

COORDINATED SCIENCE LAB ANNUAL REPORT 2017



FINDING SOLUTIONS TO THE WORLD'S CHALLENGES

HOW CSL TRANSFORMED TECH IN 2017



I ILLINOIS
Coordinated Science Lab
COLLEGE OF ENGINEERING



CYBERSECURITY



INTERNET OF THINGS



Cybersecurity continued to be a hot focus area in 2017, with investments in more secure and resilient systems coming from both government and industry.

The crown jewel of those new projects is Illinois' new **CREATE Programme for a Trustworthy and Secure Cyber-Plexus (TSCP)** in Singapore. The new five-year initiative will work to make information systems both trustworthy, meaning it behaves as expected even during disruptions, and secure, or hardened against malicious attacks. Research will mostly focus on power grid applications.

The TSCP CREATE Programme will be led by **David Nicol**, the Franklin W. Woeltge Professor of Electrical and Computer Engineering and director of the **Information Trust Institute**. The initiative is funded by Singapore's National Research Foundation, and builds upon the research and relationships that were established during the past nine years in which the **Advanced Digital Sciences Center** has operated in Singapore.

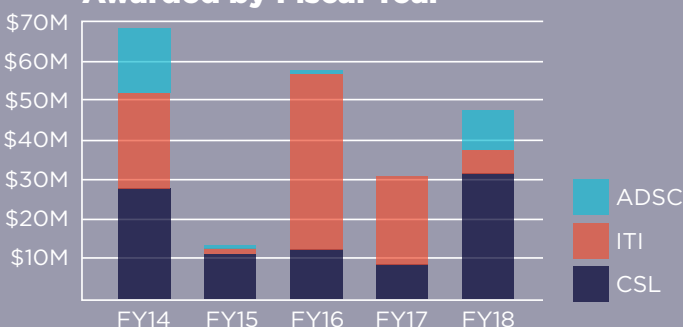
On the battlefields of tomorrow, humans and technology will work together in a seamless, cohesive network, giving soldiers a competitive edge and keeping troops and civilians out of harm's way.

This past year, CSL was selected to lead a \$25 million initiative to develop the scientific foundations of a next-generation Internet of Battlefield Things (IoBT), designed to enable new predictive battlefield analytics and services. The **"Alliance for IoBT Research on Evolving Intelligent Goal-driven Networks (IoBT REIGN),"** funded by the Army Research Lab, includes collaborators from seven additional organizations.

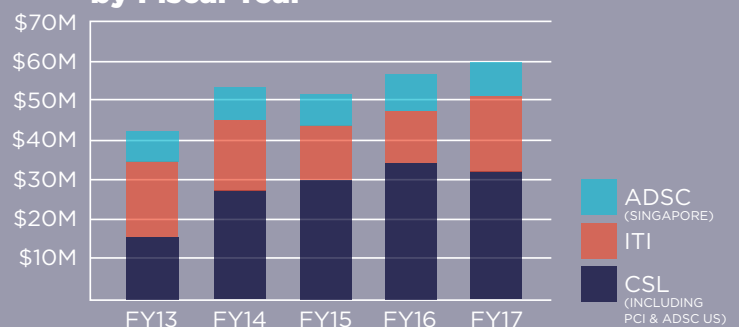


CSL researcher **Tarek Abdelzaher**, a professor of computer science, aims to create a cyber network of "things" that adapt as the mission evolves. This effort to understand and exploit the unique capabilities of networked battlefield systems is an interdisciplinary problem that brings together researchers in cyber-physical computing, information theory, security, formal methods, machine learning, networking, control, and cognitive science, among other disciplines.

New Grants/Contracts Awarded by Fiscal Year



Total Expenditures by Fiscal Year





INTELLIGENT ROBOTICS



CSL pushes boundaries on robotics design and capabilities. In 2017, **Seth Hutchinson** and **Soon-Jo Chung**, former CSL professors, and PhD student **Alireza Ramezani** developed a robotic bat—dubbed Bat Bot (B2)—with soft, articulated wings that can mimic the key flight mechanisms of biological bats.



With more than 40 joints, bat wing structures allow them to easily change shape and move in multiple, independent directions. Bat-inspired robots have an advantage over current quadrotor robots: the soft-wing architecture makes them more



efficient, increasing battery life, and they are less intrusive because they do not use high-speed rotors that emit loud, high-frequency noise.

The researchers envision many applications that lead to safer and more productive environments, such as swooping into construction sites to monitor progress, delivering packages with improved efficiency and flying into disaster areas where it's unsafe for humans.



HEALTH IT



Big data analytics have endless possibilities in health care. At CSL, several researchers led by ECE Professor **Ravishankar Iyer** are working with Mayo Clinic to advance challenges in precision medicine that impact how we treat and cure diseases.

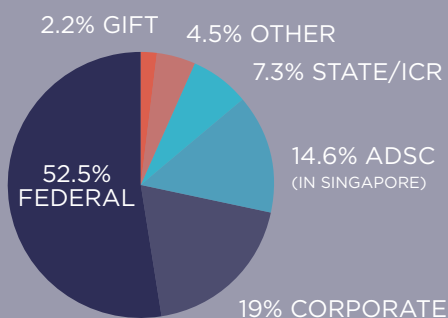


PhD student **Arjun Athreya** examines metformin, an anti-diabetic drug that has shown promise in treating triple negative breast cancer. Athreya's data-driven analytics and machine learning research allowed Mayo Clinic scientists to more closely examine the molecular mechanisms of TNBC, revealing the connection between metformin and reduced tumor growth.



Another PhD student, **Yogatheesan Varatharajah**, uses artificial intelligence techniques for epilepsy treatment. Varatharajah and his team developed a method to identify seizure generating brain regions using only non-seizure data. The new approach has the potential to decrease the time of an epilepsy procedure to remove the part of the brain causing seizures from days or weeks to just a couple of hours.

Fiscal Year 2017



127
FACULTY MEMBERS
(INCLUDING 17 EMERITUS MEMBERS)

51
STAFF MEMBERS

30
POST DOCTORAL RESEARCH ASSOCIATES

173
GRADUATE STUDENTS

7
NATIONAL ACADEMY OF ENGINEERING MEMBERS
(2 EMERITUS)

17
VISITING SCHOLARS

32
CHAIR & NAMED PROFESSORS
(NOT INCLUDING EMERITUS)

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CSL Studio Grand Opening Ceremony



In October, we celebrated the official opening of the CSL Studio, an interdisciplinary research space focused on solving grand societal challenges.

CSL STUDIO HOUSES THREE MAIN LABS:

- The Health Care Engineering Systems Center
- Information Trust Institute's power grid testbed
- Intelligent Robotics Lab

The CSL Studio Grand Opening featured a public tour of the Studio with 12 demos and 21 posters.

DEMOS INCLUDED:

- Flying robots
- Power grid testbed
- Virtual reality surgery simulation
- Robotic surgery

SONIC

The Systems on Nanoscale Information fabriCs (SONIC) Center, established in CSL in 2013, concluded its 5-year term on December 31, 2017.

Funded by DARPA and SRC under the STARnet program, SONIC brought together 27 faculty and approximately 100 graduate students from 10 top-tier US universities. They addressed the problem of designing computing systems in deeply scaled CMOS and beyond-CMOS nanoscale fabrics to meet the unique needs of emerging data-centric applications.

SONIC researchers validated their ideas via more than 60 integrated circuit prototypes, published more than 626 publications spanning systems, architecture, circuits, and devices, and filed 11 patents/applications.



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