



Since parents can't always be present in the vehicle with their teen, Roberts suggests parents take advantage of insurance programs such as Progressive Snapshot or the American Family Teen Safe Driver program. Snapshot is a device that plugs into the vehicle to record the frequency of teen driving, the speed of the vehicle, and other driving information that can be sent directly to the teenager or parent. The Teen Safe Driver program uses cameras installed in the vehicle to capture the teen's driving behavior.

While both methods have shown success, Roberts says that some teen drivers have resented these technologies because they imply the parent does not trust the teen. She says alternatives to these programs are smartphone applications, like the ReFuel

Me app, that can still capture similar information to the Snapshot device but also rewards the teen's safe driving

## Empowering parents to make teen drivers safer

**W**hen teenagers begin driving, parents must balance trust for these young drivers against concerns for their safety. Parents have cause for concern: According to the Centers for Disease Control, motor vehicle crashes are the leading cause of death for U.S. teens age 16 to 19, and teens are three times more likely than drivers age 20 and older to be in a fatal crash.

Shannon Roberts, a recent ISyE PhD graduate, is hoping to change those statistics. She says that one of the reasons teenagers are involved in so many accidents is their reliance on technology. For example, teens are more likely to talk on a cell phone or text while driving than other age groups. "In the case of teenagers, the technology makes it seem as though using some features, such as MP3 connectivity technology, is compatible with driving," Roberts says. "Because teenagers don't have experience driving and don't know how to balance driving and technology, it's just hazardous."

In her research surveying student drivers' driving tendencies, she raises awareness of the consequences of driving behavior, giving feedback on peer driving behavior and encouraging positive changes.



**Roberts**

by offering gift cards.

As a result of her research, Roberts was one of 13 experts chosen by WalletHub to identify the best and worst states for teen drivers. The experts ranked teen driving conditions based on the state's safety conditions, economic environment and driving laws that affect driving conditions in each particular state. Wisconsin was rated 28<sup>th</sup> overall due to a low rank in safety conditions, which ranked the quality of Wisconsin roads, teen driver fatalities per licensed driver, vehicle miles traveled per capita, and so on.



## Math makes power grids more efficient

**A**s technology has allowed for greater efficiency in public infrastructure, some sectors, like electricity transmission systems, have been slow to keep up. Part of the problem, says Professor Jeffrey Linderth, boils down to math. And as part of a U.S. Department of Energy initiative, Linderth and Associate Professor Jim Luedtke are developing mathematical tools that can help power grid operators increase efficiency and reliability.

Both Linderth and Luedtke have experience optimizing networks, including computer networks and logistical networks such as supply chains, but Linderth says that electricity's physical properties present a special mathematical problem. "Mother Nature decides how the power flows," he says. "It's very different from other network problems we've worked on in the past, where we can dictate, for example, how trucks move from point A to point B." *(Continued inside)*

## CHAIR'S MESSAGE

**Vicki M. Bier, Chair**

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The Department of Industrial and Systems Engineering at UW-Madison is one of the best in the country—consistently ranked in the top 10 for both undergraduate and graduate programs. It's no wonder our undergraduate enrollment has increased by more than 50 percent. It's great to have so much interest in our department!

This is an exciting year for us in ISyE. Not only do we have record enrollment, we're adding faculty as well. We're thrilled to welcome Alberto Del Pia, who has a doctorate in applied math from Italy. He comes to us from a prestigious IBM Fellowship, and will work with the optimization group in the Wisconsin Institute for Discovery. We're also looking forward to an additional faculty hire this year to enhance the department's strong reputation in health-systems engineering.

The department is well positioned to maintain its reputation of excellence. We continue to attract undergraduate and graduate students who achieve remarkable things, in both academics and industry. We're committed to continuing this trend, even in challenging times. Therefore, we are investing in creative ways to accommodate more students, while still providing an outstanding education. Offering educational opportunities such as our colloquium series, where students can learn from some of the best researchers from around the country, is a cornerstone of our program. We are also investing in improving instructional facilities and equipment, and fellowship funding to help us recruit and retain the best graduate students into our research program.

When I talk to many of our graduates, one common theme is how much they appreciate their time in the department, and its impact on their careers. I hope you share that appreciation as well. I'd like to encourage you to make the department one of your top philanthropic priorities this year and in the future, so that students will continue to benefit from the same kinds of challenging, hands-on experiences you enjoyed.

*Vicki Bier*

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**team of UW-Madison engineers is creating new, more robust decision-support software that could help prevent a frequent, potentially fatal blood-clotting condition in hospitalized patients.**

The work, done within the Center for Quality and Productivity Improvement and in collaboration with Geisinger Health System and UW Hospital, is part of a five-year, \$2.5 million grant from the Agency for Healthcare Research and Quality to help prevent and manage venous thromboembolism (VTE). VTE occurs when a blood clot in a vein breaks free and travels in the blood, sometimes making its way to the lungs.

If it is not noticed and treated early, VTE becomes difficult to detect and potentially fatal. "When the blood clot travels to the upper body, it might not show in the leg anymore," says Procter & Gamble Bascom Professor in Total Quality Pascale Carayon. "Then patients may complain about chest pain or difficulty breathing—symptoms similar to having pneumonia or a heart attack. Except you don't die right away from pneumonia. If you have a big pulmonary embolism, you can die. There's not much that they can do."

Each year, more than 900,000 cases of VTE occur in the United States, and approximately 60 percent of those people develop VTE either during their hospitalization or within 30 days of discharge. Bedridden and hospitalized patients are at increased risk for VTE because decreased blood flow due to prolonged immobilization can promote clotting.

To prevent VTE, hospitals typically prescribe blood thinners or place compression devices on the patient's legs to stimulate the blood flow.

However, if a patient needs certain types of surgery or has a leg injury, these preventative measures aren't always an option.

Existing VTE software does not take into consideration diagnosing or treating the condition once it develops. In fact, state-of-the-art VTE clinical decision support software only covers the patient's initial admission into the hospital, and isn't dynamic enough to handle changes that may occur during the hospitalization, says Carayon.

"For all patients who get hospitalized, something needs to be done to prevent VTE because we know it happens often," she says. "And that evaluation needs to occur at multiple stages of the hospital stay and during care transitions."

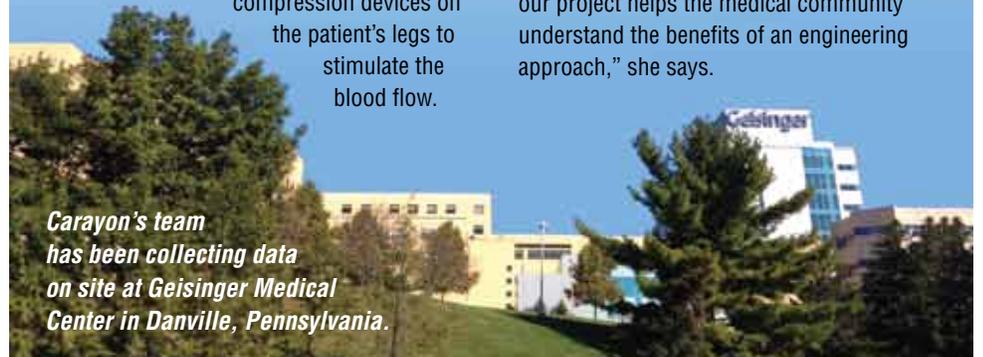
Decisions about how best to prevent, diagnose or treat VTE also vary across hospital units, and even across patients. "A trauma surgery is an emergency and there are a lot of things the trauma surgeon doesn't know about you," Carayon says. "The clinical decision support solution for that surgeon would be different than for scheduled elective surgeries."

Because of the diversity of prevention, diagnostic, and treatment options for VTE, Carayon says clinical decision support software should be tailored to particular applications. "The main goal of our study is to really understand the whole decision-making process for different types of physicians in different contexts," she says. "How can we better design the tools to really support that decision making process? That's what we're interested in."

Carayon, who recently was named to the Institute of Medicine committee on diagnostic errors in healthcare, wants to bridge medicine and engineering. "I hope our project helps the medical community understand the benefits of an engineering approach," she says.

**Researchers aim to help hospitalized patients avoid fatal blood clots**

*Carayon's team has been collecting data on site at Geisinger Medical Center in Danville, Pennsylvania.*



## ISyE alum honored at **ENGINEERS' DAY 2014**

**E**dward Kopetsky (BSIE '78, MSIE '81) received a Distinguished Achievement Award during the 2014 ENGINEERS' DAY celebration on Oct. 24 on the UW-Madison campus.

Interest in improving how things work attracted Ed Kopetsky to industrial engineering, and project work under Professor David Gustafson led to his devotion to the healthcare industry. "I saw the opportunity to contribute to improving patient care and healthcare operations. Work outside of the classroom taught me critical leadership and people skills," he says.

Kopetsky, who is the chief information officer for Stanford Children's Health and Lucile Packard Children's Hospital at Stanford, earned both his bachelor's and master's degrees in industrial engineering from UW-Madison.

In the early 1990s, he implemented one of the first integrated patient care systems supporting a multi-hospital and physician network at Sharp



*Kopetsky*

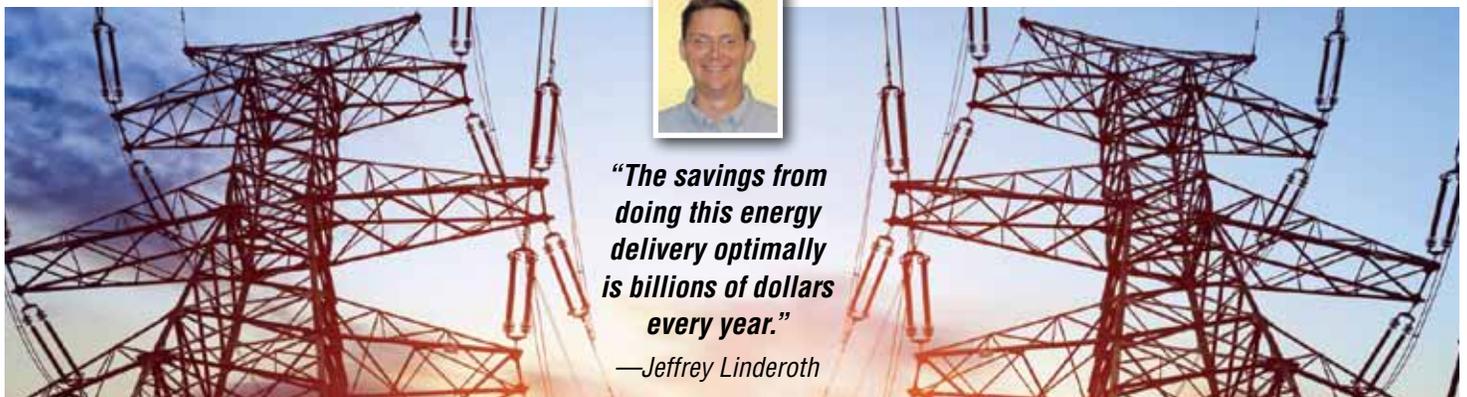
Healthcare. The system enabled storage and access to patient records regardless of location, allowing Sharp to improve patient access and the right level of care, while reducing costs of unnecessary procedures. His focus on change through leadership in information technology and process improvement helped multiple healthcare businesses grow and develop. In 1996, Kopetsky became CIO at the formation of Centura Health, the largest healthcare system in Colorado. There, he merged four information technology organizations to support Centura's large, multi-entirety healthcare system.

At Healthlink, he led development of the company's healthcare consulting business in the western United States, and later led all sales

across the country. Under his leadership, Healthlink's annual revenue grew from \$10 million to \$100 million in five years.

Kopetsky recently completed a three-year implementation of state-of-the-art enterprise systems supporting integrated patient care, high-performance business and analytics systems, and connected patient and consumer systems at Stanford Children's Health and Lucile Packard Children's Hospital. His focus now has shifted to innovation and supporting a \$1 billion hospital expansion.

He was a founding member and board chair of the College of Healthcare Information Management Executives. He is a current healthcare advisory board member for Dell and Hewlett Packard, and chairs the UW-Madison ISyE advisory board. In 2013, InformationWeek recognized him as one of the top-20 CIOs driving change in the U.S. healthcare system—a result of decades of healthcare technology and process innovation.



### **Power grids** (Continued from front page)

The physical laws governing power flow result in a seemingly contradictory notion that adding power lines may result in *reduced* efficiency in the power grid. A team of researchers, including Computer Sciences Professor Michael Ferris, demonstrated how this effect could be advantageous using a technique called transmission switching. In transmission switching, certain transmission lines are turned off or on in response to the grid's overall demand. By turning lines off in an "optimal" fashion, thus altering the power flow over the grid, Ferris' team concluded that savings of up to 25 percent in electricity costs could be achieved.

Historically, a problem with implementing transmission switching is that finding the right lines to turn off has been too computationally demanding. In real power grids, there are astronomically many possible combinations of lines that may be switched off, and each possibility affects the overall efficiency in a complicated manner. Current algorithms are not up to the challenge, so Linderth and Luedtke are developing new mathematical tools that will help solve this switching optimization problem. Operational efficiencies like these will translate into big savings for utilities and their customers. "The savings from doing this energy delivery optimally is billions of dollars every year," says Linderth.

But economics is not the only benefit that may come from improved optimization algorithms for operating power systems. Luedtke says some of the same methodology developed to optimize transmission switching can also be used to stabilize or recover power grids when portions of the grid go down due to storms or other disasters, or to quickly and effectively handle weather events that affect the operations of the power grid. "You'll have the same structure of switching transmission lines on and off," he says. "The electric current has the same physics, so the same underlying math structure still applies."

Another challenge facing power grid operators is the expanding use of renewable energy. The amount

of electricity flowing through power grids is affected by renewable energy sources both daily, as energy generation is affected by weather patterns, and over time, as wider adoption of renewable energy sources will influence the volume of power available. Because the output from renewable energy sources like wind and solar power cannot be perfectly predicted, its use adds uncertainty to planning for future transmission systems and will affect the placement of power lines and the construction of power plants. However, most tools currently in use in power systems planning ignore this uncertainty, potentially leading to inefficient or unreliable plans.

"I think if you ask power system operators why they aren't planning with respect to uncertainty," says Linderth, "they'll say that the mathematical tools aren't good enough to solve the planning problems right now. Creating those tools is one goal of this project."

(Continued on back page)

## Power grids *(Continued from previous page)*

To mathematically account for uncertainties in power grid systems, Linderoth and Luedtke are using a technique called chance constraints. “There is always some chance that things might fail,” says Luedtke. “But you can limit that chance and, given that limit, you try to operate as efficiently as you can.” These problems have been notoriously difficult to handle with current mathematical techniques, but Linderoth and Luedtke hope to change that. Luedtke says that the ultimate goal of this project is to allow utilities to deliver energy more efficiently and reliably because of the math tools they are creating.

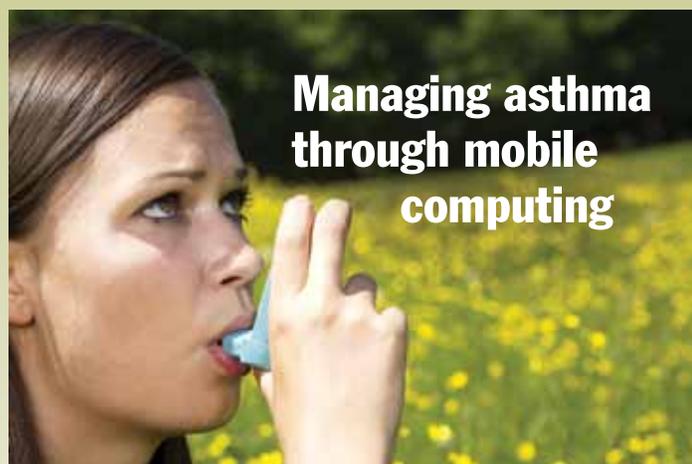
The Department of Energy applied mathematics division, as part of the Multifaceted Mathematics Approach for Complex systems (M2ACS) initiative, funds Linderoth and Luedtke’s research. That initiative has a total of 17 principal investigators and co-principal investigators, working in conjunction with Argonne National Laboratory, Pacific Northwest National Lab, and with UW-Madison electrical and computer engineering faculty Chris DeMarco and Bernard Lesieutre, as well as computer sciences faculty Michael Ferris and Stephen Wright.



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## Managing asthma through mobile computing

Asthma patients must constantly carry their inhalers, and this created an opportunity to fit inhalers with sensors that track the time and place an asthma patient uses it. From all of that data, the university research team hopes to establish a series of statistical modeling, monitoring, prognosis, and clinical intervention decision-making methodologies tailored for SAM systems. “Based on all this information, we try to build models to answer questions about the patient’s condition,” he says. “We can also track trends in inhaler usage to see how well their symptoms are managed.”



**Zhou**



**Brennan**

The goal, says Zhou, is to help doctors better understand their patients’ inhaler usage. “If a patient uses the inhaler in the late night, for example, that means the patient has their sleep disturbed by asthma,” he says, “and their condition is much more severe.” The smartphone technology can also be used help asthma patients avoid places or situations where they may be at higher risk.

Ultimately, Zhou says clinicians will be able to individualize asthma management based on usage trends. “From this information, we will build up an advanced statistical model to do predictions. Eventually we want the model to make diagnosis and prognosis for each patient individually,” he says.

Zhou believes individualized healthcare using smartphone apps is the future of medicine. “In the future, I believe a wearable device will have a lot of sensing information, and this information will be used by your doctor to provide a treatment plan,” he says. “It’s coming.”

The National Science Foundation is funding Zhou and Brennan’s research with a three-year, \$475,000 grant.

**T**here is no cure for the more than 22.2 million people in the United States who suffer from mild to severe asthma. To manage their symptoms, they often need to deliver medication directly to the lungs by an inhaler.

Even then, however, controlling asthma is a difficult endeavor—and Professor Shiyu Zhou and Moehlman Bascom Professor Patricia Flatley Brennan aim to use mobile computing technology to develop a smart asthma management (SAM) system.

The research efforts are in collaboration with Propeller Health, a leading company on mobile platform for respiratory health management, and a team led by Professor Christine Sorkness of the UW-Madison School of Pharmacy and Wisconsin School of Medicine and Public Health.