In August, the National Science Foundation (NSF) awarded the University of Illinois at Urbana-Champaign, as well as the City University of New York, a total of $399,305 EAGER grant.

According to the NSF website, the goal of this project, titled “Exploring Multimedia Information Networks,” is “to provide effective methods for organizing, searching, mining and measuring with web-scale multimedia.”

Today, because of the ever-expanding amount of various kinds of information on the web, traditional multimedia search processes are facing challenges. Through this project, researchers aim to overcome these challenges by creating a structured multimedia database, called Multimedia Information Networks (MINets), which will be able to link multimedia data by identifying semantic concepts in images, video and text. Therefore, “trying to derive semantic concepts from these is the most difficult part,” said Thomas Huang, who is the principle investigator on the project and a professor at the Coordinated Science Laboratory. He is also a professor of electrical and computer engineering and a research affiliate in Beckman Institute.

“MINets is a research grant, it’s an exploratory grant,” Huang said. This means that the project may or may not be successful, but the point of the research is simply to explore. “So there’s high risk, but potentially high return,” Huang said.

It is impossible to collect images by taking photos on your own and labeling them if you want billions of images for a database, Huang said. So in order to create this multimedia database, the researchers must crawl the web for already existing images, video and text. Huang said that the researchers start by building a small database, such as a vehicle database that includes land, marine and air vehicles. Researchers collect multimedia data, such as photos of cars, for their database by crawling the web and can then use those photos to recognize other multimedia that wasn’t previously in their database.

One of the domains that researchers are currently looking at is natural disasters. Huang said. In order to create a database about natural disasters, they must first look at the key concepts of natural disasters. However, if they are creating a database of a disaster while it is currently taking place, then they have to constantly update the database. “This kind of concept could be really useful if it succeeds, but it’s exploratory,” Huang said.

In addition to MINets being able to recognize semantic concepts in order to build its database, it is also expected to work properly in the presence of noise or uncertainty. Researchers will assess Quality of Information in MINets such as coherence, accuracy, recall, and fineness of information.

There are four main students who are working with Huang at the University on this project: Guo Jin Qi, Min-Hsuan Tsai, Shen-Fu Tsai and Shiyu Chang. All four are graduate students in electrical and computer engineering and their primary research area is in signal processing.

While Huang and his students use their background in signal processing, he said, they collaborate with Heng Ji, the co-PI and an assistant professor at CUIN, whose research interests focus on natural language processing.

“The most exciting thing is that it’s a fuzzy field... there’s many different directions you can explore,” Huang said. “You can invent new paradigms of doing things, like new ways of doing searches for multimedia data for example.”

www.csl.illinois.edu
Researchers receive $2.5 million to improve networked systems

By G. Gudeman

From taking soil moisture measurements around the country to using sensing for surveillance, many modern technologies rely on real-time networking. But too often, these systems are not as efficient or reliable as we could make them.

It’s largely because networked systems are informationally decentralized, comprising many nodes that generate disparate information and are subject to constraints on energy, data storage and computational capabilities.

CSL researchers, along with investigators at the University of Arizona, aim to address this problem by developing a general theoretical framework and tools to help optimize these sensing systems. They received a five-year, $2.5 million grant, titled CIF: Large: Collaborative Research: Contested Sensing: Distributed Signal Processing and Decision Making in Networked Systems,” funded by NSF.

“People are building these sensing systems with a large number of nodes, but without a theory to optimize them,” said CSL Professor Venu Veeravalli, Illinois’ principal investigator and ECS professor. “The sensors have to communicate, coordinate and operate in a limited resource environment, which means they have to be efficient.”

Researchers will study the role of information in sensing, signal processing and decision making for networked systems under various architectures, in both control and data-driven settings. They will also work to understand the coordination of networked systems and develop novel algorithms to enhance the functioning of these systems. In addition to three investigators at Michigan, the team also includes CSL professors Tamer Basar, professor of industrial and enterprise systems engineering, and Angela Nedic, assistant professor of industrial & enterprise systems engineering.

“Together, we will develop new event-driven sensing architectures,” Today’s sensors turn on and off arbitrarily to conserve energy. They may be on just 10 percent of the time, meaning they could miss significant events. The investigators aim to develop a “smart” system that functions as though it were 100 percent of the time, even if it is in make mode for only a fraction of that time.”

“When you look at these technologies to further our understanding of the natural world and other systems, we need to use sensors in the most effective and efficient way.”

David M. Nicol, the Illinois’ principal investigator, explains, “The complexity of software systems guarantees that there will be problems that we can only partially solve. We have a critical need for foundational design principles that anticipate penetrations, contain them and limit their effects, even if the penetration succeeds and detects.”

The Illinois’ Lab has broadened to the development of security science while leveraging expertise in research, which in this context means a systems demonstrable ability to maintain security properties even during ongoing cyber attacks. Nicol is a professor of electrical and computer engineering (ECE) at Illinois and the director of the Information Trust Institute (ITI). The Lab’s leadership is shared with co-principal investigator William H. Sanders, an ECE professor and director of the Coordinated Science Laboratory at Illinois, and José M. Mayoras, a professor of computer science.

Grad students win TECHCON awards

In September, two CSL graduate students, Joseph Sloan and Rami Abdallah, won Best in Session Awards at the Semiconductor Research Corporation (SRC) 2511 Technology Conference, also known as TECHCON.

Sloan presented a paper on the topic of multicore design titled, “Algorithmic Techniques for Fault Detection for Sparse Linear Algebra.” His paper focuses on the problem of hardware redundancies, and more generally, the difficulty to achieve high tolerance in systems with scaling processes. Sartori tackles this problem in his paper by looking at how to eliminate the errors in power systems with a large number of nodes, while tolerating an error rate of 10^-8.

Abdallah tackles this paper by looking at the complexity of implementing these systems, and how the software itself robust to errors.

Sloan presented a paper on the topic of integrated system design. His paper, titled, “Soft Computing Systems via Hardware Error Likelihood Processing,” focused on identifying circuit error statistics and ways to analyze various techniques to correct these errors, he said.

Godfrey to build better internet

Godfrey has been named principal investigator of the Pennsylvania Eureka Initiative’s (PEI) Cybersecurity Education and Research and Training Center (CERT). The project is supported by the National Science Foundation (NSF) under award numbers CNS-1014151.

PCF affiliate Brighten Godfrey (CS) is among a select group of academic researchers and Internet visionaries chosen to participate in Versign’s “Building a Better Internet” Symposium. Godfrey’s project was one of four chosen internationally to receive a $175,000 infrastructure grant that Versign awarded as part of its 25 Years of Commissions. The forum, held in September in Washington, DC, explored how the Internet’s core infrastructure can evolve to support the challenges of billions of new users, increasing complexity, and uncertainty.

Maxim Raginsky is a mathematics professor. He is interested in stochastic and probabilistic aspects of information processing and decision-making under uncertainty and complexity constraints — drawing on ideas from optimization, information theory, statistics, game theory, optimal control, and signal processing. His Ph.D. in electrical engineering is from Northeastern University.

NSA establishes $1 million Science of Security Lab at Illinois

Many aspects of life have become closely intertwined with computer networks. Unfortunately, the interdependence is a double-edged sword. The electronic medical records that make it easier for a remote expert to review your test results may also make it easy for your hospital to accidentally release part of your private medical history to a publicly accessible computer.

To tackle the challenge of securing critical systems, the U.S. National Security Agency (NSA) is giving an initial $1 million to the Information Assurance Research and Development Laboratory at an academic, “lab” 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 are secure by design, as your medical records remain confidential and your power stays on.

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