

WHITE NOISE FOR YOUR NOSE BUILDING ROBOTIC BATS TEACHING  
THE BOY ANDROID BARDEEN'S MUSIC BOX DEVELOPING GOOGLE'S  
MOONSHOTS NEW COMPE CURRICULUM

# E RESONANCE

THE MAGAZINE OF ECE ILLINOIS

SPRING 2015

COMING  
HOME

ECE ILLINOIS OPENS  
LONG-AWAITED NEW BUILDING

 ILLINOIS

# TOP OF MIND



**William H. Sanders**  
ECE Department Head  
Donald Biggar Willett Professor of Engineering

Many factors make ECE ILLINOIS a powerhouse — our curricula, our size, our students, and also importantly, our faculty. They're teaching the engineers of the future, but they're also impacting the future of their fields through world-class research. This is one of the things that makes a degree earned at ECE ILLINOIS so valuable.

Our faculty members are also innovative and entrepreneurial. More than a third have started their own companies, some after licensing university research, using their work to improve the lives of others around the world. ECE faculty members are also a force in licensing intellectual property at the University of Illinois, making up more than a quarter of all campus start-ups using university technology since 2008. They hold nearly 300 active patents.

Faculty are also critical in keeping up with the demand for our program. We've seen incredible growth in our undergraduate student body during the last five years. It has increased from 1,546 undergraduates in 2010-11, to 2,014 this school year. That's a 30 percent increase. To keep up with that demand and to account for some retiring faculty members, we have an ambitious recruiting goal: to hire 40 new faculty members in the next five years.

We've already made some great progress, as eight new tenure-track faculty members and four permanent lecturers have joined our department since January 2014. Our new hires are exceptional. Associate Professor Kiruba Haran is re-imagining efficient aircraft with funding from NASA. Assistant Professor Lav Varshney co-developed an algorithm to counteract lingering odors (read on for more) and Associate Professor Michael Bailey is investigating how attackers might exploit personalized information services online. Assistant Professor Lara Waldrop's work on the development of a small satellite, aimed at comprehensive sensing of the uppermost layer of Earth's atmosphere, culminated in the recent launch of ExoCube CubeSat.

As we continue recruiting excellent new faculty members, we must offer competitive salaries and start-up funding. The latter gives them the resources they need to create the labs where they'll continue the cutting-edge research ECE ILLINOIS is known for. The typical start-up package costs hundreds of thousands of dollars.

Those interested in making a major investment in our department can help. The new ECE Catalyst Fund will allow leadership gifts to help as we recruit pre-eminent new faculty members to ECE ILLINOIS. You can learn more about this opportunity, and other ways to support our students and faculty, by visiting [ece.illinois.edu/give](http://ece.illinois.edu/give). Partner with us — we're investing in the future of education, of engineering, and transformative technology. Together, we'll sustain the tradition of faculty excellence that makes our department so strong.

Sincerely,

A handwritten signature in black ink, appearing to read "Will Sanders".

## RESONANCE

SPRING 2015

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“Our top priority really was to create a home for the department. ... Absolutely, the most important requirement was to create a facility where students, researchers, faculty, and even the community could come together and interact,”

**-Professor Phil Krein, chairman**  
ECE New Building Committee

# ACROSS THE SPECTRUM



## NEW DESIGN CLASS

During the fall semester, ECE ILLINOIS began offering students an opportunity to study the engineering design process with a new class called ECE 398, Design and Innovation in ECE.

The course was designed as a way for students to learn and practice the engineering process before taking on Senior Design. Professor Scott Carney said the class crosses many disciplines, and teaches students how they can apply technical skills to solve problems.

“This class teaches a rigid process that allows students to be very creative and innovative, and yet know what they are doing.

**“THIS IS HOW THE MODERN WORLD WORKS. THIS IS HOW YOU PUT PEOPLE ON THE MOON OR BUILD GIANT PARTICLE ACCELERATORS,”**

-SCOTT CARNEY

## 10TH ANNIVERSARY

The Information Trust Institute celebrated its 10th anniversary Sept. 17-18, 2014. The event featured a reception and lectures on the importance of research.



## GENIUS GRANT AWARDED

Alumnus Mark Hersam (BSEE '96, PhD '00) has been named a fellow by the John D. and Catherine T. MacArthur Foundation, an honor sometimes referred to as the “genius grant.” The fellowship gives him \$625,000 in funding with absolutely no conditions as to how the money must be spent.



“The resources provided with this grant are really no strings attached; it’s rare to have this level of freedom to pursue our research goals,” Hersam said.

## ADVANCED DIGITAL SCIENCES CENTER

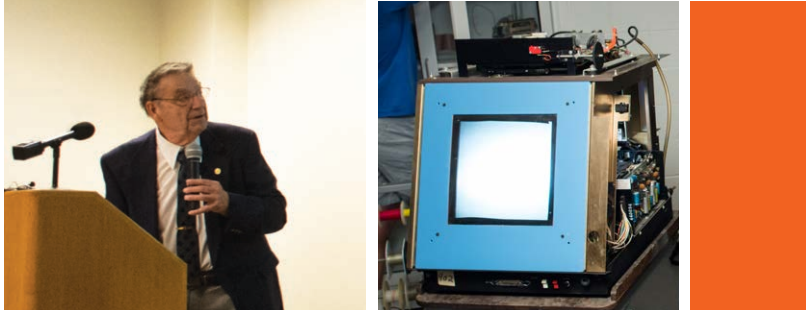
## FUNDING EXTENDED

Continuing the working relationship between Singapore and the University of Illinois, the Advanced Digital Sciences Center (ADSC) has extended its agreement with Singapore’s Agency for Science, Technology and Research (A\*STAR), to provide an additional three years of funding to the research center.

The agreement extends ADSC’s research program from five years to eight years, with a new maturity date of April 2017, as well as provides additional funding to maintain the research facility at its current capacity, with more than 90 staff, researchers, and Illinois faculty members.

## THE PLATO PROCESS

ECE Professor Emeritus and PLATO inventor Donald Bitzer (BSEE '55, MS '56, PhD '60) returned to campus in October to speak at an event sponsored by the Academy for Excellence in Engineering Education called "Past, Present, and Future," about the development process behind PLATO.



## WELCOMING NEW STAFF

Allison Winter has joined ECE ILLINOIS as associate director of advancement, and comes to ECE from the Department of Materials Science and Engineering at Illinois. In that role, she worked to engage alumni, helping them to support the department through gifts of their talent, time, and resources. She'll continue to do so in her new position, with a focus on the more than 21,500 living ECE ILLINOIS alums.

Audrey LeGrande has joined ECE ILLINOIS as the new assistant director of alumni and student relations. LeGrande serves as the connection between ECE ILLINOIS' alumni and the department, and works closely with the ECE Alumni Board of Directors. She also supports students and student groups, including the ECE Student Advancement Committee.



## PROFESSORS RETIRING

Professors Michael Loui, Thomas Huang, and Constantine Polychronopoulos retired from teaching at ECE ILLINOIS in 2014, after long, fruitful careers in the department.

Loui, Huang, and Polychronopoulos have had immensely successful research careers: Loui has done groundbreaking work in computational complexity and ethics, Huang pioneered video compression algorithms and has contributed heavily to the field of computer vision, and Polychronopoulos's systems software prototypes are ubiquitous in industry, adopted by companies like Intel, Hitachi, and Sun Microsystems.

## BAŞAR NAMED CAS DIRECTOR

Professor Tamer Başar has been named director of the Center for Advanced Study at the University of Illinois. He has been involved with the operations of the center since 2005, and is looking forward to maintaining the center's reputation for excellence.

The center supports the extraordinary human and physical resources of the University of Illinois by encouraging and promoting exemplary scholarship in all areas of knowledge, especially by identifying the very best scholars within the university.



### › PROFESSORS

› BAŞAR › BOPPART › BORISOV › CHEN  
› CUNNINGHAM › DALLESASSE  
› DOMINGUEZ-GARCIA › GILBERT  
› GODDARD › GONG › HWU › KUMAR › LIANG  
› LYDING › PILAWA-PODGURSKI  
› SCHUTT-AINE › VASUDEVAN

### › FACULTY AWARDS

#### TAMER BAŞAR

Professor Tamer Başar received the 2014 IEEE Control Systems Award “for seminal contributions to dynamic games, stochastic and risk-sensitive control, control of networks, and hierarchical decision making.”

#### STEPHEN BOPPART

Professor Stephen Boppart was named an AAAS Fellow for his “distinguished contributions to optical coherence tomography and its applications to biomedical imaging.” He was also named an American Institute for Medical and Biological Engineering Fellow.

#### NIKITA BORISOV

Associate Professor Nikita Borisov received the Best Paper Award at the Ninth ACM Symposium on Information, Computer, and Communications Security (ASIACCS).

#### DEMING CHEN

Associate Professor Deming Chen received the Best Paper Award at the 2013 IEEE International Conference on Hardware/Software Codesign and System Synthesis. He also received the 2014 IBM Faculty Award.

#### BRIAN CUNNINGHAM

Professor Brian Cunningham received the EMBS Technical Achievement Award from the IEEE Engineering in Medicine & Biology Society (EMBS).

#### JOHN DALLESASSE

Professor John Dallesasse was named a Fellow of the Optical Society of America.

#### ALEJANDRO DOMINGUEZ-GARCIA

Associate Professor Alejandro Dominguez-Garcia was selected by the National Academy of Engineering to attend the United States Frontiers of Engineering Symposium, and is the recipient of a 2014 Distinguished Promotion Award from Illinois’ Office of the Provost.

#### MATTHEW GILBERT

Assistant Professor Matthew Gilbert received a CAREER Award from the National Science Foundation.

#### LYNFORD GODDARD

Associate Professor Lynford Goddard was named an Engineering Council Outstanding Advisor.

#### SONGBIN GONG

Assistant Professor Songbin Gong won the DARPA Young Faculty Award.

#### WEN-MEI HWU

Professor Wen-mei Hwu received the 2014 B. Ramakrishna Rau Award from the IEEE Computer Society, as well as the Collins Award for Innovative Teaching from Engineering at Illinois.

#### RAKESH KUMAR

Associate Professor Rakesh Kumar was named an Engineering Council Outstanding Advisor.

#### ZHI-PEI LIANG

Professor Zhi-Pei Liang received the EMBS Technical Achievement Award from the IEEE Engineering in Medicine & Biology Society.

#### JOSEPH LYDING

Professor Joseph Lyding won the 2014 Award for Outstanding Research from the Prairie Chapter of the American Vacuum Society.

#### ROBERT PILAWA-PODGURSKI

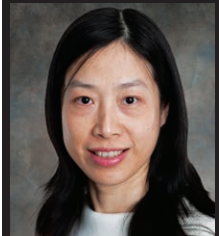
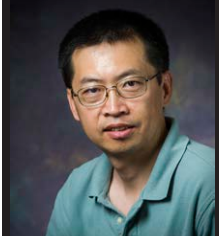
Assistant Professor Robert Pilawa-Podgurski received the Richard M. Bass Outstanding Young Power Electronics Engineer Award from the IEEE Power Electronics Society (PELS), and was named an Engineering Council Outstanding Advisor. He also won, with graduate student Yutian Lei, best paper at the 2014 IEEE Workshop on Control and Modeling for Power Electronics, or COMPEL.

#### JOSÉ SCHUTT-AINÉ

Professor José Schutt-Ainé was named an Engineering Council Outstanding Advisor.

#### SHOBHA VASUDEVAN

Assistant Professor Shobha Vasudevan received the Best Paper Award at the 2014 Design Automation Conference. “She also received the IEEE CEDA Early Career Award and a Dean’s Award for Excellence in Research from Engineering at Illinois.



## SEVEN JOIN ECE FACULTY THIS FALL

### MICHAEL DONALD BAILEY

Michael Donald Bailey joined ECE ILLINOIS as an associate professor after working as a research associate professor and co-director of the Network and Security Research Group at the University of Michigan. His research at Michigan focused on the security and availability of complex distributed systems.

### CAN BAYRAM

Assistant Professor Can Bayram's research is in the development and application of novel photonic and electronic devices. His group, the Innovative Compound semiconductor (ICOR) Laboratory, currently explores novel designs of light emitting diodes for disinfection and lighting, and of GaN-based transistors for next generation power devices.

### ZUOFU CHENG

Zuofu Cheng (BSEE '06, MS '10 PhD '14) joined the ECE ILLINOIS faculty as a lecturer after spending 12 years at ECE ILLINOIS as a student and teaching assistant. Cheng is teaching introductory courses in signal processing and embedded systems.

### ARNE WOOLSEY FLIFLET

Arne Woolsey Fliflet joined the ECE ILLINOIS faculty as a lecturer after serving as the head of the Radiation and Particle Beam Generation Section at the Naval Research Laboratory (NRL). He has been the project leader for the development of novel microwave and millimeter-wave-based materials processing techniques and established the gyrotron-based High Frequency Materials Processing Facility at NRL.

### WEI HE

Wei He joined the ECE ILLINOIS faculty as a lecturer after working as a faculty member at the Institute of Microelectronics of the Chinese Academy of Sciences. He also previously worked for the IBM Semiconductor Research and Development Center as a development staff member.

### LARA WALDROP

Assistant Professor Lara Waldrop previously worked as a research scientist and visiting lecturer at ECE ILLINOIS. Her research is focused on the development of novel ground- and space-based sensing modalities for estimation of key physical parameters of the near-earth space plasma environment, with application to predictive modeling of atmospheric evolution, mapping of orbital trajectories, and mitigation of space weather hazards.

### WENJUAN ZHU

Wenjuan Zhu joined the ECE ILLINOIS faculty as an assistant professor. She will focus on 2-D materials, identifying their unique electronic and photonic properties. She spent 11 years at IBM. At the Semiconductor Research and Development Center, she made key contributions to the 65 nm and 32 nm CMOS technology. At the T. J. Watson Research Center, she worked on 2-D materials, including graphene and layered transition metal dichalcogenides (LTMD), with research topics ranging from fundamental material properties to devices and circuits.

## ACROSS THE SPECTRUM



From left to right:  
Atkins, Williams, Maher,  
Buser, Turic, Presser,  
Wang, and Mamou.

# ALUMNI HONORED

Each year, ECE ILLINOIS honors several eminent alums for a wide variety of career achievements. These winners were honored in October.

### DISTINGUISHED ALUMNI AWARD

This award honors alumni who have made professional and technical contributions that bring distinction to themselves, the department, and the university.

#### Walter J. Atkins Jr.

MS '71, PhD '77

President

Pacific HiTech Development, LLC  
Honolulu, Hawaii

For significant contributions in engineering education and leadership, and in the field of satellite communications.

#### Nick Holonyak Jr.

BSEE '50, MS '51, PhD '54

Professor Emeritus  
ECE ILLINOIS

For the invention of the LED, semiconductor laser, and the quantum well laser for modern display, lighting, and optical communication.

#### Anthony T. Maher

BSEE '68, MS '69

Chairman of the Board  
ADVA Optical Networks  
Munich, Germany

For laying the groundwork for digital communication in the voice, data, and video networks that are ubiquitous today and significant leadership and entrepreneurship in the telecommunications industry.

#### Leon Presser

BSEE '61

Entrepreneur and Author  
Softool Corporation  
Compass Corporation  
Santa Barbara, California

For leadership and pioneering achievements in computer software education, the software industry, and for his promotion of entrepreneurship.

#### Yi-Min Wang

MS '90, PhD '93

Managing Director  
Microsoft Research Technologies  
Redmond, Washington

For contributions to dependable computing and web security, and leadership in industrial research.

#### Richard K. Williams

BSEE '80

President and CEO  
Adventive Technology  
Cupertino, California

For the invention of the trench power MOSFET technology and entrepreneurial leadership in the development of mixed power and signal integrated circuits.



## ALUMNI HONORED

### YOUNG ALUMNI ACHIEVEMENT AWARD

This award is given to alumni younger than age 40 who have made outstanding professional contributions to their fields since graduation.

#### Jack Buser

BSEE '98  
Senior Director  
PlayStation Now  
San Mateo, California

For visionary leadership in the gaming industry.

#### Jonathan Mamou

MS '02, PhD '05  
Research Manager  
Lizzi Center for Biomedical Engineering  
Riverside Research  
New York, New York

For technical contributions to biomedical ultrasonics.

### MARCIA PETERMAN AWARD

This award is presented annually to an alumna or alumnus for dedicated service to the department.

#### Denise Turic

BSCompE '88  
Senior Field Sales Engineer  
Microchip Technology  
Addison, Texas

For devoted and loyal service to the University of Illinois and the ECE ILLINOIS Alumni Association.

### LOU LIAY SPIRIT AWARD

This University of Illinois Alumni Association Award is presented to alumni who have demonstrated spirit and pride in supporting the campus.

#### Michael L. VanBlaricum

BSEE '72, MS '74, PhD '76  
Chief Scientist  
Toyon Research Corporation  
Santa Barbara, California

For extraordinary loyalty, commitment, dedication, and service to the University of Illinois.



### HEAR FROM THE HONOREES

SEE THE AWARDEES COMMENT ON THEIR EXPERIENCES AT ILLINOIS AND HEAR THEIR ADVICE FOR STUDENTS IN A BRIEF VIDEO. [GO.ECE.ILLINOIS.EDU/ALUMNIAWARDEES2014](http://GO.ECE.ILLINOIS.EDU/ALUMNIAWARDEES2014)

## HALL OF FAME

ECE ILLINOIS alumni Luke Nosek (BSCompE '96) and Larry Weber (BSEE '69, MS '71, PhD '75) were among the six newly inducted member to the College of Engineering Hall of Fame last fall.

Nosek is a technology entrepreneur who co-founded PayPal and other consumer Internet companies, and created "instant transfer" and the first online advertising network. He is a general partner at venture capital firm Founder's Fund.

Weber has been at the center of many of the innovations for plasma technology, including lower power consumption and high-contrast ratio. He helped plasma gain its foothold in the large-screen TV market.

Physicist George Craford was also inducted into the Hall of Fame. He is best known for inventing the yellow LED and was advised by Professor Emeritus Nick Holonyak Jr. at Illinois.



# THE IMPACT OF SCHOLARSHIPS



BY TOM MOONE, CS @ ILLINOIS

Ram Gudavalli (BSCompE '00) is someone who knows firsthand how scholarships can change a student's life. "Illinois gave me different opportunities for scholarships," he said. "Those helped me out quite a bit from a financial perspective."

Following his graduation in 2000, Gudavalli moved to San Francisco to work at a web consulting company. In the following years, he became involved in a series of startups, all while moving more into the gaming field.

This culminated in his co-founding Funzio, a mobile gaming company, in 2010. The company found success and quickly grew to 125 employees. In 2012, it was acquired by GREE International, and Gudavalli served as vice president of engineering.

Now, Gudavalli sees the opportunity to give back to the university and help provide scholarships to future Illinois students.

"I got a great education at Illinois," he said. "I wanted to show my appreciation for both the education I received and the support that the school provided me by paying it forward in some way. I hope it helps future students to the same degree."

He is excited to establish ECE ILLINOIS' Engineering Visionary Scholarship Fund, which is a part of the Engineering Visionary Scholarship campaign in the College of Engineering. He also established a similar fund in the Department of Computer Science.

"Ram's gift shows the generosity and leadership of our alumni," said Steve George, ECE's senior director of advancement. "We believe it will inspire his fellow alumni to support student scholarships, as well."

For more information on how you can support current students, contact Steve George at [steveg@illinois.edu](mailto:steveg@illinois.edu) or Allison Winter at [awinter@illinois.edu](mailto:awinter@illinois.edu). You can give online to the ECE Engineering Visionary Scholarship fund.

[GO.ECE.ILLINOIS.EDU/GIVENOW](http://GO.ECE.ILLINOIS.EDU/GIVENOW)

## SAVE THE DATE

Consider joining our best and brightest students as we recognize them with the scholarships, fellowships, and awards that celebrate the legacy of our alumni and friends. Our student awards banquet is scheduled for Friday, May 1, at the Hilton Garden Inn in Champaign, Ill. For more information, please contact Senior Director of Advancement Steve George at [steveg@illinois.edu](mailto:steveg@illinois.edu) or 217.244.8023.

# THANK YOU TO OUR 2014-2015 SPONSORS

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 YAHOO!	<p>Is your company interested in joining the Corporate Connection? Learn more online. <a href="http://CORPORATECONNECTION.ECE.ILLINOIS.EDU">CORPORATECONNECTION.ECE.ILLINOIS.EDU</a></p>		



The Corporate Connection industry affiliates program is a partnership between ECE ILLINOIS and CS@ ILLINOIS. Through this program, sponsor companies have increased visibility and access to the more than 4,000 students in both departments.

# COMING HOME





## ECE ILLINOIS OPENS LONG-AWAITED NEW BUILDING

BY MEG DICKINSON

The new Electrical and Computer Engineering Building is many things — a cutting-edge model of energy efficiency, a 230,000 square-foot facility to house the biggest single department on campus, and an anchor that's brought an influx of undergraduate students to the north side of Illinois' campus.

Most importantly, though, it's a true home for ECE ILLINOIS and the realization of a decades-long dream.

"Our top priority really was to create a home for the department," said Professor Philip Krein, the chairman of the ECE New Building Committee. "The energy-efficient features were important to us, but absolutely, the most important requirement was to create a facility where students, researchers, faculty, and even the community could come together and interact."

State and campus officials dedicated the new building Oct. 10, 2014, after ECE ILLINOIS opened the building for classes in August. Construction began in January 2012, but had been discussed within the department for far longer. The \$95-million project was paid for half by the State of Illinois and half by private and corporate donations.

In many ways, the building is a tool for those who use it, for both the high-quality education ECE ILLINOIS is known for, and cutting-edge research that continues to shape the world.

The building includes 45 instructional and research labs. An open lobby with a dozen tables allows students to study and gather, and they have the option of reserving many study spaces or conference rooms.

## IMPACT : COMING HOME

For the first time last fall, ECE ILLINOIS was able to host all of its classes in its own building. Several classrooms have flexible furniture — tables that can be moved and reconfigured so students can easily work in groups.

The building also provides more options for companies coming to campus to visit with ECE students, said Breanne Ertmer, ECE ILLINOIS' assistant director of corporate relations.

"It's a game-changer, not just for our students and faculty, but also for the companies coming to campus to interact with them," Ertmer said. "With nearly 3,200 students passing through the halls on a typical day, companies have enjoyed highlighted visibility by hosting meet and greets, collecting resumes, and handing out food and swag in our lobby." Ertmer said she's seen an uptick in such events.

"Student groups host visitors for technical talks and competitions and hold large-scale events and conferences such as ECE Pulse and HackIllinois," Ertmer said. "For the first time, ECE ILLINOIS hosted After Hours this spring, the biennial marquee networking event for members of the ECE-CS Corporate Connection industry affiliates program that brings together company reps and about 1,000 students."

The building's open lobby offers views into three spaces. The more-than-400-seat Grainger Auditorium is the largest on the Engineering at Illinois campus and offers unobstructed views. A nanofabrication lab is the first of its kind in the nation intended for undergraduate students. The Texas Instruments Electronics Design Lab shows freshmen busily learning as they take ECE 110, Introduction to Electronics.

Senior Brady Salz said when he first walked into the building, the effect wowed him. "I can see everything from here," Salz remembers thinking. "You can look and see so many areas of ECE, right in front of you."

## THE COUNT

THE ECE BUILDING IS A BIG PLACE. HERE'S HOW SOME OF THE MATERIALS REQUIRED FOR CONSTRUCTION STACK UP.

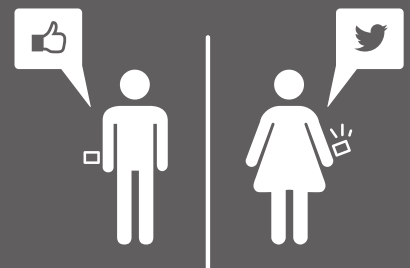


**117**  
WI-FI ACCESS POINTS

The goal here is to connect. With 117 wi-fi access points, we're wired for 52 acres of space. That's enough to cover 5 football fields. Now you can always check the score. I-L-L...I-N-I!

**101**

TOILETS



101 toilets leaves plenty of room for social media. Did you know that 75 percent of people admit using social media while using the facilities. Tweet. Tweet.

# LAUNCH

## THE CELEBRATION CONTINUES WITH LAUNCH

LAUNCH will include high-profile speakers, special faculty workshops, and a celebration at the end of the calendar year. Alumni are invited to attend these events. For more information, visit us online or contact Assistant Director of Alumni and Student Relations Audrey LeGrande at [alegrand@illinois.edu](mailto:alegrand@illinois.edu) or 217.300.1783.

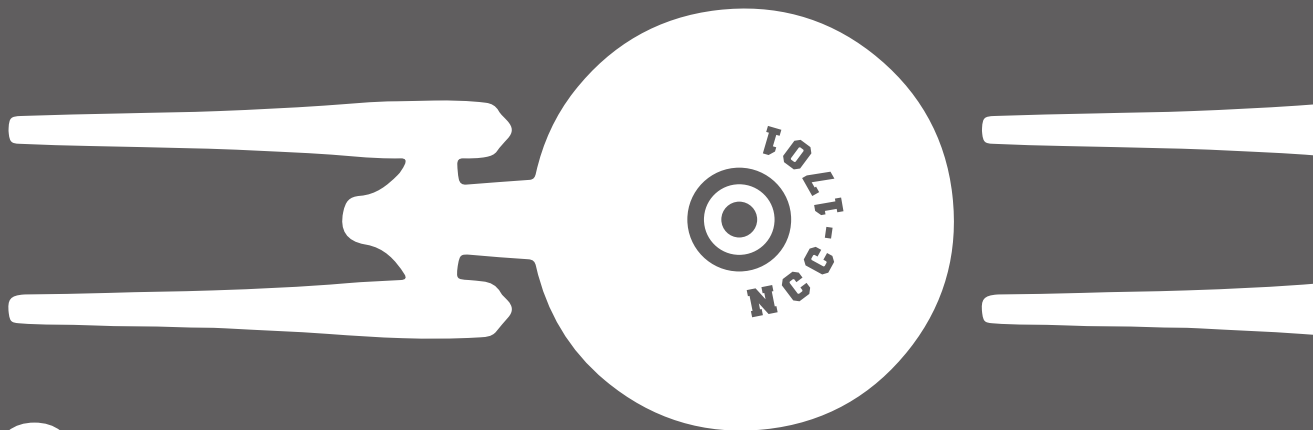
[ECE.ILLINOIS.EDU/LAUNCH](http://ECE.ILLINOIS.EDU/LAUNCH)

The Grainger Auditorium, which features ECE's signature chalkboards and a state-of-the-art triple-projection system, was named in honor of The Grainger Foundation, which donated the lead gift to the Building Campaign for ECE ILLINOIS. "The Grainger Foundation's gift to our new building, much like the Grainger Auditorium itself, is the cornerstone of the campaign to build our new home exactly as our department needed," said ECE Department Head William H. Sanders. "We are so appreciative of the Foundation's generosity."

The auditorium is surrounded on three sides by windows. These, and the building's many other windows, make the most of available sunlight. Daylighting, as it's called, is just one of countless architectural features that make the building incredibly energy-efficient. The building is designed to be net-zero energy, or produce more energy than it consumes on an annual basis. ECE ILLINOIS is striving for LEED Platinum certification for the building.

**"IT'S A GAME-CHANGER, NOT JUST FOR OUR STUDENTS AND FACULTY, BUT ALSO FOR THE COMPANIES COMING TO CAMPUS TO INTERACT WITH THEM,"**

**-BREANNE ERTMER**



# 18

DRINKING  
FOUNTAINS

Did you know that it takes 1 plastic bottle of water 700 years to decompose in a landfill? Why not fill up at one of our 18 new water fountains?



# 224 MILES

OF ELECTRICAL WIRE

If you lined up 375 USS Enterprises end to end, you would have the length of wire we used in our building. We are wired up. Live long and prosper.

## IMPACT : COMING HOME



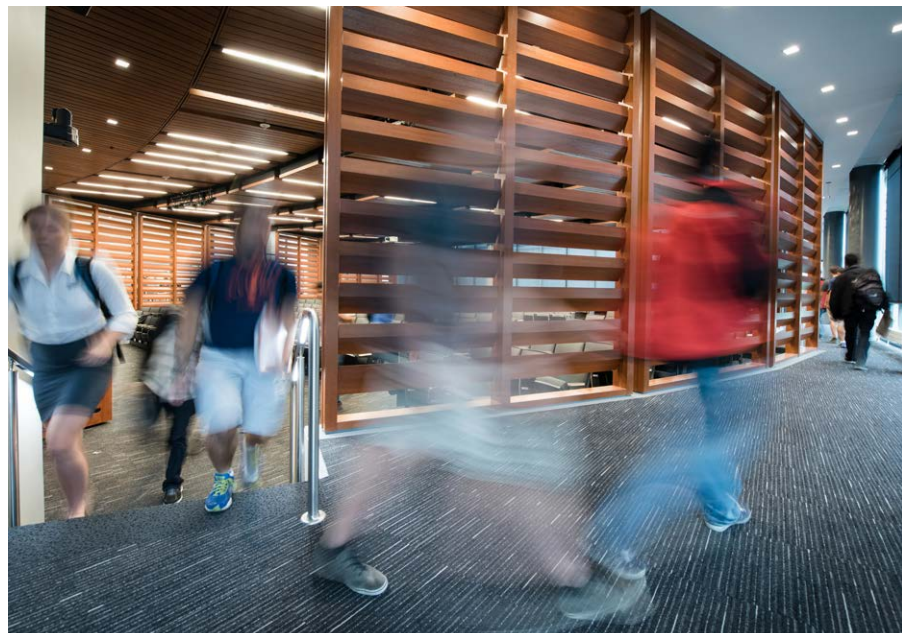
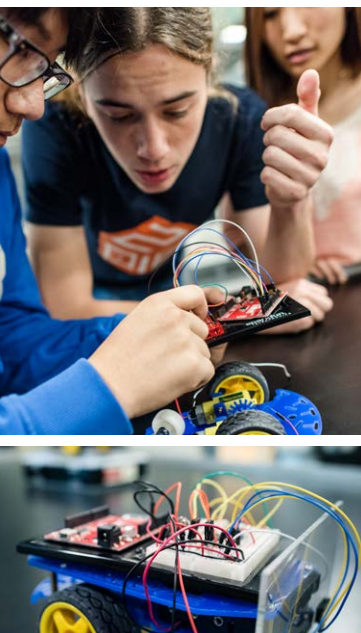
The building itself offers research opportunities, Krein said, especially for students and faculty members in the Power and Energy Systems Group. They will have direct access to the solar panels that will soon be installed on the building's roof. "We can actually use the building itself as an experimental test bed," Krein said. "I'm hoping we can become a model for others who aspire to have low-energy, large-scale facilities."

Its location, near the Beckman Institute for Advanced Science and Technology, the Coordinated Science Lab, and the Micro and Nano Technology Lab, is also an advantage for students and faculty members alike. Many faculty offices, labs, and collaborators are in those buildings. Professor Peter Sauer, who worked 37 years in Everitt Laboratory, said he appreciates that proximity.

"This is now an ECE Quad," Sauer said of the area the new building occupies with the other three research buildings. "Everybody we work with, they're right here." He also appreciates the light and life throughout the building, evident when he sees students studying together in the lobby or working with faculty members in one of the building's many glass-walled conference rooms. "Here, things are happening everywhere," Sauer said. "The students, on their own initiative, are working in little groups, which is absolutely the best way to learn something. They're excited about ECE."

Senior Nikita Parikh said she believes the building is an investment in future generations of students and faculty members. "The building matches the ECE Department's reputation," Parikh said. "I think future generations are certainly going to appreciate that."

Senior Bodecker DellaMaria sees it as a symbol for ECE ILLINOIS' commitment to innovation. "It shows we're not afraid to take that next leap into the future," he said. "This building makes it clear what we are all about."





DEDICATION : OCTOBER 10, 2014



Officials representing The Grainger Foundation dedicate the ECE Building's Grainger Auditorium. Pictured from left to right are Engineering at Illinois Dean Andreas Cangellaris, Director John Chapman, Director John Howard, Director David Kendall, Vice President and Secretary Gloria Sinclair, and Department Head William H. Sanders.



Dean Andreas Cangellaris addresses a packed auditorium at the ECE Building's dedication ceremony. From left to right, dignitaries include Department Head William H. Sanders, former Illinois Gov. Pat Quinn, University of Illinois President Robert Easter, Illinois Capital Development Board Executive Director James Underwood, Illinois Provost Ilesanmi Adesida, and Illinois Chancellor Phyllis Wise.

ECE alumnus Merle Gilmore (BSEE '70) chats with University of Illinois President Robert Easter at a reception in the building's lobby following the ceremony.



ECE graduate student Ankit Jain shows off the Advanced Digital Systems Laboratory, part of the Srivastava Senior Design Lab Suite, following the ECE Building dedication ceremony.



ECE ILLINOIS created two videos for this fall's building dedication, including one shown at the dedication ceremony that highlights the department's rich history and how the new building fits into that legacy.

Another, which thanks donors to the Building Campaign for ECE ILLINOIS, shows how the new building has affected the lives of students, faculty, and staff members who work and study there. You can watch both videos online.

[GO.ECE.ILLINOIS.EDU/BUILDINGVIDEOS](http://GO.ECE.ILLINOIS.EDU/BUILDINGVIDEOS)

**ECE HAS LEFT THE BUILDING**  
**EVERITT LAB 1949-2014**



**ECE HAS LEFT THE BUILDING.** These "ECE has left the building" T-shirts celebrate the department's tenure in Everitt Lab. The shirts are \$12 each. To order one, please visit us online.

[ECE.ILLINOIS.EDU/EVERITTSIRT](http://ECE.ILLINOIS.EDU/EVERITTSIRT)

## CONNECTING WITH ART

BY DANIEL DEXTER

### THE NEW ECE BUILDING FEATURES TWO SCULPTURES, BOTH RELATED TO ECE ILLINOIS AND THE DEPARTMENT'S IMPACT ON THE WORLD.

The two sculptures, "Amplifiers" and "Diss-Connections," were unveiled Oct. 10, 2014, as a part of the Electrical and Computer Engineering Building's dedication ceremonies. Professor George Gross, chairman of the Illinois Art-In-Architecture committee that commissioned the work, introduced the sculptors during two art dedication ceremonies.

The Capital Development Board, the State of Illinois' construction management agency, administrates the Art-in-Architecture Program to promote and preserve the arts by commissioning works for public buildings.

At the east entrance of the building stands "Amplifiers," by Nicole Beck. It represents ECE ILLINOIS legends John Barden and Nick Holonyak Jr.

Beck used Holonyak's discovery of the first visible LED as her

inspiration. "This piece is about the collaboration between professor and student, and then finally, fellow professors," Beck said. "This is the symbol of the oscillating poles that come out of an LED. These are the exact shapes that are emitted." Beck also thanked ECE ILLINOIS senior Brady Salz, who assisted with LED lighting within the sculpture.

At the ECE Building's Wright Street entrance, John Adduci's "Diss-Connections" reminds students of one of the most fundamental elements of engineering: wire.

Adduci said the design is symbolic of the connections engineers make in their work. "Everything is relative to connecting something to something else," Adduci said. "That's how we all get together. That's even how we have students connect when they are together on campus. It creates a connection."



*"AMPLIFIERS" LEFT*  
Chicago sculptor Nicole Beck, talks about the creation of "Amplifiers."

*"DISS-CONNECTIONS" RIGHT*  
Chicago sculptor John Adduci explains the concepts behind his sculpture, "Diss-Connections," at its dedication.

Go online to see a video that explains the research Beck did within ECE while designing her sculpture.

[GO.ECE.ILLINOIS.EDU/AMPLIFIERS](http://GO.ECE.ILLINOIS.EDU/AMPLIFIERS)



## GIFTS ANNOUNCED

### THE ECE BUILDING INCLUDES 15 NAMED SPACES THAT CELEBRATE AND HONOR DONORS' CONTRIBUTIONS TO THE BUILDING CAMPAIGN.

Last fall, global semiconductor company Texas Instruments (TI) announced it pledged a \$3.2 million gift to ECE ILLINOIS to name the Texas Instruments Electronics Design Lab and the Texas Instruments Student Center. The lab is where all freshmen will take ECE 110, Introduction to Electronics, and it's visible through windows from the ECE Building's lobby. This class allows students to learn the ins and outs of electronic devices, ultimately designing a small robotic car or similar final project.

The Texas Instruments Student Center, meanwhile, is where student groups like IEEE and Women in Electrical and Computer Engineering have offices and collaborative workspace. Texas Instruments also donated \$10,000 worth of laboratory equipment for use in the new building. "We are so grateful for this partnership with TI, and we believe the company's support will benefit our students as they learn about engineering and hone their leadership skills in one of our student organizations," ECE Department Head William H. Sanders said.

ECE ILLINOIS' new multipurpose room on the third floor has been named the Kavita and Lalit Bahl Meeting Room, in honor of Lalit Bahl (MS '66, PhD '69) and his wife, Kavita Kinra, both longtime supporters of Engineering at Illinois. They gave a seven-figure gift to the Building Campaign for ECE ILLINOIS.

Before cutting the ribbon to dedicate the room Oct. 11, Lalit Bahl said he had a tiny office and taught in a lab in the basement of Everitt as a graduate student. He sees the ECE Building as the opposite of that space — open, spacious, and with plenty of light where students can learn, collaborate, and cre-

ate things. "I was delighted to see this building," Bahl said. "I'm glad we got a chance to be part of this great adventure."

Also announced last fall was a significant, six-figure gift in memory of Joseph Wm. Semmer (BSEE '58), given by his wife, Carole Semmer. The Joseph W. Semmer Group Study Room was dedicated in October. Carole Semmer decided a gift to name the space would keep her husband's legacy and love for ECE ILLINOIS alive.

Both the Illinois Department of Commerce and Economic Opportunity and the University of Illinois Student Sustainability Committee awarded grants to the ECE Building to sponsor the cost of solar panels on the building's roof, totaling about \$500,000.

"We are grateful for alumni and corporations who supported the new building, and for Illinois students, whose grant impacted the energy efficiency of our building," said Senior Director of Advancement Steve George.

Opportunities to name spaces in the Electrical and Computer Engineering Building are still available. So are opportunities to sponsor solar panels, which will help the building reach its net-zero-energy goal. For more information, please visit us online or contact George at [steveg@illinois.edu](mailto:steveg@illinois.edu) or 217.244.8023.

[GO.ECE.ILLINOIS.EDU/GIVENOW](http://GO.ECE.ILLINOIS.EDU/GIVENOW)

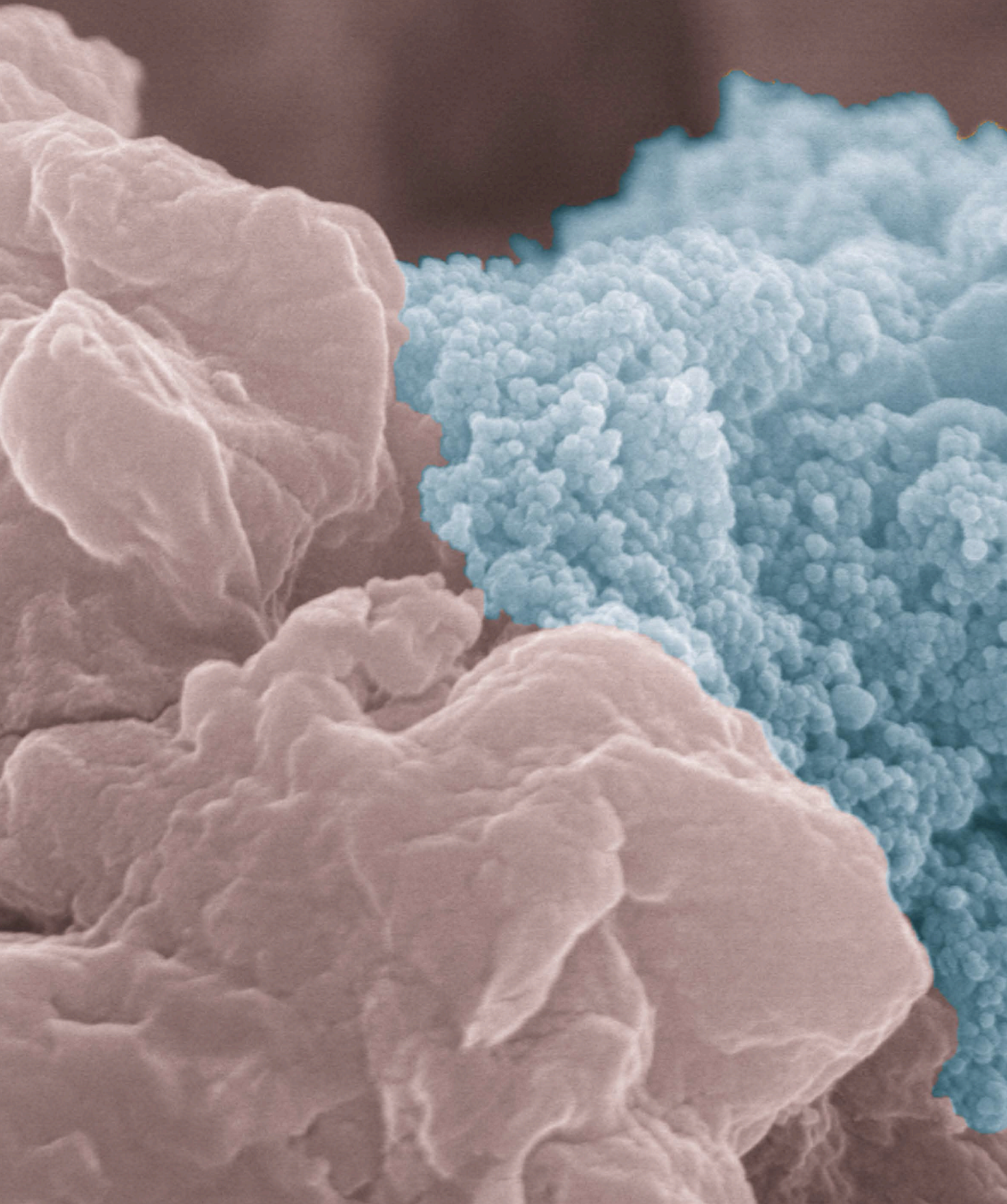


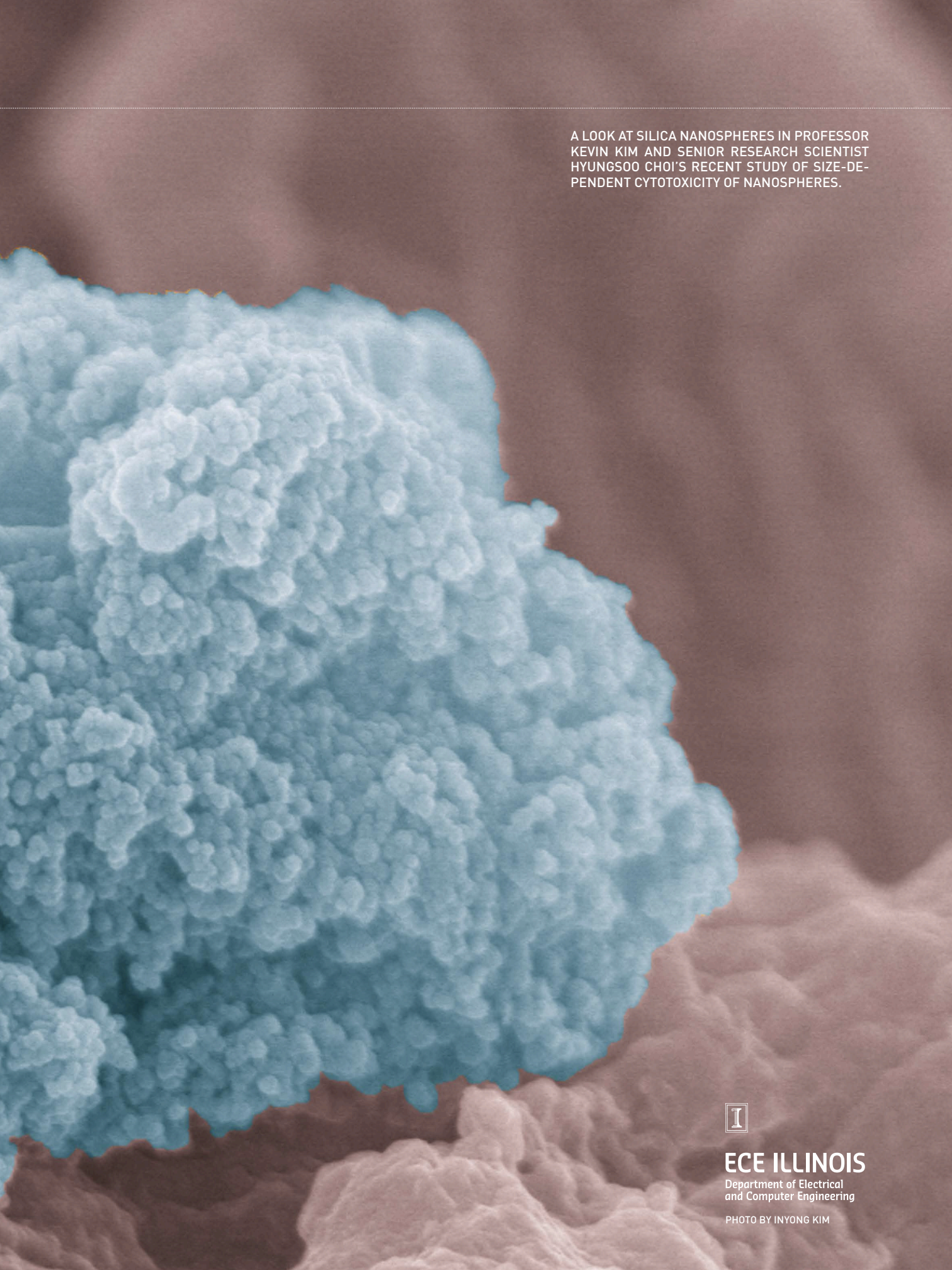
Michael Semmer, left, and Carole Semmer prepare for the ribbon-cutting dedication of the Joseph W. Semmer Study Room on the second floor of the ECE Building. The room and several other named spaces were dedicated Oct. 11, 2014.



Kavita and Lalit Bahl dedicated the Kavita and Lalit Bahl Meeting Room on Saturday, Oct. 11, 2014. They're pictured with Department Head William H. Sanders and Engineering at Illinois Dean Andreas Cangelaris.

# FOCAL POINT



A scanning electron microscope (SEM) image showing a large, irregular cluster of small, spherical silica nanospheres on the left side, colored in a light blue hue. The background and other areas of the image are in a brownish, sepia tone, showing a textured surface that appears to be the substrate or another part of the sample.

A LOOK AT SILICA NANOSPHERES IN PROFESSOR KEVIN KIM AND SENIOR RESEARCH SCIENTIST HYUNGSOO CHOI'S RECENT STUDY OF SIZE-DEPENDENT CYTOTOXICITY OF NANOSPHERES.



**ECE ILLINOIS**

Department of Electrical  
and Computer Engineering

PHOTO BY INYONG KIM

# ROBOTIC BATS

BY DANIEL DEXTER

**WHAT STARTED AS CASUAL ROBOTICS CONVERSATIONS BETWEEN ENGINEERING PROFESSORS HAS RESULTED IN A \$1.5 MILLION NATIONAL SCIENCE FOUNDATION GRANT TO BUILD MECHANICAL BATS FOR CONSTRUCTION SITES.**

Professor Seth Hutchinson has teamed with Aerospace Engineering Assistant Professor Soon-Jo Chung, Aerospace Associate Professor Timothy Bretl, an ECE affiliate, and Civil and Environmental Engineering Assistant Professor Mani Golparvar-Fard. Their goal: build a robot with the characteristics of a bat.

“Building construction projects are complicated, and rarely do they happen the way they are intended to happen,” Hutchinson said. “Keeping track of whether the building is being put together the right way at the right time is not trivial. So the bats would fly around, pay attention, and compare the building information model to the actual building that’s being constructed.”

Hutchinson will focus on the higher-level aspects of the robot planning and control algorithms, such as planning flight trajectories that take into account the constraints imposed by operating in a human environment.

Chung has been working on the flight control and dynamics of bat-like aerial robots, as well as on synchronization and partial differential equation control of flexible articulated wings. He will be the key researcher in the design and control of the robot bats.

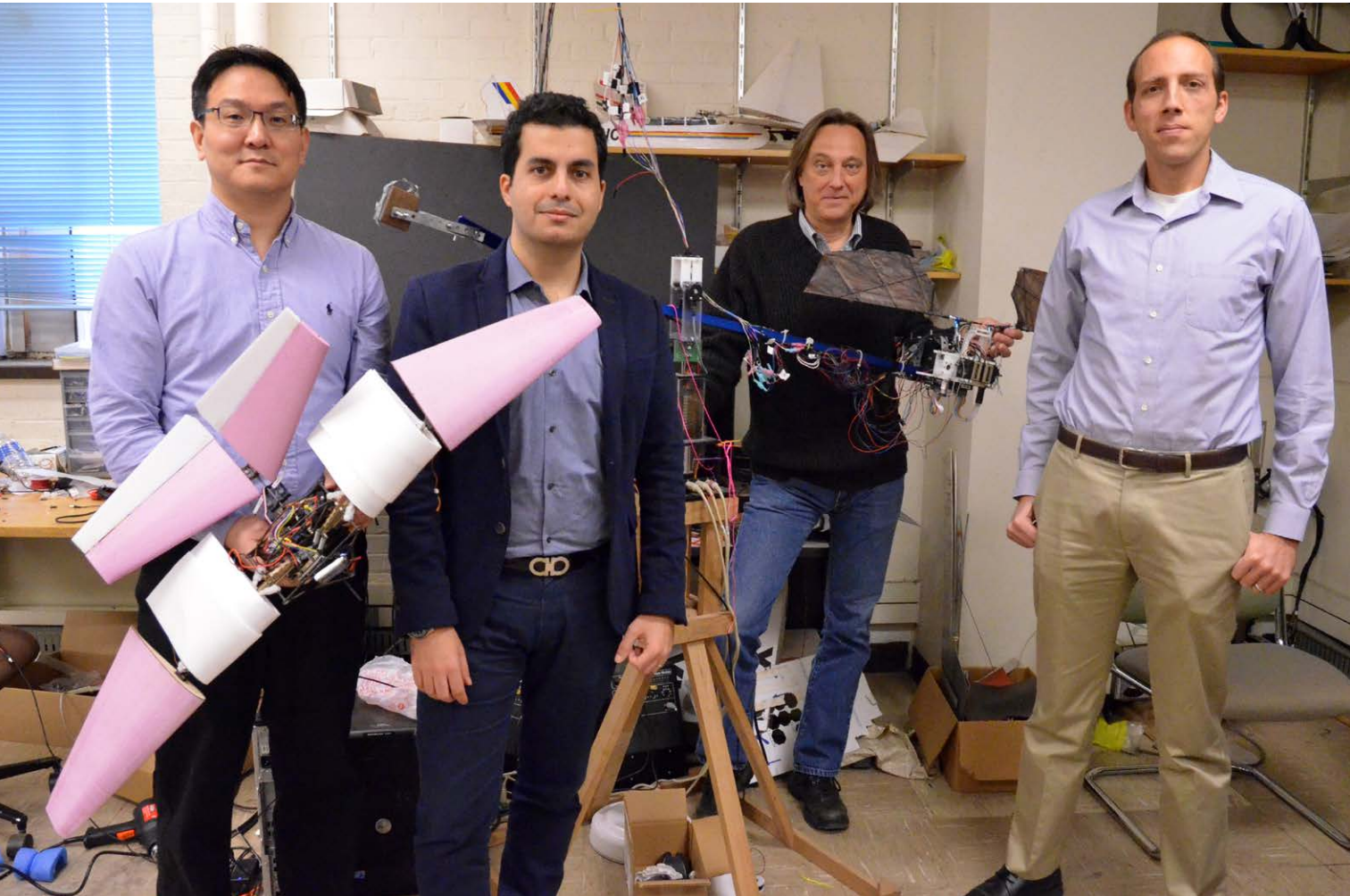
Bretl will contribute work on the motion planning of the robot, while Golparvar-Fard is researching the various ap-

plications this robot could have on a building construction site. They’re also collaborating with Brown University faculty members who are world-renowned experts in the field of bat flight, and received additional funding for their work on this project.

Bats were chosen as the architectural inspiration for the project because of their unrivaled agility and maneuverability during flight. “When a bat flaps its wings, it’s like a rubber sheet,” Hutchinson said. “It fills up with air and deforms. And then when the wing gets to the end of its motion, that rubber wing pushes the air out when it springs back into place. So you get this big amplification of power that comes just from the fact you are using flexible membranes inside the wing itself.”

Chung had already been working on the process of developing winged robotic flight. In the past, he has developed airplanes that mimicked bird flight in the way that they glide and land softly. This project is a continuation of previous work, but bat flight is even more complex than that of birds.

By replicating bat flight patterns, Hutchinson and Chung expect the robots to have a longer battery life than rotorcraft robots, such as quadcopters and helicopters, because of their ability to flap and glide instead of relying on constantly rotating propellers.



The robotic bat collaborators in Aerospace Engineering Assistant Professor Soon-Jo Chung's lab on the Illinois campus. They are, from left to right, Chung, Civil and Environmental Engineering Assistant Professor Mani Golparvar-Fard, ECE Professor Seth Hutchinson, and Aerospace Associate Professor Timothy Bretl.

"We think we can build a dynamic structure that takes advantage of the flapping wing flight in a clever way to make it low-power," Hutchinson said. "Also, you can imagine bats locking their wings and gliding. In principle, you can put one up in the air and have it circle around for a long time without spending much power at all. A quad rotor always has to be burning energy to stay in the air."

It's possible their robotic bats will be safer than other alternatives, as well. The speed with which the blades rotate on quadrotors poses a threat to workers on construction sites and people in general. Chung hopes that by implementing soft-winged robotic flight, human collisions with the robots wouldn't cause injury in the same way a collision with a quad rotor would.

The team believes that this project has the potential to revolutionize the industry of aerial robotics, and its functionality is not just limited to construction sites. Bat-inspired robotic flight has the possibility of being expanded into drone-enabled package delivery, and various other systems.

"We think we can bring many benefits to robotics by using this biologically inspired architecture," Hutchinson said. "We mean to make a robot that can have the same advantages in terms of performance, agility, and lifetime of flight as the biological thing."

# RESEARCH



CANCELING

ODD

BY ASHISH VALENTINE

We all know the feeling of walking into a room right after lunch hour and inhaling a strange assortment of scents: a stray whiff of fish here, the remnants of pungent horseradish there, that seem to seep into the walls and linger for the rest of the day.

Imagine a machine that could analyze all of the smells in a room and produce the perfect combination to cancel the room's odors, leaving it smelling completely neutral. ECE Assistant Professor Lav Varshney and his brother, IBM researcher Kush Varshney, have come a step closer to this scenario with an algorithm for creating what they call "olfactory white," or white smell: the equivalent of white noise for your nose.

"Every smell a human encounters is composed of a number of chemical compounds," Lav Varshney explained. "Each of those compounds can be matched with other compounds that cancel out its smell."

By analyzing how much of each chemical compound is in the smell, the Varshneys' algorithm can compute the compounds needed to create a counter-smell that would combine with the prevailing one to form olfactory white. The scent itself is described by researchers at the Weizmann Institute of Science in Israel as "neither pleasant nor unpleasant."





# ODOR

WITH WHITE SMELL

Apart from canceling odors in a room, the Varshneys' algorithm could also make foods more palatable in a practice called food steganography: disguising certain smells to accentuate others.

Many picky eaters are turned off by the smell of certain ingredients, like durian or asparagus. By including a natural, edible additive that could cancel certain smells while leaving others untouched, parents could get their children to eat vegetables, and adults who remain choosy could relish foods they wouldn't otherwise try.

It all started on the highway home to Syracuse, N.Y. Lav Varshney used to work at IBM's Watson Research Center in Yorktown Heights with Kush. They were making the four-hour trip back to Syracuse together, chatting about work to pass the time. Lav had been leading work on computational creativity to build IBM's Chef Watson, getting the computer to learn how to mix billions of combinations of ingredients into flavorful new dishes. He mentioned to Kush the idea of olfactory white that he'd read about while doing research for Chef Watson.

The two started chatting more about this idea of white smell and how it could work from a signal-processing perspective. If, they

reasoned, you could treat smells like any other kind of signal, say a radio signal, then just like a radio signal can be canceled, so too could smells.

With radio signals, you find the exact type of wave to broadcast that cancels it, meeting crests in its waves with corresponding troughs in yours (in lieu of throwing a giant jar of raspberry jam at it, a la *Spaceballs*). If you could find the exact type of smell that could counteract a malodor, a similar principle could apply.

The Varshneys spent the next two hours formulating the basics for their plan, tossing ideas around and playing off each other. They scrounged up some paper upon returning home and got to work immediately on coming up with algorithms to do this, and after a few weeks, a solid framework emerged.

"Once we had the basic ideas down, the math was actually pretty straightforward," Lav Varshney said. "Some of the signal processing ideas we used have been around since World War II. We applied the same mathematical ideas that cancel signals to canceling smells, but with some modern mathematical tricks."

EDUCATION

STARTING WITH COMPUTER  
**SYSTEMS**



**“WE’RE CREATING THE FUTURE  
WITH RESEARCH, AND WE CAN  
SEE THE TECHNICAL INNOVATIONS  
COMING DOWN THE ROAD BECAUSE  
OF THAT RESEARCH,”**

**-DOUG JONES**

BY MEG DICKINSON

**A new computer engineering curriculum for ECE ILLINOIS undergraduates is designed to start students thinking about engineering systems, rather than components of systems, from the moment they begin their undergraduate careers at ECE ILLINOIS.**

The new curriculum is in effect for this year’s freshmen, and several hundred others petitioned in, as well. Professor Doug Jones sees the new curriculum as an extension of the innovative research that sets ECE ILLINOIS apart. “We’re creating the future with research, and we can see the technical innovations coming down the road because of that research,” Jones said. “We can teach students what they need to know five years from now, 10 years from now. In a field that changes so quickly, this is the difference between a relevant and irrelevant education.”

Traditional education has cut computer engineering into separate layers, with classes on transistors, digital logic, computer architecture, operating systems, application programming, and more. Then, students are expected to put these components together into systems.

Classes in the new computer engineering curriculum focus on whole computer systems at once, Jones said. The result should be that students realize they have wide ranges of options to solve problems, not with just software or hardware alone. “It gives students a more mature understanding not just of how to design individual pieces, but to design the whole thing together,” he said. “We believe that’s what will characterize engineers doing significant work in the future and changing the world.”

Professor Steve Lumetta said he also expects students in the new curriculum to be better rounded, earlier in their undergraduate careers. For example, students should be ready to participate in research and take relevant internships by the end of their sophomore years because of this early exposure to engineering systems.

Another benefit for CompE students: they’ll now be able to take ECE 445, Senior Design, with their classmates who are majoring in electrical engineering. This capstone class encourages students to use the skills they’ve learned throughout their undergraduate careers to solve real-world problems through

engineering. “It’s an open-ended design experience, and students learn to keep records of their work and communicate what they’re doing with teammates and others they’re working with,” Lumetta said. “It’s a useful experience.”

ECE students expected to graduate after August 2015 were given the option to petition into the new curriculum, and 340 students did so. Junior Andrew Kluemke opted in, after taking a pilot version of ECE 120, Introduction to Computing. He believes the new curriculum will give computer engineering majors greater flexibility to pursue their interests in things like hardware verification and software engineering.

“The department did a great job of changing around the required classes so we have more technical electives,” Kluemke said. “Students can now choose how they craft their CompE experience.” Greater flexibility in classes means students like himself will be able to take more classes relevant to the careers they hope to eventually pursue, Kluemke said.

And with the Introduction to Computing class, “the department really reaffirmed its commitment to the bottom-up approach,” Kluemke said. “The first thing you’re coding is in machine code, ones and zeros,” he said. “Then, you learn assembly and then an actual programming language. It gives new students who don’t have prior experience a better chance of catching up.”

# MEET **BERT** THE BOY ROBOT.

## LANGUAGE ACQUISITION AND ROBOTICS GROUP TEACHES LANGUAGE TO AN ICUB HUMANOID ROBOT.

BY DOUG PETERSON

Pinnochio dreamed of becoming a real boy, but Bert, the iCub robot, will settle for learning how to respond to language at a rudimentary level.

Bert has large, expressive eyes that can track moving objects by color and size, and he knows how to wave in response to a verbal command. He also has the body of a 4-year-old boy, assuming that you're talking about a boy with a body made of wires and plastic and that contains more than 50 motors to control its movement.

"Our goal is to get the iCub robot to learn language in a natural way," says Onyema Osuagwu, a PhD student and member of ECE ILLINOIS' Language Acquisition and Robotics Group, led by Professor Stephen Levinson. The idea is for Bert to pick up language as a child does, by continually being exposed to chatter all around him.

The iCub was built by a consortium in Italy and first came to the Illinois campus in 2010. It is the only iCub robot in the Western hemisphere, Osuagwu says, and it came out of the box as a simple robot with few capabilities. "It was fertile soil," says Osuagwu, who hopes to find ways to get Bert to understand language and respond to words in a semi-independent way, rather than by pre-programming all of its behaviors and responses. He wants to make it more human in its interactions.

Osuagwu is among five ECE ILLINOIS graduate students working with the iCub, although many others have studied Bert on the way to completing undergraduate and graduate degrees. For instance, Lydia Majure (BSEE '06, MS '09, PhD '13) worked with Bert to study "motor babbling," in which the robot learns to gain control over the movement of his arms and hands, much the way human newborns first learn how to interact with the space around them.

In addition, Logan Niehaus (MS '11, PhD '14) taught the iCub to respond to verbal commands, while current graduate student Jacob Bryan even taught Bert to sing "Jingle Bells" for the Beckman Institute for

Advanced Science and Technology's 2013 holiday greeting. To see it, visit [go.ece.illinois.edu/holidaybert](http://go.ece.illinois.edu/holidaybert).

As Osuagwu focuses on language acquisition, he says he has moved from what he calls the "I love brains" phase of his research to, "Brains: who needs them?"

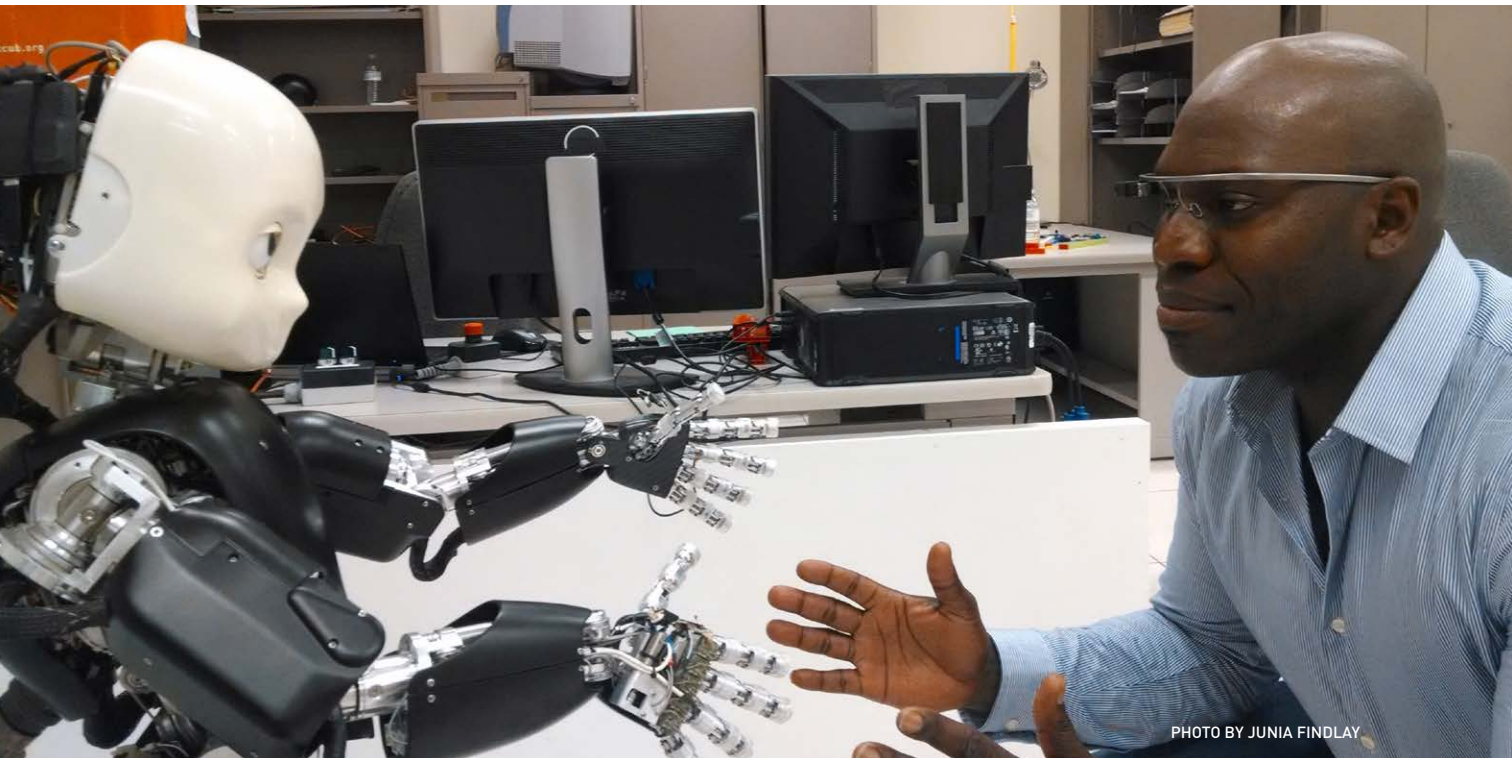
By this, he means that he initially aspired to copy the body's brain by creating the electronic equivalent of neurons. But, as he explains, this task was like "putting a very large square peg in a very small round hole." He discovered that although it is possible to use transistors to mimic some of the activity of neuronal networks, the fact remains: "transistors are not neurons."

Today, his research focuses more on "functional equivalency," a term connected to the famed computing pioneer Alan Turing. "The argument," Osuagwu says, "is that if you want to design something modeled on another thing, you don't have to build it

step-by-step as a replica. You want to replicate the functionality, and not necessarily the form."

However, even though you do not have to recreate the brain, he says it is still important for machine intelligence to have a physical body of some sort. A key principle of the Language Acquisition and Robotics Group is that there is no such thing as a disembodied mind. To learn, the mind should be anchored in a physical form that integrates various senses.

Bert uses several senses, with microphones for ears and cameras for eyes, and he also has touch sensitivity to distinguish between soft and hard objects. But even with a robot that has such abilities, the great challenge is finding ways for Bert to learn as a child might, Osuagwu says. "In my research, I bang my head against walls for a living," he adds, "but every now and again I see cracks in the wall, so I'm hopeful."



Graduate student Onyeama Osuagwu works with Bert, the iCub robot.

**BERT AND THE LANGUAGE ACQUISITION AND ROBOTICS GROUP ARE FEATURED IN AN UPCOMING MOVIE FROM NATIONAL GEOGRAPHIC, CALLED ROBOTS 3D. YOU CAN WATCH THE TRAILER ONLINE.**

[GO.ECE.ILLINOIS.EDU/BERT](http://GO.ECE.ILLINOIS.EDU/BERT)

## SMALL BOX, BIG DEAL

**JOHN BARDEEN'S MUSIC BOX  
AND WHAT IT MEANT FOR  
THE BEGINNINGS OF THE  
INFORMATION REVOLUTION.**

BY WAYNE PITARD,  
THE SPURLOCK MUSEUM



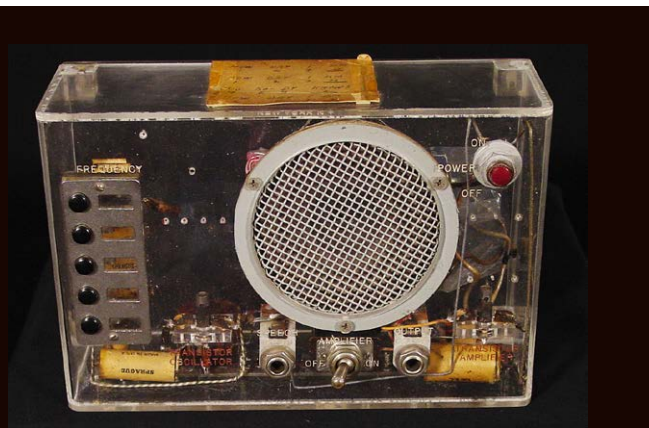
Inside the University of Illinois' Spurlock Museum, you'll find a small, rectangular box made of clear plastic, with a row of black buttons on the left and a small round loudspeaker on the right.

Although this diminutive device is modest in appearance, it is in fact one of the most important technological artifacts of the 20th century. It is John Bardeen's music box, the world's earliest portable transistorized device. Bardeen co-invented the transistor at Bell Labs in late 1947, one of the watershed moments in modern history.

The device and its eventual development into the microchip has changed our world more than perhaps any other single invention of the past century, and the music box stands at the dawn of that momentous process.

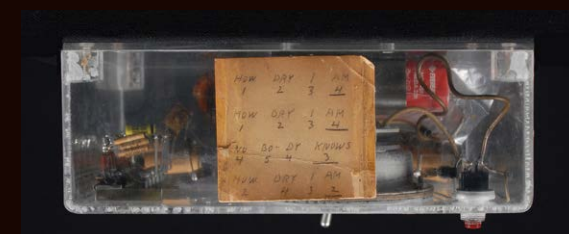
The music box was created to demonstrate the transistor — not an easy thing to do in the early months, before a practical, stable design for the transistor was developed. But in early 1949, a Bell engineer built three music boxes portable enough to easily take to conferences. Of the three, only Bardeen's survives.

Although the box looks like a radio, it is not. It is a musical instrument. On the left is a vertical row of five black buttons, each of which produces a different tone when pushed.



**TOP**  
GENERAL VIEW OF THE FRONT OF THE MUSIC BOX. ON THE LEFT ARE THE BUTTONS WHICH MADE THE MUSICAL TONES. ON EACH SIDE OF THE ROUND SPEAKER ARE THE TWO TRANSISTORS, MARKED AS “TRANSISTOR OSCILLATOR” ON THE LEFT, AND “TRANSISTOR AMPLIFIER” ON THE RIGHT.

**BOTTOM**  
THE TOP OF THE MUSIC BOX. IN THE CENTER IS THE SMALL SHEET OF PAPER THAT CONTAINS THE BUTTON NUMBERS FOR PLAYING “HOW DRY I AM” ON THE MUSIC BOX, ALONG WITH THE LYRICS OF THE SONG, ALL IN BARDEEN’S HANDWRITING.



THE REVERSE OF BARDEEN’S 1956 NOBEL PRIZE MEDAL, SHOWING NATURE PERSONIFIED EMERGING FROM A CLOUD AND HOLDING A CORNUCOPIA, WHILE PERSONIFIED SCIENCE LIFTS NATURE’S VEIL.



Thus, a simple song can be played on the box. Two of the early cylindrical point-contact transistors were installed toward the front of the case, one on each side of the speaker, so they could easily be seen. Each is labeled on the box, as well.

The transistor on the left, marked “Transistor Oscillator,” acted as an oscillator when the buttons were pushed and amplified the sound as it passed to the box’s speaker. The second transistor, labeled “Transistor Amplifier,” could be turned on when an external speaker was connected to the box using the jack labeled “Output to PA.” A microphone could also be attached at the port marked “Speech Input.”

Bardeen took the box with him to the lectures he gave on the transistor and played a tune on it to demonstrate how the tiny device worked. He generally used it at the beginning of the talk.

The first song ever publicly performed on a transistorized device? Reflecting Bardeen’s sense of humor, the scientist chose to play the Prohibition drinking song, “How Dry I Am,” which provided him a memorable lead-in to his lecture. He kept a small sheet of paper taped to the top of the box, with the key numbers and lyrics of the song to make sure he played it correctly. The paper, in his own handwriting, still sits on the top of the box.

Bardeen brought his box with him when he moved to the University of Illinois in 1951 and used it in demonstrations for his students throughout his teaching and research career. In the early years, it was used to introduce scientists, engineers, colleagues, and students to the transistor; it was several years before transistors came to be used in devices for the general public.

After transistors became common, Bardeen continued to show the music box in his lectures, to highlight its historical significance as the earliest portable transistor circuit. It continued to function through the rest of Bardeen’s life and beyond.

In 1985, he loaned it for display to the World Heritage Museum, the Spurlock’s predecessor located in Lincoln Hall, on condition that he be allowed to borrow it for lectures and demonstrations. For years, Bardeen’s first graduate student and later colleague, Professor Emeritus Nick Holonyak Jr., regularly performed routine maintenance on the music box, even after Bardeen’s death in 1991. The box continued to be playable until 2003, when it went silent. The Spurlock Museum is proud to count it as one of its greatest treasures.



The Spurlock Museum at the University of Illinois is located at 600 S. Gregory St., Urbana. It’s a world cultures museum, functioning as both an educational and research institution. It shares its collections with the public through exhibitions, guided tours, special programs, events, and more.  
WWW.SPURLOCK.ILLINOIS.EDU

**“TO THE HORROR OF MY PARENTS, I TOOK OUR APPLE II COMPUTER APART AND THEN PUT IT BACK TOGETHER, MODIFYING IT, DOING ANYTHING THAT COULD BE DONE,”**  
**—JEFF HUBER**

BY DOUG PETERSON

Jeff Huber (BSCompE '89) grew up on a small dairy farm near Galena, Ill., and has a vivid memory of standing in the cow yard as a young boy, with manure coming to the top of his boots.

“There has to be a better way,” he recalls thinking. “I loved growing up on the farm, but that moment convinced me that I should explore another option.”

That “other option” became computing. Today, this ECE ILLINOIS alumnus recently completed his 11th year as an executive with the search-engine giant, Google, where he has played leadership roles in developing and improving landmark products, such as Google Maps, Google Earth, and Gmail. He also led technology development for Google Ads, the part of the business that transformed the company from a \$1 billion business to a \$50 billion business.





# Google™

At ECE ILLINOIS, Huber was inspired by Illinois' pioneering work on Internet technologies. But his passion for computers goes back to age 13 when his family received its first Apple II computer.

"To the horror of my parents, I took it apart and then put it back together, modifying it, doing anything that could be done," he says.

Huber is the youngest of five children, and his parents told each of them that the first year of college would be covered, but they would have to make money to pay for rest of their education. This inspired Huber to be an entrepreneur and start his own computer business at age 14, selling computer supplies and software, as well as developing software. When he came to Illinois, he continued to operate the company full-time at the Business and Technology Center, a business incubator near campus.

"It was a phenomenal experience," he says. "I learned what it takes to be an entrepreneur, how to create something from nothing, and how to prioritize among the many things you can do."

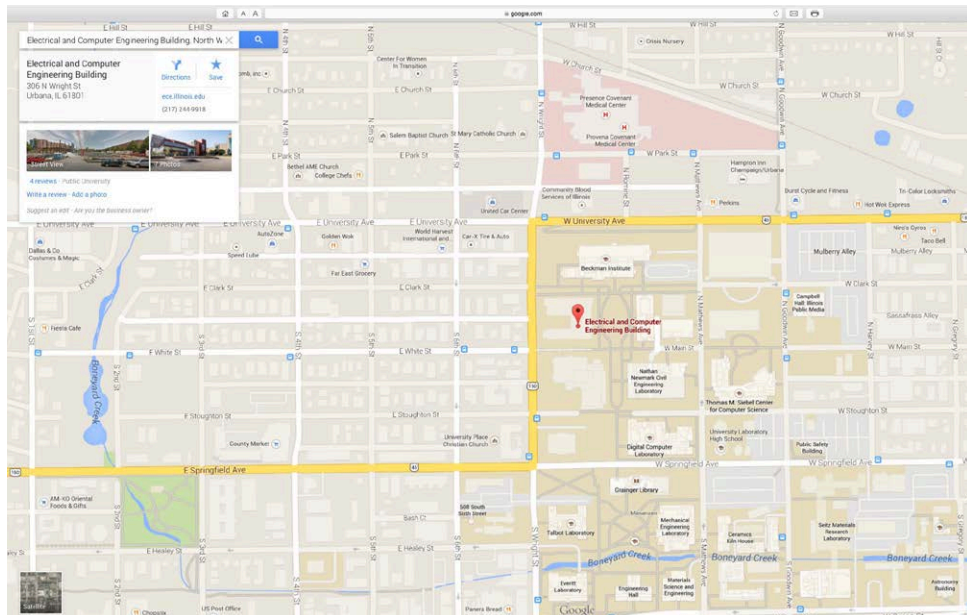
This early experience served him well when he worked as a vice president for both Excite@Home and eBay before joining Google in 2003. When he started at Google, the search engine had been established as a great product, but he says the system for how Google was going to make money was still "a bit of a backwater." With his leadership, Google Ads flourished. "A huge part of the task was defining the strategy and building the team and the culture to make it work," he says.

Google encourages employees to spend 20 percent of their time pursuing passion projects, so Huber made bootstrapping Google Apps his side project. He went on to lead development in Google Apps from 2005 to 2010 — a period when one of its most popular apps, Gmail, took off. Gmail set itself apart from other email systems because of its massive amount of storage and ability to run email searches.

As he explains, "If Google could index every page on the Web and give you a result back within 250 milliseconds, why couldn't people be able to find the attachment someone sent them last week in their email inboxes?"

In 2011, Huber moved to Google Maps, where he already had some involvement. When he first joined the company, he helped Google connect with and purchase a small company, Keyhole, which served as a prototype for what became Google Earth — the system that allows people to view satellite and street-level images just about anywhere in the world.

## FIELD REPORT : JEFF HUBER



In 2013, he began looking for new challenges, because as the head of Google Maps and Commerce, he ran a 5,000-person organization in 20 locations around the world, and that meant a lot of time spent on administrative chores.

“I wanted to get back to creating and building,” he says. Therefore, he switched to Google[x], the secretive division that tackles projects that seem more science fiction than reality. Google calls them “moonshots,” and they include such high-profile projects as Google Glass (wearable computing) and self-driving cars. To qualify as a Google[x] project, it has to be something that solves a huge problem affecting a billion or more people and uses breakthrough technology created at Google[x] that might lead to a radically innovative product within five to 10 years.

Huber is a senior vice president in Google[x]’s life sciences area, which has announced several initiatives. One product is a contact lens that diabetics can use to continuously monitor glucose levels in tear fluid. The contact lenses send glucose level readings to smartphones, but a future version may allow wearers to do a “long blink” to trigger a visual display in the lens. Another project includes using nanoparticles to detect disease within the body, with the first target being early diagnosis of cancer.

Google[x] sets its sights high with these moonshots, increasing the risk of failure — but also increasing the rewards of success.

“With the ambitious projects we’re working on, there’s a 90-percent chance of failure,” Huber says. “But in the 10 percent where we succeed, we can have a huge impact on the world. I’ll take those odds any day.”

**“WITH THE AMBITIOUS PROJECTS WE’RE WORKING ON, THERE’S A 90-PERCENT CHANCE OF FAILURE. BUT IN THE 10-PERCENT WHERE WE SUCCEED, WE CAN HAVE A HUGE IMPACT ON THE WORLD. I’LL TAKE THOSE ODDS ANY DAY,”**

**-JEFF HUBER**

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 Susan S. Zhao  
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 Terry L. Zivney

We strive to make this list as accurate as possible. If your name has been listed incorrectly or omitted, please accept our apologies.

To report an error or omission, or for information about making a gift, contact either Steve George or Allison Winter.

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# TEN ANSWERS

**Jana Messerschmidt** (BSCompE '01) is vice president of global business development and platform at Twitter. She is responsible for partnerships at Twitter, including business development, developer relations, partner engineering, platform operations, and strategy.

She often tweets photos of notable visitors to the company, as well as her dog, Tanner Stanley. Prior to joining Twitter in 2010, Jana was director of business development at Netflix, where she focused on mobile and consumer electronics partnerships. Earlier in her career, she worked at DivX and AT&T. She is @janamal on Twitter.

**WHERE WAS YOUR FAVORITE PLACE TO STUDY ON THE ILLINOIS CAMPUS?**

Grainger Engineering Library.

**WHAT'S YOUR FAVORITE TECHNOLOGICAL ADVANCE SO FAR?**

Self-driving cars. As an absolutely terrible driver myself, I love how technology will be able to improve driver safety. I can't wait for a combination of Uber + self-driving cars in the future!

**WHAT'S ONE OF YOUR FAVORITE QUOTES?**

"The essence of strategy is choosing what not to do." We can all come up with a zillion great ideas — the hardest part is picking the best one and executing.

**WHAT WAS YOUR FAVORITE ECE CLASS?**

ECE 312, Computer Organization and Design, with Sanjay Patel.

**IF YOU COULD CHOOSE A SUPER POWER, WHAT WOULD IT BE?**

To be in two places at once. I'd love to be able to increase my productivity!

**WHERE IN THE WORLD HAVE YOU ALWAYS WANTED TO VISIT?**

Russia. The history and culture absolutely fascinate me.

**IF YOU COULD BE ANY ANIMAL, WHAT WOULD YOU BE?**

My dog, Tanner (@tanner\_stanley)! He leads quite the pampered life.

**IF YOU COULD EAT ONLY ONE FOOD FOR THE REST OF YOUR LIFE, WHAT WOULD IT BE?**

I've turned into a true Californian — sushi! I could eat it all day, every day.

**YOU HAVE A FREE HALF-HOUR. WHAT DO YOU DO?**

Check my Twitter feed so that I can be up to date with the latest news. I can get lost in the Twitter app for hours.

**WHAT DO YOU MISS MOST ABOUT YOUR TIME AT ILLINOIS?**

The smell of Kam's as you're walking down Daniel Street. Just kidding.

## JANA MESSERSCHMIDT



TEN ANSWERS PROFILES AN ALUMNUS OR ALUMNA EACH ISSUE, ASKING THE IMPORTANT QUESTIONS. DO YOU HAVE ANSWERS? EMAIL US AT [ECE@ILLINOIS.EDU](mailto:ECE@ILLINOIS.EDU) AND WE MAY FEATURE YOU IN A FUTURE ISSUE. TO READ MORE ABOUT ECE ALUMS, PLEASE VISIT OUR WEBSITE.

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President-elect Timothy Killeen visits with University of Illinois President Robert Easter in November.

## NEXT UNIVERSITY OF ILLINOIS PRESIDENT NAMED

Timothy L. Killeen, the vice chancellor for research and the president of the Research Foundation of the State University of New York, in November was named the 20th president of the University of Illinois.

Killeen will succeed retiring President Robert Easter when he retires in July. He has more than three decades of experience as a teacher, researcher, and administrator in public higher education and in top leadership positions with national scientific research agencies.

A leading researcher in geophysics and space sciences, Killeen earned his PhD in atomic and molecular physics from University College London at the age of 23. In 2007, he was elected to the National Academy of Engineering, which honors the world's most accomplished engineers. Killeen's primary faculty appointment on the Urbana campus will be in ECE ILLINOIS.



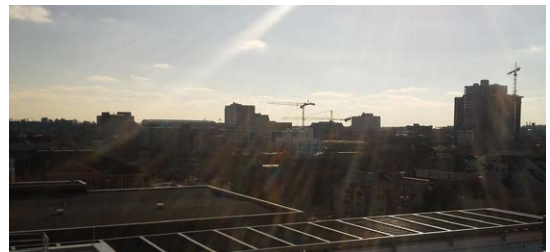
## ILLINOIS TO BUILD SOLAR FARM

Illinois is designing a solar farm on the southwest side of campus, and construction is expected to start this spring. The farm is a public-private partnership between the campus and Phoenix Solar, which will build the farm and operate it 10 years before turning it over to the campus. The farm is expected to supply about 2 percent of the campus' electricity.

## ILLINOIS WINS NIH GRANT

Illinois and the Mayo Clinic have received a \$9.34 million, four-year award to create one of several new Centers of Excellence for Big Data Computing.

The award comes as a part of the National Institutes of Health's Big Data to Knowledge initiative. The Illinois-Mayo Center, to be located on the Urbana campus, will focus on the analytical challenges posed by the rapidly growing body of genomic and transcriptomic data produced by genome-wide, high-throughput experimental technologies.



Three tower cranes are visible in Campustown as you look southwest from the roof of the Electrical and Computer Engineering Building.

## MORE HIGH-RISES GOING UP IN CAMPUSTOWN

The face of Campustown has been changing during the last decade, and the city of Champaign has encouraged that development with new zoning rules about how buildings fit into the area, said T.J. Blakeman, the City of Champaign's senior planner for economic development. Since 2004, 38 new buildings, including several high-rises, have either been built or are under construction, at an estimated cost of about \$355 million.

"The biggest catalyst for the change was solving the flooding along the Boneyard ... and the \$8 million reconstruction of Green Street in 2002," he said.

Blakeman said the city will reconstruct Green Street between Fourth and Neil Streets in 2016, which will give the west entry to Campustown a makeover. He expects Campustown development to continue west when that project is done.



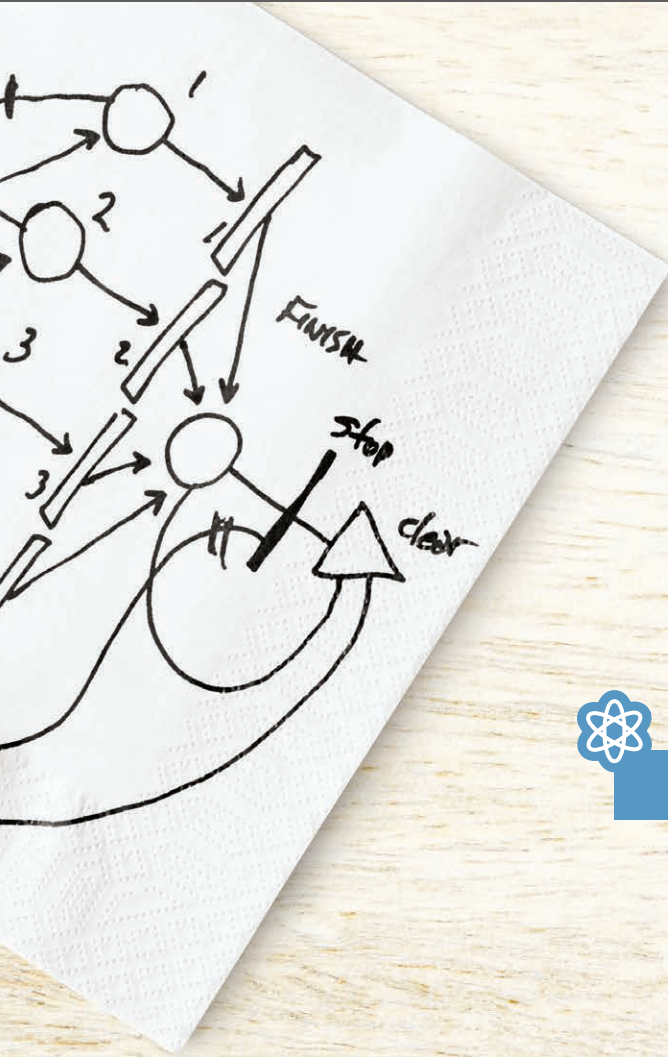
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