ISE ANNUAL REPORT 2018

THE FUTURE OF INDUSTRIAL & SYSTEMS ENGINEERING

MIND-CONTROLLED ROBOTICS

AUTONOMOUS VEHICLES

THE INTERNET OF THINGS

FINANCIAL ENGINEERING

ILLINOIS
ISE | Industrial & Enterprise Systems Engineering
COLLEGE OF ENGINEERING

ISE

RAKESH NAGI

Donald Biggar Willett
Professor in Engineering

Industrial and Enterprise Systems
Engineering Department Head

Fellow, Institute of Engineers

I am delighted to introduce our newly redesigned Annual Report in such a ground-breaking year for ISE at Illinois.

I have fond memories of a song of my childhood, Doris Day's "Que Sera Sera", Whatever will be will be. In contrast today, I realize our obligation to passionately make the world a better place and not leave it to fate. At ISE at Illinois we are working tirelessly to "define" the future and systematically place the next generation into a safer, healthier, and more prosperous world. Our faculty, alumni and students are boldly investing their creative ideas, time, and energy into a future that we would like to create for the next generations to come.

Our Annual Report this year celebrates emerging future technologies that would not be possible (or profitable) without researchers in our field. ISE at Illinois is proud to have faculty, alumni, and students working on these new problems both in theory and in industry practice.

Please enjoy our special section on the Future of Industrial and Systems Engineering.

We are also proud to introduce six new faculty who have joined us since our last issue, bringing to our department new strengths in health and human factors, optimization in machine learning and artificial intelligence, control systems, autonomy and robotics, multi-scale modeling and simulation of materials, design, and engineering education, among many other talents.

In addition, joining our six NSF CAREER Award winners are three NSF CRII Award winners.

And as our department is summiting new heights, the University of Illinois is greatly expanding its research infrastructure with the Engineering-Based Carle Illinois College of Medicine, the $48M Siebel Center for Design, and the $10M Jump Simulation Center.

It's a great time to be in industrial and systems engineering, and a great time to be at Illinois.

Sincerely,
Rakesh Nagi
Donald Biggar Willett Professor in Engineering

CONTENTS

The Department of Industrial and Enterprise Systems Engineering (ISE) at the University of Illinois, Urbana-Champaign, *innovates* the engineering discipline with forward-thinking research and scientific discoveries; *serves* education, industry, and society; *educates* a new generation of leaders in general, systems, industrial, and financial engineering.

ISE Annual Report is edited by William Gillespie, with assistance from Charlotte Collins, Zack Fishman, Madeleine Hubbard, Jessy Ruddell, Riya Sanjay, and Shawna Graddy. Additional writing by Doug Peterson and Mike Koon.

Photography by Charlotte Collins, Heidi Craddock, William Gillespie, Madeleine Hubbard, Anna Longworth, Joanna Strauss, and L. Brian Stauffer. Illustration and design by Miriam Martincic.

Readers, alumni, students: contact us at communications@ise.illinois.edu

THE FUTURE OF INDUSTRIAL & SYSTEMS ENGINEERING

Mind-Controlled Robotics

BY DOUG PETERSON

Researchers in the University of Illinois Department of Industrial and Systems Engineering are laying the groundwork for cooperative robots—or "cobots"—that might be able to read our minds.

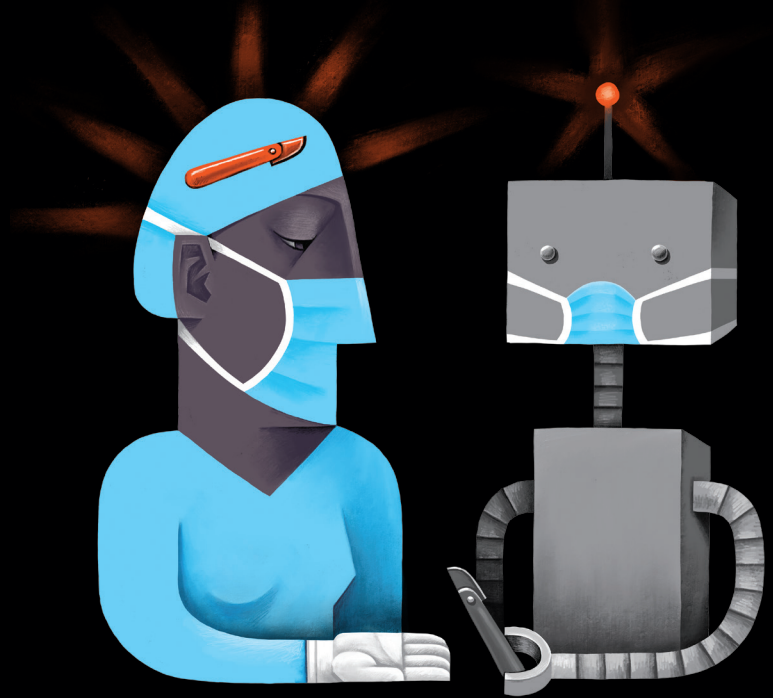
"We're trying to see what ways robots can be more friendly, and the first idea we had is a robot that senses if the human needs help," says ISE Professor Thenkurussi "Kesh" Kesavadas.

The focus so far has been on industrial applications, but Kesavadas sees their work as having medical uses as well. For instance, a mind-reading robot in the operating room could detect when a doctor needs a scalpel and then hand it to the surgeon.

Richard Sowers, an Illinois professor with a joint appointment in ISE and mathematics, is making use of electrodes attached to a "brain cap"—a cap with 60 sensors that attach to the scalp and detect brain waves through electroencephalography, or EEG.

Sowers has been probing the connection between our perception and the fear of falling—a common problem for the elderly.

The project, which began at the end of 2016, places subjects in a virtual world.



T. Kesh Kesavadas

Richard Sowers

Subjects walk on a treadmill while wearing the brain cap and a virtual reality headset that shows them hiking through a world with many sudden drop-offs. The EEG brain cap can detect their anxiety.

The goal, Sowers says, is to understand the connection between what people see and their acrophobic anxiety—the fear of heights.

In a medical setting, a surgeon could tell a mind-reading robot to adjust a camera being used to take images inside the body, says graduate student Yao Li. And in manufacturing, an operator who needs an extra hand while welding could tell the robot to rotate the part being welded—all using brain activity.

"It's interactive and it's powerful," Kesavadas says. "Nobody else is doing this."

FOR THE FULL STORY, VISIT
ise.illinois.edu/newsroom/article/mind-reading-robots

With the breadth and focus of our program, ISE students and faculty are advancing the state of the art in numerous emerging technologies. No technical domain is out of bounds for Industrial and Systems Engineers.

Autonomous Vehicles

BY MADELEINE HUBBARD

The average American can expect to be in three or four car accidents in their lifetime. Surgeons in the US often work long shifts and see many different patients with different problems in one day; because they are human, there is a chance of error.

With autonomous technology, these problems may be circumvented entirely.

ISE students, faculty, and alumni are working to reduce the number of vehicle crashes and surgical errors in the future. ISE's Systems Engineering and Design major now offers an undergraduate track in Autonomous Systems and Robotics.

Ramakrishnan Narayanan, graduate student in industrial engineering, wrote a thesis focused on using existing car sensors and simple computers and cameras to create an algorithm that would allow a car to recognize bicyclists wearing helmets.

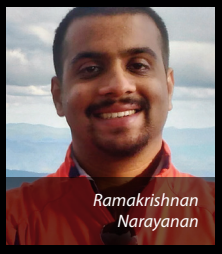
Students and faculty in ISE are also working to use autonomy outside of vehicles. Recently, ISE Humboldt Research Award winner and Professor Dušan Stipanović worked on "collision avoidance and tracking control for robotic arms." This work was done with his PhD student Shankar Deka. Stipanović says, "We hope this will have an application in minimally invasive surgery training."

Professor Bob Norris previously worked for John Deere where he created and produced the R-Gator. Norris was the lead engineer, program manager and the business manager for the project. Norris says his group was "creating a vehicle that could travel with [soldiers] autonomously and carry their equipment." Soldiers often have to carry well over 100 pounds of equipment during long missions.

ISE Professor Girish Krishnan is the faculty mentor for students studying autonomous systems and robotics. The curriculum, Krishnan says, has "real, practical courses. There are several robotics courses taught by the ECE Department, some taught by our department, and some taught by the mechanical department."

Krishnan says, "We have an excellent workspace environment here, both in the mechatronics lab as well as in many other labs, so they could kind of get their [feet wet] with any kind of state-of-the-art equipment related to autonomy. They should be aware of those opportunities."

FOR THE FULL STORY, VISIT
ise.illinois.edu/newsroom/article/autonomous-technology

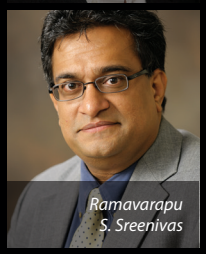

Ramakrishnan Narayanan


Dušan Stipanović


Bob Norris


Girish Krishnan


Richard Sowers


Ramavarapu S. Sreenivas

Internet of Things

BY MADELEINE HUBBARD

The Internet of Things (IoT) is arriving, and ISE is poised to greet it.

IoT, at the level of the consumer, will mean that devices—from your phone to your thermostat to your garage door to your pacemaker—may someday be digitally connected. From a central location—say, an Amazon Echo or even a watch—you would be able to monitor sensors on these devices and control their behavior. Your home, your car, and your office could one day become a seamless extension of your mobile devices.

Business Insider expects that there will be more than 24 billion IoT devices on the Earth by 2020. That's approximately four devices for every human being on the planet. And as we approach that point, $6 billion will flow into IoT solutions, including application development, device hardware, system integration, data storage, security, and connectivity. But that will be money well spent, as those investments will generate $13 trillion by 2025.

An oft-quoted description of IoT is "anything that can be connected, will be connected."

ISE students, alumni, and faculty are using their systems engineering and business knowledge to help make IoT a reality. This year, ISE introduced a specialized focus in the Internet of Things for undergraduate students.

Professor Richard Sowers is the faculty mentor for all new students choosing the new IoT Secondary Field Option. Sowers realized that the IoT Secondary Field Option "would naturally fit into a number of things that we as a department are teaching, and that this was the right time and the right setup to actually start."

Professor Ramavarapu "R.S." Sreenivas, head of graduate studies at ISE, works closely with Professor Sowers. Over the summer, they both mentored undergraduate students conducting research on the IoT.

Describing the IoT secondary field option, Sowers says, "It's a lot of hard work, but it's a billion-dollar opportunity. It's a serious challenge because it requires a mixture of many things."

He says, "Someone once asked Wayne Gretzky, 'Why are you so good?' And [Gretzky] said, 'I try to skate to where the puck is going, not where the puck has been.' The future that students will be living in is different from the future that I was living in when I was young. I think it's pretty clear that the Internet of Things will be a game-changer, and it will be part of the future."

FOR THE FULL STORY, VISIT
ise.illinois.edu/newsroom/article/internet-of-things

See page 14 for "Illinois Researchers Incorporating 'Internet of Personalized Things' into World of Healthcare"

Financial Engineering

BY MADELEINE HUBBARD

Markets have existed as long as humans have. It began with trading basic goods. As society progressed, major financial empires have risen and fallen, physical money has largely became digital, and markets have became significantly more complicated. The field of financial engineering has stepped in to navigate and simplify the modern market.

In 2010, the Industrial and Enterprise Systems Engineering department and the College of Business collaborated to create MSFE. This program is the first to be shared between two U of I colleges.

Professor Morton Lane is head of the Financial Engineering program at Illinois. He defines financial engineering as "the application of quantitative techniques to financial markets and financial products. Quantitative techniques include mathematics, science, statistics, analytics and other engineering techniques." Before becoming head of the Financial Engineering Program, Lane briefly taught at the London Graduate School of Business before spending over thirty years working in the financial sector. He worked at the World Bank, Discount Corporation of New York Futures, and Bear Stearns, before going on to create his consulting firm, Lane Financial LLC. Describing his transition back into academic life at Illinois, Lane says, "It was a new thing and I love new things, so they (the University administration) got me at the right time."


Morton Lane


Liming Feng


Alexandra Chronopoulou

Professor Liming Feng has been part of the Financial Engineering program since the beginning. Over his time at Illinois, Feng says, "I've been involved in many aspects of the MSFE program, from helping design the curriculum, to recruiting the best qualified students, to helping students with job hunting, to teaching several required MSFE courses."

Professor Ramavarapu S. Sreenivas, is the head of graduate studies at ISE and has taught in the Financial Engineering department since its inception. Although there are prominent financial engineering programs at other schools, Sreenivas says, "The world's epicenter of the futures market is up in Chicago." This gives Illinois students an advantage due to their close proximity to Chicago.

ISE Professor Alexandra Chronopoulou teaches IE 525: Numerical Methods in Finance. Chronopoulou tells students not to be intimidated by the courses. "All of our students are successful in the end, but they just have to be patient and work hard… We have very good placement rates so the reward is at the end," she says.

In the financial market, Lane says, "The universe is changing all the time. That's what makes it exciting."

FOR THE FULL STORY, VISIT
ise.illinois.edu/newsroom/article/msfe

A financial engineer, in predicting wheat markets, will use equations that factor in supply, weather, market trends, demand, among other variables.

Abigail Wooldridge

Pingfeng Wang

S. Rasoul Etesami

Molly Goldstein

Yumeng Li

Bob Norris

ISE WELCOMES NEW FACULTY

Abigail Wooldridge BY DOUG PETERSON

Professor Abigail Wooldridge has been comparing the team-based transition approach being used in a pediatric ICU with the more traditional approach in a unit for adult trauma patients. Her preliminary results show, overall, that the team approach can improve patient safety, quality of care, and worker satisfaction.

Wooldridge says she is excited to come to U of I, where she will be part of one of the top-ranked engineering colleges in the country. What's more, the University of Illinois and Carle Hospital have come together to form the new Carle Illinois College of Medicine, which puts a special emphasis on engineering for health-care solutions.

"I will need clinician collaborators for my research, and they're here," she says. "I'm interested in improving system outcomes, which means improving patient safety, quality of care, and worker outcomes."

The people she has met on the Illinois campus "have been fantastic," she adds, and she looks forward to tapping into resources such as the Health Care Engineering Systems Center and the Jump Simulation center for health-related research. She also says there is "great work going on at Illinois with the aging population. There's a lot of synergy on campus for me."

FOR THE FULL STORY, VISIT
ise.illinois.edu/newsroom/article/wooldridge-trauma-technology-teamwork

Pingfeng Wang BY MADELEINE HUBBARD

Professor Pingfeng Wang worked in industry for Dell as a quality engineer. He felt he would benefit from more "systems thinking, instead of just knowing the structures." This led him to earn his master's in applied mathematics in 2006 at Tsinghua University in Beijing.

For his PhD in mechanical engineering, Wang went to the University of Maryland. After completing his doctorate in 2010, Wang taught at the Department of Industrial and Manufacturing Engineering at Wichita State University.

Wang says, "Illinois has one of the best industrial engineering departments in the world… I think it's very unique."

His research has earned Wang several awards, including the National Science Foundation NSF CAREER Award in 2014. Other awards include the ASME 2016 Design Automation Young Investigator Award, several best paper awards from ASME and IEEE, and five research and teaching awards from Wichita State University for his work there.

As a teacher, Wang likes seeing the students "get so excited doing something that they've never done before." He also enjoys seeing the students learn from his classes and go on to have prosperous careers. Wang says it can be "a very rewarding process to see students succeed."

FOR THE FULL STORY, VISIT
ise.illinois.edu/newsroom/article/pingfeng-wang

S. Rasoul Etesami BY MADELEINE HUBBARD

While a post-doc at Princeton, Professor Rasoul Etesami says he worked on behavioral decision-making problems on smart grids and used these behavioral studies to analyze the role of electric vehicles in smart grids.

Etesami says that beside his works on decision and control his research used prospect theory "to study the behavior of decision immersion market and see how it influences the outcome and fluctuation of price." From there, Etesami focused on the management of electric charging stations across networks of roads.

Part of what drew Etesami to the U of I is the diversity. He says, "I've been to other universities, I've talked with different people, but here is especially different for me. We can pretty much find a person in any area of expertise that you want in the campus, and I love it."

With his research, Etesami says "Just focusing on one specific area is not enough. Sometimes you have to go over multiple disciplines…. That's why I want to collaborate more with people here."

FOR THE FULL STORY, VISIT
ise.illinois.edu/newsroom/article/s-rasoul-etesami

Molly Goldstein BY ZACK FISHMAN

Molly Goldstein joins ISE faculty this fall, becoming director of the Product Design Lab and teaching Engineering Graphics and Design (SE 101) to first-year students.

Goldstein worked for an environmental engineering firm as an air quality engineer. For her work, she considered costs and tradeoffs in a variety of environmental contexts. Goldstein praised her design education for effectively preparing her for the real-world applications of industry.

"Being able to take a systems approach to understanding a problem makes you uniquely qualified to solve some of the biggest societal and technical problems," she says.

After several years in industry, Goldstein then enrolled in the Engineering Education PhD program at Purdue, from which she graduated this May. For her dissertation she studied how different students approached the design process, particularly their decision-making on tradeoffs.

"I looked at how students perform and explain their design trade-offs, and my results highlight variation seen in four types of students," she says. "Taking the time to understand how students dually analyze and experience their design decisions will give me an opportunity as an educator to say, 'How can I help this individual student? How can I understand this group of students? How can I push them to make them even better designers?'"

FOR THE FULL STORY, VISIT
ise.illinois.edu/newsroom/article/molly-goldstein

Yumeng Li BY MADELEINE HUBBARD

For her PhD, Professor Yumeng Li studied Aerospace Engineering at Virginia Tech. Li says, "For my PhD work, we were working with nanocomposites. We tried to develop and analyze nanocomposites with high stiffness-to-weight ratio through multiscale simulations with emphasis on the interface effects."

For Li's post-doc she conducted her research at Vanderbilt University. There, Li says she focused "on developing multifunctional simulation framework to studying fatigue creep phenomena in alloys."

After conducting her research at Vanderbilt, Li went on to work in the Department of Mechanical Engineering at Wichita State University. After teaching for one year, Li came to work at ISE.

This fall, Li is teaching SE 498, Numerical Methods in Engineering. Li says, "It's quite exciting to join UIUC. We have many brilliant young students here and I am excited to work with them."

Li is planning on continuing her research at Illinois. Li says, "My research field is in computational material science, more specifically, multiscale simulation of multifunctional materials and design." In the future, Li says she hopes to "develop several courses that will talk about multiscale simulation."

FOR THE FULL STORY, VISIT
ise.illinois.edu/newsroom/article/yumeng-li

Bob Norris BY MADELEINE HUBBARD

While in grad school, Professor William "Bob" Norris worked at The National Center for Supercomputing Applications developing applications in virtual reality for Caterpillar. After finishing his PhD, Norris went on to work for John Deere as their first roboticist. While working for Deere Norris earned his MBA from Duke University and earned 14 patents in autonomous systems technologies.

Norris's talents shone at Deere, when he helped create and produce the R-Gator and was involved with the Tango E5 robotic mower.

After leaving John Deere, Norris used his skills in engineering and business to start up a consulting company—Robust Smart Control Solutions, LLC—aimed at high tech business opportunities. Norris says his favorite part of working with autonomous vehicles is that "there's a variety of technical and business work and challenges building new markets. You also get to meet with a lot of people and work with cutting edge technologies." Norris has been involved in multiple commercial, security, and government robotic/autonomous system projects.

FOR THE FULL STORY, VISIT
ise.illinois.edu/newsroom/article/william-norris

AutonomouStuff Collaborates with ISE to Build an Automated Future

PRESS RELEASE FROM AUTONOMOUSTUFF

AutonomouStuff is proud to work with ISE to advance research and development in the autonomous industry.

There has been a long history of collaboration between the company AutonomouStuff and the University of Illinois, from workshops to faculty to providing products for research products.

A Polaris Gem e2 (pictured) was donated to ISE in the spirit of collaboration as a platform to perform research and development. Dreams of an innovation lab focusing on automated driving technologies are taking root—a lab where students and faculty can have hands-on experience with cutting-edge, state-of-the-art technologies to make world-changing breakthroughs.

"This project is exciting because we have the opportunity to join forces with some of the most brilliant minds in the area and see the results from their research using our products," AutonomouStuff's Director of Engineering, Joe Buckner said.

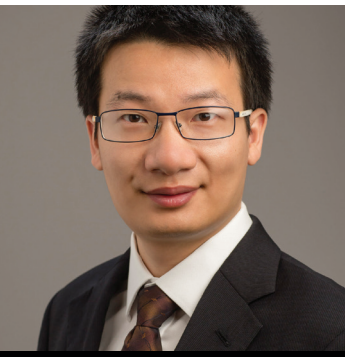
The kit was purchased by Professor William Norris for his program in autonomous systems; his student team will perform research with the Polaris GEM e2.

"At AutonomouStuff, we have built a global ecosystem of technology partners and over 2,500 customers who are all in need of technologies and highly sought-after talent," said Bobby Hambrick, AutonomouStuff's Founder & CEO. "Our collaboration with the University of Illinois fits well within our mission of enabling the future of autonomy. We are proud of our university relationships and will continue to do our part to prepare for the future of transportation."

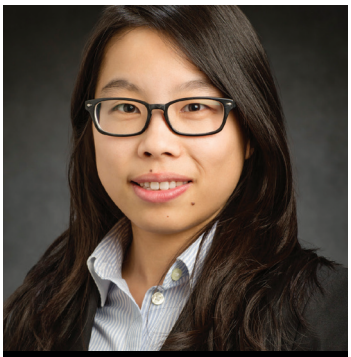
"Our collaboration with AutonomouStuff is important to establish an effective, world-class, autonomous systems program [at] ISE."
—BOB NORRIS

AWARDS & OTHER HONORS

CRII Awards (Computer Research Initiation Initiative)



Ruoyu Sun
Towards Faster Algorithms for Large-scale Constrained Optimization



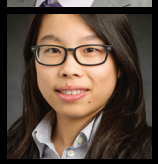
Niao He
Fundamental Limits of Conditional Stochastic Optimization

Jugal Garg
Strongly Polynomial Algorithms for Market Equilibria with Applications to Network Flows and Nash Social Welfare

Other NSF

Alexandra Chronopoulou
Estimation, Sampling, and Simulation for Long-Range Dependent Processes

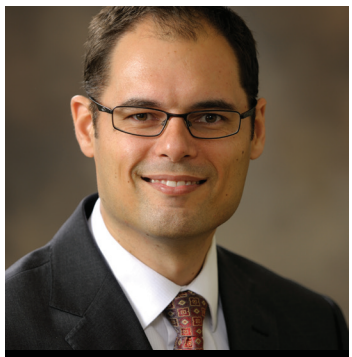
Karthik Chandrasekaran
Matrix Signings and Algorithms for Expanders and Combinatorial Nullstellensatz



Niao He
Point Processes in Healthcare and Security Analytics: Nonparametric Estimation and Efficient Optimization

Lavanya Marla (Co-PI)
Synergetic Drone Delivery Network in Metropolis

POETS ERC



James Allison
Initial Conceptual-Level Study of Aircraft Power and Thermal System Architecture Generation & Evaluation

EMI Mitigation for Dense DC-AC Converters via Structured Topological Design Exploration

Jugal Garg

Strongly Polynomial Algorithms for Market Equilibria with Applications to Network Flows and Nash Social Welfare

BY ZACK FISHMAN

The notion of market equilibrium is central to the field of economics, but recently it has also been applied to resource allocation problems. The allocation of indivisible goods presents challenges in computing its market equilibrium, yet that is the plan of Jugal Garg, who recently received a grant from the National Science Foundation to design fast algorithms that calculate market equilibria.

Garg received the prestigious CRII award in early 2018, which will fund his research and support two PhD students and an undergraduate student for two years. Working at the intersection of operations research, economics, and computer science, he hopes to develop new algorithms that can find the equilibrium allocation in a variety of scenarios.

"Market equilibria tend to be inherently fair and efficient, and that's why they're best suited for a fair allocation of goods," Garg says. He defines "fairness" to mean "envy-free" in his work.

But known problems in operations research make the search for fair solutions challenging. Garg wants to create the tools needed to solve those problems.

"We want to solve the fair allocation problems using market equilibria, and many of them are unsolved," he says. "To do that, we need to develop new algorithmic tools and techniques, and we need new structural insights on these problems."

Faculty

JAMES ALLISON

- Yong Hoon Lee, Jonathon Schuh, Randy Ewoldt, and **James Allison** were presented with the 2017 Journal of Mechanical Design Editors' Choice Award Honorable Mention on August 28, 2018 for their recent paper "Enhancing Full-Film Lubrication Performance Via Arbitrary Surface Texture Design".
- **James Allison**, in collaboration with CU Aerospace, was awarded a Phase 1 NASA SBIR grant ($125,000) for the development of 'Strain-Actuated Solar Arrays', a new technology for spacecraft attitude control with possible extension to other applications requiring ultra-quiet pointing and precise motion control.

NIAO HE

- Professor **Niao He** was selected as one of the six National Center for Supercomputing Applications (NCSA) Faculty Fellows this year.

LAVANYA MARLA

- INFORMS Transportation Science and Logistics Society Cross-Regional Grant, Oct 2017, $2000.
- Gift Grant from deepAIr Solutions, $8980.00, September 2018–May 2019.

Graduate Students

JANE LEE (advisor Lavanya Marla) received an Honorable Mention for their paper submitted to the Anna Valicek competition by AGIFORS, the Aviation Group of the International Federation of Operational Research Societies. The award committee states that while Jane was not one of two finalists for the award,"… given the quality of your work, and the enthusiasm of many committee members, you have been granted an Honorable Mention, which is very rare and reserved for exceptional circumstances."

SREEKALYAN PATIBALLA (advisor Girish Krishnan) received the Mavis Future Faculty Fellows Award. This program is designed to facilitate the training for the next generation of great engineering professors. There are three main components to the MF3 Academy—teaching, research, and service.

ISE Alumni in Academia

UCSD Professor **BEHROUZ TOURI** (PhDIE 2011) won the 2018 Donald P. Eckman Award on control systems.

Penn State Professor **CONRAD TUCKER** (PhDSEE) was one of 30 out of 20,000 Gates Millennium Scholars invited to attend the Gates Millennium Scholars Program Celebration on April 24, 2018 in Seattle.

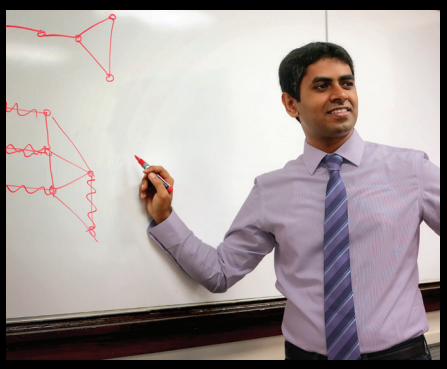
Karthik Chandrasekaran

Matrix Signings and Algorithms for Expanders and Combinatorial Nullstellensatz

High capacity and fault tolerance are desirable properties in networks (e.g., communication and transportation networks). Such properties are captured by the notion of expansion. Networks with good expansion properties are known as expanders. Even though optimal expanders are known to "exist," there is no known efficient algorithm to find one. One of the goals of Prof. Chandrasekaran's recently funded research is to design an efficient algorithm to search for optimal expanders and understand the limitations, if any, along the way. The award will support graduate students who will receive extensive training in the design and analysis of algorithms.

It might be perplexing to imagine that certain well-structured objects "exist" without an efficient search procedure to find them. Chandrasekaran gives an illustrative example: "The seemingly simple pigeonhole principle states that if there are more pigeons than the number of pigeonholes, then at least one of the pigeonholes contains two pigeons. Now consider this principle applied to the following scenario: each human has roughly a maximum of 200k hair strands on their head. So, the city of Urbana-Champaign, which has a population of 230k, should have at least two people with the same number of hair strands. However, finding two such people becomes a non-trivial task!"

Besides the pigeonhole principle, several other mathematical techniques are known to show the existence of well-structured combinatorial objects without the ability to efficiently find them. Chandrasekaran's research aims to understand the inherent difficulties and design efficient algorithms to find some of these well-structured combinatorial objects. The research will draw upon tools from various areas of mathematics, algorithms, and optimization.



Professor Alexandra Chronopoulou: Modeling Complex Systems

BY MADELEINE HUBBARD

Professor Alexandra Chronopoulou has been teaching at ISE since fall 2014. Chronopoulou says her background is in statistics and applied math, which influences her decisions in research. She says, "I'm interested in modeling systems that have some randomness in them…. In particular, my focus is on models that have long-range dependence." In models with long-range dependence, observations that are very far apart in time or space are strongly dependent. Classical statistical/probabilistic models are not able to capture this type of dependence. Chronopoulou says her research is focused on how to "develop new statistical techniques in order to better describe this phenomenon." She says, "This has applications in mathematical finance. It has applications in biophysics, biology, or internet traffic networks, hydrology, and other areas."

Currently, Chronopoulou is working on multiple research projects. Her main focus is on modeling stochastic volatility models with long-range dependence. She and her PhD student, Qi Zhao, are working on option pricing and hedging strategies under these type of models. She says, "During the 2008 Wall Street crash, the market's volatility was extremely high which drove the math finance community to explore new models."

Chronopoulou is also working on statistical interference on customer choice models. This uses data from problems to make a judgment regarding consumer decisions. Chronopoulou says, "These problems in practice have a lot of interesting data. For example, the data is sparse due to missing observations or exhibit latent structures, and therefore efficient statistical methods need to be developed."

She says, "I'm working with a couple of master's students on healthcare applications." Chronopoulou and her graduate students are working on modeling hospital waiting times and hospital readmission rates that are directly linked with the quality of a hospital. "What I'm doing is I'm trying to assess how interventions in policies affect the readmission rates," she says.

Looking at her own work, Chronopoulou says, "When you do research on something, you're better at teaching it because you know the big picture."

She says her students are her favorite part about teaching financial engineering classes. "They are very motivated, they know why they're here, and they know that they have to work hard to get their degree and move on to their professional life, so you don't have to do much convincing why they have to be in the classroom, or why what you're doing is important." She says, "The students are very enthusiastic and they work very hard… I love it."

"When you do research on something, you're better at teaching it because you know the big picture."

Chronopoulou says she enjoys working with master's and undergraduate students groups equally. "As long as there's interactions [in class] and the students seem to be excited, I don't have a subject preference. What I care more about is the relationship that I have with the students rather than the topic."

Both of Chronopoulou's parents are teachers in Greece. As a teacher herself, Chronopoulou says, "I think that when you work with students it makes you think about your own research as well." She says she gains a lot of things from teaching as well, and feels "immediate joy in a sense when students are happy."

FOR THE FULL STORY, VISIT
ise.illinois.edu/newsroom/article/alexandra-chronopoulou

Deborah Thurston: Leader in $70M REMADE Institute

BY ZACK FISHMAN

ISE Professor Deborah Thurston has long researched sustainable practices in manufacturing. Now, she is working to apply research like hers within the industry.

Thurston is on the leadership team of the REMADE Institute, a coalition of universities, laboratories, and companies founded in 2017 that aims to reduce the pollution and energy waste of American manufacturing. Funded by $70 million spread over five years from the Department of Energy and an equal amount matched by its partners, the REMADE Institute is promoting efforts to apply pre-existing theoretical research and create real improvements in efficiency.

"The whole idea is to help industries use the work that people in academia are developing in research and bring it to the manufacturing plant floor sooner, much sooner," says Thurston, who notes that academic research often gets trapped in the so-called "Valley of Death", where new findings often remain unimplemented for years.

"We're trying to shorten the time between when things are invented or developed by researchers and the time they finally make it into use," she says.

Thurston is the Node Lead of Design for Reuse & Disassembly, a role in which she provides intellectual leadership and technical expertise to the development of design practices that make products more easily reused, remanufactured, or recycled.

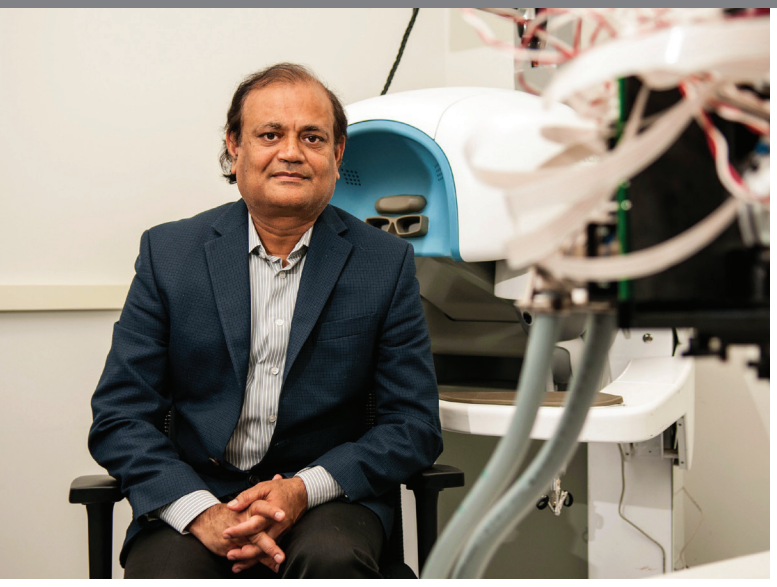
"What we're trying to do is hang onto that embodied energy through design practices that anticipate end-of-product-life activities that don't waste that embodied energy but instead use it again in a second or third life cycle," says Thurston.

The REMADE Institute has ambitious goals for its five years of federal funding. It strives to catalyze a 30 percent decrease in raw material consumption, a 30 percent increase in secondary feedstock material use, and a 25 percent improvement in energy use per product throughout the American manufacturing industry, among other objectives. Thurston believes these improvements will bring about lowered costs for both the economy and the environment, and she is pleased to be a part of these changes.

"It's kind of like a dream come true after working in this area for much of my career," she says. "The idea that so much of our money is wasted, so much energy that's embodied in products ends up in the landfill—it's a waste, and we could be using those resources much more effectively doing other things, so it's important work."

FOR FURTHER READING, VISIT
The REMADE Institute
remadeinstitute.org

Video interview with Professor Thurston
ise.illinois.edu/newsroom/article/professor-thurston



Research Engineer Pavithra Rajeswaran guides a visitor through a Virtual Reality demonstration during the Jump Simulation Open House

ISE Researchers Incorporate "Internet of Personalized Things" into Healthcare

BY MIKE KOON,
SUMMARY BY ZACK FISHMAN

A team of researchers at Illinois' Health Care Engineering Systems Center (HCESC) are working to bring medical assistance into the home using the Amazon Echo. HCESC director and ISE professor T. Kesh Kesavadas, coordinating with ISE professor R.S. Sreenivas and research engineer Pavithra Rajeswaran, wants patients to be able to use the Echo to call a doctor through voice commands or be monitored with medical sensors while recovering from major operations. In this way, patients can save money by returning home sooner for recovery, senior citizens vulnerable to heart attacks or falls can be closely monitored through AI for early signs of risk, and even basic tests like blood pressure can be taken from the comfort of home and sent to the doctor. "We want to make healthcare friendlier," says Kesavadas.

FOR THE FULL STORY, VISIT
engineering.illinois.edu/news/article/24365

Revolutionary Jump Simulation Center Opens its Doors at Illinois

BY MIKE KOON

The $10 million Jump Simulation Center opened this month on the University of Illinois at Urbana-Champaign campus. It promises to help train a new type of doctor uniquely equipped to transform healthcare.

With such innovative equipment as the Virtual Reality Intubation Simulator, the Center will not only train Carle-Illinois College of Medicine students but also be a site for testing new medical devices; mobile, low-cost technologies for rural and developing areas; medical simulation tools; and bio-printing and bio-fabrication techniques. The Center can provide customized training programs for hospitals, community centers, and organizations looking for a state-of-the-art simulation center.

"Anything they want to test in an operating room, they can test in our facility," said ISE Professor T. Kesh Kesavadas, Director of the Healthcare Engineering Systems Center at Illinois. "It is a place where new doctors can learn what happens inside a clinic and students will experience what it will feel like in an urgent care center."

It also culminates several years of planning. In 2014, a $62.5 million endowment established the Jump Applied Research for Community Health through Engineering and Simulation (Jump ARCHES), a partnership between the Jump Trading Simulation Education Center at OSF HealthCare in Peoria and the Healthcare Engineering Systems Center (HCESC) at Illinois' College of Engineering.

"We are developing innovative virtual reality training techniques in our research labs," said Kesavadas. "The Jump Simulation Center is an opportunity for us to test these technologies and techniques and at the same time custom design a new model of education for the Carle Illinois College of Medicine."

FOR THE FULL STORY, VISIT
engineering.illinois.edu/news/article/27330

ISE Researchers Develop Improved Crutch Using Flexible Robotics

BY ZACK FISHMAN

Researchers at the University of Illinois are using robotics to make crutches safer and more comfortable.

ISE graduate student Gaurav Singh and Professor Girish Krishnan have created a new crutch that implements "flexible robotics" to reduce physical stress and improve mobility, in conjunction with colleagues in the Department of Mechanical Engineering.

The new research improves upon the Lofstrand crutch, a model where each crutch attaches to the forearm with a plastic cuff and has a horizontal handle for the user to hold. However, using the traditional Lofstrand crutch can result in hyperextension from putting significant stress on the wrist, potentially leading to carpal tunnel syndrome and other wrist issues.

The soft robotic device designed by Singh and Krishnan's team have been developed to prevent these painful problems. Instead of a rigid, plastic arm cuff to hold the crutch in place, they instead have created a flexible sleeve made of soft pneumatic fiber-reinforced actuators that create a constricting motion using air pressure.

Singh explains that the sleeve, which is attached to the modified Lofstrand crutch, squeezes the user's forearm with each step."It applies a constriction force around your forearm, and that transfers some of the load from the palm to the forearm, reducing the load on the wrist," he says. By easing the stress put on the wrists, this new design could prevent hyperextension.

Soft and flexible robotics provide benefits over conventional "hard" robotics, according to Singh. The sleeve can conform to the shape of many forearms rather than needing specific designs for each individual, and users would have an easier time performing tasks involving wrist motion, such as turning a doorknob.

Krishnan cites inspiration from nature for the design of the sleeve. He provides examples such as a grapevine tendril or an octopus tentacle wrapping around a support. Similarly, the robotic sleeve features actuators that spiral around the forearm in a helical shape, providing a better grip.

To power the sleeve, Mechanical Engineering Professor Elizabeth Hsiao-Wecksler and her graduate student Chenzhang Xiao designed a piston system implemented into the bottom of the crutch. The mechanism is activated when placed on the ground.

"When the piston pump [is] compressed during crutch loading, one-way valves inside the piston chamber will force the air into a Pneumatic Elastomeric Accumulator (PEA) inside the crutch shaft," their team wrote for the Design of Medical Devices Conference in 2017. "That collected and stored pneumatic energy [is then] used to inflate the sleeve orthosis."

Because the crutch captures the energy needed for the sleeve, Krishnan describes the self-sufficient device as "energy-harvesting."

The research is in its final stages, with human testing being done by a team at the University of Wisconsin—Milwaukee, but the project holds a greater meaning in the timeline of human-wearable technology where little successful research has been conducted.

"About five to six years ago there was talk about soft flexible devices in augmenting human motion and giving additional support, but there were no functioning prototypes," says Krishnan. "Today, the success of this project paves way for more clothing-like devices that can be worn and give support to different parts of the body. This is certainly a seminal work in showing that perhaps all these visions can come true."

FOR FURTHER READING, VISIT
Monolithic Systems / Soft Robotics Lab
monolithicsystemslab.ise.illinois.edu

Gaurav Singh presents the flexible robotics crutch at the 2017 Chittenden Symposium: Assistive Technologies in Health

May 2017–May 2018

FACULTY ACCOMPLISHMENTS

CONFERENCE PAPERS +
PUBLICATIONS +
GRANTS +

Conference Papers

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8. J. Liu, P. Paré, A. Nedich, **C. Beck**, and T. Basar. "On a Continuous-Time Multi-Group Bi-Virus Model with Human Awareness." Proceedings of the IEEE CDC, Melbourne, Australia, 2017.
9. P. Paré, S. Ruf, J. Liu, and **C. Beck**. "A Viral Model of Diffusion of Innovations with Antagonistic Interaction." Submitted to IEEE Conference on Decision and Control, 2018.
10. L. Buccafusca and **C. Beck**. "Maximizing Power in Wind Turbine Arrays with Variable Wind Dynamics." Submitted to IEEE Conference on Decision and Control, 2018.
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4. **K. Chandrasekaran** and S. Mozaffari. "Odd Multiway Cut in Directed Acyclic Graphs." International Symposium on Parameterized and Exact Computation (IPEC 2017), 2017.
5. K. Berczi, **K. Chandrasekaran**, T. Kiraly, E. Lee, and C. Xu. "Global and fixed-terminal cuts in digraphs." Approximation, Randomization and Combinatorial Optimization.

Algorithms and Techniques (APPROX 2017), 2017.
6. N. Agarwal, **K. Chandrasekaran**, A. Kolla, and V. Madan. "On the Expansion of Group-Based Lifts." Approximation, Randomization and Combinatorial Optimization. Algorithms and Techniques (RANDOM 2017), 2017.

ALEXANDRA CHRONOPOULOU

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3. Y. Yang, J. Etesami , **N. He**, and N. Kiyavash. "Online Learning for Multivariate Hawkes Processes." Neural Information Processing Systems (NIPS), 2017.
4. B. Dai, A. Shaw, **N. He**, L. Li, and L. Song. "Boosting The Actor With Dual Critic." International Conference on Learning Representations (ICLR), 2018.

JUGAL GARG

1. **J. Garg**, M. Hoefer, and K. Mehlhorn. "Approximating the Nash Social Welfare with Budget-Additive Valuations." To appear in the proceedings of the 29th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA), 2018.
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2. P. Shrey, C. Pramod, and **T. Kesavadas**. "Development and Evaluation of a Haptics-based Rehabilitation System." International Symposium on Medical Robotics, Atlanta, GA, USA, March 1–3, 2018.
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4. K. Wang, K. Adimulam, **T. Kesavadas**. "Tetrahedral Mesh Visualization in a Game Engine." To appear in the proceedings of the IEEE Virtual Reality Conference, Germany, March 17–18, 2018.
5. W. Kuocheng, **T. Kesavadas**. "Deformable Body Formulation for Virtual Surgery." 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, South Korea, July 11–15, 2017.
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1. Y. Li, **P. Wang**, and W. Xiao. "Uncertainty Quantification of Atomistic Materials Simulation with Machine Learning Potentials." AIAA SciTech Forum, Kissimmee, FL, USA, January 8–12, 2018.
2. N. Yodo and **P. Wang**. "Design for Resilience of Complex Systems through Control-Guided Failure Restoration." AIAA SciTech Forum, Kissimmee, FL, USA, January 8–12, 2018.

QIONG WANG

1. D. Mitra and **Q. Wang**. "Management Strategies for Industrial Laboratories with Knowledge Memory." IFIP Performance 2017, New York, NY, USA, 2017.

Publications

JAMES ALLISON

1. Y. Lee, J. Schuh, R. Ewoldt, **J. Allison**, "Enhancing Full-Film Lubrication Performance via Arbitrary Surface Texture Design," ASME Journal of Mechanical Design, 65(2), p. 35, June 2017. DOI: 10.1115/1.4036133
2. D. Herber, T. Guo, **J. Allison**, "Enumeration of Architectures with Perfect Matchings," ASME Journal of Mechanical Design, 139(5), May 2017, p. 051403. DOI: 10.1115/1.4036132
3. J. Schuh, Y. Lee, **J. Allison**, R. Ewoldt. "Design-driven modeling of surface-textured full-film lubricated sliding: validation and rationale of non-standard thrust observations," Tribology Letters, 65(2), June 2017, p. 35. DOI: 10.1007/s11249-017-0818-8
4. C. Chilan, D. Herber, Y. Nakka, S. Chung, **J. Allison**, J. Aldrich, O. Alvarez-Salazar, "Co-Design of Strain-Actuated Solar

Arrays for Spacecraft Precision Pointing and Jitter Reduction," AIAA Journal, 55(9), September 2017, pp. 3180–3195. DOI: 10.2514/1.J055748

5. A Deshmukh, **J. Allison**, "Design of Nonlinear Dynamic Systems using Surrogate Models of Derivative Functions," ASME Journal of Mechanical Design, 139(10), August 2017, p. 101402-101402-12. DOI: 10.1115/1.4037407
6. W. Crossley, S. Luan, **J. Allison**, D. Thurston, "Optimization Problem Formulation Framework with Application to Engineering Systems," Systems Engineering 20(6), November 2017, pp. 512–528. Invited contribution to CESUN special issue. DOI: 10.1002/sys.21418

CAROLYN BECK

1. P. Paré, **C. Beck**, and A. Nedich, "Epidemic Processes over Time-Varying Networks," accepted to IEEE Transactions on Control of Network Systems, 2017. DOI: 10.1109/TCNS.2017.2706138
2. S. Bhatti, **C. Beck**, and A. Nedich, "Spectral Clustering, Graph Partitioning and Mixing," accepted to IEEE Transactions on Network Science and Engineering, 2018.
3. D. Katselis, **C. Beck**, and R. Srikant, "Mixing Times and Structural Inference for Bernoulli Autoregressive Processes," accepted to IEEE Transactions on Network Science and Engineering, 2018.
4. J. Liu, P. Paré, A. Nedic, C. Tang, **C. Beck**, and T. Basar, "Analysis and Control of a Continuous-time Bi-Virus Model," conditionally accepted to IEEE Transactions on Automatic Control, 2017.
5. P. Paré, J. Liu, **C. Beck**, B. Kirwan, T. Basar, and A. Nedich, "Analysis, Identification and Validation of Discrete-time Epidemic Processes," conditionally accepted to IEEE Transactions on Control System Technology, 2018.
6. T. Doan and **C. Beck**, "Distributed Resource Allocation Over Dynamic Networks with Uncertainty," submitted to IEEE Transactions on Automatic Control, 2017.
7. P. Paré, J. Liu, **C. Beck**, A. Nedic, and T. Basar, "Analysis and Control of Multi-Competitive Viruses with Mutations over Time-Varying Networks," submitted to IEEE Transactions on Control of Network Systems, 2017.
8. T. Doan, S. Bose, D. Nguyen, and **C. Beck**, "Convergence of the Iterates in Mirror Descent Methods," submitted to IEEE Control Systems Letters, March 2018.
9. C. Jayaraman, J. Sosnoff, and **C. Beck**, "On the Relationship between Trunk Kinematics and Shoulder Pain in Manual Wheelchair Users," to be submitted to Clinical Biomechanics.

KARTHIK CHANDRASEKARAN

1. K. Berczi, **K. Chandrasekaran**, T. Kiraly, E. Lee, and C. Xu, "Beating the 2-approximation factor for Global Bicut," Math Programming.
2. **K. Chandrasekaran**, C. Gottschalk, J. Koenemann, B. Peis, D. Schmand, and A. Wierz, "Additive Stabilizers for Unstable Graphs," Discrete Optimization.

XIN CHEN

1. **X. Chen**, P. Hu, and Z. Hu. 2017, "Efficient Algorithms for the Dynamic Pricing Problem with Reference Price Effect," Management Science, 63(12), pp. 4389–4408.
2. **X. Chen**, X. Gao, Z. Hu, and Q. Wang, "Population Monotonicity in Newsvendor Games," Management Science, forthcoming.
3. **X. Chen**, X. Gao, and Z. Pang, "Preservation of Structural Properties in Optimization with Decisions Truncated by Random Variables and Its Applications," Operations Research, forthcoming.

ALEXANDRA CHRONOPOULOU

1. **A. Chronopoulou** and K. Spilopoulos, "Sequential Monte Carlo for Fractional Stochastic Volatility Models," to appear in Quantitative Finance.
2. R. Yousefi-Maragheh, **A. Chronopoulou**, and J. Davis, "A customer choice model with Halo effect," submitted to Management Science.
3. P. McGlaughlin and **A. Chronopoulou**, "Discretization error in the simulation of reflected fractional diffusions," submitted to Journal of Applied Probability.

S. RASOUL ETESAMI

1. **S. R. Etesami**, S. Bolouki, A. Nedich, T. Basar, and H. Poor, "Influence of Conformist and Manipulative Behaviors on Public Opinion," IEEE Transactions on Control of Network Systems, 2018.
2. **S. R. Etesami**, W. Saad, N. Mandayam, and H. Poor, "Stochastic Games for Smart Grid Energy Management with Prospect Prosumers," IEEE Transactions on Automatic Control, 2018.
3. A. Truong, **S. R. Etesami**, J. Etesami, and N. Kiyavash, "Optimal Attack Strategies against Predictors—Learning from Expert Advice," IEEE Transactions on Information Forensics and Security, 21 June 2018.
4. **S. R. Etesami** and T. Basar, "Price of Anarchy and an Approximation Algorithm for the Binary-Preference Capacitated Selfish Replication Game," Automatica, Volume 76, February 2017, pp. 153–163.
5. **S. R. Etesami** and T. Basar, "Pure Nash Equilibrium in A Capacitated Selfish Resource Allocation Game," IEEE Transactions on Control of Network Systems, 2017.
6. G. Rahi, **S. R. Etesami**, W. Saad, N. Mandayam, and H. Poor, "Managing Price Uncertainty in Prosumer-Centric Energy Trading: A Prospect-Theoretic Stackelberg Game Approach," IEEE Transactions on Smart Grids, September 2017.
7. **S. R. Etesami**, W. Saad, N. Mandayam, and H. Poor, "Smart Routing of Electric Vehicles for Load Balancing in Smart Grids," submitted to Automatica, February 2018.
8. **S. R. Etesami** and T. Basar, "Dynamic Games in Cyber-Physical Security: An Overview," Journal of Dynamic Games and Applications (DGAA), October 2017.

JUGAL GARG

1. **J. Garg**, R. Mehta, V. Vazirani, and S. Yazdanbod, "ETR-Completeness for Decision Versions of Multi-Player (Symmetric) Nash Equilibria," ACM Transactions on Economics and Computation, forthcoming 2018.
2. **J. Garg**, R. Mehta, V. Vazirani, "Substitution with Satiation: A New Class of Utility Functions and a Complementary Pivot Algorithm," Mathematics of Operations Research, forthcoming 2018.
3. **J. Garg**, "Market Equilibrium under Piecewise Leontief Concave Utilities," Theoretical Computer Science, 703: 55-65, 2017.

NIAO HE

1. Y. Yang, J. Etesami , **N. He**, and N. Kiyavash, "Nonparametric Hawkes Processes: Online Learning and Generalization Bounds," submitted to Mathematics of Operations Research, 2018.
2. B. Dai, A. Shaw, L. Li, L. Xiao, **N. He**, Z. Liu, J. Chen, and L. Song, "SBEED Learning: Convergent Control with Nonlinear Function Approximation," submitted 2018.
3. H. Lee, **N. He**, and J. Hu, "Dynamic Programming for Stochastic Control Systems with Jointly Discrete and Continuous State-Spaces," submitted 2018.

THENKURUSSI KESAVADAS

1. N. Sankaran, P. Chembrammel, A. Siddiqui, K. Snyder, and **T. Kesavadas**, "Design and Development of Surgeon Augmented Endovascular Robotic System," IEEE Transactions on Biomedical Engineering. DOI: 10.1109/TBME.2018.2800639
2. S. Deka, X. Li, D. Stipanović, and **T. Kesavadas**, "Robust and safe coordination of multiple robotic manipulators," Journal of Intelligent and Robotic Systems, November 2017. DOI:10.1007/s10846-017-0699-y
3. X. Li, H. Alemzadeh, D. Chen, Z. Kalbarczyk, R. Krishnan Iyer, and **T. Kesavadas**, "Surgeon Training in Tele-robotic Surgery via a Hardware-in-the-loop Simulator," to appear in Journal of Healthcare Engineering, issue on Robotics in Biomedical and Healthcare Engineering (RBHE).

HARRISON KIM

1. K. Avrithi and **H. Kim**, "Optimization of Piping Supports and Supporting Structure," accepted to Transactions of

ASME: Journal of Pressure Vessel Technology, 2017.
2. D. Suryadi and **H. Kim**, "A Systematic Methodology Based on Word Embedding for Identifying the Relation between Online Customer Reviews and Sales Rank," 2017, in review.
3. H. Han, S. Chang, and **H. Kim**, "Multiple Target Exploration Approach to Finding Solution Space: A Case Study for Automotive Vehicle Design," 2018, in review.

DOUG KING

1. Z. She, **D. King**, and S. Jacobson, "Analyzing the Impact of Public Transit Usage on Obesity," Preventive Medicine, 99, June 2017, pp. 264–268.
2. **D. King** and S. Jacobson, "Random acts of violence? Examining probabilistic independence of the temporal distribution of mass killing events in the United States," Violence and Victims, 32(6), December 2017, pp. 1014–1023.
3. **D. King**, S. Jacobson, and E. Sewell, "The Geo-Graph in Practice: Creating United States Congressional Districts from Census Blocks," Computational Optimization and Applications, 69(1), January 2018, pp. 25–49.
4. A. Khatibi, **D. King**, M. Kazerooni, and S. Jacobson, "Sampling From the 9,223,372,036,854,775,808 Possible Brackets in the NCAA Men's Basketball Tournament Using the Power Model," in review.
5. R. Swamy, **D. King**, and S. Jacobson, "A Case for Transparency in the Design of Political Districts," in review.
6. Z. She, **D. King**, and S. Jacobson, "Is Promoting Public Transit an Effective Intervention for Obesity? A Longitudinal Study of the Relation between of Public Transit Usage and Obesity," in review.

NEGAR KIYAVASH

1. C. Quinn, A. Pinar, and **N. Kiyavash**, "Bounded-Degree Connected Approximations of Stochastic Networks," to appear in IEEE Transactions on Molecular, Biological, and Multi-Scale Communications.
2. J. Etesami and **N. Kiyavash**, "Learning Causal Relationships in Dynamical Systems through Recovery of Functional Dependencies," to appear in IEEE Transactions on Signal and Information Processing over Networks.
3. A. Truong, J. Etesami, R. Etesami, and **N. Kiyavash**, "Optimal Attack Strategies against Predictors—Learning from Expert Advice," under revision, IEEE Transactions on Information Forensics and Security.
4. A. Truong, J. Etesami, R. Etesami, and **N. Kiyavash**, "Optimal Attack Strategies against Predictors—Learning from Expert Advice," to appear in IEEE Transactions on Information Forensics and Security.
5. A. Ghassami and **N. Kiyavash**, "A Covert Queueing Channel in FCFS Schedulers," to appear in IEEE Transactions on Information Forensics and Security.
6. G. Yu, S. Jacobson, and **N. Kiyavash**, "A Multi-objective sequential Stochastic Assignment Problem for Entry Screening," in submission.
7. G. Yu, S. H. Jacobson, and **N. Kiyavash**, "Asymptotic Analysis for Multi-objective Sequential Stochastic Assignment Problems," in submission.
8. D. Cullina, K. Singhal, **N. Kiyavash**, and P. Mittal, "On the Simultaneous Preservation of Privacy and Community Structure in Anonymized Networks," preprint.
9. D. Cullina, K. Singhal, and **N. Kiyavash**,"Significance of Side Information in the Graph Matching Problem," preprint.
10. R. Etesami and **N. Kiyavash**, "On Optimal Policy for a Malicious Expert in Recommendation Systems," preprint.
11. S. Kadloor, P. Venkitasubramaniam, **N. Kiyavash**, and A. Mishra, "A Statistical Inference Perspective on Preventing Timing Analysis in Networks," to appear in IEEE Signal Processing Magazine—Special Issue on Signal Processing for Cyber-Security and Privacy.

GIRISH KRISHNAN

1. S. Patiballa and **G. Krishnan**, "Qualitative Analysis and Conceptual Design of Planar Metamaterials With Negative Poisson's Ratio," Journal of Mechanisms and Robotics, 10(2), 2018, 21006. DOI: 10.1115/1.4038977
2. X. Zhang and **G. Krishnan**, "A nested pneumatic muscle arrangement for amplified stroke and force behavior," Journal of Intelligent Material Systems and Structures, 2017, 1045389X1773092. DOI: 10.1177/1045389X17730920
3. G. Singh and **G. Krishnan**, "A constrained maximization formulation to analyze deformation of fiber reinforced elastomeric actuators," Smart Materials and Structures, 26(6), 2017, 65024. DOI: 10.1088/1361-665X/aa6dc6
4. S. Patiballa and **G. Krishnan**, "Estimating Optimized Stress Bounds in Early Stage Design of Compliant Mechanisms," Journal of Mechanical Design, 139(6), 2017, p.062302.

LAVANYA MARLA

1. **L. Marla**, V. Vaze, and C. Barnhart, "Robust Optimization: Lessons Learned from Aircraft Routing," Computers and Operations Research, Vol 98, October 2018, pp. 165-184.
2. J. Lee*, **L. Marla**, and A. Jacquillat, "Dynamic Airline Disruption Management under Airport Operating Uncertainty," Invited for resubmission in Manufacturing and Service Operations Management.
3. **L. Marla**, Y. Yue, and R. Krishnan, "Data-driven Omniscient Bounds and Greedy Policies for Ambulance Allocation and Dynamic Redeployment," Under revision for resubmission.
4. K. Krishnan*, **L. Marla**, and S. Deo, "Managing EMS Systems with User Abandonment in Emerging Economies," Preprint, to be submitted to Stochastic Systems.
5. **L. Marla**, Y. Yue, K. Krishnan, R. Krishnan, and S. Deo, "Emergency Services in Emerging Economies: Challenges and Some First Steps," Indian School of Business Insight Magazine.

RAKESH NAGI

1. K. Date and **R. Nagi**. "RLT2-based Parallel Algorithms for Solving Large Quadratic Assignment Problems on Graphics Processing Unit Clusters," accepted to INFORMS Journal of Computing, September 2018.
2. O. Thakoor, J. Garg, and **R. Nagi**. "Multi-Agent UAV Routing: A Game Theory Analysis with Tight Price of Anarchy Bounds," submitted to IEEE Transactions on Automation, Science and Engineering, April 2018. Conditionally Accepted, July 2018 (Revised August 2018).
3. G. Tauer, K. Date, **R. Nagi**, and M. Sudit. "An Incremental Graph-Partitioning Algorithm for Entity Resolution," accepted to Information Fusion, June 2018, for March 2019, Vol. 46, pp. 171–183.
4. M. Samadi, **R. Nagi**, A. Semenov, and A. Nikolaev. "Seed Activation Scheduling for Influence Maximization in Social Networks," OMEGA, The International Journal of Management Science, June 2018, Vol. 77, pp. 96–114.
5. Y. Xia, R. Batta, and **R. Nagi**. "Controlling a fleet of UAVs to collect uncertain information in a threat environment," Operations Research, May–June 2017, Vol. 65(3), pp. 674–692. [INFORMS MAS Koopman Prize in 2018.]

SEWOONG OH

1. W. Gao, **S. Oh**, and P. Viswanath, "Breaking the Bandwidth Barrier: Geometrical Adaptive Entropy Estimation," accepted to IEEE Transactions on Information Theory, 2018.
2. W. Gao, **S. Oh**, and P. Viswanath, "Demystifying Fixed k-Nearest Neighbor Information Estimators," accepted to IEEE Transactions on Information Theory.
3. H. Kim, W. Gao, S. Kannan, **S. Oh**, and P. Viswanath,"Discovering Potential Correlations via Hypercontractivity," Entropy, 19(11), October 2017, p. 586.
4. P. Kairouz, **S. Oh**, and P. Viswanath, "The Composition Theorem for Differential Privacy," IEEE Transactions on Information Theory, 63(6), June 2017, pp. 4037–4049.
5. G. Fanti, P. Kairouz, **S. Oh**, K. Ramchandran, and P. Viswanath, "Hiding the rumor source," IEEE Transactions on Information Theory, 63(10), October 2017, pp. 6679–6713.

HENRIQUE REIS

1. S. Zhe, B. Behnia, W. Buttlar, and **H. Reis**, "Assessment of Low-Temperature Cracking in Asphalt Concrete Pavements using an Acoustic Emission Approach," ASTM Journal of Testing and Evaluation, 45(6), 2017, pp. 1948–1958.
2. B. Behnia, W. Buttlar, and **H. Reis**, "Nondestructive Evaluation of Thermal Damage in Asphalt Concrete Materials," ASTM Journal of Testing and Evaluation, 46(1), 2018, pp. 118–126. DOI:10.1520/JTE20160378
3. M. McGovern, W. Buttlar, and **H. Reis**, "Damage Evaluation and Life Extension of Asphalt Pavements Using Rejuvenators and Non-Collinear Ultrasonic Wave Mixing: A Review," ASME Journal of Nondestructive Evaluation, Diagnosis and Prognosis of Engineering Systems, 1(1), 2017, pp. 011002-1–011002-13. DOI: 10.1115/1.4037502
4. B. Hill, D. Oldham, B. Behnia, E. Fini, W. Buttlar, and **H. Reis**, "Evaluation of Low Temperature Viscoelastic Properties and Fracture Behavior of Bio-Asphalt Mixtures," International Journal of Pavement Engineering, 19(4), pp. 362–369, 2018. DOI: 10.1080/10298436.2016.1175563
5. B. Behnia, W. Buttlar, and **H. Reis**, "Evaluation of Low-Temperature Cracking Performance of Asphalt Pavements using Acoustic Emission: A Review," Applied Science Journal, Special Issue: Structural Health Monitoring of Large Structures Using Acoustic Emission—Case Histories (invited publication), 8(2), 2018, p. 306. DOI:10.3390/app8020306
6. J. Conway, M. McGovern, and **H. Reis**, "Quantitative estimation of high-temperature hydrogen attach damage using nonlinear ultrasonics," submitted to Materials Evaluation, March 2018.

RICHARD SOWERS

1. N. Srivastava, P. Maneykowski, and **R. Sowers**, "Algorithmic geolocation of harvest in hand-picked agriculture," Natural Resource Modeling, 2018.
2. D. Manuel and **R. Sowers**, "Optimal Transport to Cold Chain in Hand-Picked Agriculture," Natural Resource Modeling, 30, 2017.
3. J. Chen, M. Flood, and **R. Sowers**, "Measuring the Unmeasurable: An application of uncertainty quantification to Treasury bond portfolios," Quantitative Finance, 17, 2017, pp. 1491–1507.

RAMAVARAPU S. SREENIVAS

1. R. Reck, **R. S. Sreenivas**, and M. Loui, "Evaluating the Effectiveness of an Affordable and Portable Laboratory Kit for an Introductory Control Systems Course," to appear in Advances in Engineering Education, 2017.

ALEKSANDR STOLYAR

1. L. Nguyen and **A. Stolyar**, "A queueing system with on-demand servers: local stability of fluid limits," Queueing Systems, 2017. DOI: 10.1007/s11134-017-9564-8
2. S. Foss and **A. Stolyar**, "Large-scale Join-Idle-Queue system with general service times," Journal of Applied Probability, 54(4), 2017, pp. 995–1007.
3. S. Shneer and **A. Stolyar**, "Stability conditions for a discrete-time decentralised medium access algorithm," 2017.
4. D. Mukherjee and **A. Stolyar**, "Join-Idle-Queue with Service Elasticity: Large-Scale Asymptotics of a Non-monotone System," 2018.
5. A. L. Stolyar and Q. Wang, "Exploiting random lead times for significant inventory cost savings," 2018.

RUOYU SUN

1. **R. Sun** and Y. Ye. Worst-case Complexity of Cyclic Coordinate Descent: O(n2) Gap with Randomized Version. arXiv:1604.07130v2 [math. OC]. August 12, 2018.
2. **R. Sun**. On the Efficiency of Random Permutation for Coordinate Descent and ADMM. August 29, 2018.
3. S. Liang, **R. Sun**, Y. Li, and R. Srikant. Understanding the Loss Surface of Neural Networks for Binary Classification. arXiv:1803.00909 [cs.LG] March 5, 2018.

DEBORAH THURSTON

1. W. Crossley, S. Luan, J. Allison, and **D. Thurston**, "Optimization Problem Framework with Application to Engineering Systems," Systems Engineering, 20(6), 2017, pp. 512–528.

PINGFENG WANG

1. N. Yodo, **P. Wang**, and M. Rafi, "Enabling Resilience of Complex Engineered Systems Using Control Theory," IEEE Transactions on Reliability. DOI: 10.1109/TR.2017.2746754, 2017.
2. N. Yodo, **P. Wang**, and Z. Zhou, "Predictive Resilience Analysis of Complex Systems Using Dynamic Bayesian Networks," IEEE Transactions on Reliability, 66(3), 2017, pp. 761–770.

QIONG WANG

1. X. Chen, X. Gao, Z. Hu, and **Q. Wang**, "Population Monotonicity in Newsvendor Games," to appear, Management Science.
2. A. Stolyar and **Q. Wang**, "Exploiting Random Lead Times for Significant Inventory Cost Savings," submitted to Management Science.
3. D. Mitra and **Q. Wang**, "Management of Intellectual Asset Production in Industrial Laboratories," submitted to EJOR.

Grants

JAMES ALLISON

1. NSF SYS, 2015–2018, $120,423, Toward a Method for Achieving Synergy between Heuristic Rules of Thumb and Quantitative Methods in Engineering Design
2. B Koe, 2017, $20,000, Assessing the Potential for Capturing Low Potential Wind Energy
3. NSF, 2017–2022, $500,000, CAREER: Integrated Design of Intelligent Structures with Tailored Distributed Damping
4. NASA SBIR Phase 1, with CU Aerospace, 2017, $39,000, Strain Actuated Solar Arrays
5. NSF POETS, 2017–2018, $65,000, Multi-physics Design Optimization Methods for FCML 3D Packaging
6. NSF POETS, 2017–2018, $78,460, Integrated System Optimization Methods for Electro-Thermal Power Systems
7. NSF POETS (IAB Award), 2018, $52,991, EMI Mitigation for Dense DC-AC Converters via Structured Topological Design Exploration
8. AFRL (via NSF POETS Directed Funds), 2018, $50,000, Initial Conceptual-Level Study of Aircraft Power and Thermal System Architecture Generation and Evaluation

KARTHIK CHANDRASEKARAN

1. NSF: AF: Small, 2017, $250,000, Matrix Signings and Algorithms for Expanders and Combinatorial Nullstellensatz, joint with Prof. Kolla. (See p. 11.)

XIN CHEN

1. ZJU-UIUC Institute Research Program, 2018–2019, $75,000, Data-drive Perishable Inventory Management
2. Didichuxing (gift fund), 2018–2018, $14,731, Dynamic Pricing in Carpooling
3. JD.com (gift fund), 2018–2019, $70,000, Omni-channel Inventory Management

JUGAL GARG

1. NSF, 2018–2020, $175,000, Strongly Polynomial Algorithms for Market Equilibria with Applications to Network Flows and Nash Social Welfare

NIAO HE

1. NSF, 2018–2020, $175,000, Fundamental Limits of Conditional Stochastic Optimization
2. CRRC, 2017–2018, $150,000, Research on Key Technology of Rail Transit-Based Wireless Sensor Intelligence Data.

THENKURUSSI KESAVADAS

1. Jump ARCHES, UIUC-OSF Award, 2018–2019, $203,850, Mixed Reality Environment for Medical Education Curriculum, Co-PI J. Vozenilek
2. NSF Cyber Physical Systems, 2016–2019, $500,000, CPS: Breakthrough: Towards Resiliency in Cyber-physical Systems for Robot-assisted Surgery Technology to Improve Safety of Robotic Surgery Using STAMP Theory and Simulation, PI R. Iyer, Co-PI T. Kesavadas
3. NSF Smart and Connected Health, 2015–2018, $436,965, Collaborative Research: Cognitive Haptic-based Rehabilitation System for Patient-Centric Home, (Collaborative part for University of Buffalo $325,000, Co-PI E. Esfahani)
4. NSF National Robotic Initiative, 2014–2018, $558,000, Human Cognition Based Control of Industrial Robots
5. Jump ARCHES, 2016–2018, $50,000, Robotic Simulation for Adverse Event Training, PI R. Iyer, Co-PI T. Kesavadas

HARRISON KIM

1. John Deere Grant—Phase VIII, 2017–2018, $180,000, Sustainable Product Design—Phase VIII

NEGAR KIYAVASH

1. NSF, 2017–2021, $368,280, CIF: Medium: Collaborative Research: Maximal Leakage and Active Receivers for Side and Covert Channel Analysis
2. ONR, 2016–2020, $319,835, A Comprehensive Approach to Inferring Functional and Statistical Dependencies
3. NSF, 2016–2020, $250,000, CIF: Small: Collaborative Research: Analytics on Edge-labeled Hypergraphs: Limits to De-anonymization, Lead PI Mittal
4. ARO, 2015–2020, $1,225,777, MURI: Adaptive Exploitation of Non-Commutative Multimodal Information Structure
5. ARO, 2015–2018, $360,000, Casual Inference in Complex Networks
6. NSF, 2017–2021, $250,000, SATC: Core: Small: An Exploration of Schedule-Based Vulnerabilities in Real-time Embedded Systems, Lead PI Modan

LAVANYA MARLA

1. Department of Homeland Security, $96,562, Grant extension (Phase 2) from the US Department of Homeland Security, administered through the Critical Infrastructure Resilience Institute, PI G. Weaver, Co-PI L. Marla
2. Department of Homeland Security, administered through the Critical Infrastructure Resilience Institute, 2017, $78,402, PI G. Weaver Co-PI L. Marla

RAKESH NAGI

1. "Sandia—Applied Research Institute Alliance," Sandia National Labs, $121,766, PI J. Yedetore, co-PI H. Filippini and **R. Nagi**, (April 2017–August 2017).
2. "Adaptive Decentralized Resource Optimization," Office of Naval Research (ONR) 14-010, $673,102, PI A. Nedich, co-PI A. Olshevsky and **R. Nagi**, (Feb 2016–Jan 2019).

SEWOONG OH

1. NVIDIA, 2017, NVIDIA Quadro 5000 GPU, NVIDIA GPU GRANT
2. NSF, 2017–2020, $292,280, CIF: Medium: Anonymous Broadcasting over Networks: Fundamental Limits and Algorithms, Lead PI P. Viswanath

JUSTIN SIRIGNANO

1. Blue Waters, 2017, Educational allocation, 50,000 hours, Deep Learning Course
2. Blue Waters, 2018, Educational allocation, 25,000 hours, Deep Learning Course
3. Microsoft computational grant, 2018, $10,000, Deep Learning Course

RAMAVARAPU S. SREENIVAS

1. Sandia National Labs, 2018, $85,093, Towards a Science of Actionable Intelligence
2. DARPA, 2018–2019, $50,092, A Demonstration Platform for Dynamic Mission Planning with Multi-Domain Autonomous Systems, Lead PI H. Trong
3. Jump ARCHES, 2018–2019, $34,250, Natural Language Powered Platform for Post-Operative Care for Long Distance Caregiving

RICHARD SOWERS

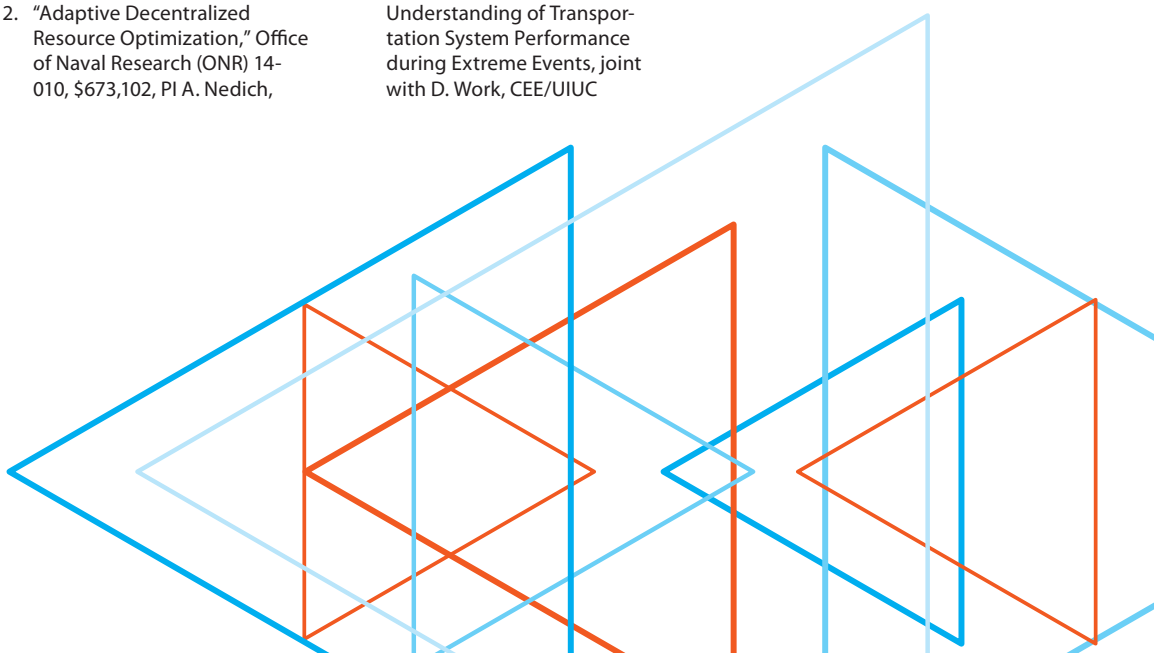
1. NSF IIP, 2017–2018, $50,000, 1748498: I-Corps: Data Analytics for Hand-Picked Agriculture
2. NSF CMMI, 2017–2020, $500,000, 1727785 Signatures and Barcodes: Data-driven Understanding of Transportation System Performance during Extreme Events, joint with D. Work, CEE/UIUC
3. Siebel Energy Institute (Seed Grant), 2017, $50,000, Quantifying the Predictability of City-scale Urban Traffic, joint with D. Work

DEBORAH THURSTON

1. DOE as part of Manufacturing USA Initiative, 2017–2022, $1,035,886, Reducing Embodied-energy and Decreasing Emissions (REMADE) Institute, Lead PI N. Nasr

PINGFENG WANG

1. National Science Foundation, $244,590, CMMI-1813111: CAREER: Designing Engineered Systems for Resilience and Sustainability by Considering Post-design Retrofits
2. National Science Foundation, $221,339, CMMI-1802489: Using Operational Performance Data to update Design Models for the Design of Failure-Resilient Engineered Systems



THE FUTURE

BELONGS TO INDUSTRIAL & SYSTEMS ENGINEERS

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