COORDINATED SCIENCE LABORATORY

2013 Annual Report

TABLE OF CONTENTS

DIRECTOR'S MESSAGE

Klara Nahrstedt, Acting Director

FOR CSL, 2013 HAS BEEN THE YEAR OF "BIG": BIG RESEARCH INITIATIVES, BIG FUNDING, AND BIG DATA.

During the past academic year, CSL researchers have been awarded grants that established the $30 million Systems On Nanoscale Information fabriCs (SONIC) Center, led by Naresh Shanbhag and Andy Singer, and the $16 million Center for Exascale Simulation of Plasma-Coupled Combustion (XPACC), led by William Gropp and Jonathan Freund.

CSL has been so successful in attracting these major grants in part because of its innate ability to bring researchers together through interdisciplinary activities, which funding agencies are increasingly demanding. In addition, CSL provides an incredible support structure for large projects, offering everything from technical writing assistance to grant management to programming support by a staff that is experienced in supporting big initiatives.

Because this key infrastructure is in place, CSL is able to pursue interdisciplinary initiatives that seek to solve societal problems. CSL received $4 million for initiatives that advance computational genomics, next-generation robotic devices and other semiconductor and related technologies. Steve Lumetta and Ravi Iyer are leading efforts to develop the CompGen initiative, which will leverage the power of big data and large-scale parallel systems to enable a better understanding of new genomics and the basic processes of life. In addition, the Next-Generation Medical Devices initiative, led by Lui Sha and Dr. Richard Berlin of Carle, is working to create advanced medical robots and next-generation intensive care units.

CSL also became more intentional about big data activities, seeing to advance big data research and infrastructure. Currently, the Lab has purchased four nodes on the Golub campus cluster, with the hope of facilitating more research in everything from remote sensing to physics. In addition, CSL is leading the requirement analysis for big data IT support within the College. The goal is that by expanding this infrastructure, CSL and the rest of the College will be better positioned to capitalize on big data funding opportunities.

In the coming year, the Lab will look to build community among faculty, students and staff. Planned initiatives include a workshop of female assistant and associate professors in electrical and computer engineering and computer science departments across the country to discuss interdisciplinary research; weekly student-led social events during the Spring 2014 semester; round-table discussion with Office of Technology Management (OTM) Director Lesley Millar; and a "Foundation Information Session" with Janelle Weatherford from the OVIA Foundation Relation Office to learn about new funding possibilities.

By continuing to build our human and IT infrastructure and strengthen our community, CSL is positioning itself to continue to attract large multidisciplinary grants that transform the way we live, work and play.

ENERGY EFFICIENCY: COMPUTING FOR A GREENER WORLD

As the world moves toward a mobile, instantaneous, data-rich environment, CSL faculty members are at the forefront of today's energy-efficiency research, working to develop low-cost, low power software, hardware and devices.

"Making sense of our data rich environment is a challenge, as embedding intelligence into information processing devices uses a lot of energy," said CSL Professor and SONIC Director Naresh Shanbhag. "Therefore, energy efficiency and robustness enhancing techniques will be required for designing intelligent devices of the future.

Here are a few related projects making headlines recently.

GREEN SUPERCOMPUTING

For CSL Professor Wen-mei Hwu, previous collaborative work in high performance computing with NCSA and NVIDA led to the development of the EcoG CPU cluster computer, one of the world's three most energy-efficient supercomputers in 2011. He is now working on a defense project that is designed to achieve 70 times more energy efficiency in computing.

Hwu and his team have developed a new processor design based on the concept of micro-engines that are extremely energy efficient for certain applications and will be used in mobile applications, such as computational photography and computer vision. By the end of the project, they will have developed at least 10 varieties of micro-engines in a prototype processor.

"If we can solve the problem of energy efficiency, then we can add a lot of computational capabilities in these devices, such as creating a smart phone that could go for a month without recharging," said Hwu, the AMD Jerry Sanders Chair of Electrical and Computer Engineering.

ENERGY EFFICIENT NANOSCALE DEVICES

The essence of CSL's new Systems On Nanoscale Information fabriCs (SONIC) Center's research is to create energy-efficient, low-power, reliable information processing systems on nanoscale complementary metal-oxide-semiconductors (CMOS) and beyond CMOS technologies.

"Energy efficiency pervades everything we do, from our algorithms and architectures to circuits and devices," said Shanbhag, the Kilby Professor of Electrical and Computer Engineering. "Our approach to achieving energy efficiency and robustness in nanoscale fabrics is to leverage the science of statistical inference."

The multi-university research team, led by University of Illinois at Urbana-Champaign faculty members and supported by CSL, is working to build the next generation information processing and computing systems using Shannon-inspired communication statistical techniques.

RELIABLE SOFTWARE DESIGN

CSL Professor Rakesh Kumar is looking at ways to build software on high performance computing and other parallel systems that are often unreliable. He wants to create software that can work in spite of errors and that can run on low-power devices.

Kumar and his team are considering two techniques to implement the software. The first will use algorithms that are inherently tolerant of errors and the second method will look at mathematical invariants that hold true when an application executes. These invariants can be used as error detectors. This novel approach uses algorithmic low-cost error localization and partial recomputation to efficiently correct the errors.

REAL-TIME ENERGY USAGE ANALYSIS

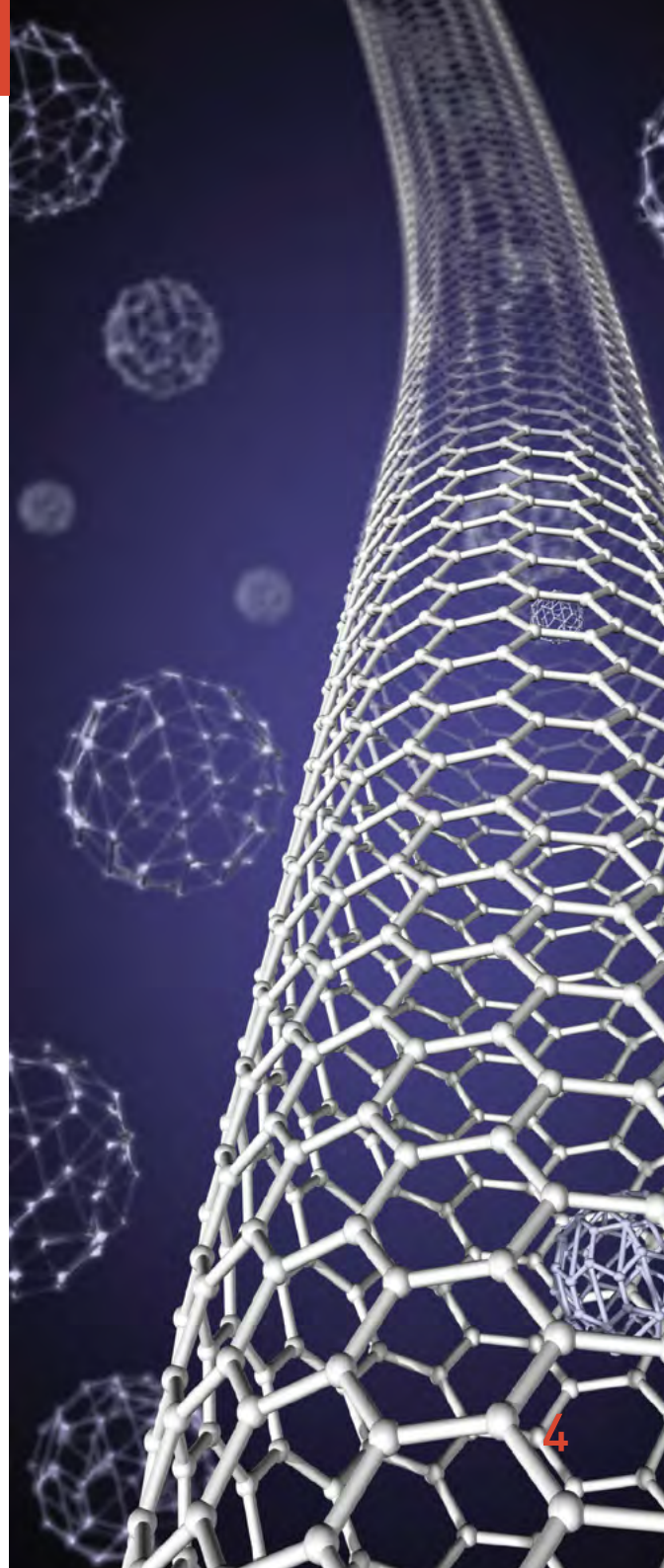
In Singapore, researchers at the Advanced Digital Sciences Center teamed up with Korea Electronics Technology Institute to track how efficiently office spaces use electricity. Research scientist Deokwoo Jung developed a sensor-driven analysis system for buildings called EnergyTrack, which continuously analyzes and interprets energy usage and provides actionable feedback on how to reduce consumption.

After months of testing in ADSC's offices – where they observed that ADSC spends 20 to 30 percent of its consumption during times when the building is unoccupied or minimally occupied -- Jung and his team are now working to test their system in other buildings in Singapore, Finland and Korea with different occupant patterns and types of HVAC systems.

FUTURE CAPABILITIES

From energy-efficient nanoscale devices to low-cost, error-tolerant software and energy use analysis, researchers at CSL are passionate about the future of low cost, high efficiency technology.

"Energy efficiency is important for enabling capabilities," Kumar said. "Without energy efficiency, often all you can do is build ducks – systems that compromise on capabilities or performance. Ducks can swim, walk and fly, but they do none of those very well."



EMBEDDED CONVERTER HELPS INCREASE SOLAR ENERGY CAPTURE

Snow, leaves, bird droppings and dust are all common inconveniences that home and business owners must deal with. Unfortunately for homes or businesses using solar energy, those everyday inconveniences can dramatically reduce the overall performance of their solar arrays and end up costing users money on their energy bills.

Professors Robert Pilawa, Alejandro Dominguez-Garcia and Philip Krein are working to incorporate small, efficient, inexpensive embedded power converters into solar panels that will increase overall energy capture.

The converters will help mitigate the negative effects of shading, which comes from clouds, trees or anything landing on the solar panels such as snow or dust, by essentially taking power from higher performing panels and transferring it to lower performing panels.

Additionally, the converters provide increased monitoring to identify which panels are not performing, which is especially useful for users operating thousands of solar panels at one time.

The researchers have tested their work in a lab setting and will be using the Illinois Center for a Smarter Electric Grid's (ICSEG) new experimental solar array on the south side of the University of Illinois at Urbana-Champaign campus to test it on a large scale. ICSEG is part of the Information Trust Institute.

"In the lab, we can make a case for it, but for anyone to buy it, you have to show it on real hardware in a real system in the real world," Pilawa said. "You have to show that in x amount of years, it'll pay for itself."

STRATEGIC RESEARCH INITIATIVES: PUSHING INTERDISCIPLINARY ADVANCES IN EMERGING FIELDS

In 2012, the College of Engineering introduced its Strategic Research Initiative, with the goal of pursuing exploratory research in emerging fields and enhancing existing capabilities for new interdisciplinary focus areas or centers. CSL researchers play a prominent role in these interdisciplinary efforts, participating in seven of 10 initiatives. Here's a look at those activities:

WIDE-BANDGAP (WBG) POWER ELECTRONICS RESEARCH INITIATIVE TOWARD A CENTER OF EXCELLENCE AND ENTREPRENEURIAL OPPORTUNITIES

*Kyekyoon (Kevin) Kim, **Elyse Rosenbaum**, and **Philip T. Krein**, Electrical and Computer Engineering*

ATOMIC-SCALE DESIGN OF OXIDE HETEROJUNCTIONS FOR ENERGY CONVERSION

*Elif Ertekin, Mechanical Science and Engineering; Lane Martin and **Angus Rockett**, Materials Science and Engineering; Ed Seebauer, Chemical and Biomolecular Engineering*

OPTIMIZING DNA STORAGE EFFIFIENCY VIA JOINT CONSTRAINED AND ERROR-CONTROL CODING

***Olgica Milenkovic**, Electrical and Computer Engineering; Jian Ma, Bioengineering; Huimin Zhao, Chemical and Biomolecular Engineering*

POWERING BIG DATA - A SYSTEMS APPROACH TO FUTURE COMPUTING PLATFORMS

*Robert Pilawa-Podgurski (PI), **Philip Krein**, Yi Lu, **Naresh Shanbhag**, Electrical and Computer Engineering; **Roy Campbell**, Computer Science*

A THEORY OF COGNITIVE AND ALGORITHMIC DECISION MAKING

***Andrew C. Singer, Tamer Başar,** and **Maxim Raginsky**, Electrical and Computer Engineering; **Karrie Karahalios** and Svetlana Lazebnik, Computer Science; **Angelia Nedich**, Industrial and Enterprise Systems Engineering*

BEYOND SPEECH: TOWARDS AN INTERDISCIPLINARY STUDY OF SOUND

*Paris Smaragdis, computer science and electrical and computer engineering; **Mark Hasegawa-Johnson**, Electrical and Computer Engineering; **Rob A. Rutenbar**, Computer Science; J. Stephen Downie, Graduate School of Library and Information Science; Heinrich K. Taube, School of Music*

DIGITAL/CYBER SECURITY AND NUCLEAR SECURITY

*Rizwan Uddin, Nuclear, Plasma, and Radiological Engineering; **William Sanders**, Electrical and Computer Engineering (with additional collaborators from NPRE and CSL)*

XPACC: EXASCALE COMPUTING TO FUEL ADVANCES IN COMBUSTION RESEARCH

A new initiative led by CSL's Parallel Computing Institute may spark the development of more environmentally friendly and higher performing jet engines.

Last fall, researchers received $16 million to fund a new center that will leverage extreme-scale computing to predict how plasmas could be used to control combustion. The research, funded for five years by the Office of Advanced Simulation and Computing of the National Nuclear Security Administration, may pave the way for cleaner-burning combustors and more reliable and higher performance jet engines, as well as greater fuel flexibility.

"This would be a whole new mode of managing combustion," said PCI Director William Gropp, the principal investigator on the grant. "We aim to make breakthroughs in this emerging field at the basic science level that ultimately lead to a greener world."

By using plasmas as a control mechanism in combustion, researchers believe they can manage the chemical process, thereby reducing emissions of greenhouse gases into the environment. Plasmas could also help stabilize flames for hypersonic, high-speed jet engines, in which air passes through so fast that the flame can be extinguished.

But understanding just how to manage plasma is a difficult problem, requiring three-dimensional, fluid computer simulations that can cover many space and time scales. To make reliable predictions, researchers need scalable computational resources to model and analyze the physics components, which range from flow turbulence to electrodynamics.

The efforts will include the development of new technologies for heterogeneous petascale and exascale systems. Computer scientists and engineers will create better tools for managing efficient data structures, mitigate the irregularities that come with both extreme-scale computing and the fluid nature of the chemical processes, develop novel computational and programming tools for mapping hardware architectures, and design simulation models specifically for turbulence, combustion, plasma dynamics and the electro-chemical properties of surfaces.

The center is a joint initiative between PCI and CSE, with simulation and scientific application research led by Professor Jonathan Freund.

http://xpacc.illinois.edu

PLASMA-CONTROLLED COMBUSTION

In a normal combustion event, many steps occur between the spark and the firing of an engine. Control of the intermediary steps is not possible with current technology. However, plasma – a gas that is transformed into a new state of matter when its atoms are ionized – has properties that enable intervention at intermediary steps. Plasma can create the same chemical species that occur during normal combustions and also can produce heat during the different phases, making the chemical process happen faster.

PASSIONATE ON PARALLEL REU

Since 2010, Illinois has hosted the Passionate on Parallel Research Experience for Undergraduates (REU) program, funded by the National Science Foundation, to train the next generation of students in a field that increasingly demands more highly trained professionals. This summer, the Parallel Computing Institute welcomed 10 students from across the United States to the Illinois campus for the 10-week program.

The REU encourages students to consider how parallelism could solve big problems, ranging from how galaxies form to whether a person could control a machine using only their thoughts. Students must be majoring in a science, technology or math discipline and meet certain computer science requirements.

Watch for more information about the next program, to be held June through August in 2014.

2013 Passionate on Parallel Team (from left): Illinois Prof. Matthew West, REU Director; John McCann, University of Alabama in Huntsville; Ali Hajimirza, University of Kentucky; Jack Lestina, University of Tulsa; Terrance Howard, University of Illinois; Ainoghena Igetei, Syracuse University; Justin Dufresne, Providence College; Alexander Knaust, University of Texas at El Paso; Benjamin Harbolt, Whitworth University; Alhaji Mansaray, University of Illinois; and Abhijit Pujare, Yale University.

(Above)
Interns present the results of their research at a poster session at the Illinois Summer Research Symposium, held at the I-Hotel July 25-26.

(Left)
REU students learn how Cedar Rapids, Iowa-based Rockwell Collins uses parallel computing in its flight simulation facility.

THE ILLINOIS CYBER SECURITY SCHOLARS PROGRAM: ITI RECEIVES $4.2 MILLION TO TRAIN STUDENTS IN CYBER SECURITY

From financial to medical information, our most private data is increasingly online -- and so are the cyber criminals who seek to sabotage the information systems that support the data. But while the number of cyber crimes has steadily risen over the years, the number of cyber security experts needed to stop them has not kept pace.

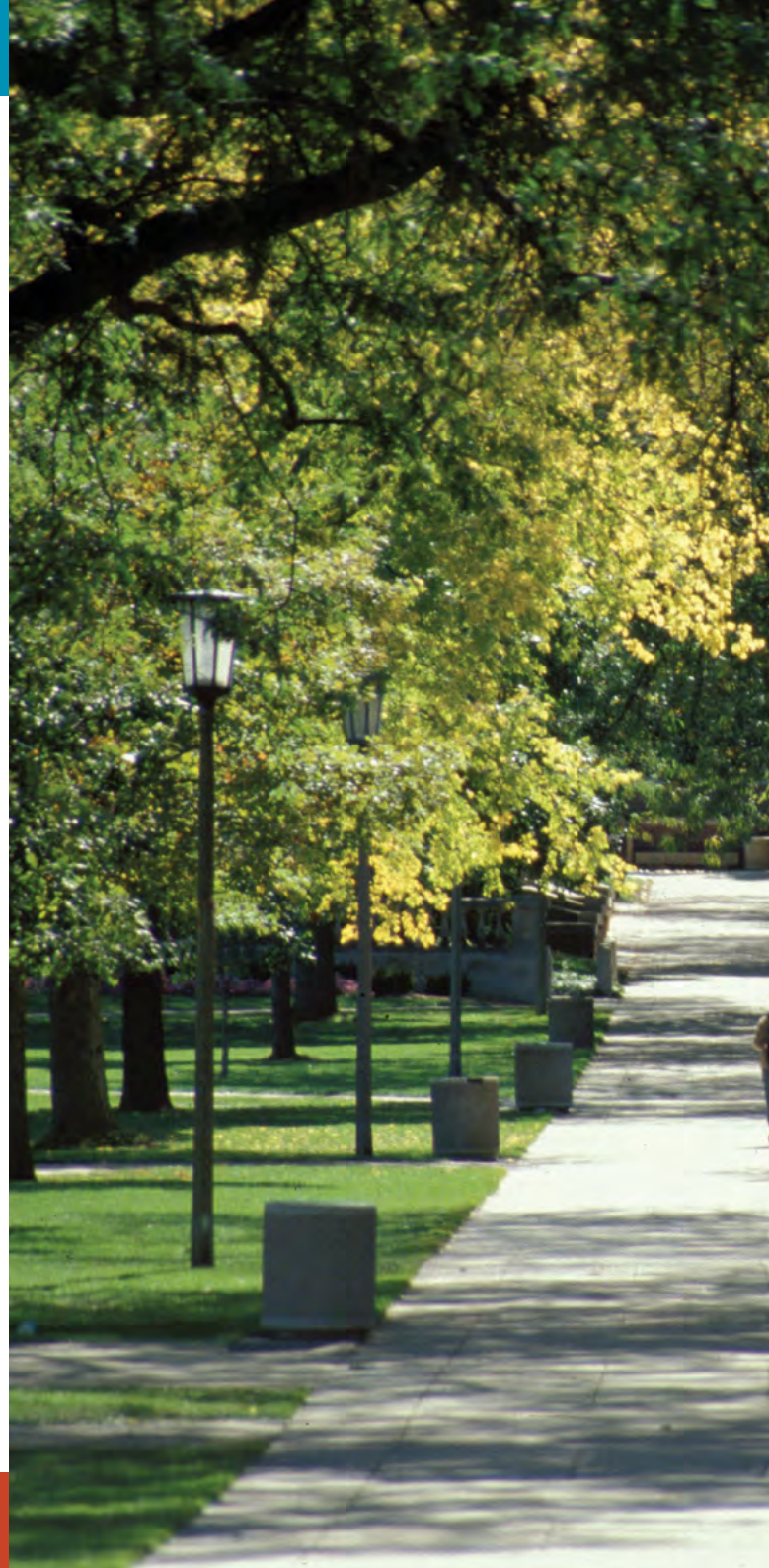
The University of Illinois at Urbana-Champaign has received a four-year, $4.2 million grant from the National Science Foundation to renew a program that trains students in cyber security, a field that is projected to experience an annual shortage of 20,000 to 40,000 skilled workers for the foreseeable future, according to Reuters. The Illinois Cyber Security Scholars Program (ICSSP) teaches students how to protect the nation's cyber infrastructure by designing more secure systems and methodologies, as well as better cyber policy.

"Our goal with ICSSP is to train students to have an immediate impact in the field, especially at government agencies and laboratories," said Roy Campbell, the lead researcher for the ICSSP initiative and the Sohaib and Sara Abbasi Professor of Computer Science.

ICSSP will offer a multidisciplinary approach to cyber security, bringing together computer science and engineering undergraduate and graduate students and law students, who are needed to write policies that better protect the technology systems of the 21st century. Law students and computer science students will take courses in the other discipline to enhance their knowledge of both fields. Graduates of the program will receive a certificate in cyber security.

In addition to Campbell, ICSSP core leadership team includes ITI: Information Trust Institute researchers Masooda Bashir, an assistant professor of library and information science, and Jay Kesan, a professor of law. The professors hope that if students are introduced to cyber security early in their educational careers, they will become excited about working in this important field of study.

"I once had a student tell me, 'I see this as a way to defend my country without picking up a gun,'" Bashir said. "It's really critical work."



FOR MORE INFORMATION ABOUT THE SONIC CENTER SEE:
http://www.sonic-center.org

SONIC CENTER: COMPUTING FOR THE NANOSCALE ERA

As devices continue to shrink and improve in energy efficiency, the transistor switches that provide the backbone for everything from cell phones to computers increasingly battle reliability and energy consumption problems.

In January 2013, the Systems On Nanoscale Information fabriCs (SONIC) Center was launched with the goal of designing reliable and energy-efficient computing systems -- even when using switches that are so small that their behavior is fraught with uncertainty. SONIC's innovative research agenda seeks to address this issue by treating the problem of computing using unreliable devices and circuits as one of communicating information over unreliable channels.

"Essentially, we're not going to try to build a reliable switch, but instead discover methods to build reliable systems," said SONIC Director Naresh Shanbhag, the Jack Kilby Professor of Electrical and Computer Engineering and CSL researcher. "It turns out that while information resides at the highest level and nanoscale components at the lowest level, they can both be mathematically described with the same statistical framework. No one has successfully captured this similarity between them before."

The $30 million multi-university center has already reported results. SONIC researchers at Stanford University have built a complete computer using carbon nanotube technology, validating its potential as a future alternative to silicon-based chips, which become hotter as devices continue to shrink. The accomplishment was celebrated at the SONIC Year 1 Annual Review Meeting, held in October in Champaign-Urbana.

SONIC is funded through the Semiconductor Technology Advanced Research Network (STARnet), supported by the Semiconductor Research Corporation (SRC) and the Defense Advanced Projects Research Agency (DARPA), part of the Department of Defense.

PARTICIPATING UNIVERSITIES

Carnegie Mellon University
Princeton University
Stanford University
University of California, Berkeley
University of California, Santa Barbara
University of California, San Diego
University of Illinois at Urbana-Champaign (lead)
University of Michigan - Ann Arbor

COMPGEN BRINGS BIG DATA TO LIFE

When scientists first mapped the human genome in 2000, the promise of personalized medicine went from a remote dream to a breakthrough within grasp. Thirteen years later, however, momentum has slowed because the ability to sequence DNA has begun to outpace computing – in particular, the capability of storing, transmitting and, most critically, analyzing the data.

With a $2.6 million grant from the National Science Foundation, University of Illinois researchers from across campus are collaborating to build an instrument that will enable faster, more accurate DNA sequencing and the processing of massive data sets. The potential payoff: A better understanding of the basic processes of life, illumination on how evolution works and custom treatments for disease, among other breakthroughs.

"We're on the cusp of a second genomic revolution, but we need big data to make it happen," said Gene Robinson, director of Illinois' Institute for Genomic Biology. Robinson, together with IGB researchers Saurabh Sinha and Victor Jongeneel, is teaming up with researchers in the Coordinated Science Laboratory (CSL) to develop and build the instrument. The CSL team includes electrical and computer engineering professors Steven Lumetta and Ravi Iyer.

The team building this unique instrument includes a consortium of 15 companies, universities and research institutions. They'll design the instrument's hardware and software simultaneously, creating a single integrated platform to drive new breakthroughs in genomics. The consortium will also allow for new applied research projects that require the instrument. Already teams are collaborating on improved error correction, genome assembly and variant calling.

The amount of genome data available for exploration doubles every five months," said CSL interim director Klara Nahrstedt. "A project like CompGen is perfect for Illinois, requiring an organization that has a deep understanding of both Big Data and of biology and genomics."

Iyer agreed: "I believe that genomic data is indeed the most complex of all big data problems and has the potential to be transformational to computer science and engineering in all of its aspects."

Currently, the world's most powerful sequencers map an individual's DNA by chopping up a human's 3 billion nucleotides, which encode the instructions for a gene, into very tiny strings that machines can effectively process. Researchers must then take the tiny strings and order them correctly, much like putting together a million-piece puzzle.

With the CompGen instrument, the goal is to be able to accelerate genomic science, using new computational technologies and techniques to leverage the more widespread availability of genomic data. It will do this by incorporating technologies—like non-volatile memory and die-stacked memory—that are only beginning to make their way to commercial products.

Lumetta, principal investigator on the project, will lead the instrument's design, which will combine custom, state-of-the-art technologies that enable the processing, information retrieval and storage of massive data sets. With CompGen's scaling capabilities, scientists hope to be able to compare large genome collections, with the idea of exploring such complex issues as the impact of climate change on gene expression and ecosystems and exploring social aspects of genomics.

"With Illinois' expertise in genomic research and high-performance computing, we believe that we can have an enormous impact in this field."

FOR MORE INFORMATION ON THE COMPGEN INITIATIVE SEE:

http://compgen.illinois.edu

ACCORDING TO THE UNIVERSITY OF LEICESTER:

One human genome is made up of about 3 billion nucleotides. This is enough to fill 130 encyclopedia-sized books that could take nearly 95 years to read.

NEW MEDICAL DEVICES INITIATIVE TO AUTOMATE MEDICAL SYSTEMS

To err may be human, but when it comes to medicine, human errors often mean the loss of life and health.

A team of researchers, led by CSL Professor Lui Sha (Computer Science), Dr. Richard Berlin (Carle Foundation Hospital), CSL Professor Naira Hovakimyan (MechSE) and Professor Irfan Ahmad (MNTL), has formed the CSL Next-Generation Medical Device initiative to safely automate medical systems technology, with the aim of reducing errors and providing physicians with a more complete picture of patients' health.

The initiative has two thrusts: developing advanced situational awareness and Golden Hour devices for emergency medicine, and building next generation surgical robotic instruments.

Research in the first thrust is already underway, funded by the National Science Foundation and in part by Harvard Medical School and Massachusetts General Hospital (MGH). Illinois researchers have been working closely with physicians in the Carle ICU and collaborators at MGH to create an Advanced Situation Awareness design for emergency critical medicine. The initial clinical model for this design is cardiac arrest resuscitation in a hospital setting.

In cooperation with Dr. Pier Giulianotti and Dr. Enrico Benedetti, University of Illinois Chicago College of Medicine and Dr. Richard Berlin of Carle, the UIUC team is developing next-generation surgical robotics, leveraging the strength of the College of Engineering's expertise in bio-nano sensors, biomedical imaging, machine learning, safety-critical control and safety-critical system integration architecture. The new robotics will provide surgeons with more precision and imaging capabilities, enabling them to visualize cancerous tumor residua, blood vessels, and bile ducts as vivid, solid 3D objects.

In the future, the CSL Initiative will develop new devices to enable better evaluation and treatment of patients before they reach the hospital. For example, EMTs could employ devices that utilize nano sensors and biomarkers to evaluate patients' vital signs at a trauma scene and transmit the data to physicians in a regional hospital for real-time communication and consult via a mobile wireless network – think an integrated clinical Skype for EMTs.

"Medicine is a field that has been slow to embrace automation," Prof. Sha said. "Our goal with this initiative is to demonstrate the real power of technology to save lives."

Current faculty working on the Initiative's proposals and projects includes Lui Sha, Tarek Abdelzaher, John Hart, Klara Nahrstedt and Marianne Winslett (CS); Irfan Ahmad and Brian Cunningham (MNTL); Rashid Bashir (Bio Engineering); Ryan Bailey (Chem); Rohit Bhargava and Patty Jones (Beckman); Naira Hovakimyan, Joseph Bentsman, Iwona Jasiuk, Martin Starzewski and Sameh Tawfick (MechSE); and Bill Sanders (ECE).

http://publish.illinois.edu/medicalsystems

ILLINOIS ALUM GIVES $1.1 MILLION FOR EDUCATION, RESEARCH IN FAIL-SAFE SYSTEMS

For Herman Dieckamp, the path to becoming president of one of the nation's largest electric power companies came straight through Champaign-Urbana.

A native of Jacksonville, Ill., Dieckamp studied engineering physics at the University of Illinois in the late 1940s. That background later served him well when he was chief operating officer and president of General Public Utilities, which he led through its heights as a leader in electric and nuclear technology and through its depths when a major accident occurred in one of its nuclear power plants.

Now he's giving back to his alma mater, donating a house valued at $1.1 million, with proceeds going to create an endowment fund benefitting the College of Engineering. The endowment will advance teaching and research in highly reliable, fail-safe and resilient systems, which are necessary to protect critical infrastructure, such as nuclear power plants.

"My education at Illinois helped me be able to read a book about a discipline and understand how it works and what it was all about," said Dieckamp, speaking from his home in New Hampshire. "I was able to take what I learned and apply it to new and emerging technologies, which helped me throughout my career."

The son of first-generation German immigrants, Dieckamp attended a one-room parochial school, studying under the same teacher for eight years of primary school. He went on to Jacksonville High School, scoring impressive enough grades to earn him a college scholarship awarded by his state representative.

He chose the University of Illinois in part because of its engineering program. But it was 1946, and veterans returning home from World War II were snapping up coveted spots. When he wasn't accepted into the program of his choice, he spent his freshman year in liberal arts studies. Then, one day, he noticed a chart in the Illini Union listing various engineering disciplines. Engineering physics caught his eye.

"I thought, 'I think I'll try that,'" Dieckamp said. "I basically picked my future career out of a hat."

The gamble paid off. With a strong background in the fundamentals of math and physics, Dieckamp positioned himself for a thriving career in energy, a field then undergoing transformative changes with the emergence of nuclear technology.

After graduating in 1950, he took a position at North American Aviation, where he studied the effect of radiation on the physical properties of materials. The work added to the body of atomic research advanced through the Manhattan Project.

By 1956, Dieckamp was working to develop a nuclear power source for satellites. His team successfully launched a nuclear power system into orbit in 1965, but the tide was turning toward microelectronics and solar energy, and the project was shut down. Dieckamp later moved into research and development for sodium-cooled fast reactors, which produce fuel for nuclear power reactors.

Through that research, he began working with electric power companies, and was eventually elected to the first technical advisory committee for the Electric Power Research Institute. By that time president of Rockwell's Atomics International Division, he worked to convince electric utilities to invest in fast reactors. In 1973, General Public Utilities recruited him as executive vice president. One year later, he was named president and chief operating officer.

He still held the title in 1979 when the unthinkable happened: In the early morning hours of March 28, a nuclear power plant operated by Metropolitan Edison, a subsidiary of GPU, experienced a nuclear meltdown.

The reactor at the Three Mile Island facility in Pennsylvania experienced a failure in the secondary, non-nuclear section of the plant. A valve that should have closed became stuck, leaking the cooling water that kept the core at normal temperatures. Operators misinterpreted instrument readings and further reduced water to the system. The move proved devastating, causing the reactor to overheat and the core to partially melt.

"It was indeed a serious accident and we were very fortunate that no one inside or outside the plant received meaningful damaging radiation," said Dieckamp. "It was a combination of operator error and not fully understanding the behavior of the plant, as well as systems that failed, that contributed to the accident."

Dieckamp, who stepped down as president in 1988, thinks the company and the nuclear industry have since made many positive changes, and that there's an important place in the energy industry for safe nuclear technology. He hopes his investment in building fail-safe systems at Illinois will create "extreme reliability" in nuclear plants and other critical infrastructure.

"There's never been a time when building resilient and reliable systems has been more important," says William H. Sanders, the interim head of Illinois' Department of Electrical and Computer Engineering. "We are grateful for Herman's generosity in helping us move this field forward."

Says Dieckamp: "This whole concept of highly reliable fail-safe, fail-proof and resilient systems is so important to keep technology advancing and people safe. I want to support this area so that the chance of something like Three Mile Island is significantly more remote."

NAHRSTEDT NAMED ACTING DIRECTOR OF THE COORDINATED SCIENCE LABORATORY

Klara Nahrstedt, the Ralph M. and Catherine V. Fisher Professor in the Department of Computer Science, has been named acting director of the Coordinated Science Laboratory (CSL).

"As a leading researcher for the College, for CSL, and the Information Trust Institute, she is a natural choice to carry on the work of our most successful units," said Andreas Cangellaris, dean of Illinois' College of Engineering.

Nahrstedt is a leading researcher in multimedia systems, with seminal contributions to quality-of-service (QoS) management for distributed multimedia systems. Her two textbooks, "Multimedia Computing, Communications and Applications" and "Multimedia Systems," are among the most widely used textbooks on multimedia technology. Her online book, "QoS in Wireless Networks over Unlicensed Spectrum," was published in 2012 and presents an extensive system view on achieving Quality of Service approaches in WiFi-based wireless networks.

As a researcher in the Information Trust Institute's Trustworthy Cyber Infrastructure for the Power Grid (TCIPG) Center, she is also looking at how competing QoS and security demands can both be answered in the context of critical cyber-physical systems, such as the power grid.

Nahrstedt joined the Illinois faculty in 1995 and has received numerous honors, including the IEEE Communications Society Leonard G. Abraham Prize, the IEEE Computer Society's Technical Achievement Award, the University Scholar Award, and the Humboldt Research Award, among others. She is a Fellow of the IEEE and ACM, and, since 2009, she has chaired the ACM Special Interest Group on Multimedia.

As acting director, Nahrstedt leads CSL while its current director, William Sanders, serves as the Interim Head of the Department of Electrical and Computer Engineering at Illinois.

LEARNING TO SEE SYSTEMS PROGRAM TEACHES STUDENTS TO EVALUATE VALUES IN TECH SYSTEMS

CSL's Center for People & Infrastructures helped lead the creation of a new graduate-level interdisciplinary program that will train students to think about the values embedded in technology systems.

The Learning to See Systems program will encourage students to gain a better understanding of the values that systems enbody, in part because social networks, search engines and other technological systems are built by people with values and in part because users can influence values. The latter was recently illustrated by a recent study on Google autosearch, which showed that when the query "women should" was typed into the search engine from Dubai, most popular responses returned by autosearch included "women should stay at home" and "women should be slaves," among others.

Learning to See Systems offers graduates a certificate and is part of the INTERSECT program through the Graduate College.

http://seeingsystems.illinois.edu/

CSL RESEARCHERS PARTICIPATE IN STARNET PROGRAMS

CSL researchers are playing a role in three of six new programs launched in 2013 through the Semiconductor Technology Advanced Research Network (STARnet), supported by the Semiconductor Research Corporation (SRC) and the Defense Advanced Projects Research Agency (DARPA).

In addition to the Illinois-led SONIC Center (see p. 10 for more info), researchers Wen-mei Hwu and Deming Chen are contributing to the Center for Future Architectures Research, headed by the University of Michigan, which will explore future generation scalable computing systems. Doug Jones, also director of the Advanced Digital Sciences Center in Singapore, is part of the team addressing pervasive integration of smart, networked sensors and actuators in our connected world at the TerraSwarm Research Center at the University of California, Berkeley.

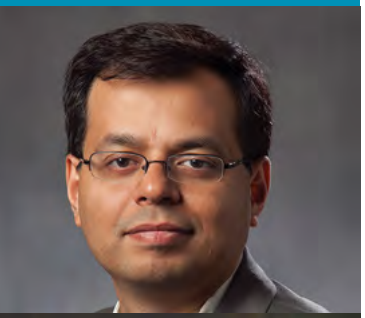
DOUG JONES NAMED NEW DIRECTOR OF ADVANCED DIGITAL SCIENCES CENTER

In July, the University of Illinois named Douglas L. Jones as the new director of the Advanced Digital Sciences Center in Singapore. Jones replaced Marianne Winslett, an Illinois professor of computer science, who served as director from 2009 through June 2013.

Jones plans to continue to lead ADSC in the areas it already excels in, such as computer vision, digital hardware, information mining, depth imaging, video tracking and smart grid, as well as facilitating collaborations in Singapore and the U.S. and strategically focusing ADSC's areas of research emphasis.

"ADSC needs to take advantage of the unique opportunities that come from being located in Singapore," he said. "So far, we've been in a growing phase and always trying to get bigger. Going forward, we're going to be a little more strategic on what we want to focus on and emphasize."

NEW FACULTY

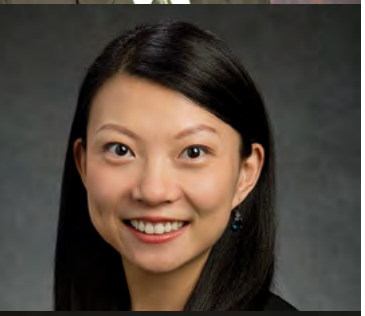


ROMIT ROY-CHOUDHURY

CSL faculty member Romit Roy Choudhury began as an electrical and computer engineering and computer science associate professor in fall 2013 after graduating from Illinois in 2006 with a Ph.D. in computer science. His research interests include wireless protocol design, mainly at the PHY/MAC layer and in mobile computing at the application layer. He was awarded the ACM MobiSys Best Demo Award in 2011 and the Google Faculty Research award in 2013.

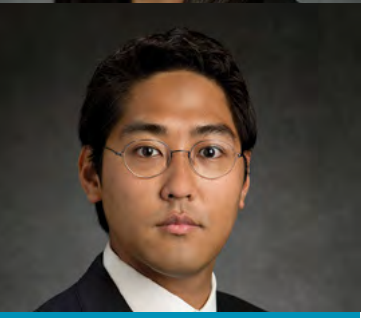
PAVAN KUMAR HANUMOLU

Pavan Kumar Hanumolu is an associate professor of electrical and computer engineering, who received his Ph.D. in electrical engineering from Oregon State University in 2006. His research interest is in circuits, including high-speed, low-power I/O interfaces, time-based signal processing, and power-management circuits. Hanumolu received the National Science Foundation CAREER Award in 2010 and the Faculty of the Year Award in 2011 from the College of Engineering and the School of EECS at Oregon State University.



GRACE XINGXIN GAO

Grace Xingxin Gao is an assistant professor in the Department of Aerospace Engineering and graduated from Stanford University in 2008 with her Ph.D. in electrical engineering. Her research interests include systems and signals and control, with an emphasis on satellite navigations and autonomous vehicles. She serves as an Institute of Navigation council member and co-chair of the Technical Committee on Air Navigation. Gao has also won a number of awards, including the RTCA William E. Jackson Award and the Institute of Navigation Early Achievement Award.



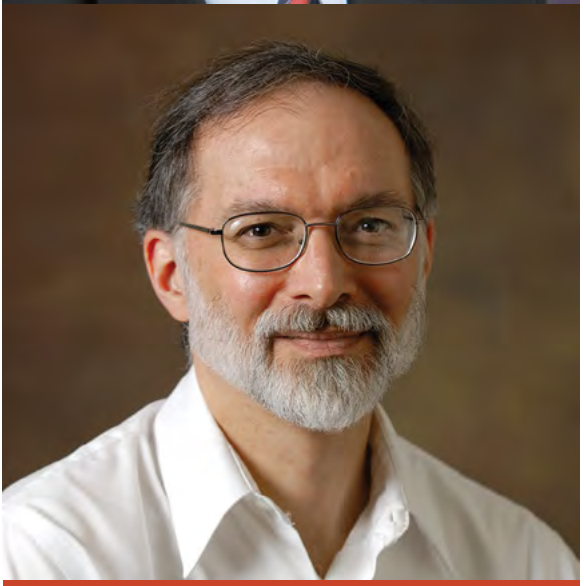
SEWOONG OH

CSL faculty member Sewoong Oh began as an Assistant Professor of Industrial and Enterprise Systems Engineering at Illinois in 2012. He joined CSL in 2013 and his research focuses on extracting meaning information for societal data, specifically related to ranking and recommendations. Additionally, he is working to design crowdsourcing systems that are more reliable and cost-efficient. Oh graduated from Stanford University in 2011 with a Ph.D. in electrical engineering and worked as a postdoctoral researcher at MIT following graduation.

RETIRING FACULTY

JIM COLEMAN

Jim Coleman is an Intel Alumni Endowed Chair of Electrical and Computer Engineering who retired after 31 years as an Illinois professor. During his tenure, he directed the Integrated Circuits Fabrication Laboratory. Throughout his career, he received many awards, including the John Tyndall Award, the highest recognition accorded to researchers in optical communications, from The Optical Society (OSA) and the IEEE Photonics Society in 2013. He also was elected to the prestigious National Academy of Engineering in 2012, and in the same year, he became a fellow in the International Society for Optics and Photonics (SPIE). He graduated from the University of Illinois in 1975 with a Ph.D. in electrical engineering and his research focused on microelectronics and photonics.



JOHN ABELSON

John Abelson is a professor of material science and engineering and co-director of the Energy and Sustainability Engineering Initiative. He graduated from Yale University with his B.S. in 1979 and from Stanford University with his Ph.D. in materials science and engineering in 1987, joining the Illinois faculty in 1988. He has been active in the Materials Research Society and is a Fellow of the American Vacuum Society. Throughout his career, Abelson has focused on developing novel synthetic methods for thin film materials that are used in advanced microelectronic and energy applications. He has received many awards during his time at Illinois including being named Fellow of the AVS-Science and Technology Society and Young Investigator in the IBM Materials program at Illinois.

POWERED PROSTHETIC DEVICES HELP AMPUTEES WALK NATURALLY

According to the Amputee Coalition of America, the number of lower-limb amputees is expected to double by 2050, especially due to the increasing prevalence of diabetes.

Electrical and Computer Engineering Ph.D. graduate student Navid Aghasadeghi recognized this problem and is putting his control theory knowledge to use to help lower-limb amputees. He received a $42,232 grant from the National Institutes of Health to pursue this research, along with advisor and CSL Assistant Professor of Aerospace Engineering Tim Bretl.

“I see health problems as one of the biggest challenges that the world faces,” Aghasadeghi said. “I thought that the knowledge that I had from control theory should be applicable and I wanted to see a complete loop in developing the theory and then testing the theory in application to see if the whole system could work.”

Previously, prosthetic devices were passive, meaning that they behaved like a spring system that didn’t provide power to the individual, but now powered devices that include a motor at the ankle and knee are available.

“With passive devices, it has been shown that amputees spend more energy over a gait cycle and that the gait is not natural,” Aghasadeghi said. “With powered devices, if we can provide the right control to the device, we should be able to provide natural locomotion to the amputee.”

Aghasadeghi began by using locomotion trajectories from unimpaired individuals and the physical characteristics of the amputee, such as height and weight, to customize controller parameters for the devices. He is working on a theory called inverse optimal control, which hypothesizes that human motor control can be modeled as being optimal with respect to a performance criterion. With this theory, Aghasadeghi determines the performance criteria of an unimpaired human walking and uses those criteria to derive controllers for prosthetic devices.

“I’m trying to understand the challenges clinicians face and use my theoretical knowledge to develop a precise mathematical representation of the problem they are facing,” Aghasadeghi said.

ROUND-UP OF CSL EVENTS

SYMPOSIUM ON EMERGING TOPICS IN CONTROL AND MODELING

The 2013 Symposium on Emerging Topics in Control and Modeling: Social and Economic Behavior was held November 7-8, 2013, and exposed researchers to control and modeling challenges related to the social and economic behavior of systems, with the aim of exchanging knowledge and fostering collaborations between academia, industry and government agencies. During the two-day conference, attendees learned about important challenges existing in control and modeling of social and economic systems through invited talks, poster sessions, panel discussions and networking opportunities.

CSL STUDENT CONFERENCE

The 8th annual CSL Student Conference was held on January 31 and February 1, 2013, and featured talks and posters covering research in the reliable and high performance computing, circuits, thin film electronics, remote sensing and space sciences and communications, among other topics. The conference is organized by CSL graduate students and serves as an opportunity for students to present their work to faculty, invited speakers and fellow students. In 2013, participants attended talks by four invited speakers from the California Institute of Technology, Stanford University, Google Research and Carnegie Mellon University, as well as 14 student presenters and a panel discussion.

ALLERTON CONFERENCE

The 2013 Allerton Conference on Communication, Control and Computing was held October 2-4, 2013, and celebrated the 51st anniversary of the conference, which is one of the longest-running conferences in the systems area. The conference gathers experts in the areas of communication systems, information theory, optimization, control theory, game theory, networked systems, learning theory and many other areas. CSL Professor Tamer Başar co-chaired the conference with CSL Associate Professor Olgica Milenkovic and this year's conference had over 450 attendees and 51 sessions with 285 papers presented over the three days. Kannan Ramchandran of the University of California, Berkeley gave the plenary lecture on the topic of codes for the storage cloud. The conference is held annually at the Allerton Park and Retreat Center in Monticello, Ill., and roughly 7,000 papers have been presented over the years.

CSL AWARDS

Tarek Abdelzaher
2012 IEEE Outstanding Technical Achievement and Leadership Award

Vikram Adve
ACM Software System Award

Narendra Ahuja
2012 BITS Pilani Distinguished Alumnus Award from The Birla Institute of Technology and Science

C. Barth and R.C.N. Pilawa-Podgurski
Best Paper Award at 2013 IEEE Workshop on Control and Modeling for Power Electronics

Andy Borum
NSF Graduate Research Fellowship (Timothy Bretl)

Yoram Bresler
Innovation Transfer Award at the Champaign County Innovation Celebration

Timothy Bretl
Associate Editor, IEEE Transactions on Robotics

Timothy Bretl and Dennis Matthews
Finalist, ICROS Best Application Paper Award at the IEEE/RSJ International Conference on Intelligent Robotics and Systems

Cao, Liangliang, Hyun Duk Kim, Min-Hsuan Tsai, Brian Cho, Zhen Li, Indranil Gupta, ChengXiang Zhai, Thomas S. Huang
Best Paper Award at 2012 ACM Conference on Knowledge Discovery and Data Mining (KDD) BigMine Workshop

Soon-Jo Chung
NSF CAREER award

James C. Coleman
2013 John Tyndall Award from The Optical Society and the IEEE Photonics Society

Victoria Lynn Coverstone
Elected a Fellow in the American Institute of Aeronautics and Astronautics

Marina Danilevsky
2012 – 2013 NSF graduate fellowship (Jiawei Han)

Lito de la Rama
MRS Graduate Student Silver Awards, Spring 2013 MRS meeting (Leslie H. Allen)

Hongbo Deng, Jiawei Han, Hao Li, Heng Ji, Hongning Wang, Yue Lu
Paper selected for Statistical Analysis and Data Mining Special Issue of "Best of SAM 2013" at Proc. of 2013 SIAM Data Mining Conference

Ahmed El-Kishky
2013 – 2014 NSF graduate fellowship (Jiawei Han)

Milton Feng
2013 R.W. Wood Prize from The Optical Society

Brighten Godfrey
Ranked as Outstanding Teacher, Fall 2012

Brighten Godfrey, Matthew Caesar, Ahmed Khurshid, Wenxuan Zhou
2012 Best Paper Award at the Workshop on Hot Topics in Software Defined Networking

Brighten Godfrey, Mo Dong, Qingxi Li
Internet2 Innovative Application Award, July 2013

William Gropp
Member-at-Large for the Information, Computing and Communication section of The American Association for the Advancement of Science (AAAS); Thomas M. Siebel Chair in Computer Science; 2013 HPCWire's "People to Watch"; Best Paper Award at ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming

Quanquan Gu
2013 - 2015 IBM Ph.D. fellowship (Jiawei Han)

Indranil Gupta
Associate Editor for the ACM TAAS Journal

Jiawei Han
University of Illinois 2012 Excellence in Graduate and Professional Teaching Award

Jaiwei Han's research group
ACM SIGKDD KDDCUP award

Siva Kumar Sastry Hari
Paper selected as IEEE Micro Top Picks for 2013; 2013 Feng Chen Memorial Award; Margarida Jacome Best Poster Award at the 2012 Gigascale Systems Research Center Annual Symposium; selected to attend the 2013 Heidelberg Laureate Forum (Sarita Adve)

Mark Hasegawa-Johnson
Elected to Board of Directors of the International Speech Communication Association

Kevin T. He
2012 Best Paper Award at the IEEE International Conference on Nanotechnology (Joe Lyding)

Naira Hovakimyan
Technical Achievement Award, 2012 World Congress, 9th International Conference on Mathematical Problems in Engineering, Aerospace and Sciences, Vienna, Austria; Keynote speaker, 2012 ICNPAA World Congress: Mathematical Problems in Engineering, Sciences and Aerospace, Vienna, Austria; 2013 Associate Editor of Journal of the Franklin Institute (Ravi Iyer)

Thomas S. Huang
University of Illinois at Urbana-Champaign Swanlund Chair

Ming Ji, Binbin Lin, Xiaofei He, Deng Cai, Jiawei Han
2012 Best Paper Award candidate and 2011 Best Poster Award at ACM SIGKDD International Conference on Knowledge Discovery and Data Mining

Peter Kairouz
2012 Roberto Padovani Scholarship from Qualcomm (Andrew Singer and Pramod Viswanath)

Hyungsul Kim, Yizhou Sun, Julia Hockenmaier, Jiawei Han
Paper selected as one of the best papers being invited to the journal "Knowledge and Information Systems" at the 2012 IEEE International Conference on Data Mining

Negar Kiyavash
Associate Editor for IEEE Signal Processing Letters

Justin C. Koepke
2012 Geim and Novosolev Graphene Prize at the IEEE International Conference on Nanotechnology (Joe Lyding)

Steven LaValle
University of Illinois at Urbana-Champaign University Scholar

CSL AWARDS (continued)

Stephen Levinson, L. Niehaus
2012 IEEE International Conference on Development and Learning - Epigenetic Robotics Paper of Excellence Award

Daniel Liberzon
2013 IEEE Fellow

Yu Lin and Danny Dig
Best Paper Award at the 2013 International Conference on Software Testing, Verification and Validation

Michael C. Loui
2013 Campus Award for Excellence in Graduate Student Mentoring

Joe Lyding
2012 IEEE Pioneer Award in Nanotechnology

William Mansky
Mavis Future Faculty Fellowship

Darko Marinov
2012 ACM SIGSOFT Impact Paper Award for his ISSTA 2002 paper

Kevin Meier
DoD SMART Fellowship (Seth Hutchinson and Soon-Jo Chung)

Olgica Milenkovic
Willett Scholar and Dean's Award for Excellence in Research

Sayan Mitra
Best Paper Award at IFIP International Joint Conference FMOODS/-FORTE 2012; Samsung Global Research Outreach (GRO) award; IEEE 2013 Eta Kappa Nu's C. Holmes MacDonald Outstanding Electrical and Computering Engineering Teacher Award

Daniel Morgan
NASA Space Technology Research Fellowship (Soon-Jo Chung)

Klara Nahrstedt
2012 ACM Fellow

Angelia Nedich
2013 Donald Biggar Willett Scholar; Editorial positions in SIAM Journal on Optimization, IEEE Transactions on Automatic Control and IEEE Transactions on Control of Network Systems.

David M. Nicol
Named Franklin W. Woeltge Professor of Electrical and Computer Engineering

Brandon Norick
2013 – 2014 NSF graduate fellowship (Jiawei Han)

Tom Overbye
Elected to National Academy of Engineering

Robert Pilawa
Google Faculty Research Award

Cosmin Radoi and Danny Dig
ACM SIGSOFT Distinguished Paper Award at the 2013 International Symposium on Software Testing and Analysis

Maxim Raginsky
2013 NSF CAREER award

Aimee Rickman
Office of the Provost's Award for Excellence in Undergraduate Teaching (Center for People and Infrastructures)

Dan Roth
2012 Fellow of the Association for Computational Linguistics; Named Associate Editor-in-Chief (2013-2014) and Editor-in-Chief (2015-2016) of the Journal of Artificial Intelligence Research

Dan Roth, Mark Sammons, Alla Rozovskaya, Kai-Wei Chang
Won the Conference on Computational Natural Language Learning Shared Task on Grammatical Error Correction, the annual competition in the Natural Language Processing field

Rob Rutenbar
2013 Donald O. Pederson Best Paper Award for an article published in IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems

M. Schuck and R.C.N. Pilawa-Podgurski
Best Paper Award at 2013 IEEE Power and Energy Conference at Illinois

Naresh Shanbhag
Jack Kilby Professorship; Director of Systems on Nanoscale Information fabriCs (SONIC) Center; General co-Chair of 2013 IEEE Signal Processing Workshop, Taipei, Taiwan, October 2013

Andrew Singer
Entrepreneur Advocacy Award at the Champaign County Innovation Celebration

Marc Snir
IEEE Award for Excellence in Scalable Computing

Yizhou Sun, Brandon Norick, Jiawei Han, Xifeng Yan, Philip S. Yu, Xiao Yu
KDD Best Student Paper Award at 2012 ACM SIGKDD International Conference on Knowledge Discovery and Data Mining

Josep Torrellas
High-Impact Paper Award at the 2012 International Conference on Computer Design; Named Program Chair of the 2014 International Conference on Parallel Architectures and Compilation Techniques

Alfonso Valdes
Most Influential Paper Award at RAID 2012

Shobha Vasudevan
2013 ACM SIGDA Outstanding New Faculty Award

Pramod Viswanath
2013 IEEE Fellow

Chi Wang
2012 – 2013 Microsoft Ph.D. fellowship (Jiawei Han)

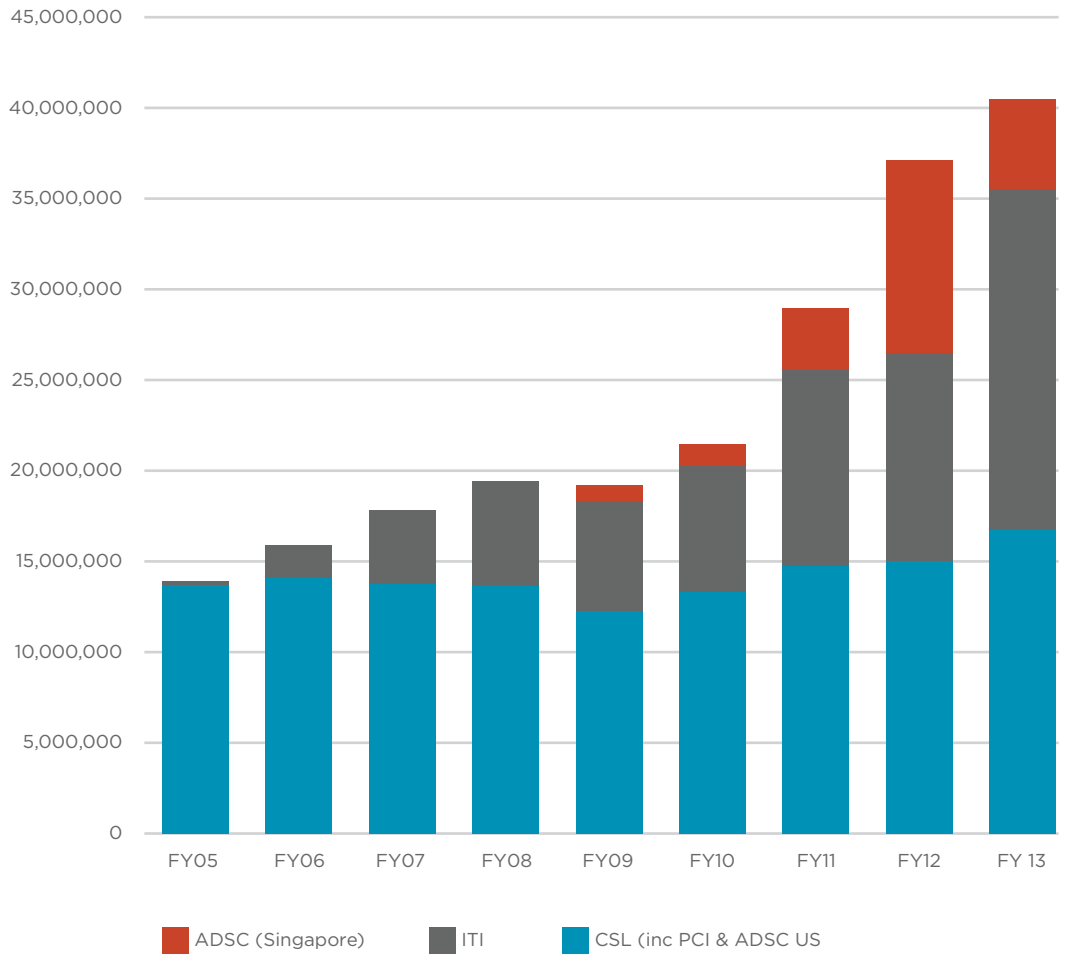
Tim Weninger
2012 – 2013 NSF graduate fellowship (Jiawei Han)

Martin Wong
Edward C. Jordan Professorship; ACM/IEEE Design Automation Conference Prolific Author Award – DAC 40 Club; ACM/IEEE Design Automation Conference Long Publication Streak Award

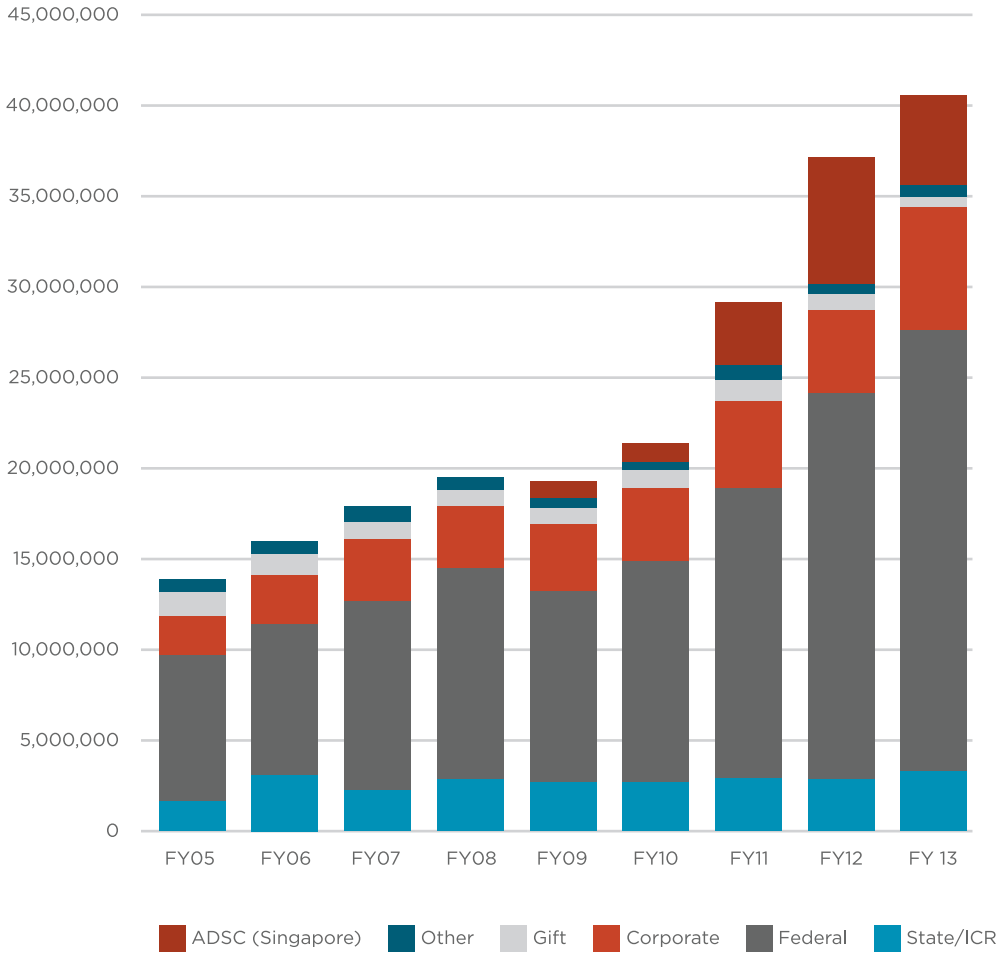
Joshua D. Wood
Silver Medal, 2012 TSMC Outstanding Student Research Award; 2012 Geim and Novosolev Graphene Prize at the IEEE International Conference on Nanotechnology (Joe Lyding)

CSL FINANCIAL INFORMATION

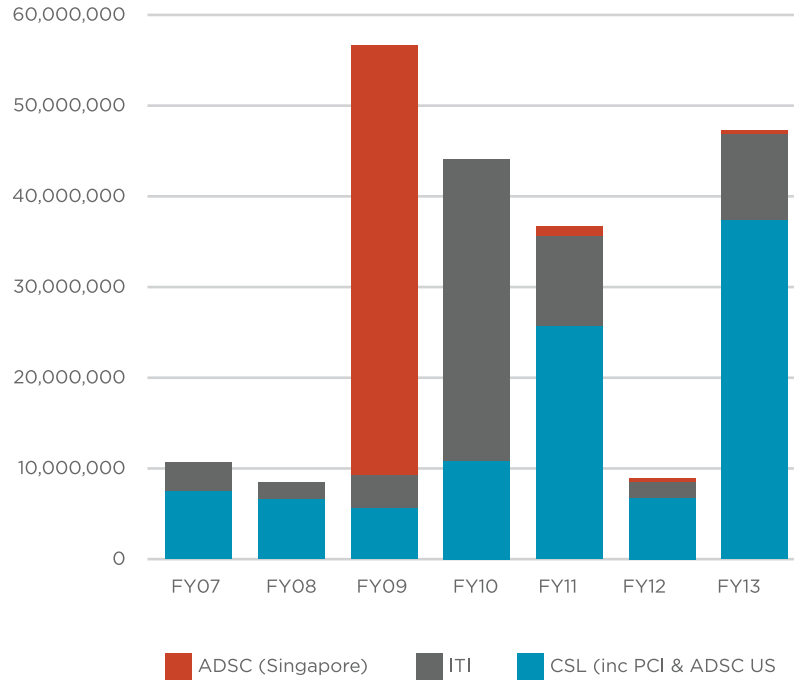
TOTAL EXPENDITURES BY FISCAL YEAR



CSL & INSTITUTE EXPENDITURES BY TYPE



NEW CONTRACTS/GRANTS AWARDED BY FISCAL YEAR



1308 West Main St. Urbana, IL 61801
Phone: 217-333-2511
Website: csl.illinois.edu