bigger the wave the faster it erodes," explained Mariotti. "We found that it is not just how strong the wave is, but where the wave hits. If the wave hits the marsh at the lower part, then it will erode faster than if it hit at the higher part."

This finding revealed that northern-exposed marshes were at a greater risk for erosion because the northerly winds pushed the water out causing the water levels to drop and expose lower portions of the marshlands. Waves are then able to break down and remove larger sections of sediment. Southern-exposed marshes, however, have some protection because the southerly winds cause the water levels to rise so the waves hit at a higher, less vulnerable part of the marsh.

The model also showed areas where the simulation did not match with historical data. This prompted Mariotti to examine those areas for possible explanations. He said, "If we assume the model is perfect, then we can look at the places where there is a mismatch. We can say that erosion at these points is not due to wave impact; it must be from something else, another mechanism."

In places where the simulated erosion didn't occur, Mariotti found that there had been human intervention efforts to protect the marshland. Officials sometimes use techniques like floating barriers, marsh creation projects, and rock walls to try to slow the rate of land loss. Mariotti believes his model may be a way to quantify the results of such programs.

His next steps include updating the model with additional processes and mechanisms of erosion to better simulate the overall erosion patterns, so the model can better predict future land loss and evaluate the effectiveness of possible intervention efforts. This capability could save government agencies thousands of dollars for future land protection projects.

Mariotti emphasized, "Marsh loss will create economic damages and will make communities more susceptible to storms. It could decrease fishery and tourism. Marsh loss in the future will be an issue. Our response boils down to a good model that can predict that future."

Parameterization in Ocean Modeling: A Micro Approach with Macro Implications

While many researchers focus on large-scale operational models that can recreate or predict natural events, Jun-Hong Liang, assistant professor at the Center for Computation & Technology (CCT) and the LSU Department of Oceanography & Coastal Sciences, is more interested in the ocean's micro-scale processes. Liang's work in physical oceanography focuses on parameterization, which is the reduction of complex, small-scale processes into simple mathematical equations. These equations provide computational building blocks to improve existing operational models.

"The approach I'm taking is slightly different from other modelers because other modelers will use a realistic model to study a specific phenomenon—Scott Hagen is studying storm surge and Zuo 'George' Xue is studying carbon exportation—but they require parameterization in their models," explained Liang. "For some of the processes that are not resolved by their models, they need simple mathematical formulas to represent those processes. I am trying to develop those simple formulas."

Since Liang's research is based on first principles, his work is often applied to other researchers' large-scale projects. His National Science Foundation (NSF) study on bubble-mediated air-sea gas exchange, for example, has possible significance for Xue's study of carbon exportation in the Louisiana Coastal Plains.

"Traditionally, people think gases can only go in or out of the ocean at the ocean-atmosphere interface, but it also goes in or out of the ocean through gas bubbles. If we could better quantify the effects of the bubbles, then we could better quantify the effects of other chemical process like carbon exportation," said Liang.

Additionally, his study on oil particle movements over ocean surface waters for the Gulf of Mexico Research Initiative (GoMRI) resulted in parameterization that has the potential to improve numerous existing operational models. Liang used a fine-scale model to determine the equation representing turbulent flow-fields, or dynamic currents. He also developed a formula to account for variation in particle buoyancy. Researchers, like Hagen, could use these formulas to improve their storm-surge models by accounting for more accurate currents during a tropical event or to track the movement of oil if a spill occurred during a hurricane. Greater accuracy would allow government agencies and relief organizations to be better prepared for possible disasters.

Ultimately, Liang said, "We are all essentially working on the same thing, but the purposes of our simulations are very different."

Science

Securing and Speeding Communications Into the Future with Quantum Communications

Credit: Ame' T. Posey

IBM displayed their quantum computer dilution refrigerator at the 2018 Supercomputing Conference (SC18). Quantum computers require temperatures near absolute zero to avoid interference. The IBM dilution refrigerator is composed of more than 2,000 components that allow it to reach temperatures as cold as 15mk–colder than outer space.

The "Father of Information Theory," Claude Shannon, established the foundation of the modern digital age with his 1948 landmark paper, A Mathematical Theory of Communication. His theories became the basis for many forms of communication (i.e., cellphones, the internet, file compression). Today, scientists in quantum computing expand upon Shannon's work, allowing greater exploration into the natural limits of communication and computation.

"All kinds of amazing things happen when you reassess Shannon's classical theories under the lens of quantum theory," said Mark M. Wilde, a 2018 LSU Rainmaker award recipient and associate professor of physics with the LSU Department of Physics & Astronomy and the Center for Computation & Technology (CCT). "You can communicate securely, in ways that were not thought to be possible classically. You can communicate faster. You can do things like teleportation–a famous protocol that was proposed in 1993."

The U.S. government recently increased their support of quantum computing research and development with the signing of the National Quantum Initiative Act on December 21, 2018. Wilde called the move "reactionary" to the global race for a quantum computer.

"It is known that the killer application (of quantum computers) is breaking RSA encryption, which is a method that is used for encryption now in online banking, and so if a quantum computer came online now, say in China, then we, in the U.S., could be in big trouble," explained Wilde.

U.S. national security agencies are also interested in developing new methods of secure encryption through quantum key distribution – encryption methods based on physical principles. Wilde has worked on several encryption projects through grants from the Defense Advanced Research Projects Agency (DARPA) and the Office of Naval Research (ONR).

“Quantum communication and computing efforts at LSU are stronger than ever,” exclaimed Wilde.

Brain Science Series

The newly founded LSU Multidisciplinary Initiative for Neuroscience Discovery (LSU MIND) partnered with the Center for Computation & Technology (CCT) and the LSU College of Humanities & Social Sciences to present the Brain Science Speaker Series. This series of seven speakers aims to facilitate discussion of neuroscience research opportunities at LSU. Melissa Beck, LSU professor of psychology and LSU MIND executive committee member, said the committee hoped that bringing together faculty and students from multiple departments with similar interests in brain science would lead to future research collaborations, a larger LSU MIND goal.

"What has been going on at LSU are very isolated pockets of neuroscience research," said Beck. "We want to bring people together to have conversations about the research to find out where there are innovative ways to collaborate so we can increase our competitiveness for federal grants."

LSU MIND's partnership with CCT, in particular, is an effort to increase collaborations with computational scientists. These collaborations are important because neuroscience research often generates massive amounts of data, and requires machine learning to help researchers look for data patterns. Beck explained that advancements in high performance computing opened new possibilities for neuroscientists to explore more complex issues, like brain activity causation instead of correlation.

"We have the ability to measure brain activity in high spatial and high temporal acuity. We have the ability to disrupt activity in certain areas of the brain. We have the ability to distinguish from single-cell activity and whole-brain activity," she said. "I think the tools are all there now. It's just trying to figure out how best to use them, how best to process all this data to get the answers to the questions."

LSU MIND designed the Brain Science Speaker Series to bring together people with both traditional and nontraditional interests in neuroscience. Each of the seven speakers was chosen for their area of expertise within brain science and their current influence in the field. The series opened on October 12, 2018, with a lecture on fear and anxiety by Joseph LeDoux, professor of science and director of the Emotional Brain Institute at New York University. The lecture not only examined scientific developments in the study of fear but also the impact of how scientists communicate their findings to the public. Beck said the breadth of topics made it easier to generate a broader outreach.

She added, "I think these events have been successful in getting the word out there about this group of people doing neuroscience research and how to become a part of it. We've been contacted by people who had never heard of us until they attended the event. In that way, the series has been really effective."

More information about past and upcoming speakers is available at sites01.lsu.edu/faculty/lsumind/speaker-series/.

STEM Training for Better Retention Rates

In 2012, the President's Council of Advisors on Science and Technology (PCAST) determined industry demands would require an additional one million STEM graduates within the next decade. Student retention rates in STEM fields, however, have remained relatively unchanged. According to the National Center for Education Statistics (NCES), the retention rates have hovered at 45 percent for the last 100 years. That percentage is even lower for women and minorities. With the decade ending soon, researchers are still working to develop better retention programs.

The LSU Multidisciplinary Initiative for Neuroscience Discovery (MIND) and the Center for Computation & Technology (CCT) started a partnership in 2017 to develop an experiment based on research showing a connection between spatial reasoning skills and success in STEM disciplines. Melissa R. Beck, professor in the LSU Department of Psychology and executive member of MIND, led the project.

"There has been a lot of research to show that people who are good at tasks that measure your spatial reasoning skills also tend to be successful in STEM disciplines," she said. "One way we thought we might be able to increase student retention in STEM disciplines is to help individuals who have poor spatial reasoning skills to improve those skills. Potentially, we could develop a training protocol."

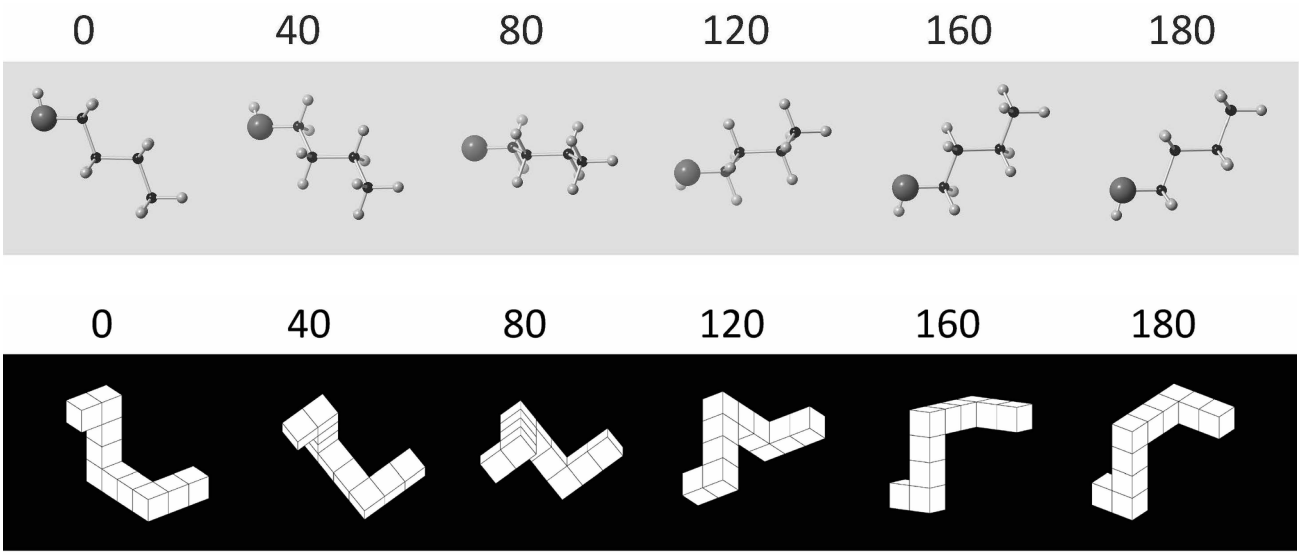
The experiment began with a pre-training test using mental rotation tasks. Participants then completed six training sessions over the next two to three weeks before taking a post-training test. During the experiment, scientists performed and monitored fMRI brain scans and tracked participant eye movements.

Beck explained, "We were interested to see if we could determine, in addition to improvements in performance, if there were areas of the brain or networks in the brain that changed as performance improved. We also measured eye movements because we wanted to see if there was a particular change in attention strategy. If we isolated the change in strategy, then that could help inform future training programs."

The experiment found changes in both the brain's spatial reasoning networks and in the distribution of attention across stimuli as performance improved.

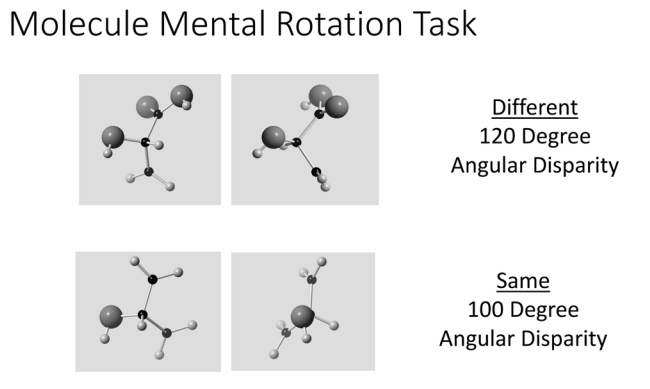
"Initially the saccade amplitude, the distance (the eye moves) between each fixation, was smaller, and after training it was larger. This indicates that (participants) are processing more of the object as they improve performance," said Beck.

Researchers also found that performance improved across trainees, and results were able to be generalized to a novel stimulus. This means that participants were better able to complete spatial reasoning tasks with both the training stimuli (3D blocks) and with new stimuli (ball and stick molecule) models. The models were based on actual molecular compounds found in chemistry to represent polar molecules. Beck said the idea was to demonstrate the connection between these skills and the day-to-day



Credit: Melissa Beck

Spatial reasoning skills practiced with cube models translated directly to the same skills necessary to rotate chemical molecule models.



tasks scientists complete in the discipline.

She added that there is still a lot to explore, but the initial results are promising. Beck and CCT are planning grant submissions and several follow-up studies to determine how to maximize training results and the possible training limits.

“It’s possible that, if someone’s not really good at spatial reasoning, there’s only so much training can do,” said Beck. “But potentially we could develop a training protocol that would help some students improve. They would perform better in class. They would stay in the major. They would be successful, and we’d increase diversity and retention in those disciplines.”

Bioinformatics: Computing the Future of the Medical and Pharmacological Industries

The U.S. Food and Drug Administration (FDA) made headlines in 2017, and again in 2018, after approving what it termed as the first "gene therapy drugs" in America: Keytruda and Vitrakvi. These medications are cancer treatments that use genetic and molecular profiling to target tumors with specific genetic mutations. Commonly, this type of medicine is referred to as precision medicine. Michal Brylinski, LSU associate professor in biological sciences with a joint appointment at the Center for Computation & Technology (CCT), believes Keytruda and Vitrakvi are just the beginning of a revolutionary change in the medical and pharmaceutical industries.

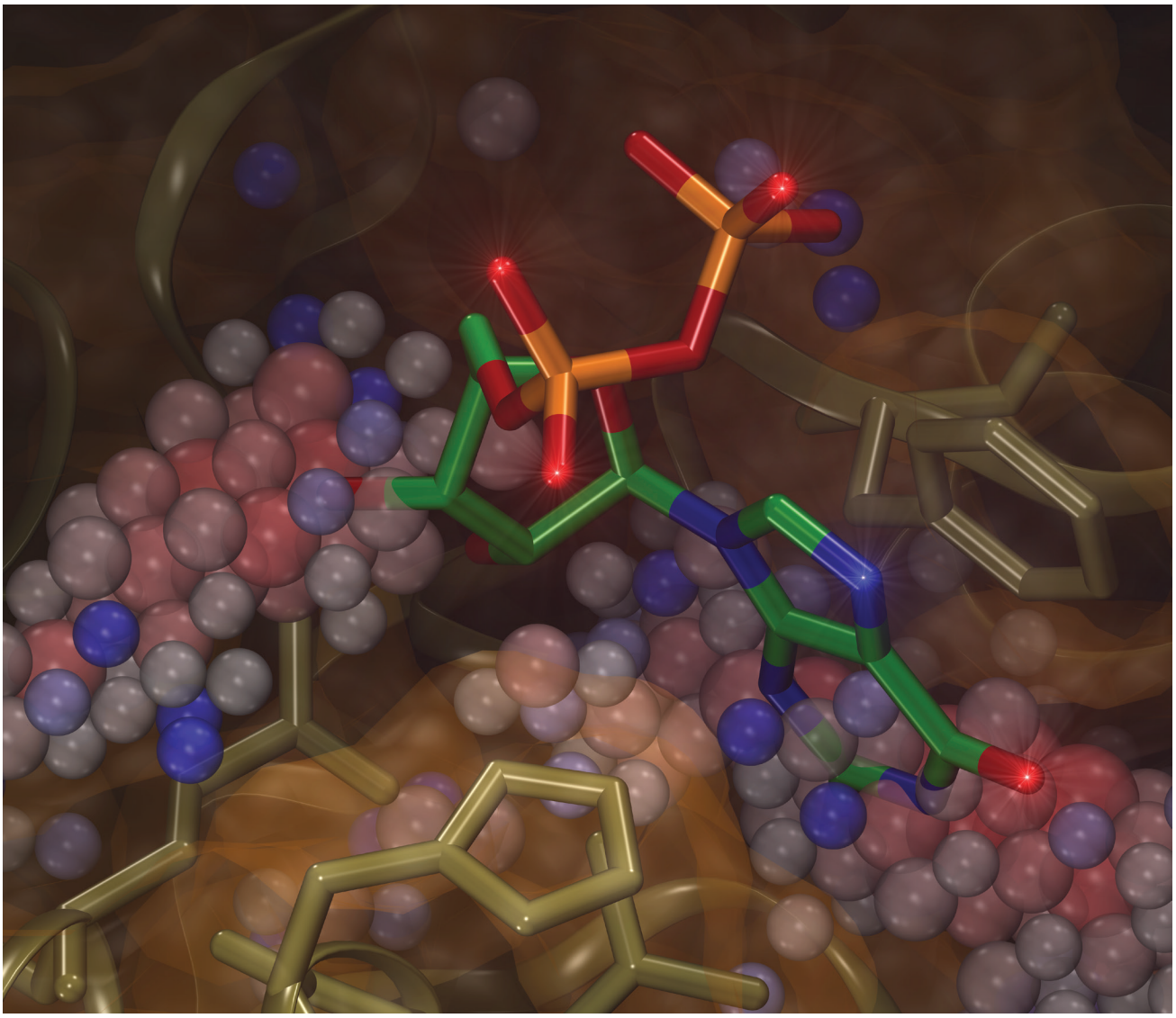
"The (bioinformatics) field is moving so fast right now, and there is a lot of interesting work," said Brylinski. "We have so much information that we can collect from patients; for instance, we can sequence the genome and correlate it with the phenotype. Because of this, we can be more precise when targeting not only cancer but other diseases as well. The number of possibilities is so huge that you need artificial intelligence (AI) just to cover all this data and to figure out the most optimal treatments."

Brylinski is currently working on several data science and AI projects related to precision medicine with his team at the Computational Systems Biology Group (CSBG). The CSBG team combines aspects of multiple biology disciplines to analyze the organization and evolution of biological networks with the goal of developing new modeling and computational tools that will be applicable to drug discovery and design. Their current projects are funded under a National Institutes of Health (NIH) R35 Umbrella Grant.

Many of the available tools and techniques are unrefined or untested in bioinformatics. Brylinski addresses this problem through collaborations with CCT data scientists, who combine advanced biological algorithms with code designed for non-biomedical data. The CSBG then tests the resulting code with data pulled from the NIH patient databases.

"I think I would be able to do some smaller projects with just my group but nothing on the current scale," said Brylinski. "For those kinds of projects, you need infrastructure, expertise, and knowledge. You need interdisciplinary collaboration."

Brylinski has two more years (ending in 2021) on the NIH R35 grant. He plans to have several open-source, AI products in public use by the end of its funding cycle.



Credit: Michal Brylinski

GDP molecule bound to a signal recognition particle receptor ftsY from E. coli. Spheres are class-activation map points computed with deep learning that reveal important regions of the binding site. This information can be exploited to develop selective and efficacious drugs targeting this protein.

Pu L., Govindaraj R.G., Lemoine J.M., Wu H.C., and Brylinski M., "DeepDrug3D: Classification of ligand-binding pockets in proteins with a convolutional neural network." *PLOS Computational Biology* 15(2): e1006718. doi.org/10.1371/journal.pcbi.1006718

Computational Chemistry: First Principles

In September 2017, the Department of Energy (DOE) awarded then LSU Assistant Professor of Chemistry Kenneth Lopata an Early Career Award for his research on attosecond dynamics in solid-state materials. Attosecond dynamics studies investigate the mechanics that occur at the speed an electron moves—one quintillionth of a second—when matter is affected by high-intensity and/or high-energy light. The ultrafast speed makes the movements impossible to view in current time-scale resolutions. Lopata's Early Career project aims to use quantum mechanical theory to develop computer simulation tools that are able to predict the attosecond dynamics of solid-state materials, particularly near dopants and defects. The $750,000 grant runs from 2017 to 2022.

In addition to the Early Career Award, the DOE recently renewed Lopata's grant for the study of hole migration through 2021.

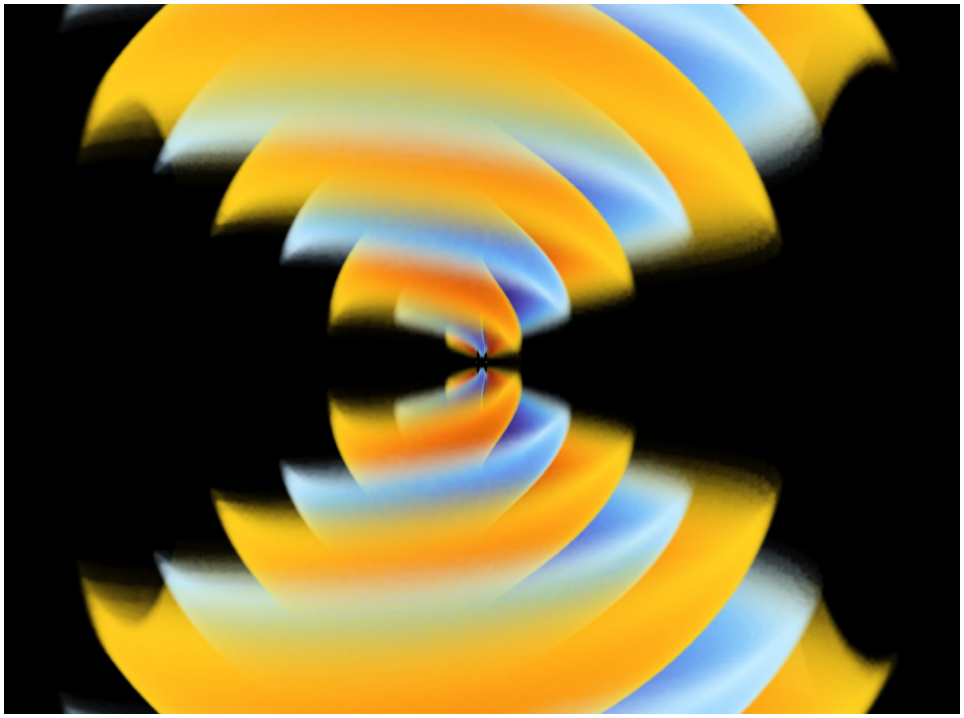
"We think of electrons as particles, but in quantum mechanics, they are better thought of as de-localized clouds of probability. They are spread out in space, so we call it a density," Lopata explained. "If you ionize your molecule in a particular way, you can create a hole in your density, which is an absence of charge. This hole can then move across the molecule in a controlled way. That's hole migration."

Lopata believes that both his projects fit squarely within the main missions of the DOE: understanding and controlling energy and matter flow.

"These processes are basically the fastest and most fundamental chemistry you can ever imagine," he said. "It's fundamental science, but it underpins everything–making and breaking chemical bonds using light, causing chemical reactions using light, damaging molecules using light, harvesting light to gain energy, and using light to understand what matter is made of. In all of these things, you need to understand how electrons reorganize. It in itself is sort of an outstanding question."

Lopata has previously developed numerous simulations for processes like strong-field ionization, electron spectroscopy, and attosecond charge migration. These simulations are essential for interpreting time-scaled experiments and explaining mechanisms of excited state in both molecules and solid-state materials. Lopata refers to the simulated visuals as one of the ultimate prizes of computational chemistry. He added that he views his continued work with the DOE as one more step towards viewing electron movements at the time scale they actually occur–a career goal.

Opening New Worlds of Information Through the Einstein Toolkit



Credit: Barry Wardell (Provided Courtesy of The CACTUS Group)

Modeled gravitational waves admitted by the merger of two black holes.

Wardell, B., Hinder, I., Bentivegna, E., "Simulation of GW150914 binary black hole merger using the Einstein Toolkit." 2016. doi.org/10.5281/zenodo.155394

Developed over the last two decades by the Cactus Framework team, the Einstein Toolkit is a suite of computational software components and tools that are particularly useful for relativistic astrophysicists. Specialized tools include solvers for vacuum space-times, relativistic hydrodynamics, and more. The toolkit is applicable to the analysis of any general astrophysical systems like black holes, neutron star collisions, and gravitational waves.

Steve Brandt, assistant director of computational science at the LSU Center for Computation & Technology (CCT) and current lead of the Cactus Framework team, said the excitement within the relativistic astrophysics community has greatly increased since 2015. In September of that year, researchers at the Laser Interferometer Gravitational-Wave Observatory (LIGO) detected the gravitational waves of two merging black holes for the first time in history. These waves, often described as ripples in space-time, were predicted by Albert Einstein's theory of general relativity, published in 1915. The observational confirmation of Einstein's theory created an unprecedented opportunity to study the origins of the universe and learn more about the laws of physics.

The following year, in another significant development for relativistic astrophysics, a group of physicists from the University of Catania and the University of Portsmouth released one of the first numerical simulations capable of applying Einstein's complete theory of general relativity. Eloisa Bentivegna, University of Catania team lead, used the Einstein Toolkit to develop the model, because she said other Cactus Framework team members had already completed much of the programming groundwork over the toolkit's collaborative history.

While most Einstein Toolkit projects, like Bentivegna's model, are primarily for astrophysics applications, Brandt also noted that the toolkit is applicable to any project described by a hyperbolic partial differential equation.

"You can use it in any kind of physical system where you have fluid mechanics, electrodynamics, or anything that you can describe by a set of fields evolving in time," explained Brandt.

He added that the Cactus Framework team is always searching for new research applications and working on improvements to the toolkit's capabilities. For more information on how to use the Einstein Toolkit, please visit einsteintoolkit.org.

Data Science & Analytics

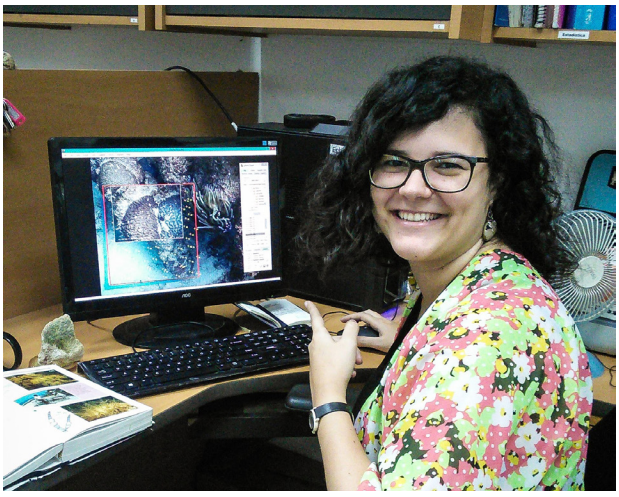
Social Media for Scientists

Lance Porter, LSU professor in the Manship School of Mass Communication and focus area lead for cultural computing at the Center for Computation & Technology (CCT), reported that new research suggests "selfies" may be a strategic tool for changing stereotypes and building trust in the scientific community. Social stereotypes categorize scientists as highly competent, but relatively cold and socially disconnected. They will often be respected, but not always trusted. Public trust is vital for scientists to effectively communicate information about pressing issues like public health concerns or climate change.

Porter co-authored a paper, titled "Using Selfies to Challenge Public Stereotypes of Scientists", with Paige Jarreau, science blogger with the LSU College of Science, after significant evidence showed self-portraits could humanize and increase perceptions of scientists as warm. Warmth, in communication theory, is closely associated to relatability and sincerity. According to the stereotype content model, perceived warmth even has a greater impact on people's beliefs about individuals or stereotyped groups than perceived competence.

"By sharing selfies and stories from their daily lives in the lab/field, talking about their motivations and struggles, inviting viewer participation, and opening up the scientific process, scientists could foster trust by individually and collectively embodying warmth as well as competence," stated the researchers. "By humanizing themselves on social media, scientists may be able to increase trust, public support, and interest in science."

Credit: Paige Jarreau & Lance Porter



Research indicates that photos of scientists smiling and appearing friendly generate warmth and trust with the general public.

Jarreau, P., Cancellare, I., Carmichael, B., Porter, L., Toker, D., & Yammine, S., "Using Selfies to Challenge Public Stereotypes of Scientists." doi.org/10.31235/osf.io/qac4u

Porter hopes more people in the scientific community will start paying greater attention to how they communicate with the general public. He warns that they will miss major opportunities to build trust and "turn the tide" of the scientific narrative if they don't.

Jarreau and Porter are seeking publication of their research in an open-access journal by late 2019.

LSU Social Media Panel Turns Mistake into Golden Opportunity

The LSU Manship School of Mass Communication, in conjunction with the Center for Computation & Technology (CCT), is spearheading an expansive, interdisciplinary project called the LSU Social Media Panel (LSU SMP). The panel is composed of 600 Twitter users and 11 years of Twitter content. Originally obtained by mistake in 2017, the LSU SMP quickly became a hub of new research activity for departments across the campus.

"We paid the data provider to give us following networks and other pieces of data, but they basically gave us a list of Twitter accounts," explained Lance Porter, director of the Social Media Analysis & Creation Lab at the Manship School and joint-appointed faculty member at CCT. "We brought in a post-doc to help us write the code to just pull the data on our own so we wouldn't have to rely on the data provider. That's when the project really took off."

Panel participants completed exhaustive demographic surveys covering information like politics, personality types, income levels, ethnicity, and religion. They also gave permission for open access to their Twitter history. Researchers in various LSU departments are currently studying the survey results and account content for 13 different research projects. These projects cover not only mass communication topics like the digital divide and fake news, but they also look at social issues like those surrounding race and gender, as well as political and business applications. The panel has resulted in over a dozen papers so far.

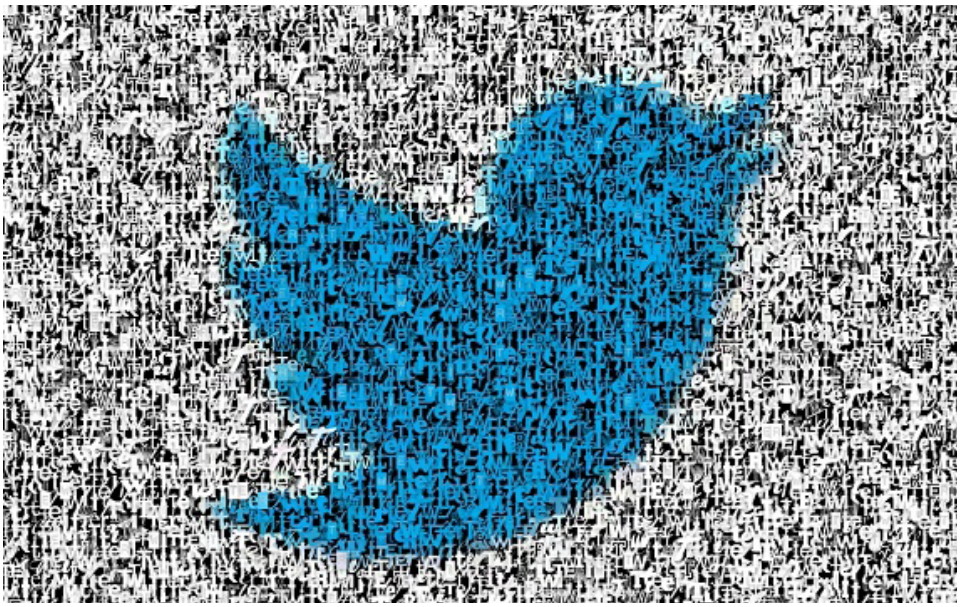
The first published paper to utilize the Panel as a research sample was a methodological study headed by LSU Assistant Professor Michael Henderson, with Porter collaborating. The study compared survey-reported behavior with actual behavior. While there were some variations in the extreme outliers, Henderson and Porter found that the majority of survey results significantly mirrored real-world data.

Porter said, "Anytime you're doing survey research about social media use you need to validate that it's an accurate way to measure (the behaviors). We're the first group to really do that. It was just a little methodological study but an important one."

He continued his research by examining the categorical breakdowns of Twitter use and users. He discovered that most of the Twitter use fell into four categories: life casting (sharing personal updates), politics, entertainment, and promotion. Promotion, in particular, was a category that surprised the research team. This user group is composed of mostly women in their 40s or older that share coupons, survey links, or enter-to-win sweepstakes. They, in most cases, do not participate in the other Twitter categories.

"When we first saw it come up in our results, we thought our data was corrupt. We used some other tools to look at Twitter outside of our data set, and we saw that it is actually a significant piece of what's happening on Twitter," said Porter.

After examining the 11 year content history, Porter was able to determine that promotion became a popular category after Twitter changed their terms of service



An average of 330 million daily Twitter users tweet over 6,000 tweets per second, or 500 million tweets per day. With such a large, active user base, social scientists and advertisers alike are eager to learn more about the populations' demographic make-up and online behaviors.

in 2011, allowing more transactional and promotional content. He also saw a declining trend in life casting during that time. Porter said the most shocking discovery, however, was that politics only accounted for 2 percent of Twitter use.

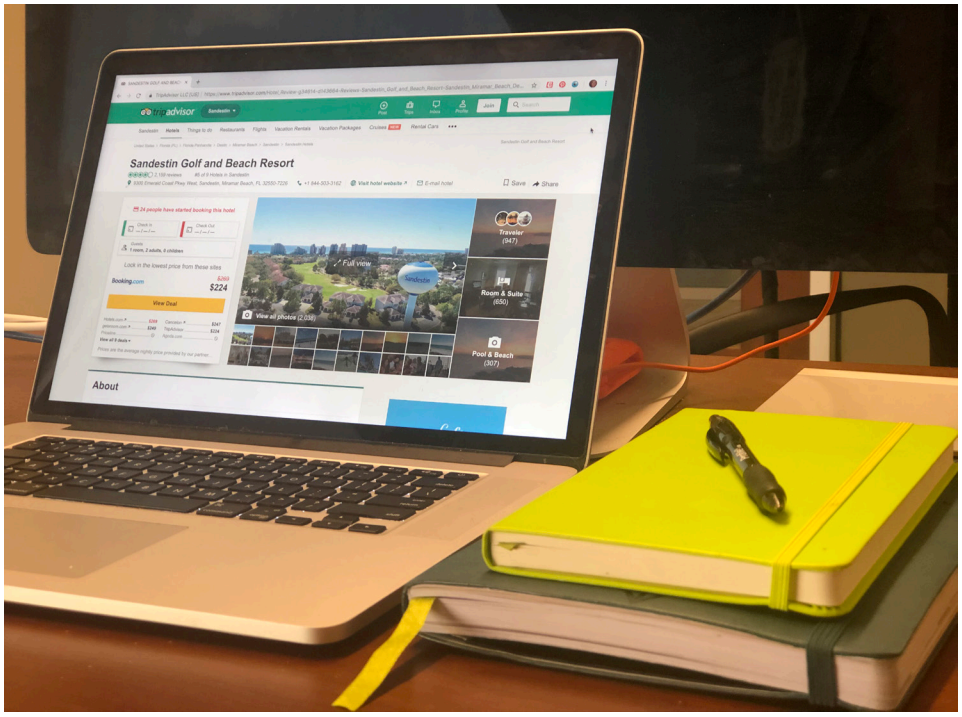
"Politics rise and fall by election year, but these spikes stayed within two percent," Porter explained. "Of course, there are a growing number of super influential people on Twitter. The president uses it, which has caused political tweets to increase slightly, so we're interested to look at 2018's data. We want to see if it will keep going up."

Despite politics only accounting for a small percentage, political scientists are still eager to use the panel to determine how political use breaks down by race. Early results showed that African Americans use Twitter more than other racial groups, and they tended to be more political, with a narrative of "speaking truth to power." Spanish-speaking users, however, tended to stay silent on politics. Focus groups indicated that their silence was driven by fear and discomfort in the current political atmosphere.

Porter said the panel is still in its infancy, and that they'd only begun to scratch the surface of the possible applications. He is currently seeking funding from the LSU Board of Regents that would allow him to increase the panel to 2,100 Twitter accounts and expand to Instagram. Porter believes the larger panel will allow LSU researchers to apply for grants from organizations like the National Science Foundation (NSF), the National Institutes of Health (NIH), and the U.S. Food and Drug Administration (FDA). The NIH and FDA have already expressed interest in using the Social Media Panel to examine health communications. Porter hopes the panel will become similar to a TV ratings system, such that researchers can use it to look at social media communication trends among a large swath of the population.

Systematically Increasing Customer Satisfaction

Credit: Ame Posey



TripAdvisor is one of many third-party information systems that affect businesses on a daily basis. When used effectively, these systems can help businesses reach more customers and provide better service. They can, however, also hinder or damage companies if ignored or misused.

Gabriele Piccoli, a faculty member at the Center for Computation & Technology (CCT) and the Schlieder Chair of Information Sciences at the LSU E. J. Ourso College of Business, described the field of information sciences as "existing at the intersections of organizations and technology." It is an especially important subject for businesses looking to be successful in the modern marketplace.

"Companies compete on the quality of the service they can provide," said Piccoli. "Increasingly, customers come with their iPhones and other kinds of technology. Increasingly, customers are comfortable with self-servicing. If you put those two trends together, then you have a situation where any service provider must be able to provide service through technology."

Piccoli further explained that every aspect of an information system, from programming and software requirements to visual design and user behavior, must be analyzed for system optimization. Projects can range from the more technological aspects of developing a new system to more qualitative studies on user trends. Piccoli is currently working on two projects in the latter category: a qualitative study on company responses to online customer reviews and a

research project to identify competencies for working with information systems beyond company control.

In the first study, Piccoli and one of his doctoral students are using high performance computing (HPC) to analyze texts from online forums to identify common elements that can be linked to higher customer satisfaction.

“Reviews have been greatly analyzed on the quantitative side, the numeric ratings, but we are trying to analyze the actual text of the review. We’re trying to figure out what kind of response is optimal,” said Piccoli. He hypothesizes that congruent responses, meaning responses that address all the concerns presented in the review, will have optimal results and higher ratings. Piccoli, however, did not have any definitive results to release at the time of interview. He hopes to complete the textual analysis later in 2019.

The second project focuses on websites like TripAdvisor, Booking.com, and Expedia – all information systems that publicly use other companies’ information without those companies having any control over the system itself.

“To give you an example,” Piccoli explained, “a hotel owner is going along doing their work when all of a sudden, out of nowhere, comes this website that has information about the hotel, without any say so from its owner. People start to use this website. People start to write reviews on this website so even more people go to this website. This website becomes very powerful. If you are an organization that finds itself sucked into one of these systems, you can decide not to think about it. That’s one decision, probably not a very good decision. The better decision is to develop competencies that allow you to be successful in this system that is beyond firm control.”

By examining the structure of these information systems, Piccoli believes he can identify the skills companies need to optimize their presence on these websites in order to gain larger market shares. His goal is to turn these systems into assets for company growth instead of potential liabilities.

With these and other projects, Piccoli said that his work is constantly evolving as new technologies develop. He said that being successful in information sciences requires adaptability and creativity in addition to the technological and computational skills necessary for system development. He cites CCT as a place he can hone both skill sets.

“CCT is a place to find inspiration more than anything,” said Piccoli. “I see the great work that others are doing, and seeing a bit of emerging technologies before they become mainstream lets me think about how those technologies can affect businesses and organizations in the future.”

Phylanx: Making HPC Accessible for Domain Experts to Expand Research Reach

Domain experts often want to expand their research with projects requiring advanced technology, like distributed machine learning. Unfortunately, they often lack the personnel and the programming skills to develop efficient high-performance computing (HPC) applications. Hartmut Kaiser, research scientist at the Center for Computation & Technology (CCT) and director of the STE||AR Group, believes his new open-source HPC programming platform, Phylanx, could help close the technological gap for domain scientists. The platform will be able to translate commonly used programming languages into the more multifaceted algorithms necessary for HPC and parallelization.

“This technology will enable (domain experts) to write their code in Python, but still be able to execute their applications on distributed compute resources,” said Kaiser. “Without this tool, the programming burden would prevent many scientists from efficiently utilizing the hardware resources that they have access to.”

CCT Research Scientist Patrick Diehl, described how aerospace engineers could use Phylanx to develop a machine learning program capable of predicting properties of combination materials for use in airplane construction. He explained that it is too expensive to physically fabricate and test the thousands of possible combinations. However, the Phylanx produced program could first learn the properties of individual materials, then predict the properties of different combinations, and finally run simulation tests. Engineers would then only need to fabricate the materials most likely to meet the study parameters. This program would significantly reduce the cost of lab experimentation, while simultaneously increasing the probability of success.

“If you develop something, it’s useless if you don’t have it used for real things,” Kaiser said. “It would be like you designed an engine for a car and you never use it in a car; you just let it sit on the desk. Phylanx will be used for real projects. I believe it will really open up the world of HPC, especially machine learning, for domain experts.”

One of the major challenges facing Kaiser and the STE||AR Group is efficient data distribution, or scaling, for time-sensitive computation. Efficient scaling can be inhibited by factors such as computation overheads, communication latencies, and algorithmic limitations. The STE||AR Group is collaborating with the University of Arizona and University of Oregon to develop visualization and performance measurement tools that help overcome the scalability challenge. This concentrated focus on distributive scaling sets Phylanx apart from current programs on the market, like TensorFlow by Google.

“Phylanx, unlike TensorFlow, has been designed with distributed computing in mind,” explained CCT Scientific Program Coordinator, Adrian Serio. “We are confident that built upon HPX we will be able to distribute applications more efficiently than current software offerings.”

STE||AR is currently working under a $1.2 million grant from the U.S. Department of Defense.

Outreach & Networking

SCALA and Frontiers Growing Students' Opportunities for Over a Decade

Susanne Brenner, LSU Boyd Professor in the Department of Mathematics and associate director of academic affairs at the Center for Computation & Technology (CCT), has dedicated much of her career to expanding the reach of computational science. Her expansive network of area experts has opened doors for many LSU students to meet mentors and access resources outside of their classes, internships, and research. Brenner believes two of her founding programs play a role in facilitating these opportunities, the Scientific Computing Around Louisiana (SCALA) annual conference and the Frontiers of Scientific Computing Lecture Series (Frontiers).

"SCALA is a venue for people to get together to exchange ideas and discuss challenges in computational science," explained Brenner. "Frontiers is a way to bring top experts in the field to lecture at LSU. Both events are good opportunities for students and faculty to network and meet top researchers who encourage them in their careers."

Watching students' progress is one aspect of the program that Brenner finds very rewarding. With SCALA now in its 10th year, Brenner discussed some of the students she's seen grow through participation in the program over the last decade. She remembered one graduate student who nervously gave her first presentation at an early SCALA conference. The student continued to attend the event each year, seeking mentorship and advice from established researchers on how to improve both her work and presentations. That student is now an established researcher herself who mentors others.

While SCALA focuses on strengthening connections in and around Louisiana, Frontiers provides LSU students specifically with opportunities to learn directly from internationally recognized experts. Notably, Nicholas Zabaras, from the University of Notre Dame, presented a lecture on Bayesian Deep Learning for Predictive Scientific Computing in 2018, and Xiao-Chuan Cai, from the University of Colorado Boulder, presented a lecture on Numerical Simulation of Blood Flows in Human Arteries in 2017. LSU has hosted the series since 2007, with one to two lectures annually. Previous lecture topics included big data algorithms, space-time multigrid solvers, and numerical modeling. When planning each lecture, Brenner said she looks for both current topics and highly regarded speakers.

"These opportunities make a big impression on students," said Brenner.

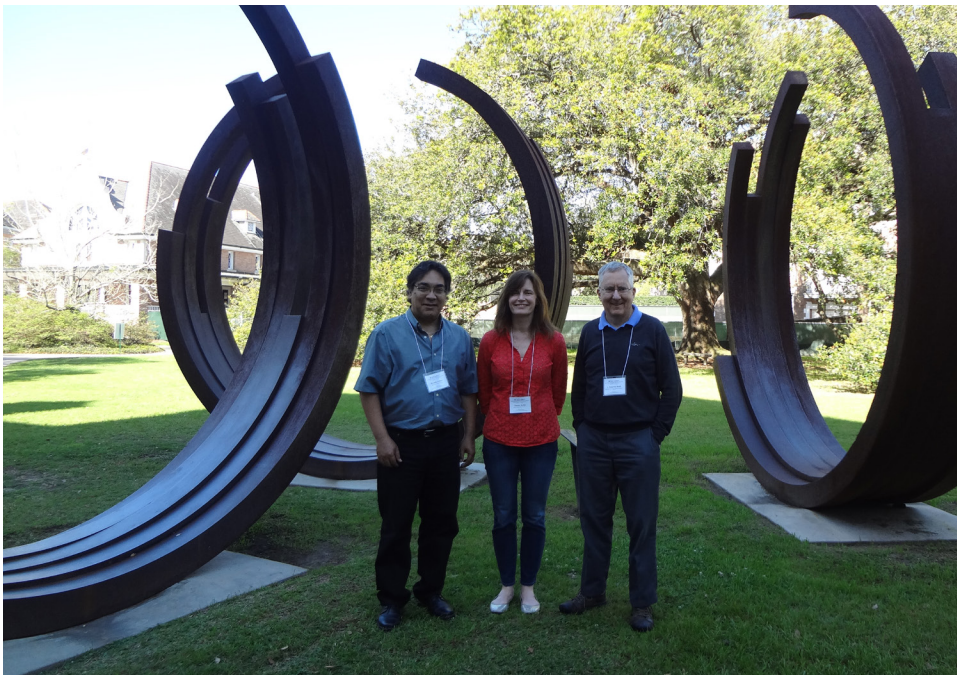
Anyone interested in learning more about SCALA or Frontiers and seeing up-to-date schedules can find more information at the following websites:

- SCALA: sse.tulane.edu/ccs/scala-2019
- Frontiers: cct.lsu.edu/events/lectures/frontiers-scientific-computing-lecture-series

Credit: Susanne Brenner

From left to right: Marisa Eisenberg, Howard Elman, and Johnny Guzman, SCALA 2018 invited speakers

From left to right: 2017 main speakers Ricardo Cortez (Tulane University), Tammy Kolda (Sandia National Laboratories), Ridgway Scott (University of Chicago)



SC18: Celebrating 30 Years of HPC Inspiration

The SC (Supercomputing) Conference Series celebrated its 30th anniversary with its largest conference in history. SC18 hosted 13,071 attendees and 364 exhibitors at the Kay Bailey Hutchison Convention Center in Dallas, Texas from November 11-16, 2018. During the six-day event, attendees presented 118 posters, 68 papers, 16 doctoral showcases, 38 workshops, 35 tutorials, 15 panels, 12 invited speaker presentations, and nine high performance computing (HPC) showcase talks. Steve Brandt, assistant director of computational science at the Center for Computation & Technology (CCT), called it a "spectacular showcase of the world's computing abilities."

Brandt himself has attended the SC Conference Series for the last 15 years, half the series' lifespan. He said that he keeps going back mostly for the fun.

"You reconnect with all the people that you know in all the other places around the country, around the world, that work on supercomputing. You find out what the newest technology and research is in HPC," Brandt explained.

He added that CCT's willingness to send faculty, students, and staff to the conference every year for the last 15 years is a major demonstration of LSU and the center's commitment to be a leading source of HPC and computational science research.

"It's about the networking," said Brandt. "It's exposing our students to career opportunities and exposing us to potential students or faculty. It's a chance to put our name in front of others. Regular attendance, I believe, has made a huge impact on our program."

SC18, as with previous conference iterations, focused on forward-thinking topics like the developing trends in quantum computing and artificial intelligence, but conference organizers also paid tribute to the conference's 30-year history. A pavilion display showcased the timeline of HPC milestones, centering its presentational journey on a vintage Cray1 supercomputer to reflect its inspiring beginnings. The SC18 website states, "This anniversary offers all of us the opportunity to review and celebrate our collective accomplishments, not only in HPC, but also in society at large."

The SC18 Steering Committee chose to reflect these past accomplishments through the theme HPC: Inspires. This theme was most clearly presented at the SC18 Plenary meeting, HPC and AI: Helping to Solve Humanity's Grand Challenges. Panelists discussed the pioneering applications of HPC technologies to problems like global food insecurity, the spread of infectious diseases, and population migration.

"Never before has HPC been more crucial to empowering science for the benefit of humanity," stated SC18 Conference Chair Ralph A. McEldowney "From hurricane and earthquake predictions to solving global hunger challenges, the importance of HPC has never been greater."

Credit: Ame Posey

Students, faculty, and staff from CCT attended SC18 in Dallas, Texas to learn about the newest advancements in supercomputing. LSU displayed a new booth at the event to promote research at CCT.

Red Stick Invests in Louisiana Industries on an International Stage

Over the last decade, Louisiana has invested millions into a developing digital media industry, but investments are only one part of the equation. Assistant Director of Economic Development at the Center for Computation & Technology (CCT) Randy Dannenberg described how surprised people used to be when they heard that Louisiana developed video games, created apps like Waitr, or produced films. He called it an "I didn't know" atmosphere.

To help get the word out about Louisiana's growing digital industry, the LSU Digital Media Arts & Engineering (DMAE) program, CCT, and Louisiana Economic Development (LED) partnered with local stakeholders to turn the Red Stick International Animation Festival, established in 2005, into the Red Stick International Digital Festival. The re-branding focused on expanding awareness about all investment opportunities available in the state and exposing a broader pool of local creators to an international audience.

"Technology is evolving in surprising and interesting directions," said Jesse Allison, LSU Experimental Music & Digital Media associate professor. "We don't see it in the wild until creative people make things with it in useful and inspiring ways. That is what Red Stick is all about: bringing creative-technologists out of their labs and companies and garages to showcase the kinds of digital culture we create right here in Louisiana."

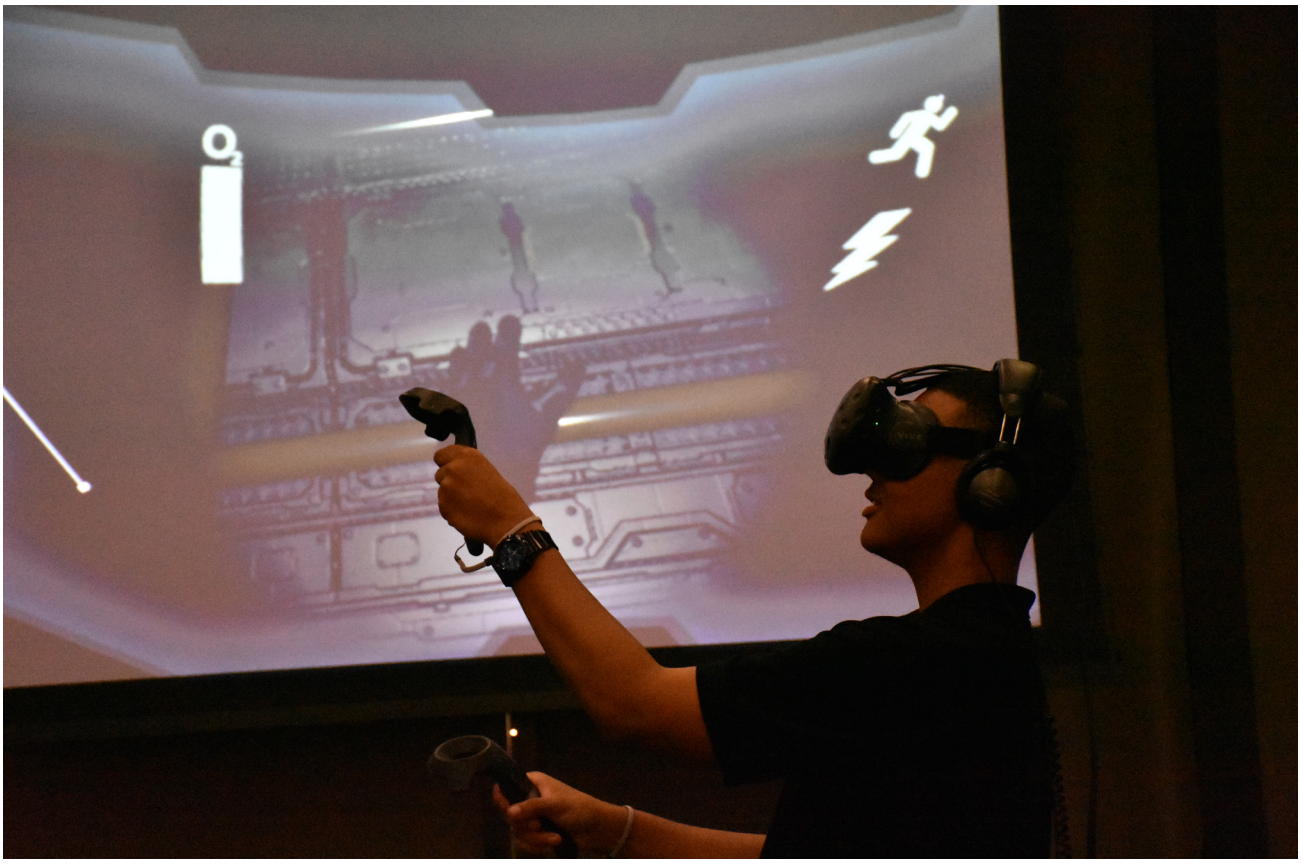
Tailored events allow local creators and companies to demonstrate their current developments or display their creations. While special guest presentations, open discussions with industry experts on techniques, new technologies, and market knowledge.

"It's this sort of atmosphere where people can exchange ideas and build awareness," said Dannenberg.

Guests, in the last two years (2017 & 2018) alone, included lauded industry experts like two-time Academy Award cinematography nominee Chris White; Sessionwire audio software; video game developers from SSX, Star Wars: Battlefront, League of Legends, Need for Speed, and Fortnight; as well as scientific organizations like NASA; and the open-source, electronics platform, Arduino. The caliber of guests adds to the quality of discussions and demonstrations at events. Dannenberg explained that, in addition to adding credibility to Louisiana's economic efforts, the festival helped create an atmosphere that fosters digital development in the region.

"Look at Baton Rouge and Austin (Texas) 20 years ago to now," Dannenberg said. "They are both college towns. They are both capital cities. They both have similar populations. Since the advent of the South by Southwest (SXSW) festival in Austin, however, you can mark Austin's exponential growth in local technology investments and creator populations. That is what we want for Baton Rouge and Louisiana."

Interested participants can find more information on how to get involved at redstickfestival.org.



Credit: Chris Cano

Clockwise from top: Attendee playing a VR horror game set in space created by a group of students; digitally fabricated lanterns by Amanda Verastegui; Matt Blessing's JoyStyx instruments, embedded acoustic instrument with joystick-controlled granular synthesis and spatial sound

Four-Time CCT Summer Camp Participant Now LSU Freshman

Adam Schwarzenbach is an LSU freshman computer science major with an excitable demeanor that bubbles over in his conversations. While still in high school, his outgoing personality made him stand out at CCT-sponsored summer camps, leading to several ongoing mentorships with LSU professors. He greatly credits these mentorships and his camp experiences for his decision to attend LSU.

Q: What camps did you attend?

A: I attended four: Gamecrash: Adventures in Video Game Design (2015), Introduction to Video Game Design (2016), Programming Music Summer Camp (2017), and Beowulf Boot Camp (2018).

Q: What stood out to you about the summer camps?

A: The free snacks of course! No, being serious, what stood out was the attention to detail that some of the professors went into to teach us. It was sort of an inside look into what was going on behind the scenes.

Q: Why did you keep coming back to the camps?

A: I thought it could look good on my résumé as a computer science nerd because it's all about experience.

Q: Did you have a favorite camp?

A: I really liked the music camp because there was this program called EarSketch that taught us to code audio files. I played around with it after the summer camp was over, so I was emotionally invested in it over other programs. I made four or five completed pieces. Three of them were original pieces that I created from scratch. The other two were remixes of songs that I liked, but I thought, "This (song) is great, but it can be better."

Last semester, I submitted my works to Dr. Edgar Berdahl (assistant professor of experimental music and digital media), and he really enjoyed the tambour and use of tension in it. He said he was really impressed. He showed them to the graduate students teaching the experimental music class, and I got in. I feel very lucky.

Q: Was there a camp that was more challenging than the others?

A: The Beowulf Boot Camp was the most complex for me because I didn't know much about it. I picked up on the coding language Python easily, but the content was the hardest to understand. It just didn't click like the rest did. I had to learn the concept of parallelization, which is a very complex concept.

Q: How did the camps impact your decision to attend LSU?

A: In the last one, one of the teachers asked to see my résumé. He said if I ever came to LSU then they might have a job opening for me as a student worker. It was pretty hard to pass up at that point. None of the other schools offered me a job. Plus LSU has plenty of opportunities, plenty of classes, and it's just an hour drive from New Orleans, which is where I'm from.

Q: What advice would you give someone planning on attending the camp to help them get the most out of the experience?

A: Talk with the professors afterwards to try to get a sort of relationship with them because it might make a difference, like getting into a class you want. One of my friend's father used to say that it's not about what you know but who you know. You can get a lot further in life based on the connections you make than on whatever learned experience you have. Not always, but most of the time, nine out of ten.

Q: Do you have any suggestions for future camp topics or ideas?

A: I did a paper on traditional art vs. digital art. I really enjoyed that topic because I do both. If they did an art theme camp, then I would like to see something like that happen.

Adam plans to work in IT after graduation, but he would also love to have a side job working in indie game design. He said the CCT camps and his LSU classes have helped him to see this as a possibility.

For more information about the summer camps, visit cct.lsu.edu/cct-events for more information.

REU Samples Possible Academic and Research Careers

"If you are interested in graduate school or interested in a research career, our REU program is a good way to sample what it is like," said Juana Moreno, LSU associate professor of physics and astronomy at the Center for Computation & Technology (CCT) and principal investigator of the National Science Foundation (NSF) REU award titled, "Interdisciplinary Research Experience in Computational Sciences."

This Research Experience for Undergraduates (REU) is a 10-week, summer research program open to any undergraduate student with an interest in computational science. Participants receive a $5,000 stipend, plus housing and $600 in travel expenses. High school students are also eligible for a shorter program if funding is available. Selected applicants partner with faculty mentors from CCT on research topics in five core academic areas:

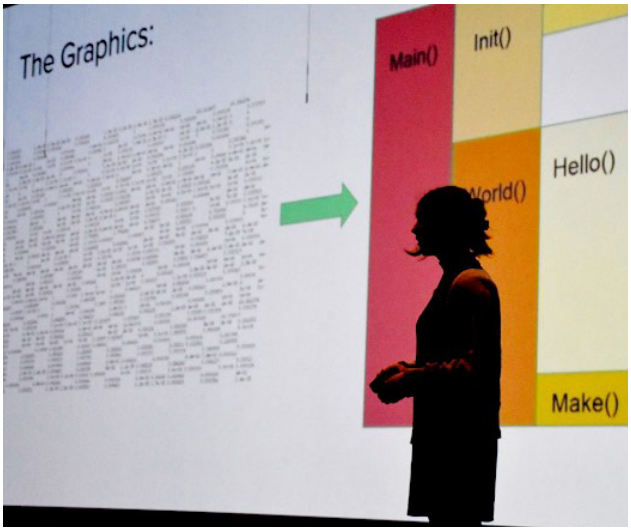
- Core Computing Sciences
- Coast to Cosmos
- Material World
- Cultural Computing
- System Science and Engineering

"The undergraduate and high school students participating in our program are engaged with authentic computational science projects, learn how to use state-of-the-art cyberinfrastructure tools, experience activities that characterize research careers, and work in interdisciplinary research teams," Moreno explained. "These activities have the potential to be transformative in both the students' education as well as their future careers."

At the end of the program, participants create posters to display at the LSU Summer Undergraduate Research Forum (SURF). An REU panel selects three students to apply to present their research at national conferences. Successful applicants are fully funded.

Interested students can learn more about this opportunity at reu.cct.lsu.edu.

Credit: LSU CCT



Clockwise from Bottom Left: Anna Neshyba's giving her initial presentation for her REU project; 2017 REU students tour the Laser Interferometer Gravitational-Wave Observatory (LIGO) in Livingston, Louisiana; 2017 program participants explore the physics behind bubble suspension.

Google Summer of Code: A One-of-a-Kind Student Opportunity

For the fifth year in a row, the prestigious Google Summer of Code (GSoC) program selected the Center for Computation & Technology's (CCT) Systems Technology, Emergent Parallelism & Algorithm Research (STE||AR) Group as a mentoring organization for 2018. GSoC is a premier, global software development training program for both undergraduate and graduate students. Participants work with mentoring organizations, often remotely, on three-month long, open-source projects, receiving professional mentorship and advanced coding training for which participating students receive both great work experience and a stipend from Google. The STE||AR Group, which focuses on distributed parallel computing research, hosted seven student participants in 2018 with five submitting completed projects for the Group's primary software product: HPX, a standard C++ library for parallelism and concurrency.

"This program provides excellent opportunities for students from all over the world to get involved with leading open source projects. We at LSU see it as part of our mission to help them in learning how modern software development is done," said Hartmut Kaiser, a research scientist leading the STE||AR Group at CCT and an adjunct faculty in the Division of Computer Science & Engineering at LSU. "Through our involvement with GSoC over the years we have been able to gain dozens of new members for our group, many of whom still contribute to our work."

Kaiser added that GSoC is a uniquely rare opportunity for computer science students to gain highly sought-after coding skills through professional mentorship. Kaiser recalled that as a student he had very limited opportunities to work on large batches of code and very limited opportunities to get personalized feedback from his professors and supervisors. "GSoC, however, exposes participants to global experts that give personal attention to developing and mentoring students' coding skills," Kaiser said. Ram Ramanujam, director of CCT, said, "It is an important recognition for the STE||AR Group to be selected for GSoC five years in a row."

Successful student participants included: Nikunj Gupta, who worked on components needed to turn HPX into a full C++ runtime replacement; Ahmed Samir, who developed algorithms for all-to-all communication in HPX; Gabriel Laberge, who extended HPX's smart executor framework; Jakub Golinowski, whose project investigated integrating HPX with another large open source library called OpenCV; and Evgeny Dedov, who worked on a Newtonian physics sandbox. The work of Nikunj and Gabriel stands out as especially successful. They were invited to spend the following summer as interns to work directly with the STE||AR Group at LSU.

Students interested in applying for future GSoC programs, should contact the STE||AR Group at hpx-users@stellar.cct.lsu.edu. Applications usually open in March.

Honors & Awards

Honors & Awards

SUSANNE C. BRENNER

- Louisiana State University System Boyd Professor, 2017
- Householder Lecture, University of Tennessee and ORNL, 2017
- SEC Faculty Achievement Award, 2017
- SIAM Classics in Applied Mathematics, Editor-in-Chief, 2018-present
- Scientific Advisory Board, Hausdorff Center for Mathematics, University of Bonn, 2017-present
- Member-at-Large, American Association for the Advancement of Science (Section A), 2017-2021

MICHAL BRYLINSKI

- LSU Alumni Association Rising Faculty Research Award, 2017

SCOTT HAGEN

- Most Cited Article Award (2012-2016) from the Chinese Geoscience Union (in February 2017) for the article:

  Hagen, S.C., Bacopoulos, P., "Coastal Flooding in Florida's Big Bend Region with Application to Sea Level Rise Based on Synthetic Storms Analysis." *Terrestrial, Atmospheric and Oceanic Sciences,* Vol. 23, No. 5, October 2012, pp. 481-500. dx.doi.org/10.3319/TAO.2012.04.17.01(WMH)

KENNETH LOPATA

- LSU Alumni Association Rising Faculty Research Award, 2018
- Tiger Athletic Foundation Undergraduate Teaching Award, 2017

GIULIO MARIOTTI

- Tiger Athletic Foundation Undergraduate Teaching Award, 2018

HYE YEON NAM

- Jule Collins Smith Museum of Fine Art (jcsm.auburn.edu/exhibitions/ootb-2017-digital-exhibition-1-nam/), Honorable Mention, Auburn, Alabama, October 2017

DERICK OSTRENKO

- Tiger Athletic Foundation Undergraduate Teaching Award, 2018

LANCE PORTER

- LSU Rainmaker Mid-Career Scholar Award, 2016 (awarded in 2017)
- 2018 Top Faculty Paper Award in the Communication Technology and Policy Division, Association for Education in Journalism and Mass Communication Annual Conference for the paper:

  Jiang, K., Wang, R., Porter, L. & Johnson, M. (August 2018). Pundits, Presenters and Promoters: Investigating Gaps in Digital Production among Social Media Users Using Self-Reported and Behavioral Measures.

JAGANNATHAN "RAM" RAMANUJAM

- ACM SIGPLAN Most Influential Paper Award 2018 for the paper:

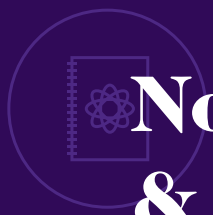
  U. Bondhugula, A. Hartono, J. Ramanujam, and P. Sadayappan, "A practical automatic polyhedral parallelizer and locality optimizer," Proc. ACM SIGPLAN 2008 Conference on Programming Language Design and Implementation (PLDI'08), June 2008
- 2016 Distinguished Research Master Award, Louisiana State University, awarded in April 2017 (one award in STEM disciplines in recognition of outstanding career accomplishments in research and scholarship, given each year at LSU)

GOLDEN G. RICHARD III

- Best Student Paper Award: N. Lewis, A. Case, A. Ali-Gombe, G. G. Richard III, "Memory Forensics and the Windows Subsystem for Linux," *Proceedings of the* 2018 Digital Forensics Research Conference (DFRWS), July 2018, Providence, Rhode Island.

GEORGE XUE

- Phi-Kappa-Phi award (LSU Chapter) for non-tenured faculty for year 2018.



Notable Publications & Presentations

Notable publications

BLAISE BOURDIN

- Tanné, E., Li, T., **Bourdin, B.**, Marigo, J. J., & Maurini, C. (2018). Crack nucleation in variational phase-field models of brittle fracture. *Journal of the Mechanics and Physics of Solids*, 110, 80-99. Most cited article in 2018 of the *Journal of the Mechanics and Physics of Solids*.

SUSANNE C. BRENNER

- **Brenner, S. C.**, & **Sung, L. Y.** (2017). A new convergence analysis of finite element methods for elliptic distributed optimal control problems with pointwise state constraints. *SIAM Journal on Control and Optimization*, 55 (4), 2289-2304.
- **Brenner, S. C.**, & **Sung, L. Y.** (2018). Virtual element methods on meshes with small edges or faces. *Mathematical Models and Methods in Applied Sciences*, 28(07), 1291-1336.

LESLIE BUTLER

- Brooks, A. J., Ge, J., Kirka, M. M., Dehoff, R. R., Bilheux, H. Z., Kardjilov, N., Manke, I., **Butler, L.G.** (2017). Porosity Detection in Electron Beam Melted Ti-6Al-4V using High-Resolution Neutron Imaging and Grating-Based Interferometry. *Progress in Additive Manufacturing*, 2, 125-132.

MICHAL BRYLINSKI

- Govindaraj, R.G., Naderi, M., Singha, M., Lemoine, J., **Brylinski, M.** (2018) Large-scale computational drug repositioning to find treatments for rare diseases. *NPJ Syst Biol Appl* 4: 13.

SCOTT HAGEN

- Alizad, K., **Hagen, S. C.**, Medeiros, S. C., Bilskie, M. V., Morris, J. T., Balthis, L., & Buckel, C. A. (2018). Dynamic responses and implications to coastal wetlands and the surrounding regions under sea level rise. *PLOS ONE*, 13(10), e0205176.
- Kidwell, D. M., Dietrich, J. C., **Hagen, S. C.**, & Medeiros, S. C. (2017). An Earth's Future Special Collection: Impacts of the coastal dynamics of sea level rise on low-gradient coastal landscapes. *Earth's Future*, 5(1), 2-9.

RUDY HIRSCHHEIM

- Baham, C. W., **Hirschheim, R.**, Calderon, A., Kisseka, V. (2017). An Agile Methodology for the Disaster Recovery of Information Systems under Catastrophic Scenarios. *Journal of Management Information Systems*, 34(3), 633-663.
- Love, J., **Hirschheim, R.** (2017). Crowdsourcing of Information Systems Research. *European Journal of Information Systems*, 26(3), 315-332.

REVATI KUMAR

- Li, K., Galle Kankanamge, S. R., Weldeghiorghis, T. K., Jorn, R., Kuroda, D. G., & **Kumar, R.** (2017). Predicting Ion Association in Sodium Electrolytes: A Transferrable Model for Investigating Glymes. *The Journal of Physical Chemistry C*, 122(9), 4747-4756. (cover art).
- Galle Kankanamge, S. R., Li, K., Fulfer, K. D., Du, P., Jorn, R., **Kumar, R.**, & Kuroda, D. G. (2018). Mechanism behind the Unusually High Conductivities of High Concentrated Sodium Ion Glyme-Based Electrolytes. *The Journal of Physical Chemistry* C, 122(44), 25237-25246.
- •Du, P., Li, A., Li, X., Zhang, Y., Do, C., He, L., Rick, S. W., John, V. T., **Kumar, R.**, & Zhang, D. (2017). Aggregation of cyclic polypeptoids bearing zwitterionic end-groups with attractive dipole–dipole and solvophobic interactions: a study by small-angle neutron scattering and molecular dynamics simulation. *Physical Chemistry Chemical Physics*, 19(22), 14388-14400.

HYE YEON NAM

- **Nam, H.** (2018). Invisible. History of the Future (bostoncyberarts.org/history-of-the-future/), Boston CyberArts Gallery, Boston, Massachusetts. May - July 2018.
- **Nam, H.** (2017). *Floating Identity*, Out of the Box, *Honorable Mention*, Jule Collins Smith Museum of Fine Art (Juror: Jean Shin), (jcsm.auburn.edu/exhibitions/out-of-the-box-2017/), Auburn, Alabama, October 2017 - October 2018; also, at the Art Science Exhibits, Berlin Science Week, Berlin, Germany, November 2017.

LANCE PORTER

- Crosswell, L., & **Porter, L.** (2018). *Politics, Propaganda, and Public Health: A Study Case in Health Communication and Public Trust.* Lexington Books (peer-reviewed book).

JORGE PULLIN

- Ashtekar, A., & **Pullin, J.** (Eds.). (2017). *Loop Quantum Gravity: The First 30 Years*. World Scientific Publishing Co. Private Ltd.

JAGANNATHAN "RAM" RAMANUJAM

- Ali-Gombe, A. I., Saltaformaggio, B., **Ramanujam, J.**, Xu, D., & **Richard III, G. G.** (2018). Toward a more dependable hybrid analysis of android malware using aspect-oriented programming. *Computers & Security*, 73, 235-248.

GOLDEN G. RICHARD III

- Lewis, N., Case, A., Ali-Gombe, A., & **Richard III, G. G.** (2018). Memory forensics and the Windows Subsystem for Linux. Digital Investigation, 26, S3-S11. Also in Proceedings of the 2018 Digital Forensics Research Conference (DFRWS), Best Student Paper Award.
- Bhatia, R., Saltaformaggio, B., Yang, S. J., Ali-Gombe, A. I., Zhang, X., Xu, D., & **Richard III, G. G.** (2018). Tipped Off by Your Memory Allocator: Device-Wide User Activity Sequencing from Android Memory Images. In Proceedings of the 2018 Network and Distributed System Security Symposium (NDSS).

WILLIAM A. SHELTON

- Huang, S., Kim, J., **Shelton, W. A.**, Plummer, E. W., & Jin, R. (2017). Nontrivial Berry phase in magnetic BaMnSb2 semimetal. *Proceedings of the National Academy of Sciences*, 114(24), 6256-6261.

MAYANK TYAGI

- **Tyagi, M.** (2017). Offshore Spill Response Systems: Capping and Containment. Encyclopedia of *Maritime and Offshore Engineering*, John Wiley, 1-6.
- Akhmadullin, I., & **Tyagi, M.** (2017). Numerical analysis of downhole heat exchanger designed for geothermal energy production. *Geothermal Energy,* 5(1), 13.

GEORGIOS VERONIS

- Sharifi, S., Banadaki, Y. M., Nezhad, V. F., **Veronis, G.**, & Dowling, J. P. (2018). Aperiodic multilayer graphene based tunable and switchable thermal emitter at mid-infrared frequencies. *Journal of Applied Physics*, 124(23), 233101.
- Mahigir, A., Chang, T. W., Behnam, A., Liu, G. L., Gartia, M. R., & **Veronis, G.** (2017). Plasmonic nanohole array for enhancing the SERS signal of a single layer of graphene in water. *Scientific Reports*, 7(1), 14044.

MARK WILDE

- Takeoka, M., Seshadreesan, K. P., & **Wilde, M. M.** (2017). Unconstrained capacities of quantum key distribution and entanglement distillation for pure-loss bosonic broadcast channels. *Physical Review Letters*, 119(15), 150501.
- Das, S., Bäuml, S., & **Wilde, M. M.** (2018). Entanglement and secret-key-agreement capacities of bipartite quantum interactions and read-only memory devices. *Physical Review Letters*, 121, 150501.
- Mario Berta, M., Brandao, F. G. S. L., Majenz, C. & **Wilde, M. M.** (2018). Conditional Decoupling of Quantum Information. *Physical Review Letters*, 121(4), 040504.

Plenary and Keynote Talks

BLAISE BOURDIN

- 10th ICACM U.S.-France Symposium Dynamic Damage and Fragmentation, Fort Walton, Florida. Keynote lecture, May 2017
- 5th Conference on Computational Modeling of Fracture and Failure of Materials and Structures (CFRAC 2017), Nantes, France. Plenary lecture, June 2017
- Mathias conference, TOTAL, Paris, France. Keynote lecture, October 2017
- Society of Engineering Science 55th Annual Technical Meeting, mini-symposium "Phase-Field Modeling in Materials Science and Engineering," Madrid, Spain. Keynote lecture, October 2018

SUSANNE C. BRENNER

- C0 Interior Penalty Methods, Midwest Numerical Analysis Day, University of Kansas, April 14-15, 2018
- C0 Interior Penalty Methods, 7th International Conference on Advanced Computational Methods in Engineering (ACOMEN 2017), Ghent, Belgium, September 18-22, 2017
- C0 Interior Penalty Methods, Current Trends and Challenges in Numerical PDEs, Purdue University, July 7-8, 2017
- An Additive Schwarz Analysis of Multiplicative Schwarz Methods, 24th International Conference on Domain Decomposition Methods, Svalbard, Norway, February 6-10, 2017

SCOTT HAGEN

- The Mississippi River Delta Plain as a basis for understanding low gradient coastal land margin systems and how we may engineer our response to climate change, 6th International Conference on Estuaries & Coasts, Caen, France, August 20, 2018
- How to assess climate change impacts at the coastal land margin and produce transdisciplinary research outcomes, Environmental, Water resources, and Coastal engineering Graduate Research Symposium, NCSU, Rayleigh, North Carolina, March 2, 2018
- Pathways at the coastal land margin to assess climate change impacts with transdisciplinary research outcomes, 2017 CSDMS annual meeting Modeling Coupled Earth and Human Systems: The Dynamic Duo, Boulder, Colorado, May 23-25, 2017

RUDY HIRSCHHEIM

- History of IS Outsourcing. ICIS2018, Advances in Sourcing Special Interest Group Workshop, San Francisco, California, December 2018
- Assessing Scholarly Influence. Big 12 PhD Workshop, Oklahoma State University, Stillwater, Oklahoma, April 2018

REVATI KUMAR

- Force-fields for molecular simulations: A brief introduction with examples, Mercury consortium, Furman University South Carolina, July 2017

MARK WILDE

- Plenary talk, Trading communication resources in quantum Shannon theory, Information Theory Workshop 2017, Kaohsiung, Taiwan

Other Invited Talks

SUSANNE C. BRENNER

- C0 Interior Penalty Methods
  - University of Electronic Science and Technology of China (UESTC), Chengdu, China, December 18, 2017
  - International Conference on Recent Advances in Computational and Applied Mathematics, Wuhan, China, December 14-17, 2017
  - AMSS-PolyU Joint Research Institute Distinguished Lecture, The Hong Kong Polytechnic University, December 12, 2017
  - Colloquium, University of Houston, October 11, 2017
  - Oberseminar Numerik, Ruhr-Universitat Bochum, Bochum, Germany, March 27, 2017
- A New Convergence Analysis of Finite Element Methods for Elliptic Distributed Optimal Control Problems with Pointwise State Constraints, SIAM Annual Meeting, Pittsburgh, July 10-14, 2017
- Finite Element Methods for Fourth Order Elliptic Variational Inequalities, Recent Advances in PDE: Theory, Computations and Applications, Indian Institute of Technology Bombay, Mumbai, India, June 8-10, 2017
- Finite Element Methods for Fourth Order Elliptic Variational Inequalities
  - Shenzhen Institutes of Advanced Technology, Shenzhen, China, June 5, 2017
  - Householder Lecture, University of Tennessee at Knoxville, April 28, 2017
- Computational Mathematics, Householder Lecture, Oak Ridge National Laboratory, April 27, 2017
- Additive Schwarz Theory, Domain Decomposition: Past, Present, and Future, A Workshop in Honor of Olof Widlund's Retirement, Courant Institute, February 24-25, 2017

SCOTT HAGEN

- "Pathways to resiliency through economic assessments of dynamic sea level rise," 37th IAHR World Congress, Kuala Lumpur, Malaysia, August 13-18, 2017
- "System of systems approaches to tide and surge simulations on low-gradient coastal landscapes," National Cheng Kung University, Disaster Prevention Education Center, Taichung, Taiwan, April 10, 2017
- "How to assess climate change impacts at the coastal land margin and produce transdisciplinary research outcomes," The University of Southern Mississippi, Gulf Coast Research Laboratory, April 19, 2018
- "The dynamic effects of sea level rise on low-gradient coastal landscapes," National Academy of Sciences, Blue Carbon Workshop, Webinar, July 26, 2017
- "ADCIRC and the Coastal Dynamics of Sea Level Rise," ADCIRC User's Group Meeting, Norwood, Massachusetts, May 4, 2017
- "The Future of Water: Regional Collaboration on Shared Climate, Coastlines, and Watersheds," SEC Academic Conference, Starkville, Mississippi, March 27-28, 2017

RUDY HIRSCHHEIM

- Panel: "Against Method" and "Anything Goes?" A Critical Discussion Based on the "Strange Ideas" from Paul Feyerabend on whether Epistemological Anarchy Can Benefit IS Research, 38th International Conference on Information Systems, San Francisco, California. December 15, 2018
- Hirschheim, R., Panel Discussant, Socio-Technical Systems Workshop, London School of Economics, London, UK, "History of STS in the Information Systems Field," October 24, 2018
- Panel Discussant, IAOP Research Workshop, International Association of Outsourcing Professionals, San Antonio, Texas, "Crowdsourcing: Lessons Learned," February 18, 2017

REVATI KUMAR

- "Developing Robust Force-Fields: From electrolytes for energy storage to atmospheric processes," Greater Boston Area Theoretical Seminar organized by MIT, Harvard and Boston University at MIT, Cambridge, Massachusetts, February 2018

JUNHONG LIANG

- "Bubble-mediated air-sea gas exchange," Seminar, University of South Florida, St Petersburg, Florida, October 2018
- "Understanding and parameterizing horizontal dispersion of buoyant materials in the ocean surface boundary layer," Seminar, Naval Research Laboratory, John Stennis Center, Mississippi, June 2018

GIULIO MARIOTTI

- Invited talk at 2018 AGU Fall meeting

JORGE PULLIN

- Invited talk at the meeting Grav19 at the University of Cordoba, Argentina, April 2019
- Mini course on numerical relativity and two talks at the Instituto Balseiro, Argentina, July 2018
- Two invited talks at CSIC, Consejo Superior de Investigaciones Cientificas, Spain, July 2018

MAYANK TYAGI

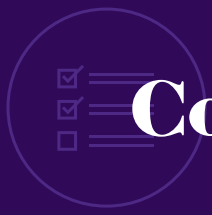
- Lattice Boltzmann Method (LBM) simulations study for the effects of stress, compaction, and plugging on inertial flow parameters in proppant packs, MATHIAS 2017, Workshop by TOTAL, Paris, France, October 2017
- Computational Fluid Dynamics (CFD) simulations study of the wellbore construction processes including cuttings transport during drilling, fluid displacement during primary cementing, and near wellbore flow around completions during production operations, MATHIAS 2017: Workshop by TOTAL, Paris, France, October 2017
- Simulation Challenges for Petroleum Engineering Applications at Diverse Length Scales, Invited Talk, King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia, October 2017

GEORGIOS VERONIS

- Using phase-change materials to switch the direction of reflectionless light propagation in non-PT-symmetric structures, SPIE Optics + Photonics 2018, San Diego, California, August 2018
- Non-PT-symmetric plasmonic waveguide-cavity systems: unidirectional reflectionlessness and broadband near total light absorption, SPIE Optics + Photonics 2017, San Diego, California, August 2017

MARK WILDE

- “Quantum information, statistics, probability” with a special session dedicated to A. S. Holevo’s 75th birthday, Moscow, Russia, September 2018
- Quantum Limits of Optical Communication II, September 19-21, 2018, Warsaw, Poland
- University of Oxford Quantum Information Seminar, May 2018
- Analysis in Quantum Information Theory, Institut Henri Poincare, Paris, December 2017
- Summer School on “Mathematical Aspects of Quantum Information,” Institut des Etudes Scientiques de Cargese, Corsica, France, September 2017
- Within and beyond quantum mechanics, Sopot, Poland, May 25-27, 2017

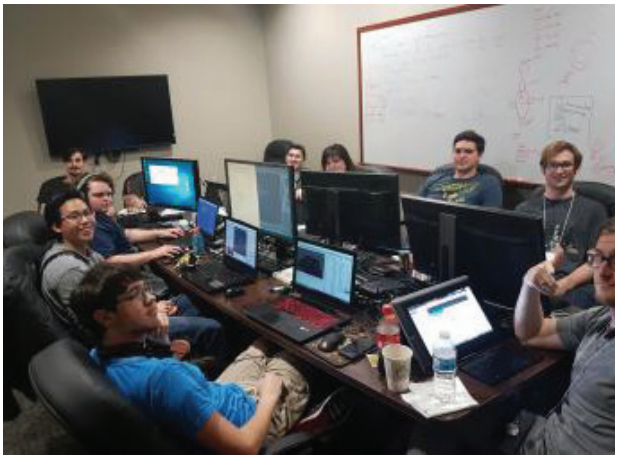


Conferences & Events

2017

Credit: LSU CCT and LSU Department of Physics & Astronomy

NanoDays 2017



Credit: LSU DMAE

Global Game Jam 2017

Credit: LSU DMAE

PAX South 2017

JANUARY

January 20–22
Global Game Jam - CCT's Digital Media Center, LSU
CCT was a host site for the 9th annual Global Game Jam, the largest game jam in the world.

January 27–29
PAX South - San Antonio, Texas
PAX South annually draws crowds of over 70,000 gaming enthusiasts and developers. CCT and the Digital Media Arts & Engineering (DMAE) program co-sponsored an exhibit booth to recruit and promote LSU's work in video game development.

FEBRUARY

February 23–25
19th Annual SQuInT Workshop - CCT's Digital Media Center, LSU
Regional experts in quantum information science gathered at CCT and the LSU Department of Physics & Astronomy for the 2018 Southwest Quantum Information and Technology (SQuInT) workshop.

MARCH

March 1–3
Game Developers Conference - San Francisco, California
As the premier event for professional video gave developers, the Game Developers Conference was a prime networking opportunity for students in the DMAE program.

March 9
Cinema for the Ears Concert - CCT's Digital Media Center, LSU
In partnership with the CCT Digital Media Center, the Experimental Music & Digital Media (EMDM) studio created a high-definition sound projector using a palette of over 92 speakers. EMDM featured their design in a concert billed as a "musical experience that you can find nowhere else."

March 10–11
National Student Electronic Music Event - CCT's Digital Media Center, LSU
Conference attendees were treated to original electronic music performances and discussion on the musical genre's applications and future direction.

March 17–18
Scientific Computing Around Louisiana (SCALA) - Tulane University, New Orleans, Louisiana
2017 marked the eighth annual conference with Tulane University hosting and LSU co-sponsoring. (For more information, see page 54)

March 25
NanoDays @ Highland Road Park Observatory - Baton Rouge, Louisiana
Family friendly physics fun greeted guests at the local observatory for a day of STEM activities. Students and faculty from the LSU Department of Physics & Astronomy gave small demonstrations to explain the physics behind each activity.

March 31–April 2
DADA Animation Jam - CCT's Digital Media Center, LSU
LSU's Digital Art and Design Association (DADA) launched their inaugural Animation Jam with great success. All completed works are available at vimeo.com/album/4512792.

APRIL

April 1
High Voltage @ EBB & Flow Festival - Baton Rouge, Louisiana
The LSU electronic music group, High Voltage, took the stage at the 2017 Baton Rouge EBB & Flow Festival.

April 27–30
Red Stick International Digital Festival - Baton Rouge, Louisiana
Red Stick 2017 brought together powerhouses from the video game and digital media industries. (For more information, see page 58)

April 30
High Voltage @ LASM Planetarium - Baton Rouge, Louisiana
High Voltage held a local concert at the Louisiana Art & Science Museum Planetarium to showcase original compositions by LSU students and faculty.

MAY

May 29–June 2
Gamecrash: Adventures in Game Design Camp - CCT's Digital Media Center, LSU
Middle and high school students delved deeper into the video games they love by learning to create their own.

JUNE

June 1
DMAE Movie Night Double Feature: Particle Fever & Indie Game: The Movie - CCT's Digital Media Center, LSU
DMAE hosted a film screening of two critically acclaimed documentary features.

June 26–30
Beowulf Boot Camp - CCT's Digital Media Center, LSU
Participants in the Beowulf Boot Camp learned how to build their own mini-supercomputing clusters from scratch and how to program them with Python for parallel computation.

JULY

July 7–9
RTX Austin - Austin, Texas
CCT sponsored an exhibit to promote the DMAE program and film/video game development opportunities at LSU for the 2017 RTX Austin – a three-day gaming and internet culture event hosted by Rooster Teeth.

July 17–21
Baton Rouge Energy Venture Camp 2017 - BRCC and LSU
LSU and Baton Rouge Community College (BRCC) co-hosted a camp sponsored by Shell Oil to introduce high school students to the energy industry.

July 17–21
Programming Music Summer Camp - CCT's Digital Media Center, LSU
Twenty-four middle and high school students learned how to create web-based instruments and original compositions using Java Script.

July 24–26
PyFUN Programming Summer Camp - CCT's Digital Media Center, LSU
CCT hosted 25 middle school students for its 2017 introductory programming camp.

July 28
LSU Summer Undergraduate Research Forum (SURF) - CCT'S Digital Media Center, LSU
SURF 2017 showcased the summer research projects of undergraduates in various LSU programs.

OCTOBER

October 27–28
Electric LaTex 2017 - CCT's Digital Media Center, LSU
Louisiana and Texas musicians gathered in Baton Rouge for Electric LaTex 2017, celebrating advancements in electronic music.

NOVEMBER

November 3–4
ACM ICPC South Central USA Regional Programming Contest - CCT's Digital Media Center, LSU
LSU served as the host for the 2017 ACM ICPC regional competition and hosted 13 teams, of which six placed in the top 50.

November 13–17
Supercomputing Conference 2017 (SC17) - Denver, Colorado
LSU and CCT sponsored an exhibit at SC17 in Denver, Colorado. CCT faculty also contributed to tutorials as part of the conference student programming and participated in the Mentor-Protégé networking events.

2018

Credit: LSU DMAE

Global Game Jam 2018

Credit: LSU CCT

SURF 2018

Credit: Susanne Brenner

Finite Element Rodeo 2018

JANUARY

January 12–14
PAX South - San Antonio, Texas
The Digital Media Arts & Engineering (DMAE) program at CCT sponsored an exhibition booth at the 2018 PAX South video game conference to promote video game development at LSU.

January 26–28
Global Game Jam 2018 - CCT's Digital Media Center, LSU
LSU served as a host site for the 2018 Global Game Jam and submitted 13 games, which are available to play at globalgamejam.org/2018/jam-sites/lsu-global-game-jam/games.

FEBRUARY

February 2–3
Scientific Computing Around Louisiana (SCALA) - CCT's Digital Media Center, LSU
CCT hosted 54 attendees at the 9th Annual SCALA Meeting. (For more information, see page 54)

February 16
High Voltage Concert - CCT's Digital Media Center, LSU
The experimental music group, High Voltage, presented an eclectic concert of trans-media works that interwove live performers, acoustic instruments, and original technology into an amplified auditory experience.

February 23–24
Finite Element Rodeo - CCT's Digital Media Center, LSU
The Finite Element Rodeo is an annual gathering of interdisciplinary researchers and students to discuss the theory and implementation of the Finite Element Method (FEM) – a problem-solving numerical model.

MARCH

March 12–16
Quantum Communication, Measurement, and Computing (QCMC) - CCT's Digital Media Center, LSU
Speakers from over 15 different countries presented lectures on quantum information science and technology at the 14th Annual QCMC Conference.

March 21–23
Game Developers Conference - San Francisco, California
DMAE Director Marc Aubanel described the annual Game Developers Conference as "the premier global event for people who develop games professionally." CCT and DMAE sponsored an exhibitor booth to promote video game development at LSU.

APRIL

April 6–7
Conference on Biology and Bioinformatics - CCT's Digital Media Center, LSU
The annual Conference on Biology and Bioinformatics is a statewide platform to share research findings and industry developments with the local scientific community.

April 13

Screening and Q&A of Don Hertzfeldt's World of Tomorrow Episode Two - CCT's Digital Media Center, LSU

Don Hertzfeldt, a two-time Academy Award nominee and Sundance Grand Prix (animation short) winner, brought his newest film, World of Tomorrow Episode Two, to LSU.

April 13–15

2018 DADA Animation Jam - CCT's Digital Media Center, LSU

TurboSquid sponsored the 2nd Annual DADA Animation Jam at CCT's Digital Media Center. Two animation entries are available for viewing at vimeo.com/264855433 (The Red Beetle by Emma Gonzales) and vimeo.com/264873093 (Love Bug by Arden Hale).

April 17

Regional Seminar on Smart Manufacturing by the Clean Energy Smart Manufacturing Innovation Institute (CESMII) - CCT's Digital Media Center, LSU

CCT organized a one day workshop for CESMII to present new technologies developed on the open source SM PlatformTM system.

April 24–28

Redstick International Digital Festival - Baton Rouge, Louisiana

The Red Stick development team used 2018 to rebrand and retool the annual festival into an event focused on broader applications of digital media and cross-sections of art with science. (For more information, see page 58)

April 27

5th Annual EPIC Workshop - CCT's Digital Media Center, LSU

EPIC@LSU (Enabling Process Innovation through Computation), a program by the LSU College of Engineering and CCT, held its fifth annual workshop addressing HPC solutions to industry problems in chemical and petrochemical manufacturing.

MAY

May 18–19

Southeastern Theoretical Chemistry Association Meeting (SETCA) 2018 - CCT's Digital Media Center, LSU

Theoretical and computational chemists from the Southeastern United States met at CCT for the 2018 SETCA conference.

May 28–June 1

Gamecrash: Adventures in Game Design Summer Camp - CCT's Digital Media Center, LSU

Excited middle and high school students explored computer science and programming concepts through popular video games.

JUNE

June 4–8

Girls Rock! Sound Engineering Summer Camp - CCT's Digital Media Center, LSU

Bringing together the art of music composition with modern technology, Girls Rock! introduced middle school girls to the inventiveness of sound engineering.

June 11–15
PyFUN Programming Summer Camp - CCT's Digital Media Center, LSU
Middle school students began to explore the world of programming at the 2018 PyFUN summer camp.

June 18–22
Programming Music Summer Camp - CCT's Digital Media Center, LSU
Middle and high school students took to their computers before taking to the stage at the Programming Music Summer Camp.

JULY

July 9–13
Beowulf Boot Camp - CCT's Digital Media Center, LSU
CCT faculty taught 25 eager high school students how to build and program Beowulf supercomputing clusters at the 2018 Beowulf Boot Camp.

July 16–20
Baton Rouge Energy Venture Camp 2018 - BRCC and LSU
Sponsored by Shell Oil, the Baton Rouge Energy Venture Camp introduces high school students to careers in the energy industry. LSU co-hosted the event with Baton Rouge Community College (BRCC).

July 27
Summer Undergraduate Research Forum (SURF) - CCT's Digital Media Center, LSU
SURF 2018 celebrated its 25th year with student projects from various LSU laboratories.

OCTOBER

October 1
Cinema for the Ears - CCT's Digital Media Center, LSU
The LSU College of Music & Dramatic Arts partnered with CCT to present a cutting-edge multimedia performance that combined digital music, video, and physical textures.

October 26
Animation Show of Shows - CCT's Digital Media Center, LSU
The DMAE program hosted the 19th Annual Animation Show of Shows, which featured an assembly of 16 internationally acclaimed animated short films. (For more information, see page 13)

NOVEMBER

November 10
ACM ICPC South Central USA Regional Programming Contest - CCT's Digital Media Center, LSU
LSU sponsored two teams for the 2018 Regional Programming Contest, with one team placing third in the state.

November 12–15
Supercomputing Conference 2018 - Dallas, Texas
2018 marked the 30th anniversary of the annual SC conference. LSU debuted a new exhibit booth that showcased the many HPC projects supported by CCT. (For more information, see page 56)

Center for Computation
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