COORDINATED SCIENCE LABORATORY

2012 ANNUAL REPORT >

ENGINEERING AT ILLINOIS

2012 ANNUAL REPORT

DIRECTOR'S MESSAGE >

In an academic year that marked its diamond anniversary, the Coordinated Science Laboratory proved that it was 60 years young.

During this milestone year, the Laboratory has continued to grow at breakneck speed. The Lab recorded a whopping $37.3 million in expenditures to support its research mission in fiscal year 2012. It also added two new research centers and announced the expansion of its physical facilities, which will provide new space for labs, meeting rooms and offices.

What is the secret to CSL's longevity? The answer lies in its continued immense strength in fundamental research paired with the rise of centers and institutes that seek to solve societal problems in an interdisciplinary way.

In the past year, CSL launched the multidisciplinary Center for People & Infrastructures, which aims to better understand social norms, market structures, public policies and human capabilities that shape and are affected by the development of smart infrastructures. CSL also introduced the Parallel Computing Institute, which enables Illinois researchers from across campus to come together to invent the next generation of parallel computing platforms.

In addition, the National Security Agency funded the Science of Security Lablet in the Information Trust Institute to enable the ability of systems to maintain security properties even during ongoing cyber attacks. The $2.5 million committed so far will help create a scientific basis for building secure systems by making fundamental strides in control theory, game and decision theory, end-to-end system analysis and other areas, with security applications.

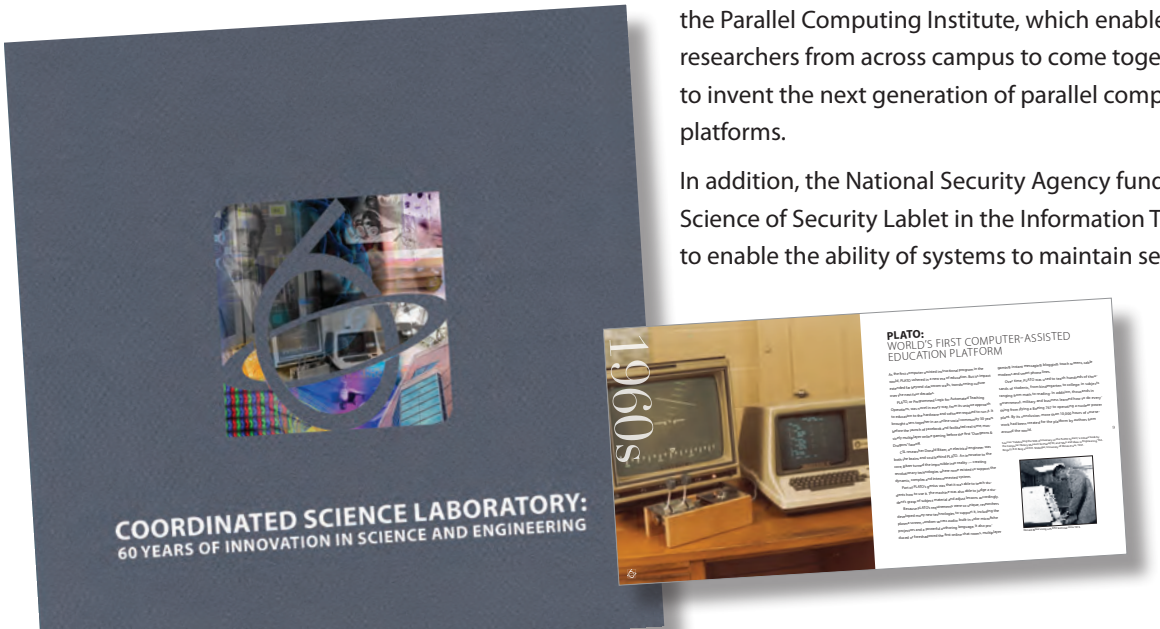
Overall, the Lab and its institutes and centers have seen a meteoric rise in research funding. Lab expenditures to fund our research mission have jumped from $21.5 million in 2010 to $37.3 million in 2012. The growth has been driven in large part by a significant investment in digital media and smart grid research through the Advanced Digital Sciences Center in Singapore, as well as increased funding by the U.S. government, particularly in areas such as medical privacy, smart grid, cloud computing and human-machine adversarial networks research.

As our research programs have grown, so has our need for more space. The College of Engineering is supporting the construction of new space in the North Parking Garage (catty-corner from our building at 1308 W. Main St.) for CSL's use. The 14,000-square feet of extra space will be used for new test bed and lab spaces, student offices, research center offices and conference rooms. Construction should wrap up in early 2014.

The 60th anniversary celebration last fall served as a reminder of CSL's powerful legacy. It also revealed that its people – and their dedication to innovation and collaboration – are the secret to the laboratory's perpetual youth.

We look forward to working with our academic, industry and government partners as we shape the next 60 years of science.

William H. Sanders
Director, CSL



LARGE-SCALE INFRASTRUCTURE

UNLOCKING GRIDLOCK >

The Coordinated Science Laboratory (CSL) is a world-class multidisciplinary research laboratory that focuses on information technology at the crossroads of computing, control and communications. Led by a faculty of world-renowned experts and researchers, CSL explores critical issues in defense, economics, energy systems, environmental sciences, life-enhancement for the disabled, medicine, and robotics. In addition, CSL has been the incubator of nationally and internationally renowned initiatives such as the Advanced Digital Sciences Center in Singapore, the Center for People and Infrastructures, the Information Trust Institute, the National Center for Professional & Research Ethics and the Parallel Computing Institute.

THINK OF BLACKOUT AS MONOPOLY® FOR THE POWER GRID.

Under development with the support of an NSF EAGER grant, Blackout will be a persistent, browser-based, multiplayer online game about dynamic markets for electric power. CSL Associate Professor **Cedric Langbort** (Aero Engineering), along with colleagues **Christian Sandvig** (University of Michgan) and **Sean Meyn** (University of Florida), are working to create a game that allows players to sell and buy electricity in a dynamic power market.

The game draws from the investigators' respective expertise in distributed control systems and pricing, and power system dynamics and control, to specify the objectives and ensure that the rules of play and environment, while simplified, retain the main essential features and challenges as real power systems.

To ease traffic in the nation's most gridlocked cities, two researchers in the Coordinated Science Laboratory contend that we must do more than pave our way to less congestion – we must also pay our way.

Researchers **Daniel B. Work** and **Cedric Langbort** are developing a method for dynamic traffic pricing that would enable city planners to create a time-differentiated tolling system that charges higher fees during peak travel times. As traffic increases, so would the cost of commuting.

The goal is to encourage people to consider public transportation – or a different departure time – using higher tolls during peak travel times as an incentive.

"You can address the congestion from a supply side, or from a demand side," said Work, an assistant professor of civil and environmental engineering at Illinois. "We're running out of space to continue improving supply. And in terms of environmental aspects, it's clear we need to manage demand, even as we continue to improve our infrastructure."

For dynamic traffic pricing to work, city planners must first be able to measure congestion patterns. Work has developed a traffic monitoring application that could make measuring congestion more practical and affordable. The application, TrafficTurk, essentially turns a smart phone into a turning movement counter. The traffic sensor system provides high-resolution images of real-time traffic conditions and can be used to generate traffic analytics.

The data can then be used to create a dynamic pricing plan – Langbort's area of expertise. Control theory has long enabled dynamic pricing in fields ranging from finance to power distribution, but has only more recently been applied to traffic. The challenges in applying it to ground transportation are less mathematical and more social and political, Langbort says.

"There's a tradeoff between gathering information and respecting privacy and trust," said Langbort, an associate professor of aerospace engineering. "The more monitoring technology you use, the better you can price, but there's more intrusion."

The idea of implementing dynamic traffic pricing is under discussion in Chicago, which holds the dubious honor of ranking No. 10 in TomTom's Congestion Index and No. 2 in the Census Bureau's list of cities with the longest average commutes. In August, Work and Langbort organized a dynamic traffic pricing workshop, funded in part by INSPIRE (the Illinois-Sweden Program for Educational and Research Experience), the Department of Civil Engineering and CSL's Center for People & Infrastructures, to outline the benefits and challenges of such a system. The workshop brought together Illinois state and city planners and industry representatives, along with academic and government counterparts from Stockholm, where a congestion tax was successfully implemented in 2007.

The CSL researchers said that it will take both new technology and public acceptance for dynamic traffic pricing to be implemented. They point to Stockholm's experience as a textbook example of how a congestion tax can be successful. Residents, who were wary of the tax at first, ultimately called for the fee to become permanent after a trial period in 2006. During that time, traffic volume was reduced by an average of 22 percent, while travel times also decreased – as much as one-third to one-half during peak travel times on arterial roads.

"If you can actually reduce congestion and improve travel time reliability, people will respond positively," Work said. "People will accept pricing for improved service on the road."

CSL LAUNCHES THE CENTER FOR PEOPLE AND INFRASTRUCTURES

From smart refrigerators to intelligent transportation systems, the next generation of infrastructure will rely heavily on information technology. But implementing such systems goes far beyond technology development alone.

CSL has launched the Center for People and Infrastructures to address the social, cultural, economic and political challenges involved in deploying smart systems in the real world. The Center brings together experts in engineering, design, the social sciences and computer science to address the complex interactions between people and technology.

For example, broadband Internet is absent, difficult to obtain and/or expensive in much of the U.S., not because the technology doesn't exist, but because of economic and public policy factors that affect the development of Internet infrastructure. In addition, smart meters for the power grid have been controversial among consumers who are skeptical that utilities are acting in their best interest.

"Infrastructures are about computers, wires and pipes but they are also about human relationships, economics and justice," said Co-Director Karrie Karahalios, associate professor of computer science. "We want to see infrastructures that not only work, but that help humans to flourish."

CLOUD COMPUTING

THEIR HEADS IN THE CLOUD >

At the Information Trust Institute (ITI), researchers seek to make complex cyber-physical systems trustworthy, with research themes focusing on power grid, health information, systems & networking, evaluation and data science. ITI is creating computer systems, software, and networks that society can depend on to be secure, reliable and available, correct, safe, private and survivable.

POWER OF THE CLOUD

Cloud computing is the large-scale use of networked, shared computing resources, an approach that allows businesses to purchase access to third-party computing resources instead of buying, setting up, and maintaining their own in-house equipment. Cloud computing is rapidly gaining momentum in the IT industry because of its numerous potential benefits. For example, storing of data at multiple remote sites offers reliability and security advantages, and costs to businesses may be dramatically reduced if they don't need their own equipment.

At the same time, cloud computing is not without its challenges. Numerous technical problems must be solved if the cloud is to remain responsive, secure and scalable. Further, the business implications of the new model have not been fully explored, and thorny legal situations have been created by a mismatch between the new technologies and old laws reflecting a now-obsolete IT scenario. ITI and CSL researchers are at the forefront of efforts to overcome those challenges.

CSL and ITI researchers are in the trenches of the cloud computing revolution, working on everything from the design of more reliable, secure cloud systems to studies of the legal and business challenges involved as businesses increasingly turn to the cloud. Here's a look at some of the efforts underway:

The campus's single largest effort on cloud computing is ITI's $6 million Assured Cloud Computing (ACC) Center, which is a joint undertaking of the AFOSR, the AFRL, and the University of Illinois. Under the guidance of director **Roy H. Campbell**, a professor of computer science, ACC's research activities focus on developing technology to support assured, mission-critical cloud computing across potentially untrustworthy third-party networks. Encompassing architecture, design, testing and formal verification, ACC's work seeks to ensure the confidentiality and integrity of data and communications, job completion in the presence of cyber attacks and failures, and timely completion of jobs.

The research group of **Thomas Huang**, a professor in ECE, has already won multiple awards for its ongoing effort to develop a new cloud-based computing paradigm for next-generation multimedia searching. The need for an efficient way to search large-scale multimedia datasets has been a serious challenge, mainly because of the difficulties of processing high-dimensional and dense feature vectors from multimedia content. Huang's team believes that processing of such data is beyond the ability of single computers or small clusters— but that the cloud computing paradigm provides enough computational power to solve the challenge. They have been designing novel algorithms to support such analysis. They believe that the ability to process such large amounts of data will encourage the emergence of new applications and systems, and are studying web-scale images together with the user information associated with these images.

Jay Kesan, professor in the College of Law, has been examining the failure of outdated laws to handle the realities of cloud computing. The problem of privacy looms large in a shared-services model; what are appropriate standards for data collection, storage and disclosure? In his most recent work, Kesan urged that consumers be afforded data withdrawal and data portability rights to facilitate transactions and promote competition in a cloud environment. He has also demonstrated the need for a more reasonable balance between privacy and security in the Cyber Intelligence Sharing and Protection Act (CISPA). Further, he notes that legal problems in the cloud are exacerbated by the question of jurisdiction. If a U.S. business uses a data center that resides in Europe, then which laws apply? Kesan is working to publicize the pressing need for legal reform.

Yi Lu, an assistant professor in ECE, received a 2012 NSF CAREER award to support her work on the problem of load balancing in a dynamically scalable cloud. Dynamic scalability is a system's ability to adapt to a fast-changing workload. Because of the huge size of clouds, the load-balancing algorithms must have low complexity. Unfortunately, existing algorithms are designed for centralized systems and do not scale well. Poorly designed low-complexity algorithms can result in significant performance degradation. Lu's ongoing work aims to design effective, low-complexity load-balancing algorithms for the cloud.

Michael Shaw, a professor of business administration, has been calling attention to the need for businesses to clearly understand the new opportunities presented by the cloud, and to make informed decisions on whether and how to incorporate cloud computing in their business models. He notes that the cloud has tremendous potential to generate new products and services, and thus new businesses and jobs. At the same time, the cloud has significant risks and disadvantages. To ensure the economic benefits of cloud computing with adequate risk management implemented, Shaw's research shows that the cloud computing strategy of a company should include an enterprise-wide business architecture plan for cloud adoption, clearly stated performance metrics along with specified service-level agreements, a governance methodology for implementing cloud services, and a business continuity policy for incident response and disaster recovery management.

R. Srikant, a professor of electrical & computer engineering, is developing innovative ways to schedule jobs in the cloud. Traditionally, wide variability in job sizes is seen as a problem, and cloud providers are anxious to ensure that small jobs are not delayed by being stuck behind large jobs in the queue. In work supported by the Army Research Office and the NSF, Srikant is pursuing the possibility that variability in cloud networks can actually be usefully exploited. His group is developing a methodology for scheduling and routing jobs, taking into consideration the wide variability in the number and size of jobs that may be in progress at any given time.

PARALLEL COMPUTING

PASSIONATE ON PARALLEL >

The Parallel Computing Institute (PCI) enables Illinois researchers from across campus to come together in new, application-focused research centers and achieve their scientific goals using the latest and most efficient parallel computing technologies. In addition to research, PCI also has a strong educational component, seeking to train future programmers and hardware designers with the skills they need to enable the next-generation of breakthroughs.

SEVEN YEARS AFTER IT WAS FIRST ANNOUNCED, THE BLUE WATERS PETASCALE SUPERCOMPUTER WILL BE IN FULL PRODUCTION AS OF MARCH 2013.

CSL Professor **Bill Gropp**, director of the Parallel Computing Institute, and Professor **Wen-mei Hwu**, PCI chief scientist, have played an integral role in the development of Blue Waters, which will be capable of sustained performance of 1 petaflop on real-world applications. Gropp (computer science) is the chief applications architect and Hwu (electrical and computer engineering) is the chief hardware architect.

Researchers will use the supercomputer to advance our understanding of the human body, plot the evolution of the cosmos and design new materials at the atomic level.

"Blue Waters will enable researchers to attack problems that are too complex and too difficult for any other system in the world," said Gropp, the Paul and Cynthia Saylor Professor of Computer Science. "Its combination of balanced compute power with enormous memory and very high I/O capability is unmatched by any system and enables a broad spectrum of applications, from astrophysics to the life sciences."

Parallelism is the key to everything from unlocking the mysteries of the universe to viewing MRI results in real time. As a relatively young field, however, there needs to be many advances in hardware and software to make these a reality. With the creation of the Parallel Computing Institute, CSL applies organizational muscle to a field it has helped pioneer. One such program, Research Experiences for Undergraduates (REU), offers undergraduates the opportunity to hone their parallel skills.

Nartezya Dykes got her first taste of parallel programming during an organization and design class as a sophomore at Atlanta-based Spelman College.

A computer science major, Dykes, 21, was intrigued by parallelism's promise of solving real world problems. So when she heard about Illinois' Passionate on Parallel REU summer program, she jumped at the chance to learn more.

"I was interested in getting out of my comfort zone and pushing myself, both in terms of skills and working in a diverse environment," said Dykes, who attends an all-black women's college. "I'm also interested in business and technology and have been exploring how computer scientists can improve corporations and help them grow. This seemed like a great opportunity to explore those areas."

PASSIONATE ON PARALLEL REU

Co-principal Investigators: Craig Zilles, associate professor of computer science, and Susan Larson, associate professor of civil and environmental engineering.

REU grant: $408,000 for three years (2012 was the last year)

Funded by the National Science Foundation, the Illinois Passionate on Parallel REU provides an opportunity for undergrads to expand their parallel programming skills through a 10-week summer research program. This year, the Parallel Computing Institute played host to 14 students who hailed from across the country and from a range of disciplines; some, like Dykes, were computer science majors, while others were pursuing degrees in fields where parallelism will provide the backbone for future breakthroughs.

The program began with students immersing themselves in coding through a one-week boot camp led by REU co-investigator **Craig Zilles**, a PCI affiliate. Then, they paired off into research teams, each tackling a different problem.

Northwestern University student Jason Hutcheson, a computational chemistry major, teamed up with a computer science major from Illinois to translate parallelism for very large systems in the application Visual Molecular Dynamics (VMD). For example, a scientist may want to simulate the process of a membrane harvesting light, which takes massive computational power. The pair was able to develop algorithms, using the CUDA programming language, to benefit modeling these large systems in VMD.

"We were able to merge our disciplines and work really well together," said Hutcheson, 21, a native of the Rockford, Ill., area. "To me, that's what is exciting, when you get to this level of science."

Hutcheson said his research experience, which also included connections with Swanlund Professor of Physics Klaus Shulten's group, helped solidify his plans for the future, which he hopes includes graduate school at Illinois. He also benefited from the weekly REU meetings that tackled topics ranging from professional and research ethics to technology commercialization.

For Dykes, the program also went beyond improving her coding skills.

"The REU experience helped me improve my analytical skills, be more of an independent thinker and a self-starter who can go beyond classroom instruction to being able to apply it," she said.

HPC ONLINE COURSE DRAWS 27,954 USERS

The Parallel Computing Institute has launched its first online class through Coursera, the University of Illinois' partner in providing online courses for free. The course, "Heterogeneous Parallel Programming," is taught by **Wen-mei Hwu**, the Sanders-AMD Endowed Chair in Electrical and Computer Engineering, and has drawn about 27,954 users. Of those, 13,333 are actively watching videos, while 6,508 are taking quizzes.

The class is geared toward students who want to learn the programming techniques in heterogeneous parallel computing systems. All computing systems, from mobile to supercomputers, are becoming heterogeneous parallel computers using both multi-core CPUs and many-thread GPUs for higher power efficiency and computation throughput. While the computing community is racing to build tools and libraries to ease the use of these heterogeneous parallel computing systems, effective and confident use of these systems require knowledge of these programming interfaces (CUDA/OpenCL, OpenMP, and MPI) and how they should orchestrate the use of these interfaces to achieve application goals.

For more information about the course, please visit https://www.coursera.org/course/hetero.

SMART SYSTEMS

TRAINING SMART SYSTEMS >

ADSC, a collaborative effort between the University of Illinois and Singapore's Agency for Science, Technology and Research (A*STAR), focuses on solving basic research problems with high scientific and economic impact in the areas of interactive digital media and the smart grid. Started with the support of the Coordinated Science Laboratory, ADSC seeks to transform the way that humans use and interact with information technology.

CUTECHAT WINS DEMOGURU AWARD AT DEMO ASIA.

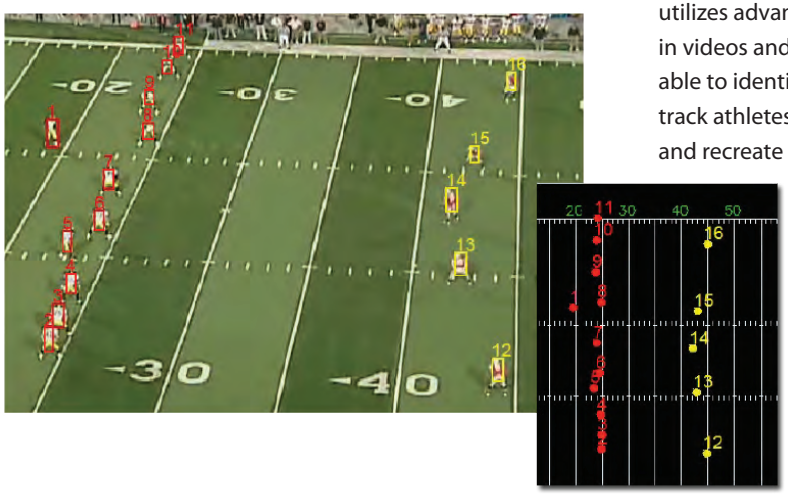
Advanced Digital Sciences Center Research Scientist **Jiangbo Lu** and his video cutout technology, CuteChat, was one of five demonstrations to win the DEMOguru award at the DEMO Asia 2012 conference, held in spring 2012, in Singapore. The conference is a launchpad for emerging technology and trends.

CuteChat is a lightweight video chat system that allows the average user to manipulate the background of their video. The technology removes the background of the user's camera feed and replaces it with another background, such as a landscape scene, or video feed. Lu developed the video cutout technology at ADSC as part of CSL Associate Professor Minh Do's (ECE) research project on low-cost virtual reality.

Breaking down film, the process of watching video to formulate strategies in sports, is an essential part of the training regime coaches and athletes across all athletic disciplines have been using for decades. Traditionally, this type of video analysis is done manually; however, the sports domain is now utilizing more technology to assist in everyday tasks, including video analysis.

Recent developments in computer vision research at the Advanced Digital Sciences Center (ADSC) in Singapore by CSL Research Professor **Narendra Ahuja** could revolutionize video analysis process, and subsequently, the way athletes train.

"The number of cameras deployed across the world is multiplying faster than we can imagine," said Ahuja, who leads the Semantic Analysis of Video research group at ADSC. "They are generating videos around the clock, at rates much faster than it could ever be assimilated by human analysts. Automated methods to understand the contents of the images and videos are therefore very important."



Ahuja and his team of ADSC researchers look at human actions and interactions in video and have created a way to analyze these complex movements and patterns automatically. The ultimate goal is to create a framework to analyze any video, with an initial focus on sports videos. The team has created a system which will help coaches understand large numbers of video clips quickly and reliably extract statistics from the videos, beginning with football.

"They're tackling fundamental problems that are of key importance when analyzing any sort of video, in particular video registration and object tracking," said ADSC Director **Marianne Winslett**, a professor of computer science and member of CSL. "They're going to make life a lot easier for coaches and athletes by providing video analysis of sports footage."

Ahuja's research team created a prototype, AutoScout, which utilizes advanced computer vision techniques to track objects in videos and analyze the objects' movements. AutoScout is able to identify what the camera is looking at on the field, track athletes during a play, provide statistics for certain plays and recreate players' motion in 3D.

In building the prototype, ADSC researchers first improved video registration, the process of mapping a video into a coordinate system of the changing scenes. In many cases, the camera may have panned, tilted or zoomed while recording the video. The team is able to separate out the motion of the object, or athlete in a sports video, from the motion of the camera and then accurately calculate the amount of camera motion. Additionally, the researchers improved object tracking methods by using particle filter framework, which improves the accuracy of their tracking by about 30 percent and is faster than the current tracking method. These two tasks represent the core research contributions.

Ahuja's team has been working with American football teams, with hopes to commercialize AutoScout in the near future. Currently, AutoScout can register and track any type of video, but can only provide analysis for certain football plays and 3D representation for football and soccer. ADSC is working with a Singapore soccer team to expand the capabilities of their technology into other sports.

Recently, the video analysis team worked with the Singapore Sports Institute to create a tablet application for the 2012 Olympic bronze medal winning Singapore table tennis team. While the tablet is for research purposes only and is only used in training, it provides real-time notational capabilities for coaches to tag actions during a practice or match, such as a serve or a scored point. The application allows coaches to quickly review game statistics and helps with video analysis.

Ahuja and his team have focused their research efforts on sports videos, but the video registration and tracking methods they have developed could be applied in many areas, such as video surveillance or tracking shopping patterns in a mall department store.

"Understanding how people use spaces can be very helpful," Winslett said. "These methods could be used to plan how public spaces should be laid out or to analyze how people are living or moving in any space, such as a public transportation station or a playground."

NEWS BRIEFS

CSL professor Adesida named Provost at Urbana Campus

CSL Professor and College of Engineering Dean **Ilesanmi Adesida** has been named vice chancellor for academic affairs and provost of the Urbana campus.

Adesida, an electrical and computer engineering professor, has served in various roles since becoming a University of Illinois faculty member in 1987. Named dean in 2006, he also has been a director of the Center for Nanoscale Science and Technology since 2001.

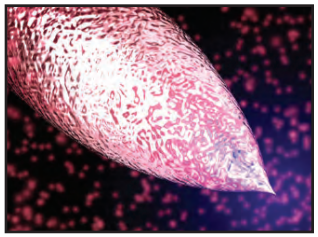
Adesida will play a critical role in developing and executing the next steps in the Visioning Future Excellence initiative, which has challenged staff and faculty members to submit new ideas that will be used to plot the Urbana campus's course far into the future, according to Chancellor Phyllis Wise.

CSL researchers head $1 million surveillance network research

CSL Professor **Petros Voulgaris** (Aerospace Engineering) is leading a multi-university group in an approximately $1 million grant over three years from the Air Force Office of Scientific Research (AFOSR) to determine how sophisticated, unmanned surveillance vehicles can provide navy antiterrorism and force protection measures in harbors.

The researchers envision a heterogeneous group of ground, underwater, surface and aerial unmanned vehicles monitoring the Navy fleet and ports. They believe that aerial autonomous surveillance of vessel traffic, current and wave patterns, and ocean weather conditions can enhance the military's ability to coordinate autonomous surveillance agents positioned underwater and on the surface.

Microscope probe-sharpening technique improves resolution, durability



A simple new improvement to an essential microscope component could greatly improve imaging for researchers who study the very small, from cells to computer chips.

CSL Professor **Joseph Lyding**, a professor of electrical and computer engineering, led a group that developed a new microscope probe-sharpening technique. The technique is described in research published in the journal Nature Communications.

Researchers receive $2.5 million to improve networked systems

Researchers in the University of Illinois' Coordinated Science Laboratory, along with investigators at the University of Michigan at Ann Arbor, are working to create more efficient and reliable networked systems. They received a five-year, $2.5 million grant, titled "CIF: Large: Collaborative Research: Controlled Sensing, and Distributed Signal Processing and Decision Making in Networked Systems," which is funded by the National Science Foundation.

Through the project, researchers will develop a general theoretic framework and tools to help optimize these sensing systems. They will study the role of information in sensing, signal processing and decision making for networked systems under various architectures, in both controlled and distributed sensing. They will also work to understand the coordination of networked systems and develop novel algorithms to enhance the functioning of these systems.

The Illinois team includes CSL professors **Venu Veeravalli** (electrical and computer engineering) **Tamer Başar** (electrical and computer engineering), and **Angelia Nedich** (industrial & enterprise systems engineering).

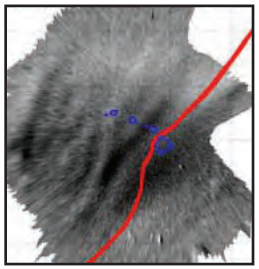
NSA establishes Science of Security Lablet at Illinois

To tackle the challenge of securing critical systems, the U.S. National Security Agency (NSA) has given $2.5 million – including an initial $1 million investment in FY2012 – to the Information Trust Institute to seed an academic "Lablet" focused on the development of a Science of Security (SoS). A major goal is the creation of a unified body of knowledge that can serve as the basis of a trust engineering discipline, curriculum and rigorous design methodologies. Such a body of knowledge would ultimately make it easier to design systems that guarantee that your medical records remain confidential and your power stays on.

The Illinois Lablet will contribute broadly to the development of security science while leveraging Illinois expertise in resiliency, which in this context means a system's demonstrable ability to maintain security properties even during ongoing cyber attacks.

The Lablet's leadership is shared between principal investigator **David M. Nicol**, a professor of electrical and computer engineering, and co-principal investigators **William H. Sanders**, who is an ECE professor and director of the Coordinated Science Laboratory, and **José Meseguer**, a professor of computer science.

Illinois researchers capture images of first tsunami-related airglow signature



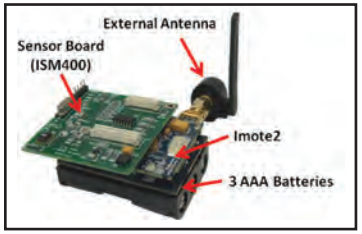
In 2011, researchers in the Coordinated Science Laboratory became the first to record an airglow signature in the upper atmosphere produced by a tsunami. The activity was observed using a camera system based in Maui, Hawaii.

The signature, caused by the March 11 earthquake that devastated Japan, was observed in an airglow layer 250 kilometers above the earth's surface. It preceded the tsunami

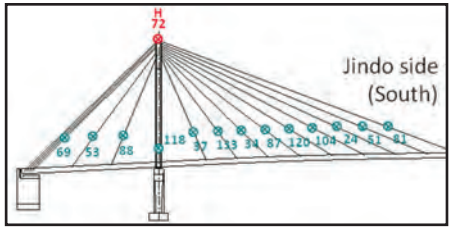
by one hour, suggesting that the technology could be used as an early-warning system in the future.

The observation confirms a theory developed in the 1970s that the signature of tsunamis could be observed in the upper atmosphere, specifically the ionosphere, according to **Jonathan Makela**, a professor of electrical and computer engineering. But until now, it had only been demonstrated using radio signals broadcast by satellites.

Economist touts Agha's bridge-monitoring research



If you can make a car smart enough to know it needs repairs, why couldn't you do the same for bridges? CSL researcher **Gul Agha**, a professor of computer science, and Civil Engineering Professor **Bill Spencer**, a professor of civil engineering, are studying how to create such "superstructures," the topic of a recent feature in *The Economist*.



The research team has created an inexpensive system for continuous, reliable structural health monitoring. The approach uses dense arrays of wireless smart sensors and concurrent and distributed real-time processing to overcome the limitations inherent in traditional systems. Already, researchers have produced a customizable software framework that simplifies development for smart sensor platforms.

In 2009, the team deployed the largest civil infrastructure monitoring system to date, and the only one using dense wireless arrays, on Jindo Bridge in South Korea.

NEW FACULTY

Ali Belabbas is an assistant professor in electrical and computer engineering. His research focuses on networked control systems and his specific research interests are in control theory and applied statistics. Belabbas holds a Ph.D. in applied mathematics from Harvard University.

Soon-Jo Chung is an assistant professor in the department of aerospace engineering. His research interests are in control and robotics for complex aerospace systems and his robotic perching research has made worldwide news. Chung's research projects have all focused on nonlinear control, estimation and synchronization of multi-agent or distributed dynamical systems. He holds a Ph.D. from MIT in estimation and control.

An MIT grad, **Alejandro Dominguez-Garcia** is an assistant professor of electrical and computer engineering. His research interests lie at the interface of system reliability theory and control, with special emphasis on applications to electrical energy systems that include: coordination and control of distributed energy resources; integration of renewable resources in power systems; reliability modeling of electrical energy systems and components; and health monitoring and fault diagnosis in electrical energy systems.

Angelia Nedich is an assistant professor of industrial & enterprise systems engineering. Nedich's research interests are convex and nonconvex optimization; linear and nonlinear optimization; large-scale decision systems; parallel and distributed algorithms; variational inequalities; and opinion dynamics. She holds a Ph.D. in electrical engineering from MIT.

Maxim Raginsky is a member of the ECE faculty. He is interested in theoretical and practical aspects of information processing and decision-making in uncertain environments under resource and complexity constraint—drawing on the fields of information theory, statistics, game theory, optimal control and signal processing. His Ph.D. in electrical engineering is from Northwestern University.

Dan Work is an assistant professor in civil and environmental engineering. Work holds a Ph.D. from the University of California, Berkeley, in civil engineering and teaches courses in transportation engineering and systems engineering. Work researches control, estimation and optimization of cyber physical systems. His research also focuses on mobile sensing, inverse modeling and data assimilation applied to problems in both civil and environmental engineering.

RETIREMENTS

Narendra Ahuja is a Donald Biggar Willet professor and longtime member of the electrical and computer engineering department. During his tenure at Illinois, Ahuja's research interests included 3D computer vision, next generation cameras, robotics, image processing, video and image analysis, sensors, patterns recognition, human-computer interaction and image synthesis. He received his Ph.D in computer science at the University of Maryland in 1979.

William O'Brien is a Donald Biggar Willet professor, who is retiring from the electrical and computer engineering department. O'Brien received his Ph.D. from the University of Illinois at Urbana-Champaign in 1970, and his primary research areas are biomedical imaging, bioengineering and acoustics. Most recently, he focused on ultrasonic bioengineering and biophysics.

Long-time ECE faculty member, **John Tucker** made significant strides in the areas of physical electronics and new nanoelectronic architectures in silicon during his career. He received his Ph.D. in physics from Harvard University in 1973.

Benjamin W. Wah is a Franklin W. Woeltge professor and professor of electrical and computer engineering. Wah received his Ph.D. in computer science in 1979 from the University of California, Berkeley. His list of research interests include artificial intelligence, planning and scheduling, satisfiability, multimedia signal processing, voice-over IP, computer networks, nonlinear programming, mixed-integer programming and applications in financial engineering.

AWARDS/ACCOMPLISHMENTS

Michael C. Loui – William and Patricia Stacy Engineering Ethics Lecturer, Department of Electrical and Computer Engineering, University of Kentucky – March 2012; Journal of Engineering Education Editorship

Aimee Rickman – Illinois Program for Research in the Humanities (IPRH) Graduate Fellowship; Myra Sadker Foundation Dissertation Award

Naira Hovakimyan – 2011 AIAA Mechanics and Control of Flight Award; Technical Achievement Award, World Congress, 9th International Conference on Mathematical Problems in Engineering, Aerospace and Sciences, Vienna, Austria, 2012; Keynote Speaker for ICNPAA World Congress: Mathematical Problems in Engineering, Sciences and Aerospace, Vienna, Austria, Jul. 2012; University Scholar of UIUC

Maxim Raginsky – Editorial Board of Foundations and Trends in Communications and Information Theory

Zhi-Pei Liang – Elected to the International Academy of Medical and Biological Engineering, 2012; Otto Schmitt Award from the International Federation for Medical and Biological Engineering, 2012

Amin Emad – 2012 ECE Sundaram Seshu International Student Fellowship

Thomas S. Huang – Azriel Rosenfeld Lifetime Achievement Award, IEEE International Conference on Computer Vision, Barcelona, Spain, Nov. 11, 2011

Thomas S. Huang, **Haichao Zhang**, **Jianchao Yang**, **Yanning Zhang**, **Nasser M. Nasrabadi** – Best Student Paper Award, IEEE International Conference on Computer Vision, Barcelona, Spain, Nov. 2011

Thomas S. Huang, **Lialiang Cao**, **Hyun Duk Kim**, **Min-Hsuan Tsai**, **Brian Cho**, **Zhen Li**, **Indy Gupta**, **ChengXiang Zhai** – Best Paper Award, KDD International Workshop on Big Data Mining, 2012

Sevinc Figen Oktem – NASA Earth and Space Science Fellowship - 2012-2013 academic year; Professor Kung Chie Yeh Endowed Fellowship, ECE department; Student Travel Award for SIAM Imaging Science Conference

Matt Crain – Graduate College Dissertation Completion Fellowship - 2012-2013 academic year

Abhishek Gupta – Mavis Future Fellow Award, College of Engineering – 2012-2013 academic year

Mark Hasegawa-Johnson – Fellow of the Acoustical Society of America, 2011; Dean's Award for Excellence in Research, 2012

Xiuling Li – Dean's Award for Excellence in Research, 2012

Dong Jin, **Yuhao Zheng**, **Huaiyu Zhu**, **David M. Nicol**, **Lenhard Winterrowd** – Best Paper Award, 26th Conference on Principles of Advanced and Distributed Simulation (PADS), Zhangjiajie, China, 2012

William Gropp, **Paul Sack** – Best Paper Award, PPoPP 2012

Cuong Pham – Outstanding Poster Presentation, UIUC Computer Science Spring 2012 Graduate Symposium; Adobe Innovation Award, Cozad New Venture Competition, 2012; Enterprise Work Incubator Award, Cozad New Venture Competition, 2012

Ravi Iyer – ACM SIGSAC Outstanding Contributions Award

Rakesh Kumar – ARO Young Investigator Award, 2012; Best Paper in Session Award, SRC TECHCON, Sept. 2011; Keynote Speaker, 7th Workshop Compiler Assisted SOC Assembly (CASA), 2012; Best Paper Award Nomination, 18th International Symposium on High Performance Computer Architecture (HPCA), 2012; Best Paper Award, International Conference on Compilers, Architectures and Synthesis of Embedded Systems (CASES), October 2011; Keynote Speaker, 2nd Workshop on Resilient Architectures (WRA), Dec. 2011; Guest Editor, Special Issue on New Software/ Hardware Paradigms for Error-tolerant Multimedia Systems, IEE Transactions on Multimedia, 2012; General Chair, 8th IEEE Workshop on Silicon Errors in Logic – System Effects (SELSE), March 2012

Timothy Wolfe Bretl – Best Manipulation Paper Award at ICRA; Associate Editor for the IEEE Transactions on Automation Science and Engineering

Taylor Johnson – ECE Computer Engineering Fellowship, sponsored by Intel Corporation, ECE department

Taylor Johnson, **Sayan Mitra** – DisCoTec '12 Best Paper Award, presented at FMOODS/FORTE '12

Sayan Mitra – Air Force Office of Scientific Research (AFOSR) Young Investigator Research Award, 2012

Rami A. Abdallah, **Naresh Shanbhag** – Low-power Design Contest Award, 2012 IEEE International Symposium on Low-power Electronic Design (ISLPED)

Rami A. Abdallah – Mechanical Engineering Van Valkenburg Graduate Research Award; Yi-Min Wang and Pi-Yu Chung Research Award; 2011 TECHCON Best in Session Award

Joseph Sloan – 2011 TECHCON Best in Session Award

Eric Kim – 2012 TECHCON Best in Session Award

Cedric Langbort – NSF CAREER Award

Takashi Tanaka – 2012 IEEE Conference on Decision and Control (CDC) Best Student Paper Award; JSPS Postdoctoral Fellowship for research abroad (from the Japanese government)

Abhishek Gupta – College of Engineering's Mavis Future Faculty Award; Conference Chair, IEEE/ACM Conference on Utility and Cloud Computing, 2012

Parya Moinzadeh, **Kirill Mechitov**, **Reza Shiftehfar**, **Tarek Abdelzaher**, **Gul Agha, Billie F Spencer** – Best Paper Award, 9th Annual Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON), June 18, 2012

Martin Wong – Edward C. Jordan Professorship in Electrical and Computer Engineering, Jan. 2012 to Jan. 2017; Acting Associate Dean of Academic Affairs, College of Engineering, Aug. 2012 to Aug. 2013

Martin Wong,**Ting Yu** – 1st Place, ACM TAU-2012 Power Grid Simulation Contest, Jan. 2012

Martin Wong, **Qiang Ma**, **Hongbo Zhang** – Best Paper Award, 49th ACM/IEEE Design Automation Conference, June 2012

Tan Yan – 2012 ACM Outstanding Ph.D. Dissertation Award in Electronic Design Automation, June 2012

Darren M. Stevenson – Research Exchange Award, Swedish Foundation for International Cooperation in Research and Higher Education (STINT), Stockholm, Sweden; Travel Fellowship, Illinois-Sweden Program for Educational and Research Exchange (INSPIRE), Illinois Strategic International Partnerships (ISIP), University of Illinois at Urbana-Champaign; Doctoral Student Travel Fellowship, Télécom Ecole de Management, Institut Mines-Télécom, Paris, France; Junior Researcher Travel Award, STS Italia / Italian Society for Social Studies of Science and Technology, Dipartimento di Sociologia, Università di Padova, Padova, Italy; Graduate Fellow, Values in Design Laboratory, Donald Bren School of Information and Computer Science, University of California, Irvine, USA

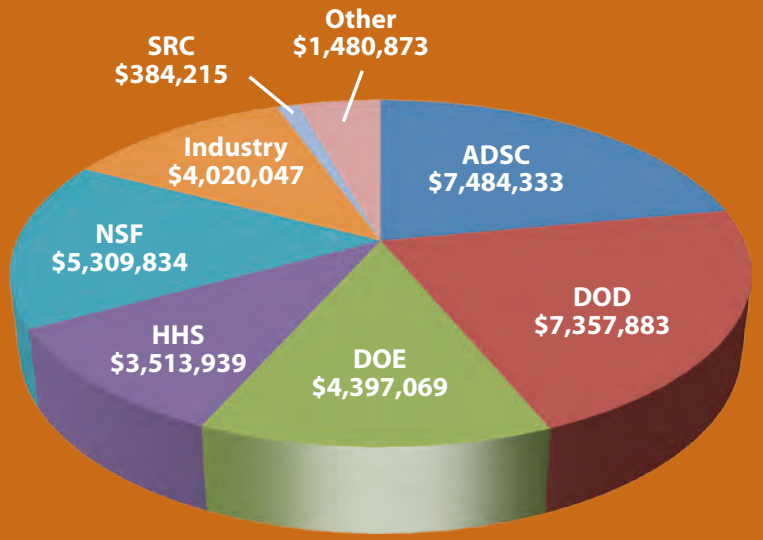
Ghazale Hosseinabadi, **Nitin H. Vaidya** – Runner-up Award, 10th International Conference on Wired/Wireless Internet Communications (WWIC), 2012

Tamer Başar – Honorary Doctorate, Azerbaijan Academy of Sciences, Baku, November 2011; Honorary Doctorate, Boğaziçi University, Istanbul, Turkey, June 2012; SIAM Fellowship, July 2012; Book: "Game Theory in Wireless and Communication Networks: Theory, Models, and Applications," Cambridge University Press, October 2011 (with: Z. Han, D. Niyato, W. Saad, and A. Hjorungnes)

Philip Krein – Editor-At-Large, IEEE Transactions on Power Electronics

FINANCIALS

RESEARCH EXPENDITURES BY FUNDING SOURCE



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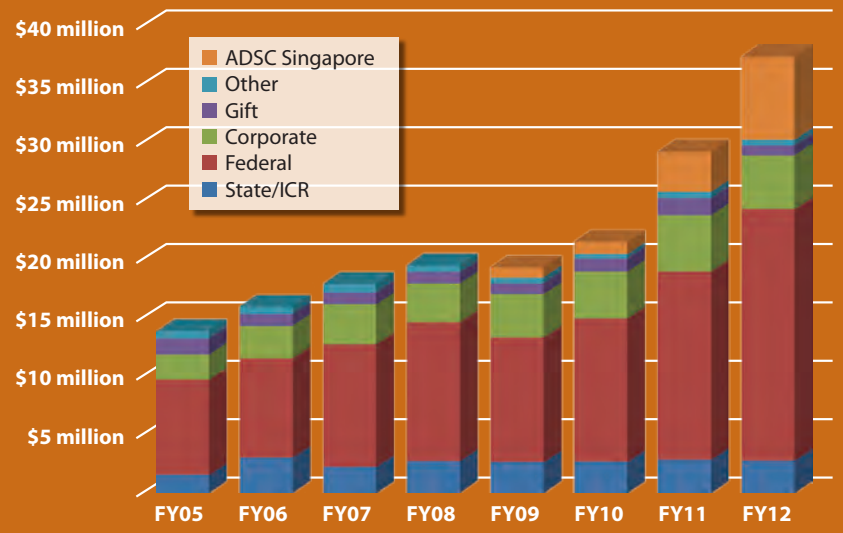

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