ENGINEERING AT ILLINOIS

INFORMATION TRUST INSTITUTE

ANNUAL REPORT 2014

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In the early 2000s, numerous events pointed to the need for the development of trustworthy systems. Malicious computer viruses – including Code Red and the SQL Slammer worm – infected hundreds of thousands of machines around the world. Several power outages caused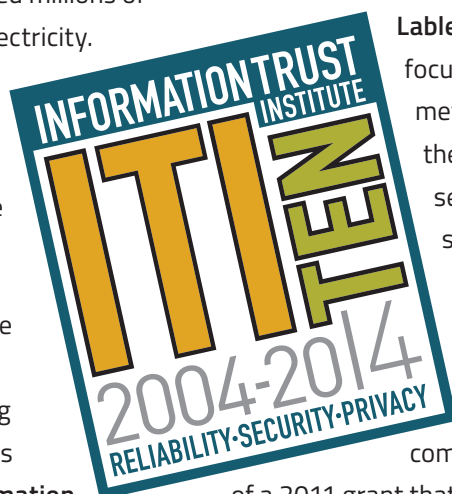 millions of Americans to lose electricity. And 9/11 sparked a global outcry for greater security measures across the board.

In this landscape, the idea for an institute focused on designing trustworthy systems took root. The **Information Trust Institute** was born in 2004, with the goal of making an increasingly cyber world more resilient, reliable and secure. The aim was to create a place where researchers would work with corporate, government and academic partners to advance the relatively new science of information trust while developing tools to help an industry that needed solutions sooner rather than later.

A decade later, ITI shows every sign of fulfilling its mission. As we celebrate our 10-year anniversary this fall, we are commemorating an institute that has contributed both to basic and applied science, helping to transform the field.

In the past year alone, ITI has received $2.1 million from the National Security Agency to create the **Science of Security for Systems Lablet**, which will focus on developing methodologies for the end-to-end security analysis of systems ranging from the power grid to the Internet. The grant comes on the heels of a 2011 grant that established the first **Science of Security Lablet at Illinois**. Both lablets have aimed to contribute to the current body of research that seeks to strongly shape security research through scientific methodologies, such as hypothesis testing and experimental repeatability.

ITI also continues to show its strength in applied research. We teamed up with industry partners on five proposals for a Department of Energy solicitation on the cyber-security of energy delivery control systems and won four of 11 awarded last winter. I believe ITI was so successful because of the strong relationships our researchers have built with DoE and our industry partners.

With the renewal of the NSF-funded **Illinois Cyber Security Scholars Program**, the institute is also helping develop a new generation of cyber professionals who are better equipped to contend with increasingly sophisticated cyber attacks. The program has 20 students in computer science, computer engineering and law presently enrolled, and another 23 graduates who are already working in security at national labs and government agencies.

In the next decade, we will persist in helping to define the science, leveraging the depth and breadth of expertise that ITI researchers offer. And we will continue working with our partners to create technologies that create a safer world now and years from now.

David Nicol
Director, Information Trust Institute

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Science of Security Lablet

Illinois was one of four universities selected to receive funding for basic cybersecurity research through the National Security Agency's Science of Security (SoS) initiative. The NSA awarded $2.1 million to create the Science of Security for Systems Lablet, which will be housed in ITI. The Lablet—the second awarded to ITI—will focus on security at the systems level, with the ultimate goal of providing methodologies for end-to-end security analysis of systems ranging from the power grid to the Internet.

Experimental Solar Array

As interest in solar energy is increasing, the Illinois Center for a Smarter Electric Grid (ICSEG) is helping lead renewable energy research with the installation of a new experimental solar array on the south side of the Illinois campus. The array, which is made up of 60 solar panels, is intended to provide power to enable research on, and validation of, novel photovoltaic (PV) inverter and control technologies.

Department of Energy Cybersecurity Grants

In the past year, ITI received nearly $4.6 million in research funding from the Department of Energy to support four cyber-security-related projects, all led by industry collaborators. They include:

Applied Resiliency for More Trustworthy Grid Operation: ARMORE will develop a distributed, peer-based framework for the application of secure information exchange in critical infrastructure to increase the security and resiliency of grid operation. Illinois researchers include Tim Yardley, Rakesh Bobba (affiliate), Klara Nahrstedt and William H. Sanders.

Collaborative Defense of Transmission and Distribution Protection and Control Devices against Cyber Attacks: CODEF researchers will create a distributed security domain layer that allows transmission and protection devices to collaboratively defend against cyber attacks in an IEC 61850 environment. Illinois researchers include Alfonso Valdes, William H. Sanders, Nitin H. Vaidya, Peter W. Sauer and Tim Yardley.

**Secure Policy-Based Configuration Framework:** PBCONF will support the secure configuration of, and remote access to, energy devices from a variety of vendors, helping to mitigate vulnerabilities created by incorrect or inconsistent configuration of energy sector devices, among other issues. Illinois researchers include Tim Yardley, David M. Nicol, William H. Sanders and Klara Nahrstedt.

Software-Defined Networking: Researchers are working to develop a flow controller – hardware device and supporting software – that will monitor, configure and maintain safe, reliable network traffic flows in system control networks for the power grid. Illinois researchers include: Rakesh Bobba (affiliate), William H. Sanders, David M. Nicol and Roy Campbell.

PRIVACY

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Real-time Embedded Systems Security

Through a three-year, $600,000 grant from the Office of Naval Research, ITI Research Scientist Sibin Mohan is working to integrate security into embedded real-time systems in a fundamental way. These systems — which monitor and control everything from aircraft to industrial plants — are increasingly connected, making them more vulnerable to cyber attacks. Mohan's work seeks to incorporate security into the design of these systems at a fundamental level.

NP-View Tool
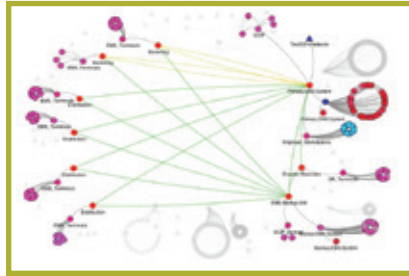
ITI Director David M. Nicol and ECE Illinois Head William H. Sanders have co-led the development of the Network Access Policy Tool (NetAPT) at Illinois. The creators received a U.S. patent for the design of the tool, while the Department of Homeland Security provided funding for a one-year effort to commercialize it. The commercial version, NP-View, performs an automated, comprehensive security policy analysis to identify any respects in which an implementation deviates from global access policy.

ADVISE Security Tool

Large companies now have a new tool to help keep their networks safe from attackers. ECE Illinois Head William H. Sanders and ITI Senior Software Engineer Ken Keefe have been awarded a one-year, $950,000 contract from the Department of Homeland Security to develop a simplified cyber security metrics modeling method to be used by those without security expertise.

The research will build on a previously developed method, ADversary VIew Security Evaluation (ADVISE), which has been implemented in the prototype tool Möbius-SE and is used by security modeling experts and scientists. Companies can use the tool to simulate potential attacks on their system to find out where they are most vulnerable.

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NEW HIRES

Amy Clay
Office Support Associate

Kate Davis
Research Scientist

Christopher Drew
Research Programmer

Brett Feddersen
Research Programmer

Dixie Heath
Associate Director

Amy Irle
TCIPG Office Support Specialist


Gabe Weaver
Research Scientist

EDUCATION HIGHLIGHTS

✱ Illinois Cyber Security Scholars Program

While the number of cyber crimes has risen over the years, the number of cyber security experts available to stop them has not kept pace. The National Science Foundation has given ITI a four-year, $4.2 million grant 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 (Reuters). The Illinois Cyber Security Scholars Program (ICSSP), open to students in computer science, computer engineering, and law, teaches participants how to protect the nation's cyber infrastructure by designing more secure systems and methodologies, as well as better cyber policy.

✱ Hackathon

Students demonstrated their hacking skills at an ICSSP-sponsored hackathon in Siebel Center last December. The event drew 120 students, none of whom were able to solve the number of problems required to win the top prize. ICSSP plans to host another hackathon this semester.
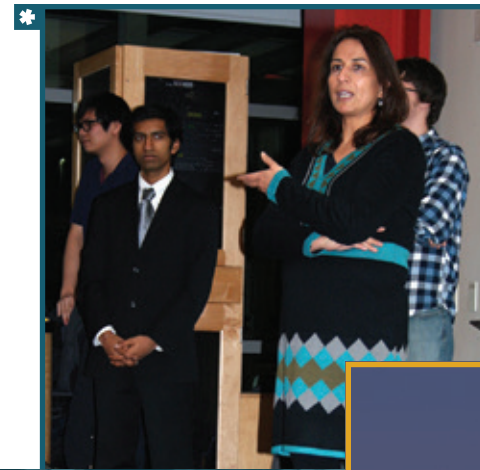
ICSSP Students at Regionals

A team of ICSSP students placed second at the 2013 Illinois Collegiate Cyber Defense Competition, a result that enabled them to advance to the Midwest regionals. In addition to thwarting hackers, the students also worked to set up security policies for the "company" and implement new services. The students were judged on their ability to respond and react to attacks on the system, whether their systems remained working during attacks, and other criteria.

MidAmerica Regional Microgrid Education and Training (MARMET)

A multi-university team is developing a microgrid training program that will help educate current and future stakeholders in the power grid industry. The group, called the MidAmerica Regional Microgrid Education and Training (MARMET) consortium, will combine cutting-edge research and advanced instructional methods for traditional and nontraditional settings. The goal, says Illinois lead Pete Sauer (ECE), is to train people in how to build a smarter grid. The group plans to leverage online classes, webinars and short courses, as well as a formal graduate curriculum.

✳ The TCIPG Minecraft World

ITI and the Office for Mathematics, Science, and Technology Education (MSTE) are working together to create an educational Minecraft scenario where students explore electricity generation and delivery. Later this fall, gamers will be able to navigate an environment that includes a wind farm, a solar farm, coal and nuclear power plants, as well as sensors, substations and other buildings. Students can find lessons that teach them about energy generation and they can build and power their own town. They can also experiment with passive house design as they explore a house that is not connected to the power grid. Password protected substations and home management systems will require players to engage in responsible cyber security practices. For more information about the TCIPG Minecraft World, visit the TCIPG Education website: **http://tcipg.org/education**.

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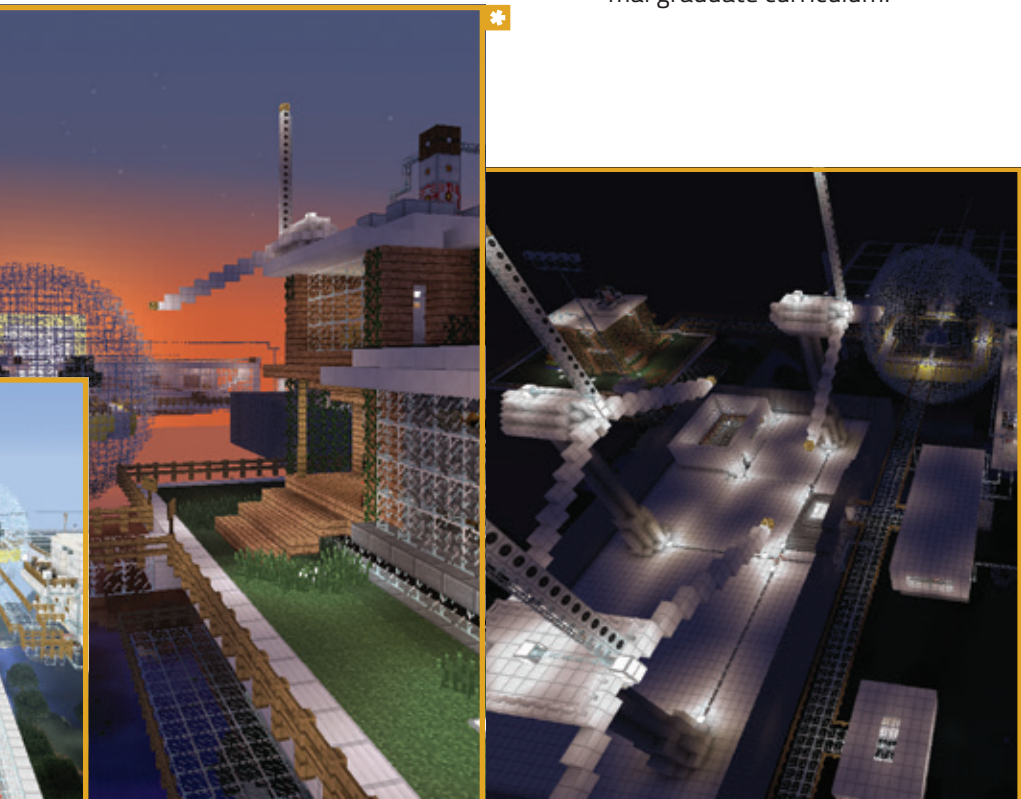
EVENT HIGHLIGHTS

❉ TCIPG Summer School

The Trustworthy Cyber Infrastructure for the Power Grid (TCIPG) Center held its third summer school June 17–21, 2013 in St. Charles, Ill., where over 170 utility and industry practitioners, researchers and students learned about the nexus between electrical energy systems and cybersecurity. The school was designed to provide an essential background in the basics of security and resiliency for cyber infrastructure in the power grid. Participants gained an understanding of an evolving smarter energy system, as well as associated cybersecurity challenges. They also had the opportunity to participate in a hands-on SCADA security assessment training lab and to work with the Ameren Smart Grid Training Platform.

❉ TCIPG Industry Workshop

The 2013 TCIPG Annual Industry Workshop was held November 5-7, 2013, in Champaign and focused on the technology development, technology transition, education and awareness that are essential to achieving a resilient power grid. Over 160 invited speakers and panelists from industry, national labs, government agencies and TCIPG partner institutions discussed leading research results as well as key challenges and problems. Workshop topics focused on architectures, components and best practices for resilient power grid systems.

Formal Methods for the Science of Security Summer School

The Formal Methods for the Science of Security Summer School was held July 22–26, 2013, in Urbana with a goal of giving security professionals and graduate students in computer science, computer engineering and related disciplines a comprehensive view of the different research directions in which formal methods are furthering the science of security. Almost 60 attendees learned from world-renowned researchers about the use of mathematical models of secure systems and verification methods and tools that advance the science of security.

State Fair Booth

ITI's power grid centers (TCIPG and ICSEG) taught Illinois State Fair attendees about the smart grid at the fair's Illinois Energy Zone August 9-18, 2013, in Springfield, Ill. The exhibit, which was sponsored by the Energy Education Council, included a solar powered phone charging station, a solar dollhouse, as well as the Tesla Town game and other TCIPG applets. ITI and MSTE staff and students talked with fairgoers about the new ECE building, University of Illinois' Real Time Digital Simulator, the Solar Research Test Bed, the Ameren Illinois Technology Applications Center and other smart grid research and related Illinois energy projects.

1st International Workshop on Digital Forensics Curriculum Standards

Illinois professors Roy Campbell and Masooda Bashir organized the 1st International Workshop on Digital Forensics Curriculum Standards (DFCS), which was held May 20–21, 2013 in Champaign. Over 40 attendees from universities and colleges that had established digital forensics curricula, or were considering adopting them, discussed digital forensics curriculum standardization and what roadblocks are impeding widespread adoption of such standards. The workshop focused on defining and evaluating the critical pedagogical elements of various topic areas, techniques for teaching them and challenges educators are likely to face.

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NEWS BRIEFS

Sanders named ECE Head

ITI researcher and inaugural director William H. Sanders was named ECE Illinois' new department head, effective August 16, 2014. Sanders, a Donald Biggar Willett Professor of Engineering, had served as interim department head since July 2013 and as director of the Coordinated Science Laboratory from 2010 to 2014. He is also the principal investigator of the Trustworthy Cyber Infrastructure for the Power Grid (TCIPG) project and co-founder of the Advanced Digital Sciences Center.

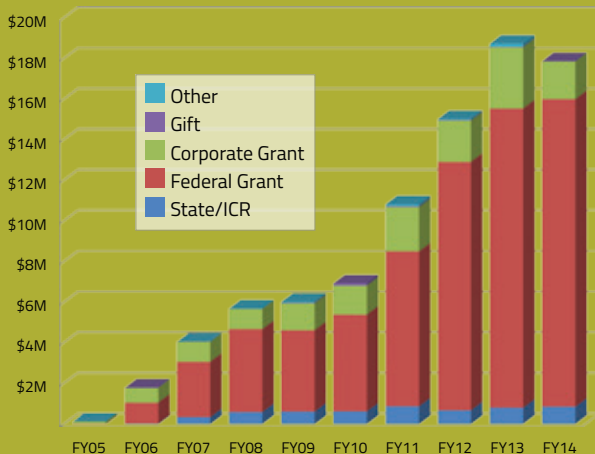## Bashir delivers invited talk about digital forensics to Illinois BoT

ITI, CSL, and GSLIS Assistant Professor Masooda Bashir gave a presentation on a new educational initiative on digital forensics to the University of Illinois Board of Trustees at their September 2013 meeting. The goal of the effort is to create a portable standard curriculum that can easily be adopted by other institutions and strongly reflects the multidisciplinary nature and breadth of digital forensics.
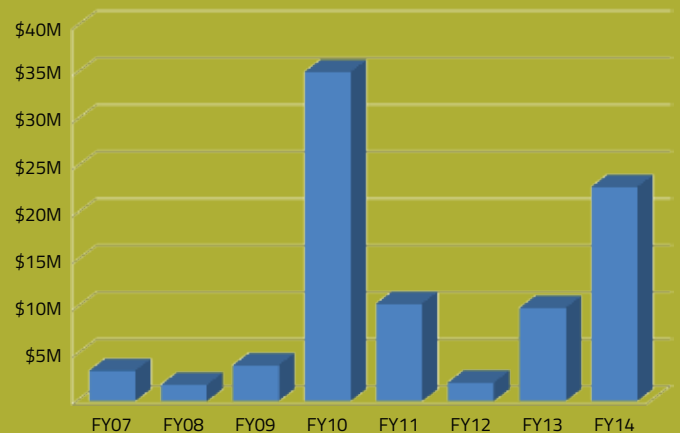
FINANCIALS

ITI Total Expenditures by Type

Legend:
- Other
- Gift
- Corporate Grant
- Federal Grant
- State/ICR

Y-axis: $2M, $4M, $6M, $8M, $10M, $12M, $14M, $16M, $18M, $20M
X-axis: FY05, FY06, FY07, FY08, FY09, FY10, FY11, FY12, FY13, FY14

New Contracts/Grants Awarded by FY

Y-axis: $5M, $10M, $15M, $20M, $25M, $30M, $35M, $40M
X-axis: FY07, FY08, FY09, FY10, FY11, FY12, FY13, FY14

Pilawa receives Google Faculty Research Award

ITI and ECE Assistant Professor Robert Pilawa-Podgurski won a one-year Google Faculty Research Award to develop a series-connected voltage domain system—a new structure for more effective data center power delivery. Pilawa-Podgurski believes energy losses could be avoided entirely through use of the series-connection, which easily converts a high voltage down automatically. This new system of power delivery could lead to significant reductions in overall energy consumption, as well as to financial savings for institutions that adopt the technology.

Ameren TAC opens; collaboration with ITI/ TCIPG researchers

Ameren Illinois opened a new $3.3 million testing facility in August 2013 that is facilitating research and development of smart grid technologies and supports the state's economic development and job creation goals. Located west of the University of Illinois at Urbana-Champaign Research Park, the Technology Applications Center (TAC) provides an opportunity for Ameren Illinois and the University to perform joint research on smart grid-related technologies and to collaborate on testing and validation procedures.

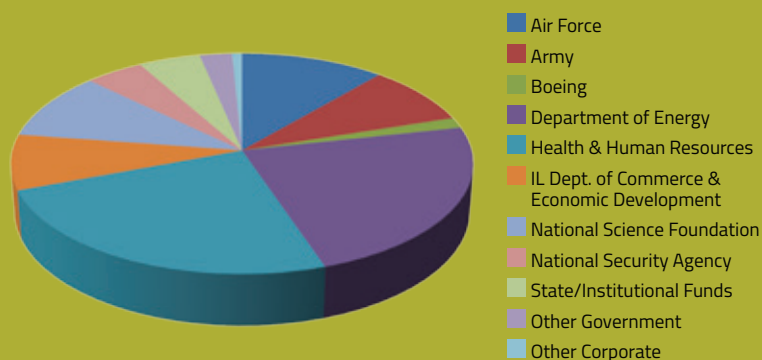### Nahrstedt named acting director of CSL

Klara Nahrstedt, the Ralph M. and Catherine V. Fisher Professor in the Department of Computer Science, was named acting director of the Coordinated Science Laboratory in July 2013. She is a leading researcher in multimedia systems, having made seminal contributions to quality-of-service (QoS) management for distributed multimedia systems. Nahrstedt joined the Illinois faculty in 1995 and has received numerous honors, including the IEEE Communications Society Leonard G. Abraham Prize and the IEEE Computer Society's Technical Achievement Award.

In addition, Nahrstedt was inducted into the German National Academy of Sciences Leopoldina, Germany's foremost academic society, in March 2014. Nahrstedt's selection to Leopoldina's membership was in recognition of her scientific achievements and impact.

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Sponsors of Funds Expended

- Air Force
- Army
- Boeing
- Department of Energy
- Health & Human Resources
- IL Dept. of Commerce & Economic Development
- National Science Foundation
- National Security Agency
- State/Institutional Funds
- Other Government
- Other Corporate

CSL:
COORDINATED SCIENCE LAB