

A collage of images representing various fields of engineering and technology. The collage includes: a large yellow 'M' logo with 'EECS' and 'A YEAR IN REVIEW' text; a close-up of a small electronic component on a surface; three students working on a project; a molecular structure with glowing spheres; a hand holding several small, clear, spherical objects; a green padlock icon on a circuit board; a hand pointing at a robotic arm; a person wearing a green visor and working on a circuit board; a white robotic arm on a grassy field; a green and white autonomous vehicle; a person wearing a VR headset; a close-up of a microchip; a person interacting with a large, glowing, blue, spherical structure; a close-up of a purple, textured, cylindrical object; a close-up of a microchip; a close-up of a glowing, blue, spherical structure; and a person riding a motorcycle with a large, glowing, blue, spherical structure.

UNIVERSITY OF MICHIGAN



Mcity, where autonomous cars are tested, at sunrise. Read about May Mobility, an autonomous vehicle startup, on page 35.



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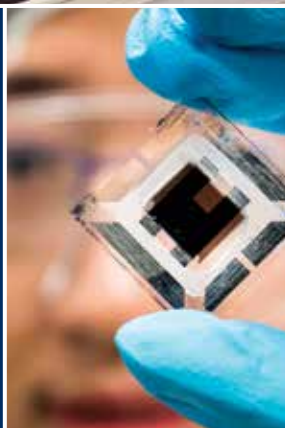
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MESSAGE

FROM THE

CHAIRS



Mingyan Liu, Chair
Electrical and Computer
Engineering



Brian Noble, Chair
Computer Science
and Engineering

Dear Friends,

Change is in the air!

In the space of two years, our department has welcomed new leadership for both divisions. Brian Noble has completed his first year as Chair of Computer Science and Engineering, and Mingyan Liu has assumed the mantle as the Peter and Evelyn Fuss Chair of Electrical and Computer Engineering, effective September 1, 2018. Liu succeeds Khalil Najafi, who became the department's first ECE Chair in 2008.

Since 2008, the department has been led by co-chairs of each division, rather than a single chair. At Michigan, we feel that this gives us the best of both worlds: independence to set our own priorities, and the foundation of a large leading EECS department.

We hope that this joint publication gives you an insight into just how broad our interests have become.

EECS has several new major research initiatives taking on the next era of computing, including the \$32M Applications Driving Architectures Center, which aims to develop a modular hardware and software infrastructure that will democratize development, and over \$16.7M spread over several projects working to push the development of microprocessors beyond the limits of Moore's Law.

Continued breakthroughs have been made just over the past year in the efficiency of solar cells, making them more competitive in the marketplace. Our robots are walking, climbing, flying, and riding Segways. Security researchers continue to look for solutions that will secure our transportation, energy, and electoral infrastructure.

And ideas so transformative they are being funded under a College of Engineering Blue Sky Initiative give the promise of clean hydrogen fuel and accessible clean water.

This year, we highlighted the faculty who are currently, or have recently been, the key organizers of professional conferences, symposiums, and workshops. We appreciate the leadership, spirit of service, and appreciation for collaboration that it takes to commit to such a time-intensive activity. And we're particularly delighted to see that seven of these events brought our colleagues to Ann Arbor.

Check out some of the new courses and programs we're offering to students, including a drone class for freshman, a data science class open to the entire University, and a multidisciplinary master's program in data science.

We hope you appreciate the effort all of our students spend on their studies, as well as the extra effort that many expend on interdisciplinary teams and groups. These students lend their valuable skills, energy, and enthusiasm to team competitions, service work around the world, and solving public problems.

We wish we could include the full-length stories of our research, student activities, and alumni spotlights. They can all be found on our website if you'd like to learn more.

And finally – to our faithful alumni and friends who support all of our many activities, from research to student trips abroad, thank you! We appreciate your support more than we can say.

RESEARCH BRIEFS

REIMAGINING HOW COMPUTERS ARE DESIGNED

University of Michigan Leads \$32M Center



*Prof. Valeria Bertacco,
Director of the ADA Center.*

As the computing industry struggles to maintain its historically rapid pace of innovation, a new, \$32M center based at the University of Michigan aims to streamline and democratize the design and manufacture of next-generation computing systems.

The Center for Applications Driving Architectures, or ADA, will develop a transformative, “plug-and-play” ecosystem to encourage a flood of fresh ideas in computing frontiers such as autonomous control, robotics, and machine-learning.

Today, analysts worry that the industry is stagnating, caught between physical limits to the size of silicon transistors and the skyrocketing costs and complexity of system design.

“The electronic industry is facing many challenges going forward, and we stand a much better chance of solving these problems if we can make hardware design more accessible to a large pool of talent,” said Prof. Valeria Bertacco, director of the ADA Center.

The center is a five-year project that is led by U-M and includes researchers from a total of seven universities, including Cornell, Harvard, MIT, Stanford, Princeton, the University of Illinois at Urbana-Champaign, and the University of Washington. It is funded by a consortium that is led by the Semiconductor Research Corporation and includes the Defense Advanced Research Projects Agency.

ADA aims to democratize the development and deployment of advanced computing systems by developing a modular approach to system hardware and software design, where applications’ internal algorithms are mapped to highly efficient and reusable accelerated hardware components. This faster and more effective approach will require that the entire design framework – from system software, to architecture, to design tools – be reimagined and rebuilt.

Five years from now, I'd like to see freshly minted college grads doing hardware startups.

— Valeria Bertacco

“You shouldn’t need a PhD to design new computing systems,” Bertacco said. “Five years from now, I’d like to see freshly minted college grads doing hardware startups.”

Researchers are looking for creative approaches to extend the utility of traditional silicon beyond the Moore’s Law era, a long-standing but waning trend in which chips become cheaper to manufacture, and more powerful, each year.

ADA researchers see customized silicon for specific applications – like chips

optimized for image search or data analytics – as a promising approach. But the biggest industrial customized silicon successes to date, such as smartphone systems-on-a-chip or graphics processing units, have required the immense resources of large, deeply integrated, vertical design teams. ADA’s goal is to change that. The center is organized into three themes:

Agile system development, which will identify patterns in the core algorithms of emerging applications and map those algorithms to new, tailored computational blocks.

Algorithms-driven architectures, which will develop reusable, highly efficient algorithmic hardware accelerators for the computational blocks.

Technology-driven systems, which will include the development of an open-source chip scaffold for these new, accelerator-centric systems. The scaffolds would include all the necessary support subsystems – such as general-purpose cores, on-chip communication fabric, and memories – to facilitate a “plug-and-play” flow so that a designer will no longer need to send a design to a fab and wait for a chip to come back.



Designing the Unhackable Computer

By turning computer circuits into unsolvable puzzles, a University of Michigan team aims to create an unhackable computer with a \$3.6M grant from the Defense Advanced Research Projects Agency.

Prof. Todd Austin leads the project, called Morpheus. Its cyber-security approach is dramatically different from today's, which relies on software – specifically software patches to vulnerabilities that have already been identified. That's been called the “patch and pray” model, and it's not ideal.

Morpheus outlines a new way to design hardware so that information is rapidly and randomly moved and destroyed. By doing so, the technology works to divert the attacker from the critical information they need to construct a successful attack.

In this way, Morpheus could protect against future threats that have yet to be identified.

“What's incredibly exciting about the project is that it will fix tomorrow's vulnerabilities,” Austin said. “I've never known any security system that could be future-proof.”

Austin said his approach could have protected against the Heartbleed bug discovered in 2014. Heartbleed allowed

attackers to read the passwords and other critical information on machines.

More than 40% of the “software doors” that hackers have available to them today would be closed if researchers could eliminate seven classes of hardware weaknesses, DARPA says. The hardware weakness classes have been identified by a

crowd-source listing of security vulnerabilities called the Common Weakness Enumeration. The classes are: permissions and privileges, buffer errors, resource management, information leakage, numeric errors, cryptographic errors, and code injection.

DARPA is aiming to render these attacks impossible within five years. If developed, Morpheus could meet this requirement, Austin said.

While the complexity required might sound expensive, Austin says he's confident his team can make it possible at low cost.

Also on the project team are Thurnau Prof. Valeria Bertacco, Prof. Mohit Tiwari from the University of Texas at Austin, and Prof. Sharad Malik from Princeton University.



Under the Morpheus approach, information is rapidly and randomly moved, creating a puzzle to thwart attackers.

Separating the Good from the Bad in Circuits Driven by Noise

Circuits that can rapidly sense and process streams of data that may include some uncertainty or change are extremely important in the development of learning machines, such as artificial vision systems and neural networks. Stochastic computing (SC) is “computing with probabilities” encoded in bit-streams, and it was designed for this type of application.

Because they represent numerical values by streams of noise, stochastic circuits offer an entirely different perspective on computer arithmetic. They replace bulky multiplication and addition modules in conventional chips with single logic gates. As a result, they can offer ultra-low power usage and small size, coupled with high error tolerance.



CSE graduate student Paishun Ting and Prof. John Hayes.

However, due to its randomness features, SC's accuracy is often low and hard to control, severely limiting its practical applications. In a new paper, Claude E. Shannon Professor of Engineering Science John Hayes and CSE graduate student Paishun Ting have addressed an important issue that arises when you compute with noise and some of the noise may be unwanted. The team can now separate “good” noise from “bad” noise.

They have proposed an algorithm called Constant Elimination Algorithm for Suppression of Errors (CEASE) to eliminate unwanted noise by introducing memory into target circuits. Their analytical and experimental results demonstrate that CEASE works optimally to eliminate unwanted noise.

Hayes and Ting received the Best Paper Award at the 30th IEEE Symposium on Defect and Fault Tolerance for this paper, entitled “Eliminating a Hidden Error Source in Stochastic Circuits.”

Designing a Flexible Future for Massive Data Centers

The days of bulky, expensive servers filling up data centers may be numbered. Researchers led by Profs. Mosharaf Chowdhury and Barzan Mozafari are spearheading a number of projects in server design which together promise to offer a cheaper and more reliable means of processing the many millions of requests these huge data centers handle every day. Called rack-scale computing, this approach recreates the power of a large server by linking up and pooling the resources of smaller computers with fast networking technology.

The principle goal of rack-scale design is to be able to treat components spread across many different computers as one huge “abstract computer.” As a user, you shouldn’t be able to tell the difference between interacting with a single super-powered server and a “server” comprised of dozens of networked, disaggregated computer parts collectively working on your task.

“Right now every server has a CPU, memory, and a disk – we are trying to disaggregate these from each other,” Chowdhury explains. “Then you aggregate all the memory together and all the disks together – making it look like all of the memory is a single pool, even when physically it is separated.”

While the user shouldn’t have to know the difference, the data centers providing these services can get more flexibility and better performance for significantly less cost when they go the rack-scale route. Rather than adding or replacing an expensive server, data centers are free to independently upgrade computation, network, and storage systems as needed. At a time when the demand for computing power and data storage capacity is growing by as much as 30-40% per year, this flexibility can be vital.



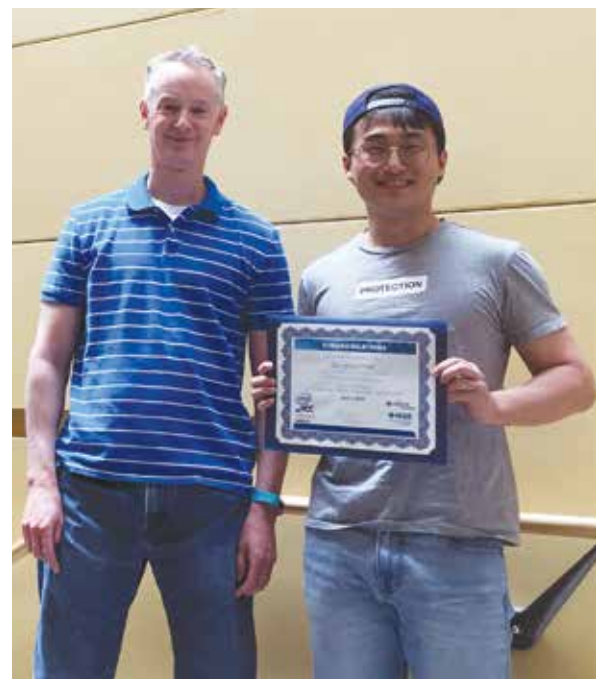
Data centers such as this one may look different in the future, with pools of smaller, cheaper computers replacing specialized server hardware.

Using Prediction to Stop System Failures

As transistor densities continue to scale, computer systems are becoming less reliable because of their increased susceptibility to temporary or transient faults, some of which can lead to application or system failures. Mission-critical systems, such as aviation and automotive components, use redundant hardware to detect and correct faults. But redundant systems are generally cost- or otherwise prohibitive for consumer electronics such as smartphones.

Instead of using redundancy to detect faults, Prof. Scott Mahlke and CSE grad students Sunghyun Park and Shikai Li are applying approximate computing techniques to predict the primary outputs of loop-dominated computation. When the actual computation and prediction produce similar values, the computation is likely fault-free. Output prediction exploits the spatial similarities of nearby data common in a variety of applications. Prediction is much cheaper than redundancy, thus even modest prediction accuracies can save large amounts of overhead.

The researchers were recognized for this project with the best paper award at the *14th Workshop on Silicon Errors in Logic – System Effects (SELSE)*. Their paper was entitled, “Low Cost Transient Fault Protection Using Loop Output Prediction.”



Prof. Scott Mahlke and CSE graduate student Sunghyun Park. Not pictured: Shikai Li.

CASSIE BLUE ON MICHIGAN TERRAIN!

Just about a year ago, Cassie Blue, Prof. Jessie Grizzle's latest bipedal robot, arrived at Michigan with some cool new features. She is the first of Grizzle's bots to walk freely without a safety gantry; she was built tougher to withstand trips and falls; and she also has control over two more joints in each leg than her predecessor, MARLO. Cassie Blue is also the first to be able to "see" – with a camera mounted on her torso, and fast image processing incorporated into her extra chip.

And then there's the power. Cassie Blue is twice as strong as MARLO and half as heavy, effectively making the robot four times as powerful.

Just 6 weeks after arrival, Cassie Blue was walking with the help of Michigan control laws. It was stunning to see, knowing that MARLO had required a year's worth of work before its balance and gaits were ready for a public premier.



MARLO knows it has the best shoes (notice her sneakers in the background) but can't help gazing at the beauty of Cassie Blue.



And she's in the lead!

Cassie Blue's Adventures



Cassie Blue gets a closer look at a sculpture in the University of Michigan Art Museum.



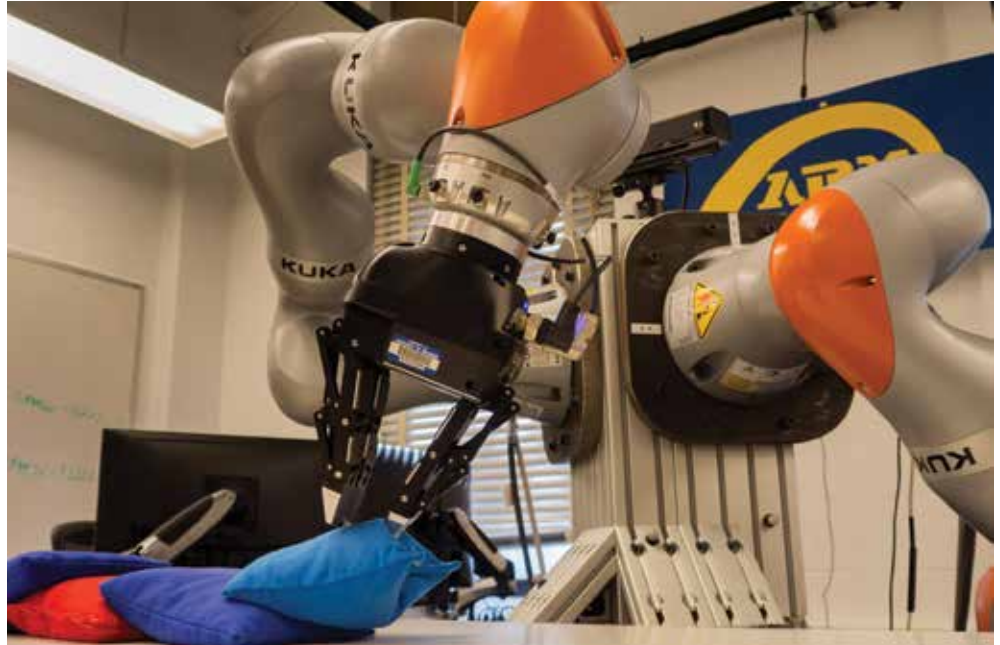
OUCH!

Helping Robots Play Nice with People

Prof. Dmitry Berenson wants robots to help us out – anywhere, any time. In order to do so, he's working with state-of-the-art equipment to design algorithms for robotic manipulation. These algorithms could turn a hunk of metal into a useful household assistant.

Berenson's research focuses on creating algorithms that allow robots to interact with the world and collaborate efficiently with people. He is applying motion planning and manipulation algorithms to robots that work in homes, factories, and operating rooms.

His group, called the Autonomous Robotic Manipulation Lab (ARM Lab), is working on all aspects of algorithm development, including creating efficient algorithms, proving their theoretical properties, validating them on real-world robots and problems, integrating them with sensing and higher-level reasoning, and distributing them to open-source communities.



Inside the ARM Lab, massive KUKA robotic arms select and delicately transfer the correct beanbag from a pile of random objects.

One key project involves the manipulation of deformable objects, meaning objects that can easily change their shape. Robots have a hard time handling soft objects such as cables, clothing, cooking ingredients, or even muscle tissue.

Berenson envisions a world where autonomous robots are able to better assist with repetitive tasks that involve deformable objects in locations such as factories, homes, and hospitals.

In addition, his group is working on locomotion planning, human-robot collaboration on manipulation, and grasping in cluttered environments. Robots will need to master these skills in order to interact safely and reliably in human environments.

BigANT Tackles the Wave Field

Prof. Shai Revzen's lab has developed an inexpensive technique to rapidly fabricate a variety of useful robots, requiring only their modules and two stock materials. One of the lab's modular bots, BigANT, just received a major redesign that lets it walk over grass, up hills, and across uneven surfaces like North Campus' biggest terrain challenge, the Wave Field.

These modular bots can help with a number of tasks that require fast, versatile action. Search and rescue teams can use them to tackle unexpected situations, a robotics start-up company can quickly make new product prototypes, a high-school robotics classroom can teach teams of kids about the principles of robotics, special forces can use them to collect intelligence behind enemy lines, and future astronauts can deploy them on a mission to the moon or Mars. All these tasks require the ability to quickly build robots capable of taking on unexpected obstacles.



BigANT navigates the undulations of the North Campus outdoor artwork known as the Wave Field.



BigANT easily walks up stairs.

Improving Communication Between Humans and Robots



A team of information scientists led by Alfred Hero, John H. Holland Distinguished University Professor, have discovered a better way to facilitate communication between humans and robots, using a twist on the classic game of 20 Questions. The potential applications extend far beyond a fun game, including gathering information from a wide array of individuals to assist in potentially life-saving scenarios.

In the game of 20 Questions, a computer figures out what you're thinking by asking no more than 20 yes or no questions. Normally new questions are asked only after learning the answer to a previous question.

However, Hero's postdoctoral researcher Hye Won Chung had the rather audacious idea of creating algorithms for the 20 Questions technique from a non-adaptive perspective.

How does this work? The robot formulates all 20 questions in advance, taking into account the fact that when you give all

of the answers back, you're going to be more certain of some answers than others.

They came up with their novel approach by resorting to classic Information Theory.

"By combining superposition coding and unequal error protection," explains Hero, "we're able to achieve the same rate, the same fast few numbers of questions needed, as in the adaptive method. But the benefit is, we have a simpler mechanism. We also don't need to compute 20 times; we compute one time."

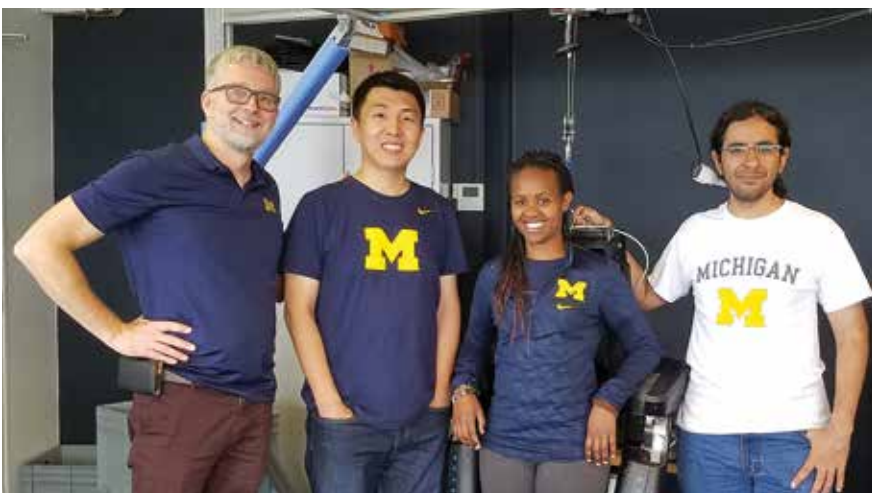
The technique also facilitates information exchange between robots and other computers, or sensor networks. Hero is now extending this method to crowdsourcing, so the robot can draw on the knowledge of thousands of people – bringing it into the realm of big data.

Mobilizing Disabled Patients with Exoskeletons

Prof. Jessie Grizzle has long said that his work in robotics could one day be used to help the disabled. Now he and his group are collaborating with Parisian company Wandercraft to make this a reality with walking exoskeletons.

Exoskeletons are still a relatively new area of research, and many competing products require users to use crutches for stability. This forces the patients to put weight on their arms, making the exoskeleton fatiguing to use and possibly resulting in more health problems. The Wandercraft Exoskeleton assures stability with some of the same mechanisms that keep Grizzle's robots upright – Grizzle's smart algorithms position its legs to ensure balance, and keep it moving at the desired speed and in the desired direction.

So far, Grizzle's team has developed algorithms for the exoskeleton's walking motion, programmed a walking gait that works best for the design, and fitted that software into its control package.



Prof. Jessie Grizzle, Ayonga Hereid, Margaret Eva Mungai wearing a V-3 exoskeleton, and Omar Harib.

The team traveled to Paris to test their algorithms on the real device, and while there, introduced major upgrades to their mathematical methods that could make Wandercraft's exoskeleton safer for users and offer better performance.

This was the group's first chance to apply their models to legged machines that attach to humans.

"Working on this project allows me to tackle the type of difficult problems I'm used to encountering with bipedal walking, while also having a more direct impact on human lives," said doctoral student Omar Harib.

Decoding the World's Most Complex Networks

Networks have always been key drivers of society, and a new \$6.25M project built on game theory and led by Prof. Mingyan Liu will develop tools to understand and shape online and on-the-ground networks that drive human decision making. It will focus on areas such as international diplomacy, street crime, cyber-terrorism, military strategy, financial markets and industrial supply chains.

In this DoD Multidisciplinary University Research Initiative (MURI), Liu's team is taking game theory to a new level using what are called multi-scale network structures.

"In the past, game theory was mostly limited to single-scale networks where interactions are governed by one type of relationship – family affiliation, for example," said Liu. "But in reality, there are many other types of relationships that affect decision making. This leads to a complex and overlapping web of networks."

The project will apply multi-scale network modeling to the rich trove of data unleashed by electronic recordkeeping – social media posts, crime statistics, demographic trends, and countless other sources. The researchers will crunch all this data to develop algorithmic tools that could, for example, illuminate the labyrinthine network behind global securities trading based on just a few scraps of information, help law enforcement stay one step ahead of criminal gangs or help international diplomats reach better decisions.

Collaborating on the project is Michael Wellman, Lynn A. Conway Professor, who believes that the project could provide an important window into the world's very largest networks. These include financial markets, which have grown so complex that even those who run them don't fully understand them.

Down the road, Liu envisions the tools that they develop being used in other areas as well, like business decision making, supply chain management, and even healthcare, where they could help the many different players in the system work together more effectively on behalf of patients.

Also participating in the MURI are the University of Southern California, Vanderbilt University, and the University of California, Los Angeles.

Artificial Intelligence for Data Science

Researchers, hospitals, companies, consumers, and government agencies are drowning in data that they can't fully exploit. Now, Prof. Jason Corso is leading a \$1.6M DARPA project to help develop a toolkit that even non-data-scientists can use to get answers from their own data.

"This is a visionary idea to help create a system that is intelligent about how it selects which algorithms to apply to a specific data set," said Prof. Laura Balzano, an investigator on the project.

The Michigan project is called SPIDER: Subspace Primitives that are Interpretable and DIVERse. It is part of DARPA's overarching project known as Data-Driven Discovery of Models.

Growing out of Corso and Balzano's expertise in image processing and computer vision, the team is developing new techniques to extract meaning from different types of data sets. For example, Corso has developed a technique that identifies what's happening in a video and provides a written summary. The team has also developed algorithms that analyze YouTube videos of car crashes to create a data set that could one day train autonomous vehicles to plan evasive maneuvers for crash prevention.

The techniques that all of the DARPA-sponsored teams develop will go into a central repository that is open to all researchers. A software system will try out the algorithms to see which work best on a given problem, and machine learning techniques will be used to assemble them into models that can propose solutions, such as whether two faces are the same or not. Finally, humans will be called in to interact with these assembling systems to provide insights about the information.

"The insights of the human expert in the loop are invaluable," said Corso. "Humans have a great way of building bridges automatically."



Building a Security Standard for a Post-Quantum Future



Prof. Chris Peikert

The world stands to gain immeasurable computing power from fully-realized quantum computers. These machines would render many classically hard problems efficient to solve, surpassing the power of decades of algorithm development for classical computers.

But with the new capabilities come some unfortunate drawbacks: some of the problems quantum computers are

the most effective at solving are the ones that keep our digital communications secure.

To prepare for this disastrous hypothetical, cryptographers in a field called “post-quantum cryptography” are attempting to design new algorithms and standards to thwart quantum codebreakers.

Patrick C. Fischer Development Professor in Theoretical Computer Science Chris Peikert has worked on many of the projects that are now at the leading edge of this area. Together with a team of eleven other researchers, he’s submitted a cryptographic scheme as a proposed standard to the NIST Post-Quantum Cryptography project. Called FrodoKEM, this family of encryption algorithms is designed to be a conservative and practical implementation of one of the most-studied approaches in the post-quantum cryptography field.

FrodoKEM is built on a problem called Learning With Errors (LWE), which in turn is built on the problem of correcting errors in a structure called a lattice. Lattices are simple but surprisingly rich geometric structures that represent multidimensional, repeating grids of points. The security of lattice-based crypto schemes rests on how easy it is to get lost in one that has hundreds of dimensions.

Lattice-based encryption works by starting from a random point in a lattice and adding some small “error” to arrive at a new location nearby. It’s exceedingly difficult to find the original lattice point if you’re only given its “noisy” version, requiring a search across hundreds of dimensions. The lattice point acts as the private key and the “noisy” version is the public key.

The core of FrodoKEM is a public-key encryption scheme called FrodoPKE. This scheme implements an efficient LWE-based public-key scheme that was developed in part by Peikert in 2011. This implementation is more compact than prior LWE schemes, with key sizes up to 10 times smaller than prior, similar systems (also developed by Peikert and collaborators) while providing stronger concrete security levels.

One tactic that sets FrodoKEM apart is its use of “algebraically unstructured” lattices, as opposed to algebraic ones that many other proposals rely on for efficiency. This lack of structure comes at some cost in performance, but is still practical for most of today’s applications and offers a hedge against future attacks targeting algebraic lattices.

FrodoKEM offers several advantages over other systems built on LWE and related problems. For one, it’s easy and compact to implement, requiring only about 250 lines of plain C code. Although its public keys and ciphertexts are larger than traditional cryptographic algorithms and some other post-quantum candidates, it’s still small enough to be compatible with other methods for use in hybrid schemes. Additionally, its implementation is resistant to a class of threats called “side-channel attacks” that other post-quantum systems can be difficult to protect against.

Since the trajectory of quantum computing is so unpredictable, and a cryptographic system would ideally have a lifetime of several decades, the FrodoKEM researchers argue that any post-quantum standard should err on the side of security and simplicity over performance and optimization. FrodoKEM was built around this philosophy.

The submission process for this new class of NIST standards will unfold over the coming years; Peikert presented this system at their first *NIST Post-Quantum Cryptography* workshop in April 2018.

A large quantum computer could retroactively decrypt almost all internet communication ever recorded.

Wearables to Boost Security of Voice-based Login

Talking to electronics has become a popular – even essential – way to command them. In this era of the Internet of Things, we place calls, send text messages, check email, get travel directions, control appliances, and even access bank accounts through voice commands.

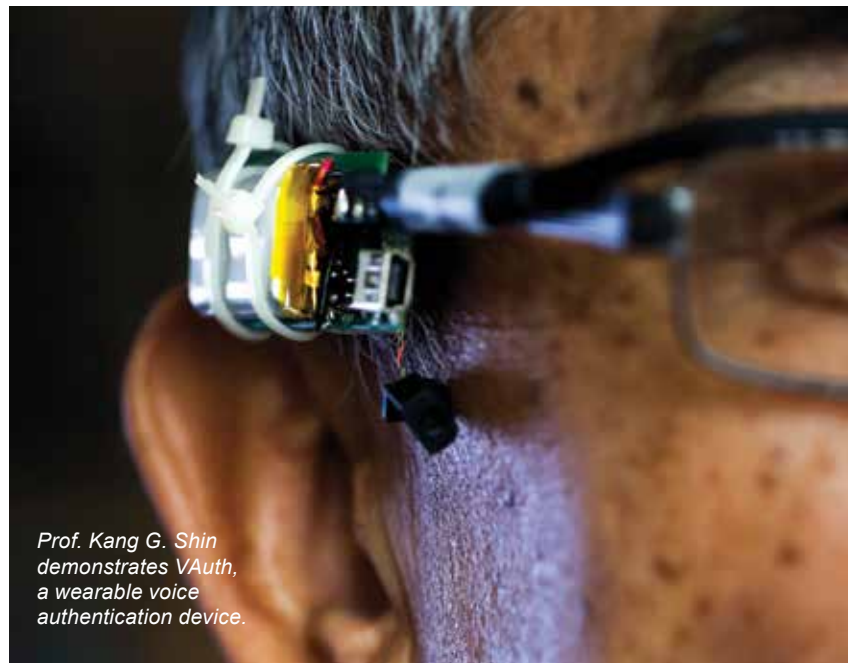
But sound is what researchers call an “open channel” that can be easily spoofed by hackers. Kevin and Nancy O’Connor Professor of Computer Science Kang G. Shin and his co-laborators believe that for voice commanded logins, a second channel should be used to authenticate the owner of the voice for security purposes.

Their solution, called VAuth, is a wearable device that can take the form of a necklace, earbuds, or a small attachment to eyeglasses. VAuth continuously registers speech-induced vibrations on the user’s body and pairs them with the sound of that person’s voice to create a unique and secure two-factor signature.

The process of speaking creates vibrations that can be detected on the skin of a person’s face, throat, or chest. The system works by leveraging the instantaneous consistency between signals from the accelerometer in the wearable security token and the microphone in the electronic device. You can only use voice authentication with your device when you’re wearing the security token.

The team has built a prototype using an off-the-shelf accelerometer, which measures motion, and a Bluetooth transmitter, which sends the vibration signal to the microphone in the user’s device.

In tests, VAuth achieved a 97% detection accuracy and less than 0.1% false positive rate, regardless of its position on the body and the user’s language, accent or even mobility. The researchers say it also successfully thwarts various practical attacks, such as replay attacks, mangled voice attacks, or impersonation attacks.



Prof. Kang G. Shin demonstrates VAuth, a wearable voice authentication device.

Cuba “Sonic Attacks” – a Covert Accident?

Beginning in December 2016, at least two dozen U.S. and Canadian personnel in the nations’ Havana embassies suffered nausea, ear pain, hearing loss, nosebleeds, vertigo, and even trouble walking, according to news reports. Doctors described the injuries as “mild traumatic brain injury” and “a concussion without a concussion.”

At the onset of their illnesses, they reported hearing concentrated, high-pitched chirping noises. While some experts hypothesized sonic attacks, others pointed to poisoning or a virus.

A team of researchers including Prof. Kevin Fu has since theorized that the “sonic attacks” could have been an accidental side effect of attempted eavesdropping.

They have shown how ultrasonic signals – outside the range of human hearing – can combine to produce audible and potentially dangerous tones similar to the undulating, high-pitched chirping that the diplomats described.

“We’ve demonstrated a scenario in which the harm might have been unintentional, a byproduct of a poorly engineered ultrasonic transmitter that was meant to be covert,” Fu said. “A malfunctioning device that was supposed to inaudibly steal information or eavesdrop on conversations with ultrasonic transmission seems more plausible than a sonic weapon. That said, our results do not rule out other potential causes.”

Ultrasound itself hasn’t been known to harm humans except with exceptionally extreme intensity, but ultrasound can produce audible byproducts capable of harm. When ultrasonic signals containing multiple tones interfere with each other through a phenomenon called intermodulation distortion, audible sound can result. Intermodulation distortion can down-convert the frequency of ultrasound into the audible range – resulting in high-pitched noises, Fu said.



First Step Made Toward Demographic-aware NLP

Understanding the associations that are formed in the mind is crucial to understanding the way humans acquire language throughout a lifetime of learning. Word associations are believed to mirror the mental model of the conceptual connections in a human mind. They start forming early in life, as language is acquired and one learns based on the environment where concepts lie in relation to each other. In addition, these associations shift and morph as a person gains new life experiences; for example, older people associate “sleep” with “awake,” instead of “bed” or “dream,” which are the top choices for younger age groups.

Michigan researchers, including Prof. Rada Mihalcea, research fellow Carmen Banea, and CSE graduate student Aparna Garimella, have found that word associations vary across different demographics, and researchers can build better natural language processing models if they can account for demographics. Their research consisted of building a new dataset with word association responses for approximately 300 stimulus words, collected from more than 800 respondents of different genders (male/female) and from different locations (India and the United States) with a total of 176,097 responses.

The results showed significant variations in the word associations made by these groups. For example, for the stimulus word “bath,” the most frequent response for both American and Indian men was “water,” while for Indian women it was “soap,” and for American women it was “bubble.”

The researchers proposed a new demographic-aware word association model based on a neural network skip-gram architecture. They showed that this method outperforms other generic methods and previously proposed models of word association, thus demonstrating that it is useful to account for the demographics of the people behind the language when performing the task of automatic word association.

They regard this as a first step toward demographic-aware NLP, and plan to address more advanced NLP tasks while accounting for demographics.



Word associations vary across demographics, which creates a challenge for NLP systems.

NATURAL LANGUAGE PROCESSING

Combining External Factors with NLP Improves Prediction of Emotions

The popular social media platform Twitter allows users to instantaneously share their thoughts with the world and interact with other users by posting, responding to, liking, and reposting tweets. Michigan researchers have discovered that you can better predict a Twitter user's emotions by taking into account both the content of their tweets and external environmental factors.

Traditional natural language processing techniques mainly focus on textual context to predict one's emotions. This technique has found success, but it does not account for environmental factors that may affect a person's emotions.

Research fellow Carmen Banea, CSE alumna Vicki Liu, and Prof. Rada Mihalcea explored the concept of grounded emotions, focusing on how external factors, ranging from weather, news exposure, social network emotion charge, timing, and mood predisposition may have a bearing on one's emotion level throughout the day.

By testing the correlation between certain external factors and Twitter sentiment, they explored which of them are most significant in grounding emotions, and therefore gained a deeper understanding of the connections that exist between external factors and one's internal emotional state.

At an individual level, they discovered that the sentiment extracted from a user's prior textual content exhibits a high correlation with an emotional response experienced twelve hours later, showing that users are consistent in their emotional states. They also found that the cumulative sentiment expressed in news is the second best predictor of user emotion. By combining all grounding signals together, they were able to obtain an emotional predictive accuracy of 66.9%, surpassing the majority class baseline of 59%.

This study not only shows that external factors prime us toward emotional responses, but also that the performance of such external features in predicting emotion can surpass the predictive accuracy of natural language processing tools that look at text alone.

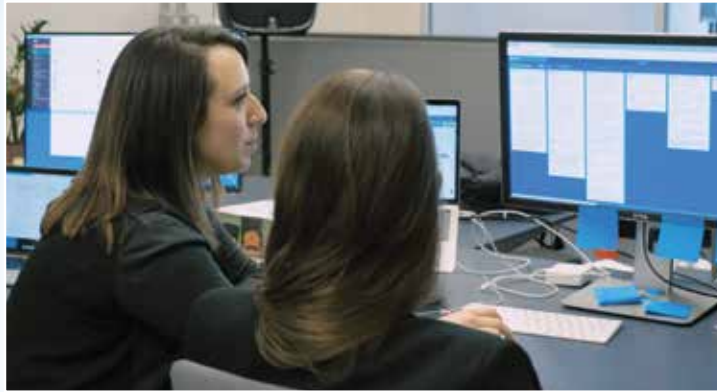


Making Online Communication Smarter

Two projects funded by Trove, an Ann Arbor-based artificial intelligence startup, will develop novel methods and tools to help make intelligent online communication smarter.

The first project, led by Prof. Danai Koutra, focuses on designing new, efficient methods for understanding the patterns behind email exchange.

The team will analyze a large-scale dataset consisting of over 3.7B email exchanges between more than 250M users over tens of years. At a global level, the proposed work will graph “who-emails-whom” including changes over time. At a user-level, user behaviors will be analyzed to identify normal and anomalous behavioral patterns by employing scalable methods and visualization systems developed in Prof. Koutra’s lab.



Researchers from U-M and Trove are collaborating to develop new paradigms for online communication.

The second project, led by Prof. Walter Lasecki, aims to create new means of interacting with online communication tools.

Deeply understanding the wealth of information encoded in a communication-based social graph is expected to inform the design of intelligent communication assistants, which will be

tailored to the needs of individual users, helping them to understand and take advantage of the invaluable information that is readily available in their daily communications.

The researchers envision a future in which intelligent personal assistants (IPAs) powered by AI will help people to more effectively triage messages through natural, multimodal interaction.

These IPAs could also help people access information in messages more easily, and gain in-depth insight into the relationships they have with their communication partners.

The team will prototype a diverse set of intelligent agents using real-time crowd-powered systems that their lab has pioneered. Crowdsourcing will allow them to flexibly create deployable human-backed systems that give insight into the potential real-world benefits

and tradeoffs of IPAs and methods of interacting with them.

The work proposed will result in new methods for interacting with overloaded communication channels through intelligent assistants.

Duplicate Text Detection System Integrated with Conference Software

When researchers submit papers to conferences, their submissions should not overlap significantly with previously published work. For conference committee reviewers, it can be tedious to evaluate each paper to make sure that the submitted work is original and innovative.

Help is now available in the form of Prof. Igor Markov’s duplicate text detection system, abbreviated as DUDE. DUDE applies computer technology used by web search engines to detect matching text in sets of technical papers.

DUDE is now integrated with conference management software available from Softconf, an internet company dedicated to organizing conferences, workshops, and other software development events. DUDE is integrated with their signature product, START V2, which is a web-based solution for managing submissions to peer-reviewed conferences and workshops.

DUDE sorts matching papers to highlight most similar pairs, presents this data, and allows conference committees to make decisions in accordance with their conference policies. DUDE allows program chairs to easily add notes next to papers that are not considered original.

DUDE is currently being used by IEEE and ACM, and helps them enforce their new 30%-policy, which requires at least 30% new material compared to earlier conference publications.



DUDE helps conference organizers to more efficiently evaluate papers for presentation at conferences.

Using Buildings as Batteries

Michigan researchers and staff are testing how to use the immense thermal energy storage capacity of large buildings as virtual battery packs. The goal is to help the nation's grid better accommodate renewable energy sources, such as wind and solar.

For power grids, supply must closely track demand to ensure smooth delivery of electric power. As renewable sources become more prevalent, so does unpredictability and mismatched supply and demand, creating a growing problem in how to keep better control of both.

To address this, and help demand for electricity react to the variability of supply from renewable energy sources, a project led by Prof. Johanna Mathieu is testing how buildings store energy.

"The goal is to utilize a building as a big battery: dump energy in and pull energy out in a way that the occupants don't know what is going on and the building managers aren't incurring any extra costs," said Ian Hiskens, Vennema Professor of Engineering, who is also involved in the project.

The large building size also means any short-term changes to a thermostat will not be felt. A building can cut or increase power to its HVAC for a short time to help a power grid match supply and demand, while the building's temperature remains unchanged.

"With help from the Plant Operations team and building managers, we were able to make short-

term adjustments to HVAC systems with no change in the actual temperature, and no complaints from building occupants," said ECE graduate student Aditya Keskar.

With more than 5.6M commercial buildings in the U.S., the cumulative effect could give energy producers and distributors a vital control to keep electricity demand and supply balanced while incorporating wind and solar energy.



Connor Flynn, an energy engineer with the Energy Management team, helps Aditya Keskar, a master's student in Electrical and Computer Engineering, retrieve data from a campus building's HVAC system.

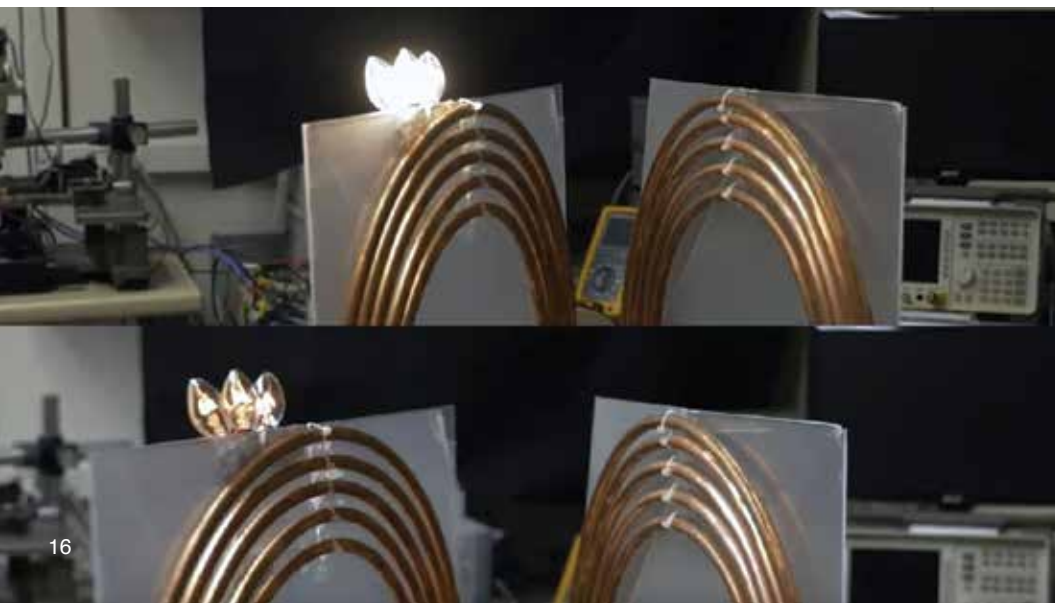
Robust Wireless Power Transfer

Imagine driving across the country in your electric vehicle – knowing it's being charged wirelessly as you go, or charging your portable devices without searching for the perfect connectors. A new wireless power transmission system being developed by Prof. Amir Mortazawi could make this a reality. His technology sheds the finicky requirements of current wireless power transfer, removing the necessity of bulky electrical cords, wires, and plugs.

Compared to conventional methods of wireless power, which require a specific distance and alignment, Mortazawi's version operates over a range of distances and orientations without a drop in power. The system offers a simple, low cost, robust solution with fixed

operation frequency. It also does not require power for its operation and can be integrated into existing wireless power transmission systems.

This technology could be applied to a range of electrical devices, including biomedical implants, mobile devices, drones, and electric vehicles.



With the coils facing in opposite directions, the light remains bright and fully charged only in Mortazawi's system (top). Current technology (bottom) is much more finicky.

Using Light's Magnetism to Harvest Solar Energy

A new \$1.7M laser laboratory is bringing a unique capability to the State of Michigan that will help explore exotic interactions between light and matter. The study of these interactions may one day result in a new method for harvesting solar energy.

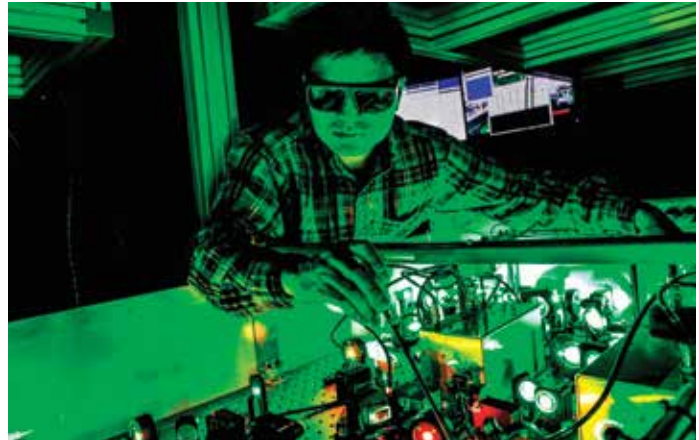
The new facility, called the Carrier-Envelope Phase laser facility, is capable of creating very short pulses of light, just a few quadrillionths of a second long, and shaping peaks inside the pulse. Prof. Stephen Rand designed the facility to develop applications for a surprising interaction his group first observed in 2007.

Before the first U-M experiments, it was widely assumed that the magnetic component of light was too weak to matter for applications. However, Rand's experiments proved that, if the intensity is right, light produces magnetic effects that are more than a million times stronger than expected.

This could change the game in solar harvesting because materials like glass can theoretically store 95% of the light energy in the form of a charge separation on their molecules.

"For solar cells, the conversion of sunlight to electricity is less than 50%," said Rand. "We hope this process will eventually do much better."

With the new laser, Rand and his colleagues will discover how exactly materials produce charge separation and how it varies



Minh Tuan Trinh, a research scientist in ECE, adjusts the optics of the new laser setup.

over time, crucial information needed to build a system that can harvest solar energy and store it in a useful way.

In addition, the new facility will provide outside researchers in Michigan the opportunity to work at the forefront of "shaped" laser pulses.

Clean Hydrogen Fuel With Artificial Photosynthesis

A new, stable artificial photosynthesis device doubles the efficiency of harnessing sunlight to break apart both fresh and salt water, generating hydrogen that can then be used in fuel cells.

The device could also be reconfigured to turn carbon dioxide back into fuel. The method advanced by the new device, called direct solar water splitting, only uses water and light from the sun.

"If we can directly store solar energy as a chemical fuel, like what nature does with photosynthesis, we could solve a fundamental challenge of renewable energy," said Prof. Zetian Mi, who led the research.

The device is made from the same widely used materials as solar cells and other electronics, including silicon and gallium nitride (often found in LEDs). With an industry-ready design that operates with just sunlight and seawater, the device paves the way for large-scale production of clean hydrogen fuel.

Previous direct solar water splitters have achieved a little more than 1% stable solar-to-hydrogen efficiency in fresh or saltwater. Mi and his team, however, achieved more than 3% solar-to-hydrogen efficiency. Just 5% efficiency is the threshold for commercialization, but Mi's team thinks they can get to 20-30% efficiency.

The colorized electron microscope image in the background shows the gallium nitride towers of the artificial photosynthesis device. These nanostructures rip water molecules apart into hydrogen and oxygen to produce clean hydrogen fuel.

Moving Deep UV LEDs Closer to Commercial Viability

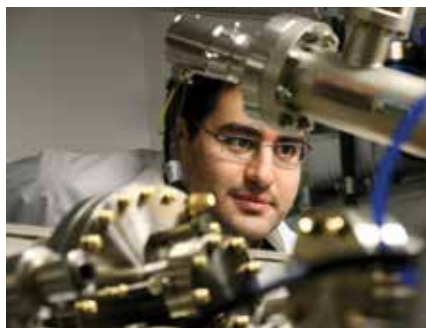
Deep ultraviolet light-emitting diodes (UV LEDs) have important current and potential applications, including air and water sterilization, industrial curing, printing, counterfeit detection, hazardous material decomposition, and many medical uses. Today's deep UV LEDs, however, lack the efficiency and power to be fully exploited for all of these applications.

Prof. Zetian Mi and his students developed two new award-winning techniques for creating deep UV LEDs, showcasing them at the *11th International Symposium on Semiconductor Light Emitting Devices*.



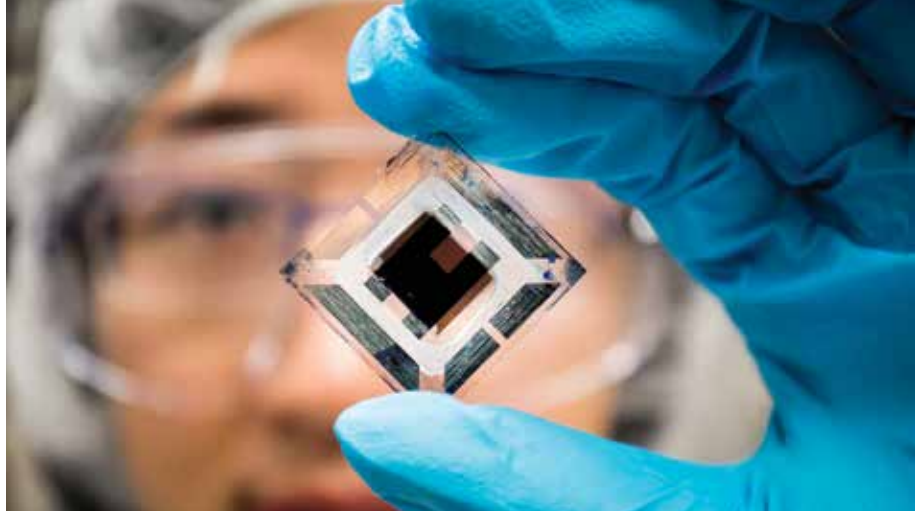
Xianhe Liu sets up the molecular beam epitaxy system to grow deep UV LEDs.

Xianhe Liu, a visiting scholar from McGill University, increased the performance of deep UV LEDs by using a titanium mask as they are built. Compared to the typical nanowire LED structure, in which the nanowires can be tilted and randomly misshapen, Liu's nanowires are like a perfect beehive.



David Laleyan checks the vacuum chambers of the molecular beam epitaxy system before growing deep UV LEDs.

David Laleyan, ECE graduate student, used boron nitride in place of the more typical aluminum gallium nitride with magnesium to create more powerful deep UV LEDs. He found that the boron nitride LED required less voltage, was able to withstand twice the current, and had ten times the light output as similar aluminum nitride nanowire devices.



Xiaozhou Che, EECS Graduate Research Assistant, holds an organic tandem photovoltaic cell.

Organic Solar Cells Reach Benchmark for Commercialization

In an advance that makes a more flexible, inexpensive type of solar cell commercially viable, Stephen Forrest, the Peter A. Franken Distinguished University Professor of Engineering and Paul G. Goebel Professor of Engineering, and his group have demonstrated organic solar cells that can achieve 15% efficiency.

This level of efficiency is in the range of many solar panels, or photovoltaics, currently on the market.

These carbon-based organic solar cells could be inexpensively manufactured in rolls that are thin enough to bend and curve around structures or within clothing, and made any color, even transparent, to blend in to their environment.

The researchers achieved this important benchmark by combining multiple advancements in design and process with specialized layers that absorb both visible and infrared light. But they think they can do even better, possibly reaching 18% in the near future.

Earlier this year, Forrest's team had achieved an important breakthrough to improve the conductivity of ALL organic semiconductors, which has always been a downside to their widespread adoption for solar cells.

They demonstrated that a thin layer of fullerene molecules – the curious round carbon molecules also called Buckyballs – can enable electrons to travel up to several centimeters from the point where they're knocked loose by a photon. In today's organic cells, electrons can travel only a few hundred nanometers or less.

"This discovery essentially gives us a new knob to turn as we design organic solar cells and other organic semiconductor devices," said Quinn Burlingame, a doctoral student in electrical engineering.



Quinn Burlingame demonstrates his original experiment that found a way to coax electrons to travel much further than was previously thought possible in the materials often used for organic solar cells and other organic semiconductors.

Color-coding Nanoparticles: The How and Why

Color-coding is often used as a simple way to organize items, like file folders, subway lines, and flavors of colorful candy. Now, Prof. Jay Guo and his team are applying color-coding to particles that are about the size of color itself, allowing scientists to quickly determine the size of nanoparticles. This can help in biomedical drug delivery, biological sensors, advanced coatings, and lithography of more advanced computer chips.

Overcoming various natural difficulties in silica nanoparticles, Guo discovered a way to make these nanoparticles shine in a range of colors based on their size. For example, 421 nanometer particles appear green, while 486 nanometer particles give off a red hue.

This method could help in biomedical drug delivery by making sure nanoparticles are both picking up drug molecules and dropping them off on target simply by looking at the change of their color. The same color signal could alert biological sensors to a change in state.

This work is also important in the so-called nanosphere lithography for computer chips and sensors, where nanoparticles have stringent requirements to be uniform in size in order to create the proper patterns to print circuits.

And it turns out that both the size of number of specific nanoparticles changes the properties of advanced coatings. This can make a surface smoother or rougher, repel or absorb water, or reflect or trap light.

Silicon dioxide nanoparticles coated with gold reflect color based on their sizes in a photo taken with a dark-field microscope.

Cooling Off with Lasers

Light is generally associated with heat. Yet, Prof. Stephen Rand and team are researching how to use light to cool things down. Specifically, they are studying how to use lasers to cool down solid matter.

The idea actually isn't new; however, the U-M team's approach is. In fact, their approach should be able to achieve an unprecedented cooling of solid matter, opening up new applications for lasers and imaging arrays in space.

Also – the Michigan team's experiments are being conducted in open-air conditions. Other groups are attempting to cool matter in a vacuum.

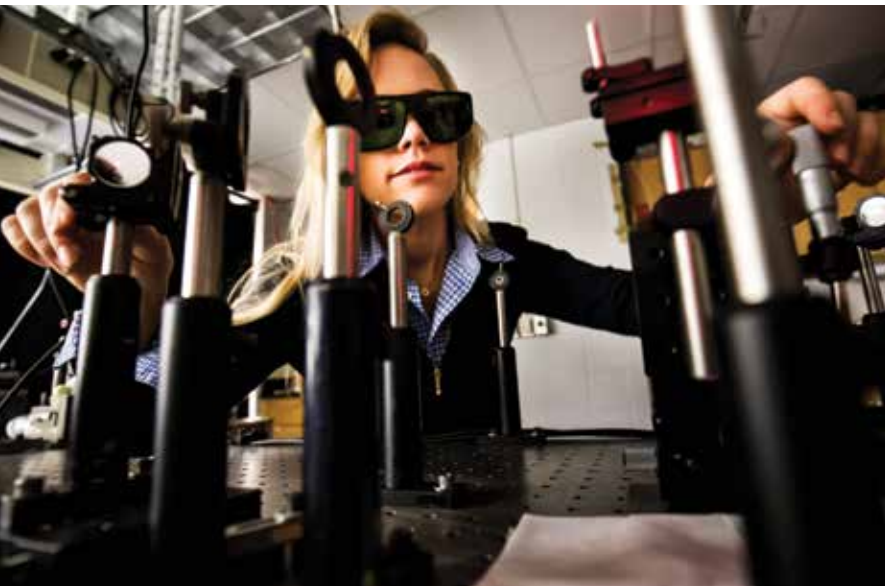
Lasers typically heat objects by adding energy to a material. But, just as a laser can make a material's atoms move faster and increase temperature, it can also make them move slower, reducing a material's temperature.

Achieving this could lead to a self-cooling, or radiation-balanced, laser. With a self-cooling laser, the heat that hinders more powerful lasers would be mitigated, and cumbersome methods of cooling based on circulation of water could be avoided.

This technology could lead to clearer pictures from space. In space, the quality of imagery with semiconductor arrays is affected by thermal noise, which reduces the sensitivity of the cameras. Current technology can only cool the circuits of these arrays to about 140K, or -270°F, far from the 1K considered possible with Rand's approach.

Two students in Rand's lab, Laura Andre and Long Cheng, have already proved the concept, and continue to make progress cooling a crystal in the open lab.

Laura Andre, ECE doctoral student, runs an experiment using a self-cooling laser.



Vulnerabilities Demonstrated in Next-generation Connected Vehicle Technology



Automakers are increasingly designing and building vehicles with connected vehicle (CV) technology that will allow the vehicles to communicate with transportation infrastructure via wireless communication. The goal is to improve mobility, safety, environmental impact, and public agency operations.

The U.S. Department of Transportation has begun testing a CV-based system called Intelligent Traffic Signal System (I-SIG), which is a vehicle-to-infrastructure technology that uses real-time vehicle trajectory data to intelligently control the duration and sequence of traffic signals. With the use of this system comes vulnerabilities, and Michigan researchers have demonstrated that even a single cyber attack against a single vehicle can significantly impact the operation of the I-SIG system, causing severe traffic jams.

The researchers, including Prof. Z. Morley Mao and CSE PhD student Qi Alfred Chen, believe attackers can compromise a vehicle (physically, wirelessly, or through malware) and use it to send malicious messages to the I-SIG system. These messages contain spoofed driving data, such as speed and location, that can cause massive congestion – they can even jam all of the traffic going one direction through an intersection.

To demonstrate the security vulnerabilities, the researchers first performed a security analysis on the I-SIG system and designed several spoofing strategies. They used these strategies to

perform a vulnerability analysis, trying different data spoofing options and identifying effective attacks.

The researchers discovered that congestion can be caused by exploiting either of two vulnerabilities. The first one is called “last vehicle advantage,” which allows an attacker to determine the traffic signal plan by spoofing as a vehicle arriving late to the light. The other is called “curse of the transition period,” which allows an attacker to inject “ghost vehicles” into the flow of traffic to drastically alter the signal plan.



The day when cars can communicate to traffic signals is rapidly approaching.

The researchers say that an attack can completely reverse the benefit of a connected vehicle-based signal control system, instead making traffic mobility 23.4% worse than without the system.

They recommend several strategies to defend against an attack, including designing an effective and robust signal control algorithm specifically for the transition period, performance improvement for road-side units, and data spoofing detection using infrastructure-controlled sensors.

This study was presented in the paper “Exposing Congestion Attack on Emerging Connected Vehicle based Traffic Signal Control” at the 2018 NDSS Symposium in San Diego, California. Additional researchers on the project include computer science undergraduate Yucheng Yin, Civil and Environmental Engineering Prof. Henry Liu, and UMTRI research scientist Dr. Yiheng Feng.

Using AI to Deter Financial Market Manipulation

Market manipulation is the deliberate use of misleading information with the intent of deceiving investors for financial gain. Increasingly, manipulators are attacking market integrity through the use of complex computer-controlled attacks. The potency of these tactics are improved dramatically through the use of sophisticated attack algorithms and deployment platforms.

Lynn A. Conway Professor of Computer Science and Engineering Michael Wellman and his collaborators are working to develop innovative approaches to the detection and deterrence of computerized manipulation of financial markets.

Their approach will monitor trading activity to develop a model that is calibrated to normal trading activity and that will recognize and extract “signatures” of manipulation. This will be paired with a system of model-based techniques for characterizing manipulation strategies.

Together, this dataset of manipulation strategies will be introduced into modeled trading environments to reveal signatures of spoofing activity, which the researchers will in turn use to construct surveillance and audit algorithms.

The research team also includes principal investigators Tucker Balch of the Georgia Institute of Technology College of Computing; Uday Rajan, Professor and Head of Finance Area, Ross School of Business at Michigan; and Michael Barr, Dean of the Ford School of Public Policy and Professor of Law at Michigan.

Their project is entitled “Detecting Financial Market Manipulation: An Integrated Data- and Model-Driven Approach,” and is funded by the NSF’s Big Data program for \$1M over three years.

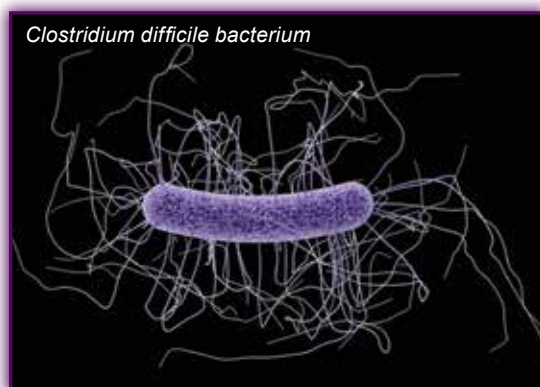


Preventing Deadly Hospital Infections with Machine Learning

Nearly 30,000 Americans die each year from an aggressive, gut-infecting bacteria called *Clostridium difficile* (*C. difficile*), which is resistant to many common antibiotics and can flourish when antibiotic treatment kills off beneficial bacteria that normally keep it at bay. New machine learning models tailored to individual hospitals could give them a much earlier prediction of which patients are most likely to develop *C. difficile*, potentially helping them stave off infection before it starts.

Developed by researchers at the University of Michigan, Massachusetts General Hospital, and MIT, the models can predict a patient’s risk of developing *C. difficile* much earlier than it would be diagnosed with current methods.

“*C. difficile* is one of the most problematic healthcare-associated bugs; despite best efforts, hospitals have had little success in reducing incidence of infections,” according to Prof. Jenna Wiens. “Our tool can help identify those patients at highest risk and aid hospitals in focusing prevention and treatment efforts.”



Clostridium difficile bacterium

Photo credit: U.S. Centers for Disease Control and Prevention.

Our tool can help identify those patients at highest risk and aid hospitals in focusing prevention and treatment efforts.

— Prof. Jenna Wiens

Prof. Wiens and her collaborators note that most previous models of *C. difficile* infection risk were designed as “one size fits all” approaches and included only a few risk factors, which limited their usefulness. The research team, which includes CSE graduate student Jeeheh Oh, took a big data approach that analyzed the whole electronic health record (EHR) to predict a patient’s *C. difficile* risk throughout the course of hospitalization. Their method allows the development of institution-specific models that could accommodate different patient populations, different EHR systems and factors specific to each institution.

Using their machine-learning-based model, the investigators analyzed de-identified data – including individual patient demographics and medical history, details of their admission and daily hospitalization, and the likelihood of exposure to *C. difficile* – from the EHRs of almost 257,000 patients admitted over six years. The model generated daily risk scores for each patient that, when a set threshold is exceeded, classify them as at high risk.

Overall, the models were highly successful in predicting infections. In half of those who were infected, accurate predictions could have been made at least five days before diagnostic samples were collected, which would allow highest-risk patients to be the focus of targeted antimicrobial interventions and precautions to be instituted to prevent transmission to other patients.

Two Kinds of Learning for More Efficient Autonomous Intelligent Agents

General autonomous agents must overcome a number of challenges when learning. They must continually react to their environment, focusing their computational resources on making the best decision for the current situation using available knowledge. They also need to learn everything they can from their experience, building their knowledge base so that they are prepared to make the best decisions in the future.

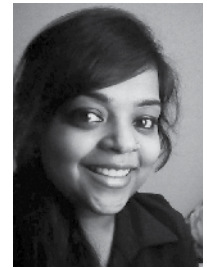
John L. Tishman Professor of Engineering John Laird and CSE alumna Shiwali Mohan have proposed that in human-like agents, learning can be split into two levels. Level 1, or L1, consists of fixed architectural learning mechanisms that are innate and automatic. Level 2, or L2, consists of deliberate learning strategies that are controlled by the agent's knowledge.

L1 learning algorithms are fast, effortless, and outside the agent's control. An agent cannot explicitly invoke them ("I will learn this right now!") or explicitly inhibit them ("I refuse to learn this!"). L2 strategies are voluntary, deliberately initiated by the agent, and become a goal or task that directs behavior. These include simple strategies such as repeating a phone number to learn it as well as complex strategies such as those involved in scientific research.

The researchers suggest that when developing general agents with broad learning capabilities, it is possible to develop a core set of primitive, automatic learning mechanisms that are shared by complex deliberate learning strategies mechanisms. The deliberate strategies leverage these primitive mechanisms, and do not have any strategy-specific



Prof. John Laird



Dr. Shiwali Mohan

learning mechanism of their own. They see this as an exciting path forward for the development of general autonomous intelligent agents. Finally, they hypothesize that non-human animals have only L1 mechanisms, and are unable to use L2 strategies.

Their paper on the work, entitled "Learning Fast and Slow: Levels of Learning in General Autonomous Intelligent Agents," earned a Blue Sky Award at the 2018 Association for the Advancement of Artificial Intelligence conference.

Replicating Essential Services in a Connected World

Interactions between different online services are a critical part of modern computing. Services large and small are typically used in conjunction with other services to form complex systems, like massive key-value stores, online shopping centers, and data processing systems.

In environments like these, one service will frequently need to issue requests to another to offer full functionality. For example, when using an online shopping service, the store has to issue a request to your credit card service to block off a certain amount of money. These kinds of interactions have become so common that they blend seamlessly into the user experience.

These interacting services are usually vital and need to be replicated for high availability. But replicating these services can prove difficult – current replication protocols are both inefficient and incorrect when accounting for their interactions with other services.

Prof. Manos Kapritsos has proposed research to rethink the design and implementation of replicated services in the context of these modern, large-scale environments. Called Aegean, his approach allows fault-tolerant replication to be implemented beyond the confines of the client-server model.

Kapritsos and his collaborators aim to debunk the long-standing assumption that replication protocols are implemented solely within the client-server model and to consider the implications that this has on how we design replicated services. On the practical side, they need to ensure that, as the world moves increasingly towards large-scale deployments, fault tolerant replication will continue to be relevant, giving practitioners a useful tool to provide high-availability without giving up on consistency.

Experiments indicate that Aegean not only restores correctness to replicated services in an interactive setting, but can also increase their throughput by an order of magnitude.



Chat Tool Simplifies Tricky Online Privacy Policies



A website's privacy policy is usually long, complicated, and full of dense language. It's common for users to check the box and skip the reading, but these documents often contain vital information about how your personal data is being processed and used.

Kevin and Nancy O'Connor Professor of Computer Science Kang G. Shin has collaborated with researchers from the University of Wisconsin-Madison and École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland in an

effort to help users weed through all that fine print. They have developed PriBot, located at pribot.org, an automated question-answering chatbot that looks and functions like a text-messaging conversation, complete with blue and gray speech bubbles and fun emojis.

"We want to help a great many people enjoy a rapidly increasing number of mobile products and services without risking their privacy by developing and distributing scalable, easy-to-use tools," said Shin.

Ask it, for example, how a specific popular online shopping website uses an individual's browsing history, and the chatbot displays small, relevant portions of the site's privacy policy. If the chatbot can't find what the website users are asking about, it volunteers to search for and add it. Currently, the site's database includes more than 20,000 privacy policies.

As a companion to the chatbot, the researchers also created a tool called Polisis. It shows users what types of data companies collect, how and why they share it, how they keep that information secure, and what data they store in an easy-to-comprehend graphical format.

Under the hood, PriBot and Polisis draw on an aspect of artificial intelligence called natural language processing. It heavily builds on text analysis to automatically understand what the policy involves. In PriBot and Polisis, the researchers accounted for such factors as variations in spelling, simplifying the policy text for non-experts, and visually presenting the information without overwhelming users.

A New Programming Language to Make Verifying Crypto Code Easy

Strong cryptography is one of the most important foundations for good digital security – it keeps our online transactions, personal details, and cloud storage locked away from prying eyes. In a best case scenario, encryption should be correct, secure, and fast.

But verifying that a crypto scheme meets all of these criteria is a challenge. High-performance cryptographic code often relies on complex, hand-tuned assembly language that is customized for individual hardware platforms. Such code is difficult to understand or analyze.

A research team including Prof. Manos Kapritsos introduced a new programming language and tool called Vale to simplify this process, supporting flexible, automated verification of high-performance assembly code.

Existing approaches to verifying assembly code fall roughly into two camps. On one side, frameworks are built on very expressive higher-order logical frameworks that allow great flexibility in how the assembly is generated and verified, as well as high assurance that the verification matches the semantics of the assembly language. On the other side are various assembly language analysis tools built on satisfiability-modulo theories (SMT) solvers. These solvers have the ability to blast their way through

large blocks of assembly and tricky bitwise reasoning, making verification faster and easier.

Vale strives to combine the advantages of both approaches, combining flexible generation of high-performance assembly with automated, rigorous, machine-checked verification. For any assembly program written in Vale, the Vale tool constructs an abstract syntax tree (AST) representing the program's code, and produces a proof that this AST obeys a desired specification for any possible evaluation of the code. After verification, the AST is available in the logical framework for further analysis and manipulation.

The goal of the project is to demonstrate that verified code can be as fast as highly-optimized, unverified code, the researchers say.

Kapritsos and the team won a Distinguished Paper Award at the 2017 *USENIX Security Symposium* for this project.



Prof. Manos Kapritsos

Finding the Water Through the Trees

The code *Huanting Huang* works with might be the furthest thing from the natural world. Yet her award-winning mathematical modeling is helping us better understand what lies beneath the surface of our natural world by knowing the shapes of trees.

Huang, a PhD candidate advised by Prof. Leung Tsang, works in remote sensing. Through the properties of water, soil, and electromagnetic waves, remote sensing enables satellites to determine how much water lies under the surface of the Earth.

To account for the scattering of waves due to vegetation, researchers create models of plants to remove the interference from the soil moisture signal.

Huang has developed a method that paints trees more accurately using full wave simulations.

By breaking down the model trees into smaller parts, the trunks and branches take more natural, tree-shaped, positions.

"With conventional methods, not only are the parts of the trees uniformly distributed in the air, but entire forests," says Huang. "That's unrealistic, though, because trunks, branches, and leaves of trees grow in a correlated structure, and trees grow in clusters. Results show that the simulation method modeling in clusters leads to much different results than the conventional method."

For this research, Huang won the IEEE Antennas and Propagation Society Ulrich L. Rohde Innovative Conference Paper Award on Computational Techniques in Electromagnetics at the 2018 *International Conference on Computational Electromagnetics (ICCEM)*.

Huanting Huang, ECE PhD candidate, is helping to get a more accurate measure of how much moisture is in the world's soil.



Solving Impossible Equations

Eric Michielssen, Louise Ganiard Johnson Professor of Engineering, has discovered a new way to rapidly analyze electromagnetic phenomena, and it's catching on.

The technique involves a new algorithm for solving Maxwell's equations that is orders of magnitude faster than prior algorithms, opening the door to its use for the design and optimization of electromagnetic devices.

Published in 1865, Maxwell's equations continue to hold the key to advancements in a wide array of applications, in particular high-frequency electronic devices and systems, and optics. To solve Maxwell's equations, Michielssen and his group convert them into a system of linear equations. In the last 2 decades, the number of unknowns in these linear equations has increased from about 100K to tens of millions.

"Using traditional methods, not even a suite of high-performance computers would be able to solve a matrix of this size," said Michielssen.

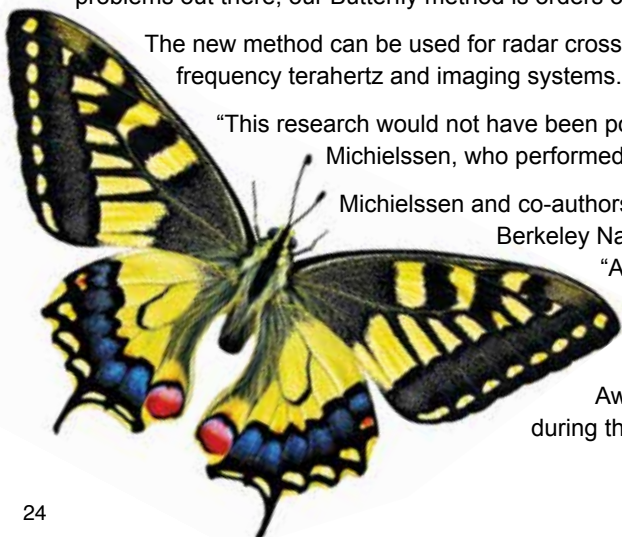
That is, until Michielssen revisited an algorithm that he developed back in 1996. This algorithm, which came to be known as Butterfly, was able to compress a system of linear equations. While of limited usefulness two decades ago, that changed when Michielssen adapted his old Butterfly compression scheme to directly solve highly complex equations quickly and efficiently.

"Our Butterfly scheme has blown new life into direct solution methods for Maxwell's equations," Michielssen said. "For many real-world problems out there, our Butterfly method is orders of magnitude faster than prior algorithms, while using fewer computing resources."

The new method can be used for radar cross section, antenna design, wireless system analysis, signal integrity, as well as high-frequency terahertz and imaging systems.

"This research would not have been possible without the vast computing resources available here at Michigan," said Michielssen, who performed the calculations on the FLUX high-performance computing cluster.

Michielssen and co-authors Han Guo (ECE doctoral student), Yang Liu (MSE PHD, EE, 2013-2015; Lawrence Berkeley National Lab), and Prof. Jun Hu (UESTC) described the research in the 2017 paper, "A Butterfly-Based Direct Integral-Equation Solver Using Hierarchical LU Factorization for Analyzing Scattering From Electrically Large Conducting Objects," published in *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 9. The authors received the prestigious 2018 Sergei A. Schelkunoff Transactions Prize Paper Award for this research, which is presented to the best paper published in the journal during the past year.



Biodegradable Hydrogel for Eco-friendly and Intelligent Agriculture

Researchers have developed a new hydrogel made from natural and biodegradable materials that is suitable for the nation's agriculture.

Hydrogels are highly absorbent polymers typically made from synthetic materials, which don't decompose. Commonly found in diapers to retain water or flower bouquets to keep plants hydrated, they are also used to help grow crops in dry areas.

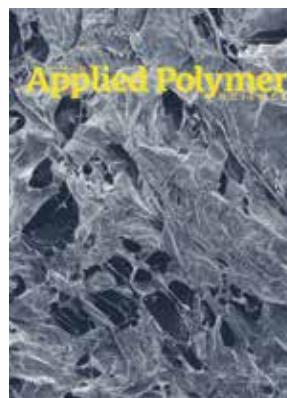
The hydrogels swell with water during rains and release the moisture into the soil during dry times, both watering plants and helping to control erosion.

Prof. Jerzy Kanicki collaborated with former visiting scholar Agnieszka Pawlicka, professor of Chemistry at University of São Paulo, to create a biodegradable hydrogel with gellan gum, which is produced by bacteria.

"We have the same advantages as synthetic hydrogels," says Pawlicka. "Except, our natural hydrogel biodegrades."

"This was just the beginning, but the end idea is to combine this with an array of sensing devices," says Kanicki. "You could adjust the hydrogel based on the location or the amount of precipitation. It's intelligent monitoring of agriculture."

These new hydrogels could also be used in health applications, according to Kanicki and Pawlicka. For example, they could be used to absorb and analyze the ions within sweat for signs of stress, or deliver medication over time.



A magnified view of the new biodegradable hydrogel appears on the cover of the *Journal of Applied Polymer Science*, volume 135, issue 2 on January 10, 2018.



A handful of hydrogels used to keep plants hydrated.

A Mission to Manage Water Globally

NASA put a satellite that included Michigan EECS technology into space January 31, 2015 for the sole purpose of measuring soil moisture. The goals of this ongoing mission, called Soil Moisture Active Passive (SMAP), include improved weather forecasting, drought monitoring, flood prediction, and improved crop productivity.

The equipment aboard the satellite is able to gather information about soil moisture in the top two inches of the Earth's topsoil on a global scale every two to three days.

Since its launch, SMAP has led yielded important new data, including: new surface flooding

maps of Texas and the Tennessee Valley following Hurricane Harvey; an entire year of worldwide soil moisture data that is yielding insights into the impacts of soil moisture on weather; and a complete picture of the presence of snow and ice around the globe. In addition, the radiometer aboard the satellite has been able to send data about extreme wind events such as hurricanes and cyclones.

Scientists have now begun the important process of interpreting the data.

Three Michigan faculty involved in the project, Kamal Sarabandi, Rufus S. Teesdale Professor of Engineering, Prof. Leung Tsang, and Dr. Leland Pierce, received a Group Achievement Award from NASA for their "outstanding contributions to the development of the Soil Moisture Active Passive mission."

In order to improve the information received from SMAP, especially due to the failure of a critical piece of radar equipment just two months into the mission, the researchers looked for other opportunities to apply their specially developed algorithms that correlated both radar and radiometer data.

Tsang's group, for example, is correlating information from SMAP's radiometer with the European Space Agency (ESA) Sentinel satellite C band radar data. His modeling has indicated a much larger microwave penetration through vegetation and forests than predicted.

"These new models encourage re-examination of data already collected, particularly over dense vegetation and forests," said Tsang.

Data interpretation, gathering, and calibration will continue for several more years. In the meantime, SMAP will continue to provide information that will, on a smaller scale, help farmers facing drought, and on a larger scale, help scientists better understand the presence and impact of water on the entire planet.

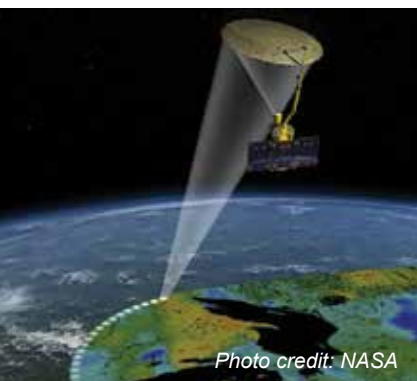


Photo credit: NASA

A \$7.75M TECHNOLOGY HUB TO ADVANCE OUR UNDERSTANDING OF THE BRAIN

Nano-sized LEDs are being used to control and record the activity of individual neurons within the brain, measuring how changes in the activity of a single neuron can affect its neighbors.

Prof. Euisik Yoon is leading a multi-disciplinary \$7.75M NSF Technology Hub to map the central nervous system. Called Multimodal Integrated NeuroTechnology (MINT), the program aims to bring together leaders in the development of unique technologies to stimulate and map circuits in the brain, and put this technology into the hands of the neuroscientists who ultimately treat neural-based diseases.

Among the tools being developed by MINT researchers are:

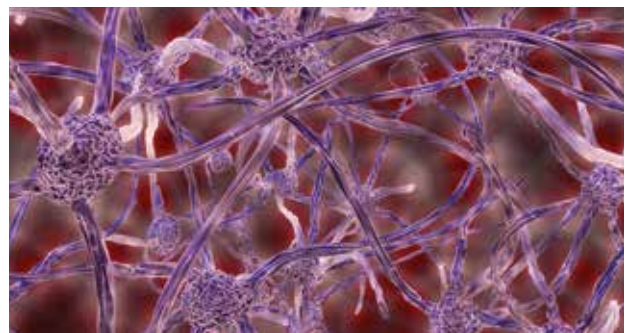
Probes – Yoon’s team developed implantable probes that use light to stimulate specific neurons in the brain, and then records the response from other neurons. These probes are about the same size as the brain cells themselves. “If you can record from motor cortex pyramidal neurons, you can predict arm movement, for example,” said Dr. John Seymour, a co-investigator on the project.

Brainbow – Prof. Dawen Cai of Cell and Development Biology developed this technique to visualize the structure of pyramidal cells and other kinds of neurons in the brain. Genetically modified brain cells produce fluorescent tags, revealing each cell as a random color. There are currently 6560 Brainbow colors.

Tissue Clearing – Prof. Viviana Gradinaru (Caltech, Division of Biology and Biological Engineering) developed a process that replaces fatty tissue with a clear gel to give a transparent view of neuron structure.

Other co-investigators on the project include: biomedical engineering professors Cynthia Chestek and James Weiland; Ken Wise, the William Gould Dow Distinguished University Professor Emeritus of EECS; and György Buzsáki, Biggs Professor of Neuroscience at New York University.

To share these new tools, the team will bring in neuroscientists for annual workshops and then provide them with the hardware and software they need to run experiments in their own labs. For the tools that prove to be most useful, they will seek commercialization opportunities so that they remain available after the project ends.



In a related project directed by Dr. John Seymour, Michigan researchers are developing highly-compliant microneedle arrays that are expected to improve our ability to monitor nerve activity during long-lasting experimentation.

This new NIH program seeks to research and develop how nerves interact with organs in order to develop treatments and therapies for diseases, including hypertension, heart failure, diabetes, and gastrointestinal disorders.

The team includes Prof. Euisik Yoon, Prof. Cynthia Chestek, and Prof. Tim Bruns of Biomedical Engineering.

A Tool to Speed Up Any Database

Processing big data takes big resources. For many organizations, the processing power needed to run queries on large databases can turn into their biggest expense.



Prof. Barzan Mozafari has developed a system that can reduce the computational costs of an existing database cluster without the need for any modifications to how queries are run. Called VerdictDB, this system uses a technique called approximate-query processing to return results with 99% accuracy at 1% of the cost.

VerdictDB speeds up aggregate queries, for which a tiny fraction of the entire data can be used for producing highly accurate answers. The system uses statistical techniques to isolate that small piece of data, and uses it to run what would normally be a much larger query. This query returns results that are accurate within a percentage designated by the user – if they want a larger response, they can request lower accuracy. Users can also run a traditional search that gives an exhaustively accurate response without approximation-queries at all, but even a 99% accurate query using VerdictDB can lower the computation costs by 100-200x.

VerdictDB works as a small, nimble piece of software that can be placed in front of any existing database. It's platform-independent, meaning you can bolt it on top of any database or query engine without having to change a single line of code in any applications that use them.

"The main advantage of this technology is its universality," says Mozafari. "Whatever you're using, you can stick to your favorite engine and platform, and still reap the benefits of approximation – money and time."

Understanding and Mining Patterns of Audience Engagement

Modern mobile and web audio technologies remove many of the technical barriers to facilitating large-scale audience participation in music concerts. Interactive music applications that shape a live music performance and form a connected ensemble can immediately be distributed to audience members to allow them to generate music from their smartphones. However, it remains an ongoing challenge to design interactions that encourage and sustain audience participation over time.

Profs. Danai Koutra and Walter Lasecki will use data mining to answer the question: what interaction patterns lead to improved audience engagement in an audience participation music performance?

As a foundation for this work, they plan to leverage the existing live performance system, Crowd in C[loud], which combines an interactive audience UI for generating music, an interface for an expert musician to orchestrate their participation, and an ephemeral social network that supports musical collaboration.



Their work will lead to insights on how to better facilitate audience engagement in general large-scale participatory systems beyond music, such as classrooms, public events, and academic conferences.

The Sound of Text

Music and words often come together, in the millions of songs and soundtracks that delight us, and yet for most of the words in the world, their music is silent.

Prof. Rada Mihalcea, Prof. Anil Çamcı, assistant professor of performing arts technology; Sile O'Modhrain, associate professor of performing arts technology; and CSE research fellow Jonathan Kummerfeld are developing data-intensive algorithms that leverage existing alignments between words and music to produce a musical interpretation for any text.

They will do this by building a large aligned collection of text and music, by drawing from publicly available digital collections of songs and lyrics, and leveraging automatic algorithms for data alignment. They also will develop novel neural network-based algorithms for text-to-music generation, building upon recent advances in sequence-to-sequence deep learning algorithms to uncover patterns of connections between language and music that can be used in the generation process.

Toward the end of the project, they plan to organize a public event which will both communicate and demonstrate the outcome of their project. It will include research presentations on data science topics interleaved with musical performances obtained by translating the text describing the research into music. Tune in!



WHAT HAPPENS AFTER A PHD IN COMPUTER SCIENCE?

Study Traces Careers of CS PhDs Using Decades of Data

Of the many burning questions in the world of computing research, the one most dear to a student's heart has typically been the least investigated: what happens after a PhD in computer science?

Prof. Danai Koutra and CSE PhD student Tara Safavi set out to provide the world's first data-driven answer, analyzing several decades of post-PhD computing careers using a large new dataset rich with professional information. From their findings, they developed a career network model, called R3, that captures the dynamics of computing careers over time.

The researchers used the HITS link analysis algorithm in conjunction with R3, making this the first application of HITS to a study on career trajectories. Together, these tools helped them draw conclusions about both individuals and organizations in computing research. With R3, the researchers identified movement between industry, academia, and government work, tracked the growth of important organizations, and built predictive models for career transitions and employer retention.

System-wide Evolution

The study reveals key organizations, from startups to universities to industry leaders, in computing research history. R3 captures factors beyond size and popularity that contribute to organizational importance, demonstrating that some organizations are important precisely for their small size, low retention, or short existences. The researchers were able to identify a variety of "hubs" and "authorities" over time, the former producing expertise that moved to other organizations and the latter attracting it. Some large companies with lots of researcher movement in and out qualified as both, such as IBM and Microsoft.

Cross-sector Career Movement

The researchers examined post-PhD career transitions across sectors. Beyond finding evidence that cross-sector collaboration is increasing, R3 reveals that there's truth to the narrative that it's easier to break into industry from a different sector (especially academia) than vice versa. They also find that PhDs transitioning from industry appear to gravitate toward more prestigious institutions than their current industry employers, while those transitioning to industry often move into startups.

Individual Retention Prediction

The researchers were able to predict career transitions by combining R3 network dynamics and individual career trajectory information. The study demonstrated that R3 could be of immediate use to recruiters hoping to retain PhDs in computing. It was also able to identify which organizations have been more successful in retaining talent, as well as how much "employee expertise" tends to move around between organizations.

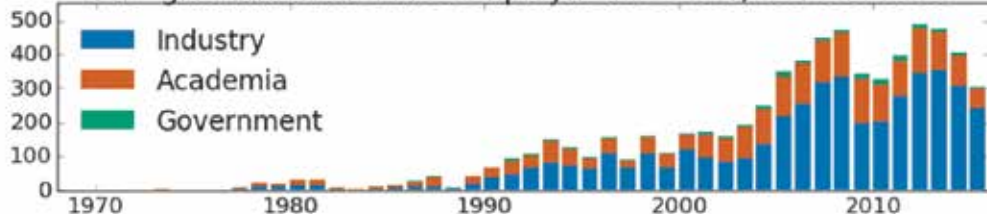
"This work is a starting point for large-scale studies of computing career trajectories," the researchers say in their findings. "Such analyses are becoming crucial as demand for computing expertise grows and our world increasingly depends on research innovations in computer science."

This project opens up many opportunities to take the study deeper. Future investigations could tackle broader data, capturing the many important researchers with PhDs from other countries or without PhDs at all. Insights can also be gleaned by comparing different sub-groups in the field, like researchers from different continents or countries, those with or without a postdoc, and historically underrepresented groups in computing.

Koutra and Safavi's career network model is able to identify organizations that produce and attract the most researchers over time, designating them "hubs" and "authorities," respectively.



PhD graduation and first employment sector, 1970 to 2015



The researchers collected a large new dataset for this study, covering the career movements of computing PhDs over the course of 45 years.



Algorithm Detects Disease by Analyzing Speech

In an advance that could one day provide new insight into neurological diseases like Huntington's disease (HD), Alzheimer's, and Parkinson's, researchers have demonstrated the first automated system that uses speech analysis to detect patients with HD.

A team of U-M and Michigan Medicine researchers including Prof. Emily Mower Provost demonstrated that the system, which uses a custom-designed algorithm to analyze a recording of a pre-selected

passage, can effectively diagnose HD. A new paper, published in the journal *Interspeech*, showed that it can successfully detect HD 81% of the time.

The work could power future systems that monitor patients continuously, providing doctors and researchers with far more detailed information than is available today. That information could help doctors improve patients' quality of life by providing more finely customized treatments, and it could help researchers find new ways to fight neurological diseases. There currently is no cure for HD, which affects approximately 30,000 Americans, with 200,000 more facing a genetic risk of developing the disease.

Speech analysis is already used to track the progression of HD, but it's an expensive and time-consuming process that requires patients to visit a clinic and record speech for manual analysis. Mower Provost says an automated system would be a vast improvement.

"Analysis that takes place in a clinic can only provide infrequent snapshots into the severity of a patient's disease," she said. "An automated system could be deployed at scale, providing doctors with fine-grained assessments of symptom changes."

Automated speech recognition systems are common today, but Mower Provost explains that off-the-shelf systems can't be used for HD patients because their algorithms are trained on healthy people. So, the team created their own algorithmic model that can transcribe the unique speech patterns of HD patients, then used the system to create a set of measures that were useful for predicting HD.

The key, said Mower Provost, was combining algorithmic expertise with a deep clinical understanding of the disease.

Undocumented Immigrants' Privacy at Risk Online, on Phones

Every day, undocumented immigrants in the U.S. face discrimination, surveillance, deportation, and other dangers. So, they're careful: limiting contact with authorities, keeping close-knit circles, and avoiding loitering.

But when it comes to their smartphones, immigrants struggle to apply this instinctive caution, according to a study by a team of University of Michigan researchers that included CSE PhD student Allison McDonald.

The study, "Keeping a Low Profile? Technology, Risk and Privacy among Undocumented Immigrants," provides insights into this community's technology use practices. It identifies several reasons why online privacy concerns may not be a priority.

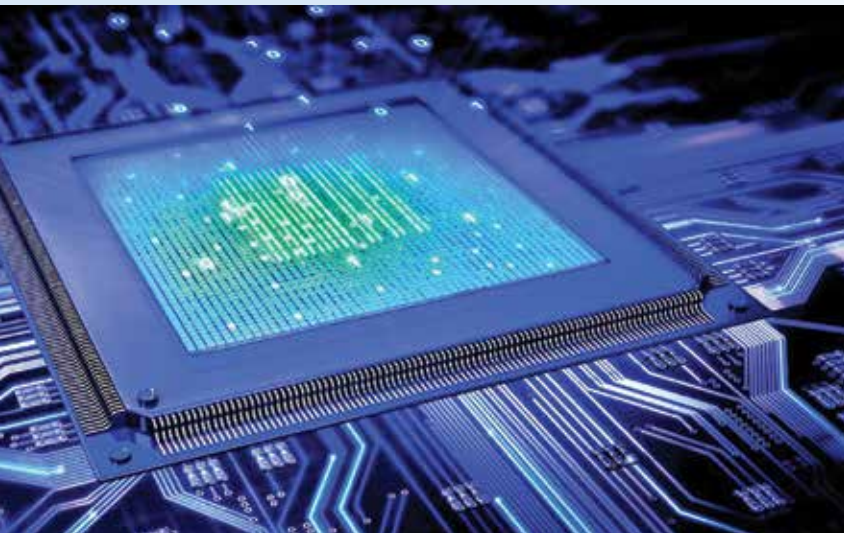
First, smartphones and social media provide them "indispensable benefits," according to the study, while any potential risks are vague. In addition, trust in major social media platforms and peers is high, leading to limited perceptions of online risks. Finally, these immigrants believe the government already knows a lot about them, so it caused them not to worry too much about online privacy. Meanwhile, "U.S. authorities are rapidly building up their tech-enabled surveillance and detention tools."

"Even minor decisions, such as the use of phone numbers as account identifiers, can substantially affect the exposure risk of vulnerable communities," according to the study.

The study's results pinpoint possible ways to mitigate the online privacy issue for undocumented immigrants, including community training that emphasizes privacy and security, designing more explicit privacy controls, and more research into ways to hide information on demand. Research on increasing awareness and accurate understanding of information flows would also benefit the immigrants – and all internet users.

This study was chosen as a "Best Paper of CHI 2018" at the *ACM CHI Conference on Human Factors in Computing Systems*.





BEYOND

EECS FACULTY ARE LEADING SEVERAL NEW DARPA PROJECTS AIMED AT THE FUTURE OF MICROELECTRONICS AS MOORE'S LAW, WHICH PREDICTED A DOUBLING OF TRANSISTORS ON A CHIP EVERY TWO YEARS, COMES TO ITS INEVITABLE END.

THE NEW PROJECTS ARE FUNDED UNDER DARPA'S ELECTRONICS RESURGENCE INITIATIVE.

\$9.5M to Design a Reconfigurable Computer

The looming threat of diminishing returns on computer chip improvements has inspired solutions from many different fronts, changing the way we think of computer hardware design. One popular technique, called application-specific integrated circuits (ASICs), has offered significant performance boosts to many key computing areas by designing hardware uniquely outfitted to handle certain tasks. But these ICs trade away all the flexibility of CPUs or GPUs (graphics processing units) for that performance boost.

In search of a better way, Prof. Ron Dreslinski is leading a team that includes Profs. David Blaauw, Hun-Seok Kim, and Trevor Mudge with a \$9.5M DARPA grant to develop a hardware architecture and software ecosystem that together can approach the power of ASICs with the flexibility of a CPU. Called Transmuter, this "software-defined hardware" can change how programs use the hardware available to them in real time, effectively acting as a reconfigurable computer.

To take on the shortcomings of ASICs and CPUs, Transmuter offers a reconfigurable approach. The system would use a run-time to monitor an application's behavior and adapt to any new demands – altering how hardware is used for better load balancing and changing how it handles data with new characteristics, for example. The software would be able to adapt the hardware as applications are running, making changes to processor interconnect speeds, connectivity, and arbitration policies, as well as processor use to allow for power-saving measures.

A reconfigurable system allows designers to create a wide range of tailored configurations for specific workloads, while maintaining the flexibility and coding efficiency we are used to with today's CPUs and GPUs.

— Ron Dreslinski

"A reconfigurable system allows designers to create a wide range of tailored configurations for specific workloads, while maintaining the flexibility and coding efficiency we are used to with today's CPUs and GPUs," says Dreslinski.

With this smart balancing of available hardware and application demands, the team expects Transmuter to offer unprecedented energy efficiency and a raw performance two orders of magnitude better than today's CPUs, and within an order of magnitude of ASIC designs. The system will be optimized for data intensive algorithms, like image and video understanding and graph analytics.

Next-generation Hardware Design Tools

To fuel innovation among small teams and startups and allow them to design and produce complex chips with ease, EECS researchers are participating in a national program that aims to build free, open-source electronic design automation tools.

"The project [named Foundations and Realization of Open and Accessible Design (OpenROAD)] makes design of really complex chips and system-on-chips feasible for a smaller design team," said Prof. Dennis Sylvester, Associate Director of the overall project and leader of the University Design subteam.

University of California San Diego leads the OpenROAD project, which includes as additional collaborators: University of Illinois, University of Minnesota, University of Texas at Dallas, Brown University, Qualcomm, and Arm, a multinational semiconductor and software design company.

The U-M team, which includes Sylvester, David Blaauw, and Ronald Dreslinski, will test the design tools and provide feedback once the partner organizations develop the OpenROAD tools. OpenROAD developers can then utilize the Michigan team's process to create a streamlined tool that will be open-source and free, helping small companies and teams avoid the complexity and cost of commercial design tools.

MOORE'S LAW

Automated Circuit Design in 24 Hours

In a \$6.5M project led by Prof. David Wentzloff, researchers will work to create an open-source hardware compiler that aims to reduce the six-month process of hand-designing analog circuits to a dramatically faster and automated 24-hour routine. The project could revolutionize and democratize designing hardware devices.

"The goal is to do for hardware what open-source compilers have done for software," said Wentzloff. "Someone could download a free suite of tools, specify the design of virtually any widget, and have that design produced in 24 hours without any knowledge of hardware."

The goal is to do for hardware what open-source compilers have done for software. Someone could download a free suite of tools, specify the design of virtually any widget, and have that design produced in 24 hours without any knowledge of hardware.

— David Wentzloff

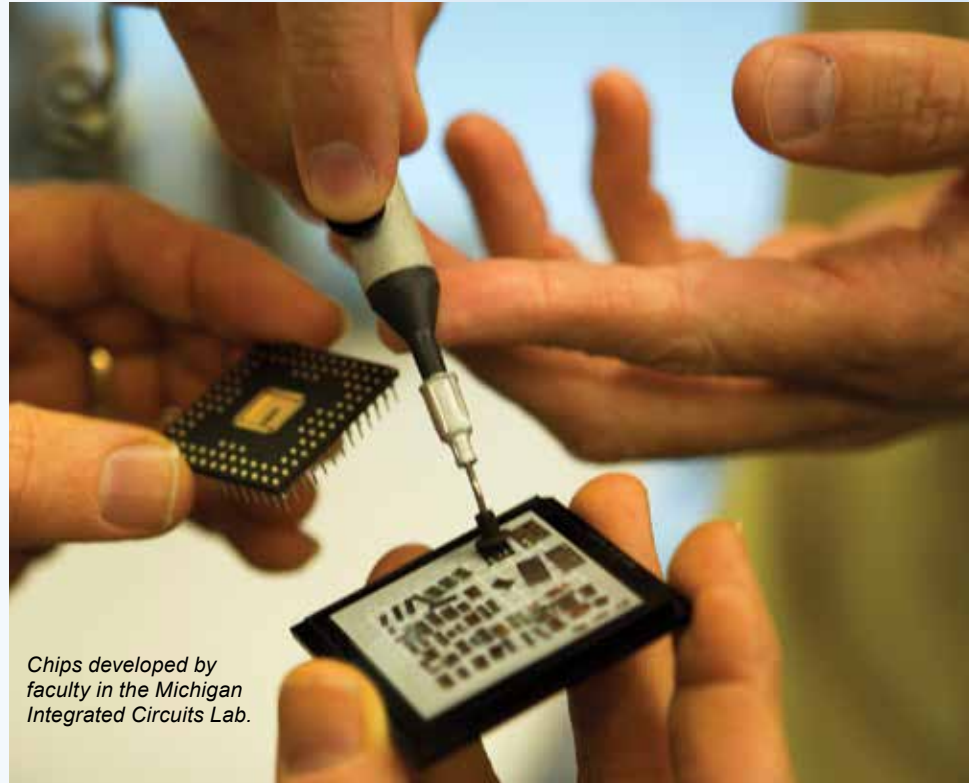
The project, "Fully-Autonomous System on Chip (SoC) Synthesis using Customizable Cell-Based Synthesizable Analog Circuits," includes Profs. David Blaauw, Ronald Dreslinski, and Dennis Sylvester; Ben Calhoun of the University of Virginia, and Arm.

"Our approach is to essentially convert the design of an analog block into a digital flow, so you can take advantage of the digital tools," Wentzloff said.

A Hybrid Chip for Intelligent Systems

Prof. Hun-Seok Kim is leading a \$5.2M project to develop a new type of system-on-chip (SoC) that mixes together the adaptability of general purpose processors with the efficiency of specialized processors, allowing for demanding applications such as highly intelligent wireless communication systems used in radar and swarms of autonomous devices.

This hybrid SoC, the Domain-Focused Advanced Software-Reconfigurable Heterogeneous System on Chip (DASH-SoC), could allow for a unified, accurate, and reliable wireless



Chips developed by faculty in the Michigan Integrated Circuits Lab.

communication design that adapts to environments and needs through changes in software instead of hardware.

This project is part of the overall program lead by Arizona State University, and also includes University of Arizona, Carnegie Mellon University, Arm, General Dynamics, and EpiSys Science. Profs. David Blaauw, Ron Dreslinski, and Trevor Mudge are also working with Kim.

"We want to demystify this notion that there's a fundamental tradeoff between flexibility and efficiency," Kim said. "This new system will demonstrate that you can design an SoC that is not only flexible but also efficient."

With this new hybrid chip, the same chip developed for wireless communications will also be adept with machine learning tasks, like image or audio classification.

We want to demystify this notion that there's a fundamental tradeoff between flexibility and efficiency. This new system will demonstrate that you can design an SoC that is not only flexible but also efficient.

— Hun-Seok Kim

M³ UPDATE

An Even Smaller World's Smallest 'Computer' Developed to Help Detect and Treat Cancer

IBM's announcement that they had produced the world's smallest computer back in March of 2018 raised a few eyebrows at the University of Michigan, home of the previous champion of tiny computing.

Now, the Michigan team has gone even smaller, with a device that measures just 0.3 mm to a side – dwarfed by a grain of rice. This feat of engineering was necessary in order to insert the device into living tissue to detect the temperature of tumors.

Because they are too small to have conventional radio antennae, these tiny devices receive and transmit data with visible light. A base station provides light for power and programming, and it receives the data.

One of the big challenges in making a computer this small was how to run at very low power when the system packaging had to be transparent. The light from the base station – and from the device's own transmission LED – can induce currents in its tiny circuits.

"We basically had to invent new ways of approaching circuit design that would be equally low power but could also tolerate light," Blaauw said.

Another challenge was achieving high accuracy while running on low power, which makes many of the usual electrical signals (like charge, current, and voltage) noisier.



The Michigan Micro Mote (M³) next to a grain of rice.

The system is very flexible and could be reimagined for a variety of purposes, but the team chose precision temperature measurements because of a need in oncology. Their longstanding collaborator, Gary Luker, a professor of radiology and biomedical engineering, wants to answer questions about temperature in tumors.

Some studies suggest that tumors run hotter than normal tissue, but the data isn't solid enough for confidence on the issue. Temperature may also help in evaluating cancer treatments.

But are these even computers?

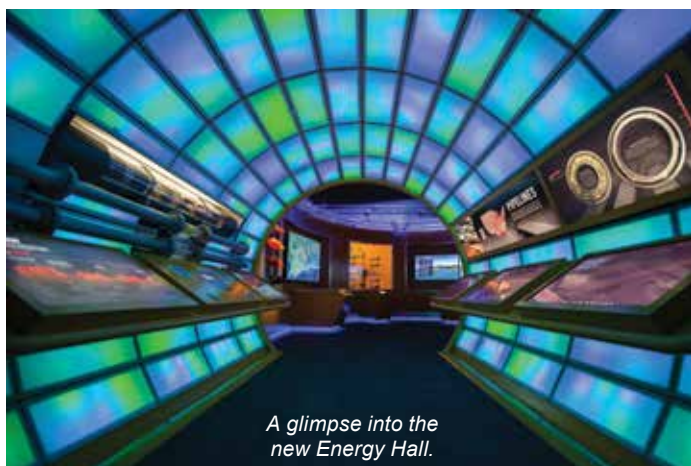
Unplug a desktop computer, and its program and data are still there when it boots itself up once the power is back. However, these new microdevices lose all prior programming and data as soon as they lose power.

"We are not sure if they should be called computers or not. It's more of a matter of opinion whether they have the minimum functionality required," said Prof. David Blaauw, who led the development of the new system together with Prof. Dennis Sylvester and more recently, Prof. Jamie Phillips.

Whatever they are called, these marvels of engineering continue to attract the attention of researchers from many different fields because of their size and versatility.

Pumped Into Oil Wells, and on Display at Houston Museum of Natural Science

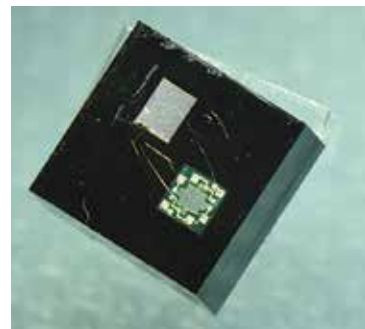
The Michigan Micro Mote (M³) is being featured for its role in oil exploration as part of a new exhibit at the Houston Museum of Natural Science.



A glimpse into the new Energy Hall.

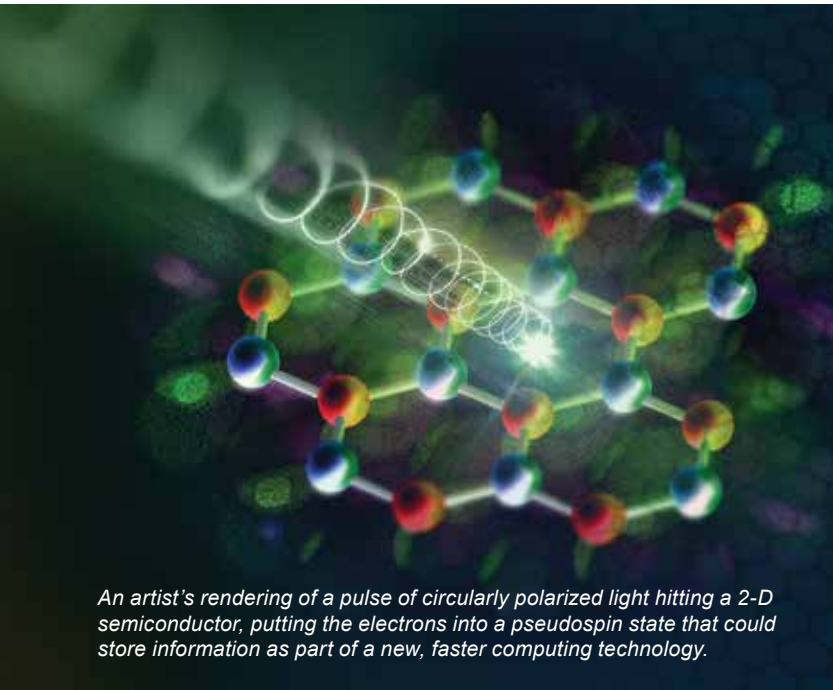
The computers are being pumped into oil wells and travel through machinery without damaging the drilling equipment. Sensors on the computers measure and log temperatures and pressures, which can help oil companies monitor the dynamic production conditions.

"It's the very worst place on earth to put electronic equipment," says David Blaauw, who is leading the project. "It's extremely hot, it's very high pressure, and it tends to have brine – a very aggressive salt mixture. If any of that hits your electronics, they will die."



A packaged Michigan Micro Mote sensing computer, measuring 5mm x 5mm, for use in oil wells.

Using Light to Make Computers Go Quantum



A technique to manipulate electrons with light could bring quantum computing up to room temperature, and make them super fast!

A team of researchers including U-M professor Mack Kira and University of Regensburg professor Rupert Huber have demonstrated how infrared laser pulses can shift electrons between two different states, the classic 1 and 0, in a thin sheet of semiconductor.

"Ordinary electronics are in the range of gigahertz, one billion operations per second. This method is a million times faster," said Kira.

Quantum computing could solve problems that take too long on conventional computers, advancing areas such as artificial intelligence, weather forecasting, and drug design.

Quantum computers get their power from the way that their quantum-mechanical bits, or qubits, aren't merely 1s or 0s, but they can be mixtures – known as superpositions – of these states. To utilize the extremely fragile quantum states of the qubits, the new study demonstrates a way to do the processing before the states fall apart.

The team prodded electrons into these states with quick pulses of infrared light, lasting just a few femtoseconds (quintillionths of a second). The initial pulse has its own spin, known as circular polarization, that sends electrons into one pseudospin state. Then, pulses of light that don't have a spin (linearly polarized) can push the electrons from one pseudospin to the other and back again. By treating these states as ordinary 1 and 0, it could be possible to create a new kind of "lightwave" computer with clock speeds that are a million times faster than seen in today's computers.

Teaching Machines to Predict the Future

A new type of neural network made with memristors can dramatically improve the efficiency of teaching machines to think like humans. The network, called a reservoir computing system and being developed by Prof. Wei Lu, could predict words before they are said during conversation, and help predict future outcomes based on the present.

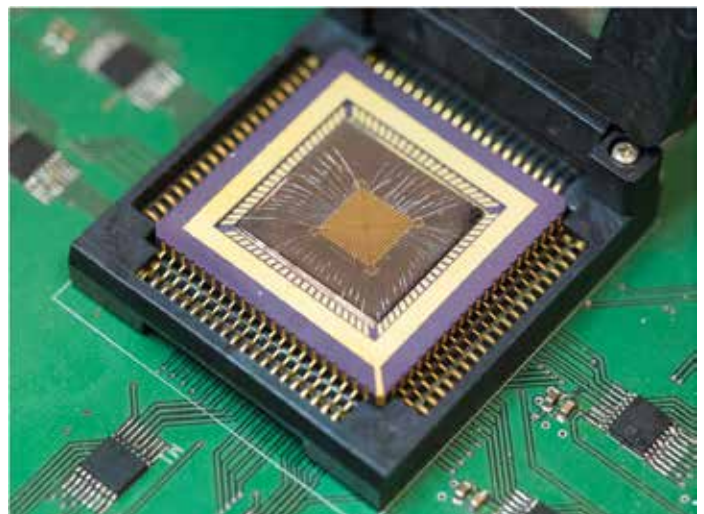
Reservoir computing systems, which improve on a typical neural network's capacity and reduce the required training time, have been created in the past with larger optical components. However, Lu's group created their system using memristors, which require less space and can be integrated more easily into existing silicon-based electronics.

Memristors are a special type of resistive device that can both perform logic and store data. This contrasts with typical computer systems, where processors perform logic separate from memory modules. In this study, Lu's team used a special memristor that memorizes events only in the near history.

Lu plans on exploring two future paths with this research: speech recognition and predictive analysis.

"We can make predictions on natural spoken language, so you don't even have to say the full word," explains Lu. "We could actually predict what you plan to say next."

In predictive analysis, Lu hopes to use the system to take in signals with noise, like static from far-off radio stations, and produce a cleaner stream of data. "It could also predict and generate an output signal even if the input stopped," he says.



The memristor that powers the reservoir computing system.

A Shoe-box-sized Chemical Detector

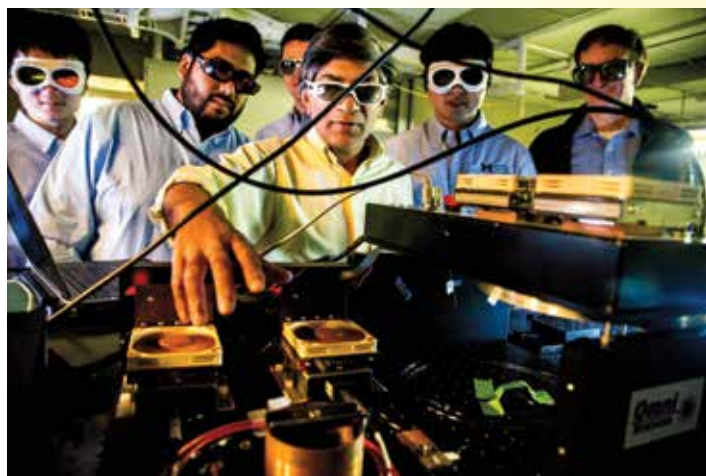
Profs. Mohammed Islam and Fred Terry have been part of a team that developed a chemical sensor prototype that will be able to detect “single-fingerprint quantities” of substances from a distance of more than 100 feet away. They are now working to shrink it to the size of a shoebox.

The project is a collaboration among U-M, global technology company Leidos, fiber makers IRflex and CorActive, and U-M startup Omni Sciences, which was founded by Islam.

The detector could potentially be used to identify traces of drugs and explosives, as well as speeding the analysis of certain medical samples. A portable infrared chemical sensor could be mounted on a drone or carried by users such as doctors, police, border officials, and soldiers. Similar detectors currently in operation need to be much closer to the substance being sensed.

The sensor is made possible by a new optical-fiber-based laser that combines high power with a beam that covers a broad band of infrared frequencies. Islam and his team built their device with off-the-shelf fiber optics and telecommunications components, plus one custom-made optical fiber.

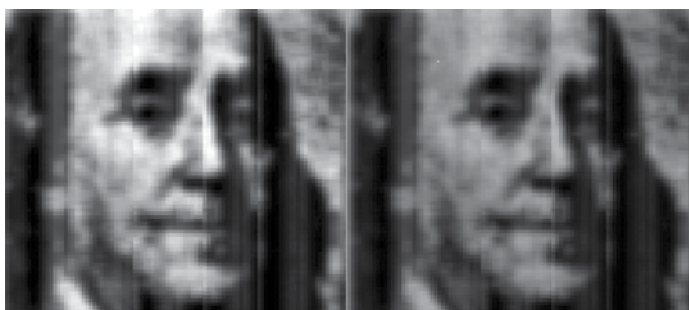
“We’ve shown we can make a \$10,000 laser that can do everything a \$60,000 laser can do,” said Islam.



To use the device, the researchers shine the laser on an object and analyze the reflected light to identify what wavelengths did not bounce back. They can identify chemicals by the unique pattern of infrared wavelengths that they absorb. The team successfully analyzed 70 mystery samples over two days of testing.

Islam sees a promising future for the technology in medicine, where the laser could provide an immediate assessment of the chemical content of tissue samples, or even analyze tissue in the body.

Solar Cells Enable Self-powered Camera



Images from a University of Michigan's self-powered sensor were captured at 7.5 frames per second [left] and 15 frames per second [right].

By combining an image sensor with solar cells, Prof. Euisik Yoon and post-doctoral researcher Sung-Yun Park developed a solar-powered camera that can capture 15 images per second, powered only by daylight.

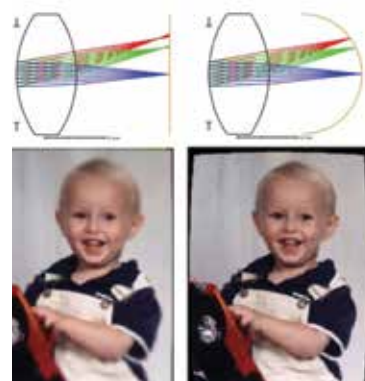
As opposed to previous attempts at self-powered image sensors, Yoon and Park's approach layers the photovoltaic cell beneath the photodetector. This allows the photodetector to capture as many photons as it can, and the photovoltaic cell collects the rest and converts them to electricity.

With this technology, Yoon says this could put a “small camera, almost invisible, anywhere.”

A More Natural Imaging System

The visual system of mammals, with its curved retina, is regarded as an ideal imaging system due to its wide field of view, low aberration, and low f-number. A camera with a similar curved image surface could provide numerous advantages to existing technology, such as a wider field of view, fewer optical errors, and fewer optical lens components – leading to cheaper and lighter camera systems. However, making the sensor array in a curved surface has been regarded as challenging technology due to the difficulty of the development of unconventional fabrication methods.

Prof. Jerzy Kanicki and Dr. Hyunsoo Kim (PHD ECE 2107) developed a method to enable an organic photo-sensor array on a hemispherical surface, using 3D printing technology for the electrode patterning of the array. The hemispherical sensor array can allow for novel imaging systems on curved substrates, such as artificial human eyes. The technology could also be used in X-ray imagers for breast cancer detection.



Effectiveness of the curved imager (left: image on flat FPA; right: image on curved array).

TECH TRANSFER

With a focus on startup companies spun-off from technology developed by faculty and students in the EECS Department.

May Mobility is Spearheading Short-Distance Autonomous Driving



Solving the “last mile” problem is a transportation dilemma for cities large and small, even those with existing mass transit systems.

May Mobility, an Ann Arbor-based startup co-founded by Prof. Edwin Olson in 2017, has developed a solution for this challenge – a fleet of low-speed, autonomous public transit vehicles planned for business districts, corporate and college campuses, medical facilities, and other communities across the country.

To make this vision a reality, May licensed five key autonomous driving related technologies from U-M, all developed in Prof. Olson’s lab. “Getting our cars on public roads within our first months of operation couldn’t have happened without this relationship with U-M,” said Prof. Olson. “It’s a good demonstration of how academia and industry can work together.”

The approach is paying off: In late 2017, May partnered with Detroit property-management firm Bedrock to run a pilot demonstration of its vehicles on Detroit city streets. In June 2018, May continued its partnership with Bedrock, putting its vehicles into actual daily use in downtown Detroit and replacing some of the buses that Bedrock had previously hired to move their employees between offices and parking sites.

May’s shuttles rely on the same technology as virtually every other company developing self-driving cars: a redundant suite of lidar, radar, and camera sensors. It adds radio frequency signals embedded in street lights or signs along the route to provide an added measure of safety. That vehicle-to-infrastructure technology will be critical to future transportation, but May can deploy it now, block-by-block, because it operates only on very short routes.

May’s progress has not gone unnoticed by investors. In January 2018, May attracted \$11.6M in funding from private donors along with local and Silicon Valley venture capital funds such as Maven, Tandem Capital, and Trucks Venture Capital. Bryce Pilz, director of licensing at U-M Tech Transfer, said the average startup in Michigan takes over four years to raise its first \$500,000 in financing, but May raised a significant seed round essentially at inception.

A month later, May announced that BMW i Ventures and Toyota AI Ventures had joined its investor-base, co-leading its seed round. This funding will allow May Mobility to launch additional new deployments across the country. In a statement, BMW i Ventures said, “We invested in the team because they’re reducing the complexity of the problem to actually deliver autonomous mobility now, instead of years from now, and the feedback loop will be invaluable to the future of the industry.”

Olson says that what sets May Mobility apart is that it’s not trying to go after the entire transportation market.

“That’s a great market, but we believe it could take 5 to 10 years for the technology to catch up,” Olson said. “We think that by starting with right-sized transportation in controlled environments we can build a successful company, have vehicles on roads in the real world first, and turn on the spigot of data and operational knowledge that will help us improve our systems faster than the car companies still in R&D mode.”

Internet-scanning Startup Pioneers New Approach to Cybersecurity

Rolling out what it's calling a "street view for cyberspace," new Ann Arbor tech startup Censys has launched the first commercially available internet-wide scanning tool.

Based on technology developed in the lab of Prof. J. Alex Halderman, Censys continuously scans the internet or a specified domain, analyzing every publicly visible server and device. It uses the data that comes back to create a dynamic, searchable snapshot of the entire internet.

Company founders, which include Prof. Halderman, his former student Zakir Durumeric (PhD CSE 2017), and CSE graduate student David Adrian, hope that Censys will become an important cybersecurity defense tool for IT experts working to secure large networks that are composed of a constantly changing array of devices ranging from servers to smart-phones and internet-of-things devices.

Censys has been available for free to non-commercial users since it began as a U-M research project in 2015. During that time, it's been used in hundreds of peer-reviewed studies and helped researchers better understand some of the most significant internet security threats of recent years. Censys became available to commercial customers in early 2018.



Prof. J. Alex Halderman, seated, and Dr. Zakir Durumeric.

AI Startup Cline on a Growth Curve to Meet Smart Banking Needs

Cline, the Ann Arbor-based artificial intelligence company co-founded by Profs. Jason Mars and Lingjia Tang along with their former students Johann Hauswald (PhD CSE 2017, MS CSE 2015, BSE EE 2013) and Michael Laurenzano (PhD CSE 2016), is going gangbusters.

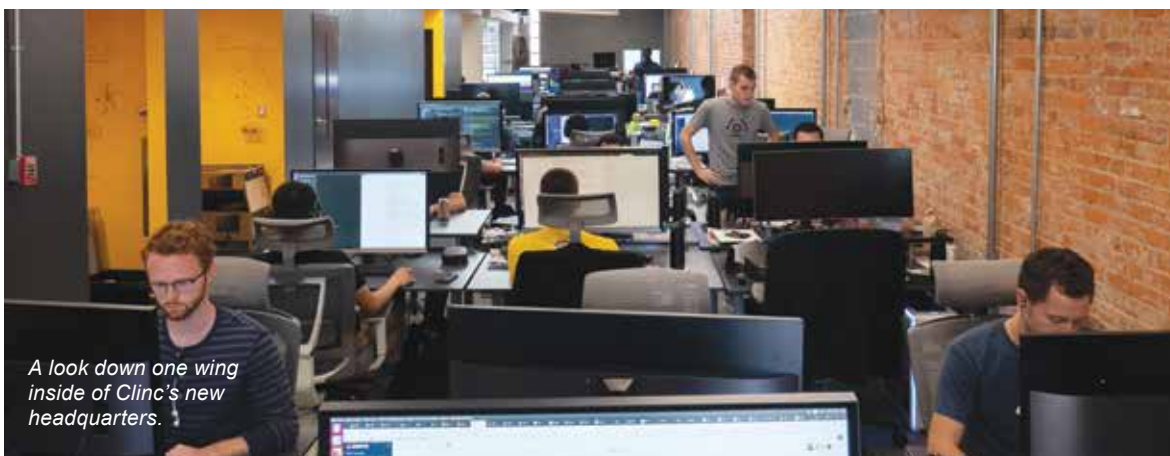
Cline is a provider of conversational AI technology, and has developed products that specifically address the needs of financial institutions. This includes Finie, a personal intelligent assistant (PIA) for personal banking, and Spotlight, a self-service conversational AI training platform.

Spotlight removes the complexity from conversational AI design and development by making it easier for their customers' in-house tech teams to use and customize sophisticated and complex systems. It leverages Cline's novel machine learning infrastructure and technology to build unprecedented conversational AI experiences.

Major financial institutions around the world have responded to Cline's product offering and vision for conversational banking, resulting in breakneck growth for the company.

In the first half of 2018, Cline doubled its headcount and moved into a new, larger headquarters in downtown Ann Arbor. Amongst the new employees is Helen Yu, Cline's first Chief Growth Officer.

In addition to its Ann Arbor headquarters, Cline has an R&D office in San Francisco and has recently opened an office in London, where it has launched a large-scale deployment with a top-three bank in the UK. Cline now has deployments on five continents.

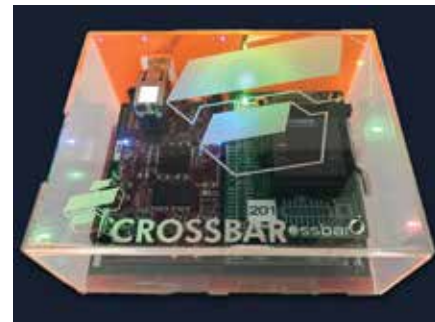


A look down one wing inside of Cline's new headquarters.

Crossbar ReRAM Technology Enabling AI

Crossbar, Inc., founded in 2010 by Prof. Wei Lu, announced an agreement May 2018 to license its ReRAM technology for artificial intelligence to Microsemi Corporation, the largest U.S. commercial supplier of military and aerospace semiconductors.

As part of the agreement, Microsemi and Crossbar will collaborate in the research, development, and application of Crossbar's proprietary ReRAM technology in next-generation products from Microsemi that integrate Crossbar's embedded ReRAM with Microsemi products manufactured at the 1x nm process node.



"The biggest challenge facing engineers for AI today is overcoming the memory speed and power bottleneck in the current architecture to get faster data access while lowering the energy cost," said Sylvain Dubois, Crossbar's VP of business development and strategic marketing, in a press release. "By enabling a new, memory-centric non-volatile architecture like ReRAM, the entire trained model or knowledge base can be on-chip, connected directly to the neural network with the potential to achieve massive energy savings and performance improvements, resulting in a greatly improved battery life and a better user experience."

Also in the news, Crossbar made the list of the key players in the 2018 Global Non-Volatile Memory Market Professional Survey Report.

Crossbar's ReRAM technology enables kilobytes to terabytes of always-on data storage to be embedded into any processor, microcontroller, FPGA, or as a standalone memory chip.

VOXEL[51] AI for Video

Voxel51 LLC, co-founded in 2016 by Prof. Jason Corso and alumnus Brian Moore (PHD Electrical Engineering:Systems 2017), focuses on providing a customizable cloud platform for computer vision and machine learning in the cloud. They are a leading early-stage AI startup, based in Ann Arbor.

Current applications include public safety and automotive sensing. The company's mission is to enable people and organizations to best use their video resources to make exceptional decisions.

Their PersonSense technology is the only widely available analytic for recognizing human action in video. In public safety settings, PersonSense is used as an early alert mechanism for recognizing possible public danger. In automotive settings, PersonSense is used to help autonomous and ADAS vehicles predict motion and activity of pedestrians to avoid accidents. Coupled with their CitySense technology, Voxel51 provides a suite of customizable state-of-the-art analytics for city-level forensics. They are working with major police departments, such as Baltimore City, to bring these tools to the benefit of society.

Their RoadSense technology detects and recognizes roadway infrastructure details in both urban and highway settings. This includes road signs and signals, intersections, lanes, and painted markings. It can also detect vehicles, perform fine-grained recognition such as make, model, and color classification, and recognize vehicle density and behaviors.

In 2017, the company received a \$1.25M grant for the project "ETA: Extensible Tools for Analytics in Public Safety" from the National Institute of Standards and Technology (NIST). These NIST grants were awarded on the basis of their ability to advance broadband communications technologies for first responders by supporting the migration of data, video, and voice communications from mobile radio to a nationwide public safety broadband network.

Voxel51 is based in Ann Arbor, MI, and is currently hiring!
<https://voxel51.com>

Turbocharged Genetic Sequencing

The emerging field of genomic analysis is on the cusp of revolutionizing the understanding of diseases and the methods for their treatment and prevention.

However, current DNA analysis is restricted to using limited data due to the large time and cost for Whole Genome Sequencing (WGS), restricting progress. As biochemical sequencing is getting faster and cheaper, the bottleneck is the analysis of the large volumes of data generated by these technologies. Faster and cheaper computational processing is required to make genomic analysis available for the masses.

Founded by Prof. Scott Mahlke and his former students Mehrzad Samadi (PhD CSE 2014) and Ankit Sethia (MSE PhD CSE 2011, 2015), Ann Arbor-based Parabricks employs proprietary high-performance computing techniques to dramatically accelerate WGS, shortening tasks that took multiple days to a single hour while generating fully equivalent output. Parabricks software integrates seamlessly with state-of-the-art deep learning techniques, enabling users to focus on extracting insights from data.

"Parabricks harnesses the computing horsepower of graphics processing units to accelerate the time for whole genome sequencing by a factor of 30-40 times," says Prof. Mahlke. "WGS used to be very expensive and painfully slow, but with great advances in sequencer platforms and Parabricks software, it is cheaper and faster than ever which is paving the way for the precision medicine revolution."



A New Company, Omniscent, is Sniffing Out Dangerous Levels of Toxic Chemicals in the Air

Omniscent, a startup founded in 2016 by Michigan researchers and alumni, is helping its first customers in Michigan and California test for air-borne toxic compounds.

The company is able to identify and measure air pollutants such as benzene and toluene more quickly and inexpensively than current technology while keeping customers informed of changing conditions at a moment's notice.

Benzene, for example, is a volatile organic compound (VOC) that is a known carcinogen. It is present in gasoline and vehicle exhaust, and it is used in the production of plastics, resins, rubber, and other materials. Toluene is another common VOC that is not only carcinogenic but also causes central nervous system dysfunction. It is found in cigarette smoke, paint, and household cleaners.

The presence of benzene in gasoline led to its strict regulation by the EPA in 2007, and now the EPA is requiring the monitoring of benzene at the perimeter of refineries as well. However, companies haven't had an affordable and effective way to monitor VOCs in real time – until now.

"The conventional solution is to sample air for weeks at a time and manually send the samples to a lab for testing," said Yogesh Gianchandani, CTO and co-founder of Omniscent and professor of Electrical and Computer Engineering. "It's very expensive, so companies can't test as frequently or in a way that's widespread. Our system does the analysis on location and feeds the data immediately to the cloud. That's truly transformative."

"Omniscent is a data company founded on the basis of unique hardware," added Gianchandani. "Our customers don't need ownership of the hardware – what they need is the data, or even more importantly, actionable information."

After strategically placing systems to detect VOCs, Omniscent systems and software take the measurements and process the data constantly, allowing

the customer to view pollutant levels on demand.

The systems are connected to the internet with Wi-Fi or cellular technology and controlled by a software interface that is available on almost any smartphone, computer, or tablet. The systems can be grouped in zones, and networked and controlled from anywhere in the world. And for the first time, users are able to see how the concentration of VOCs changes over the course of minutes or hours.

"Our autonomous system not only saves a company time and money, it offers continuous monitoring of air quality to ensure the safety of workers and the general public," said CEO and co-founder Sassan Teymouri. "It helps both technical users and management."

Early adopters in Michigan and California are currently testing the product.

"To see our technology up and running is very exciting for us," said Gianchandani.

The VOC-sensing system, initiated as part of the NSF Engineering Research Center in Wireless integrated Microsystems (WIMS) and continued in WIMS² (Center for Wireless Integrated Micro-Sensing & Systems), has been nearly 20 years in the making.

Dr. Yutao Qin, co-founder and Chief Sensor Architect at Omniscent and currently Assistant Research Scientist of Electrical and Computer Engineering, has been the key developer of the sensing system, a miniaturized gas chromatograph. The first three versions were developed during the course of his PhD studies with Gianchandani.

The Omniscent system reduces benchtop-sized hardware that normally requires operation by expert users in an air-conditioned laboratory to a completely autonomous system that is usable outdoors and is about the size of a small birdhouse.

The current version of the Omniscent system can identify and measure about 20 VOCs, although the equipment is

tailored to the needs of each type of customer. "This number can easily double over time," says Gianchandani.

"Omniscent is well-positioned for a great future," says Jan Willem Poelmann, technical advisor to Omniscent and former senior vice president of sales and



Omniscent sensing device.

marketing for Picarro, Inc., which also provides systems that measure pollutants. "Users in industries like chemical, pharmaceutical, oil & gas and air quality have been waiting for a robust, simple, and reliable solution."

While the first users are industrial, Gianchandani anticipates that others could benefit from a real-time VOC sensor.

"I'm sure that new applications will emerge," said Gianchandani. "There are citizen groups, city administrators, and health care professionals, for example, who will want to use this."

Teymouri (BSE MSE EE '81 '83), Gianchandani (PHD EE '94), and Qin (MS PHD EE '12 '15) are alumni of ECE.

DEPARTMENT NEWS

MINGYAN LIU NAMED CHAIR OF ELECTRICAL AND COMPUTER ENGINEERING

Mingyan Liu, professor and entrepreneur specializing in communication networks and predictive analytics, has been named the Peter and Evelyn Fuss Chair of Electrical and Computer Engineering (ECE), effective September 1, 2018.

“Mingyan’s wide range of academic experiences and achievements will be invaluable,” said Alec D. Gallimore, the Robert J. Vlasic Dean of Engineering. “I look forward to her innovative and inclusive leadership.”

Prof. Liu conducts research in the broad area of communication networks. Her most recent research activities involve wireless, mobile, ad hoc, and sensor networks; online learning; modeling and mining of large scale internet measurement data; incentive mechanisms for cyber security; and connected vehicle technologies.

She developed with her colleagues a predictive analytics framework that uses machine learning to estimate an organization’s likelihood of having a material data breach in the near future, and seeing real market potential, co-founded the company QuadMetrics in 2014. Within just two years, the company was acquired by analytic software company FICO.

Collaborating with faculty in electromagnetics, Liu developed a smart wireless sensor network to measure soil moisture. Soil moisture is used in all water and energy balance models, weather prediction models, and ecosystem process simulation models. She’s also worked on infrastructure monitoring with her colleagues in circuits and the Department of Civil and Environmental Engineering.

Liu is currently PI of a new \$6.25M Multidisciplinary Research Initiative Program (MURI) to develop tools to understand and shape online and on-the-ground networks that drive strategic interactions and decision making.

This collaborative and interdisciplinary approach to engineering is core to ECE today, says Liu.

“Our faculty are uniquely positioned and are actively pursuing some of the high-impact applications and emerging problems,” said Liu. “These areas include medical devices, photovoltaic materials, neuromorphic computation, and smart and connected systems.”



I’m excited to help advance all that our world-class faculty and students are doing in areas that are critical to society, including sustainable energy, information, and electronic devices for a wide range of applications that improve the human condition.

— Mingyan Liu

A Demo on How to Hack an Election

A row of voting machines purchased on eBay lined Tishman Hall, the very same equipment used today in many states – including Georgia, parts of Indiana, Kansas, Kentucky, Mississippi, Tennessee, Texas, Virginia, Florida, and Pennsylvania. Students were asked to cast ballots for the “greatest university” on these machines – choosing between Michigan and Ohio State.

Unbeknownst to the student voters, their votes weren’t going to do any good: the machines had already been hacked by Prof. J. Alex Halderman. An expert on election security, Prof. Halderman routinely hacks systems to demonstrate how vulnerable electronic voting actually is, previously turning a voting machine into a PacMan game and hacking a mock election in Washington, DC several years ago.

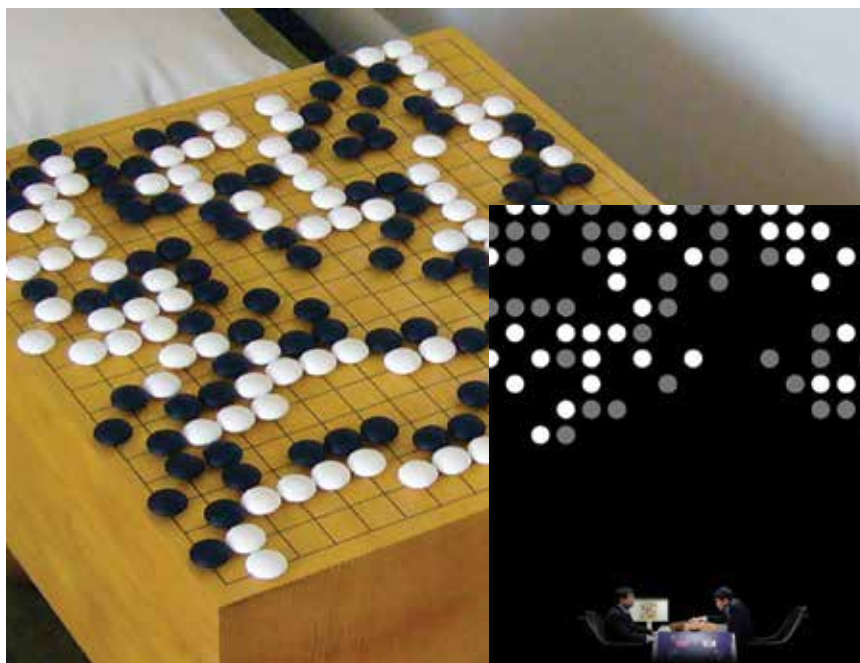
This demonstration, in which the voting machines behaved normally but which switched votes, was a part of Prof. Halderman’s collaboration with the *New York Times* to produce an opinion video on election security.

“I’m here to tell you that the electronic voting machines Americans got to solve the problem of voting integrity turned out to be an awful idea,” he says in the video. “That’s because people like me can hack them all too easily.”

Halderman has raised his voice on this issue at every opportunity, previously testifying before Congress on the matter. He says that while it’s promising that the Senate Intelligence Committee has recently shown some understanding of the problem, states must act too. He advocates for back-up paper ballots that could make true audits possible, an approach also supported by President Trump.



AlphaGo Science on Screen Event Leads Discussion on AI



On November 29, 2017, the CSE Division and the local Ann Arbor community turned out for a special screening of the documentary *AlphaGo* at downtown Ann Arbor’s Michigan Theater. The film was followed by a discussion on AI that was led by Prof. Satinder Singh Baveja.

AlphaGo documents the historic 2016 best-of-five-game competition, coined The DeepMind Challenge Match, between Lee Sedol, one of the world’s foremost Go masters, and a learning AI program called AlphaGo. Go, invented in China more than 2,500 years ago, is considered both the oldest and most complex board game.

Sedol was surprisingly bested by AlphaGo, and by the time of the Science on Screen event an even more advanced AI called AlphaGo Zero had been announced. Attendees participating in the discussion expressed both amazement and apprehension about the power of AI.

U-M Launches New Precision Health Research Initiative

The University of Michigan has launched a new initiative to harness campus-wide research aimed at finding personalized solutions to improve the health and wellness of individuals and communities.

Precision health brings together genomics with other big data. It involves taking millions of data points to understand what factors influence an individual's health and wellness. Researchers then apply that knowledge to make specific, personalized recommendations for prevention, diagnosis, and treatment.

Precision Health at the University of Michigan is about more than traditional personalized medicine. It takes a baseline of genomic and medical factors and incorporates data from sensors and wearables and weaves in social and environmental factors as well as behavior and lifestyle strategies.

Precision Health will focus on building capabilities, including data sets, tools and resources that researchers can use to facilitate collaborative work.

Eric Michielssen, PhD, Louise Ganiard Johnson Professor of Engineering and associate vice president for advanced research computing for the U-M Office of Research will be one of the three co-directors of the program. Michielssen, a computational scientist by training, coordinates research initiatives and educational programs in computational and data science across U-M's 19 schools and colleges. HV Jagadish, Bernard A. Galler Collegiate Professor of Electrical Engineering and Computer Science, is a member of the initiative's Faculty Advisory Committee.



ECE Launches ECE Innovator Program

The ECE Division has launched the ECE Innovator Program, which is aimed at inspiring and facilitating the commercialization of research conducted in ECE. The program will provide financial support to a team of entrepreneurs with both technical and product management skills.

The program acknowledges ECE as a hub of top-notch research and innovation that has led to significant commercialization of the intellectual property generated by its faculty and students. \$75K will be awarded to the winning team in 2018.

The ECE Innovator Program is made possible through a donation by ECE alumnus and serial entrepreneur Rick Bolander, Managing Director and co-founder of Gabriel Venture Partners and eLab Ventures. ECE has matched Bolander's donation to launch the program.

Mike Stander Receives College of Engineering Staff Excellence Award

Mike Stander received a 2018 College of Engineering Staff Excellence Award, recognizing 33 years of exceptional service to the Department of Electrical Engineering and Computer Science as a Hardware and Electronics Technician.

Standar has been the calm presence that gave hope to countless faculty and staff faced with a frozen computer screen or uncooperative printer. He was also the unseen hand behind countless well-functioning instruments and lab stations used in the EECS teaching labs.

Shortly after receiving his award, Mike retired from the University. He was honored with a retirement party attended by many current and former faculty, staff, and members of his family.



Photo of a small postman butterfly taken by Mike Stander, who is well-known for his landscape and nature photography.



Michael Stander, left, with Alec Gallimore, Dean of the College of Engineering.

Inaugural ECE Willie Hobbs Moore Alumni Lecture

In 2018, the ECE Division established the ECE Willie Hobbs Moore Alumni Lectureship to recognize ECE alumni from traditionally underrepresented groups who are leaders in their field and serve as role models through their leadership, impact on society, service to the community, or other contributions. The lecture series was established thanks to the leadership of Prof. Herbert Winful, with funds for the first lecture coming from the Rackham School of Graduate Studies.

Dr. Isaac Porche (PhD EE:S 1998), senior engineer at the RAND Corporation and Director of the Acquisition and Development Program in the Homeland Security Operational Analysis Center (HSOAC), was the first recipient of the lectureship. In his talk, "Information-Age Conflict," Porche talked about how the information age has changed and broadened how nation's conduct war. For more on Porche's thoughts, read his profile in the Alumni section on page 90.

Willie Hobbs Moore (1934-1994) made history as the first black woman to earn a BS and MS in Electrical Engineering (1958 and 1961) at Michigan, and the first black woman in the country to earn a PhD in physics. She did spectroscopic research on proteins at Michigan until 1977 before joining Ford as an assembly engineer. She expanded Ford's use of Japanese engineering and manufacturing methods. Porche, who also worked in the auto industry, said he felt honored to receive the award, and admired her as a trailblazer.



Dr. Isaac Porche (center) receives a commemorative award from Khalil Najafi, former ECE Chair, and Herbert Winful, who established the lectureship.



Careers in Electrical and Computer Engineering

Electrical and Computer Engineering prepares students to be leaders and tech wizards in a broad array of areas that directly impact today's world. The discipline is so broad, students can be overwhelmed by the choices offered to them. To help make ECE more personal, the Department has been bringing ECE alumni and companies to campus through a variety of activities, including an ECE Career Panel and ECE Career Fair.

2017 Alumni Participants

Featuring:

- K. Cyrus Hadavi** (PhD EE '83)
Co-founder, CEO and Chairman of the Board, Adexa
- Katherine Herrick** (BSE MSE PhD EE '93, '95, '00)
Chief Engineer, Raytheon Company
- Jordi Ribas** (MSE PhD EE '92, '96)
Corporate VP, Microsoft
- Mitchell Rohde** (BSE MSE EE '94 '96; MSE PhD BME '97, '00)
Co-founder and CEO, Quantum Signal LLC

ECE Career Fair

Participating companies in 2017 included:

- Automotive Dynamics Corp.**
- Burns & McDonnell**
- Commonwealth Associates, Inc.**
- DTE Energy**
- Duo Security**
- Exponent**
- Ford Motor Company**
- Jervis B. Webb**
- Logic Solutions, Inc.**
- MIT Lincoln Laboratory**
- QNX Software Systems**
- Quantum Signal LLC**
- Raytheon**
- Robert Bosch LLC**

ECE Expeditions Travels to Seattle



Twenty ECE students took a journey to Seattle as part of the 4th ECE Expeditions trip to meet with alumni and get an insider's view of several companies.

Accompanied by ECE faculty and staff, the students toured Amazon, Boeing, INRIX, Madrona Venture Partners, Microsoft, and Philips Healthcare.

Thanks to connections with ECE alumni, students were able to view the circuit boards within Philips' latest ultrasound devices, play augmented-reality games with Microsoft's HoloLens, watch humans and robots pack Amazon shipments, monitor real-time traffic in INRIX's control room, ask Madrona's venture capitalists what they're investing in, and walk on Boeing's factory floor next to behemoth 777 and 787 in-production aircraft.

"The tour showed us the lives of everyday engineers," says Ameya Gadkari, a junior studying computer engineering. "And, I think it helped me confirm that this is the degree that I want to do."

Alumni such as Jordi Ribas (PhD EE:S 1996), Corporate Vice President of AI Products at Microsoft and Dawson Yee (MSE EE 1997), Hardware System Engineer and Architect for HoloLens, Microsoft, talked with students about what career paths open up by studying electrical and computer engineering, how the discipline is fundamental to today's cutting-edge products and technology, and the specific engineering details that go into Microsoft AI and the HoloLens.

"I switched into electrical engineering, and this is my first semester in EECS classes," says Katy Wolff, a junior. "Going on this trip let me make a bunch of friends in the department."

"The alumni we spoke to were really passionate and knowledgeable, and they were eager to share that with other people," said Greg Meyer, a senior in electrical engineering.

The trip was particularly fruitful for electrical engineering junior Christine Campbell, who said, "I was able to get an internship at Philips this summer...because of the opportunity to meet hiring managers during our visit."



Students experiencing the Microsoft HoloLens.

Women in Computing

Singing the Praises of Women in CS

Women are making exciting and impactful contributions to the world through computer science – and they have been doing so since the earliest computing machines were imagined. That was the message that inspired hundreds of attendees at a creative and engaging campus event on the evening of November 16, 2017. That event – the Ada Lovelace Opera – was a celebration of women in computing.

Organized by the Girls Encoded student group and co-directed by Prof. Rada Mihalcea, CSE graduate student Laura Wendlandt, and School of Music, Theater & Dance graduate student Helen Hass, the event featured talks and an actual opera performance.

The evening began with eight TED-style lightning talks by female faculty and students from across disciplines who are

engaged in cutting-edge computing research. Presenters were Valeria Bertacco, professor at CSE; Ceren Budak, assistant professor at the School of Information; Reetuparna Das, assistant professor at CSE; Aparna Garimella, graduate student in CSE; Emily Mower Provost, assistant professor at CSE; Necmiye Ozay, assistant professor at ECE; Jenna Wiens, assistant professor at CSE; and Isabelle Wong, undergraduate in computer science.

The talks were followed by an opera on Ada Lovelace's establishment as the research partner of inventor Charles Babbage in the 1840s. As such, she was considered the world's first computer programmer. The opera was written and performed by students in the School of Music, Theatre & Dance.



Prof. Jenna Wiens talks about data science and its powerful role in containing the spread of infectious disease.



Ada Lovelace (right, played by Helen Hass) attempts to command the attention of Charles Babbage (Zach Crowle) as he obsesses over his Analytical Engine.

Girls Encoded Events Designed to Form Pipeline, Support

Girls Encoded is one embodiment of the CSE Division's effort to engage and support women with an interest in studying computer science. Founded by Prof. Rada Mihalcea in 2015, the initiative sponsors a variety of student- and department-led efforts throughout the academic year, including outreach to middle school and high school girls, diversity discussions, professional development lectures, and the Women in Computing lecture series. In academic year 2017-18, Girls Encoded sponsored the Ada Lovelace Opera, co-hosted with the department a talk by Anita Borg Institute founder Telle Whitney, and hosted a panel discussion with women in the computing industry in addition to other activities.



Whitney Speaks on the Strength of Inclusion at Dow Lecture

"We know how to create cultures where all people can thrive." This was the message that Anita Borg Institute co-founder Dr. Telle Whitney delivered at the 19th EECS William Gould Dow Distinguished Lecture on April 6, 2018. Specifically, she was referring to the need for a culture of inclusion in the field of computer science.

In her talk, Whitney made the case that eliminating the gender gap in technology will help us to build a more equitable future. Doing so, she said, must be approached from a variety of perspectives, beginning with K-12 education, in our approach to university programs, and in corporate practices, and laid out her thoughts on how to do so.

Whitney began her career at the center of the VLSI revolution and was instrumental in developing a number of silicon chip design methodologies that form the basis for how we design computing systems today. She became a pioneer on the subject of inclusiveness and with Anita Borg founded the *Grace Hopper Celebration of Women in Computing Conference* in 1994 and the Institute for Women and Technology in 1997. From 2002 to 2017, Whitney served as President and CEO of the Institute, and under her leadership it expanded its size and programs to include management of



CSE Chair Brian Noble, Dr. Telle Whitney, and Prof. Valeria Bertacco.

the *Grace Hopper Conference*, The Women of Vision Award, The Anita Borg Top Company for Technical Women Award. In 2004, she co-founded the National Center for Women & Information Technology, a national non-profit organization that connects more than 1,100 universities, companies, nonprofits, and government organizations nationwide to increase girls' and womens' meaningful participation in computing.

Preparing First-year Women to Succeed in CS

The second annual CS KickStart took place August 27-September 1, 2017, on North Campus in the Bob and Betty Beyster Building. CS KickStart is a free, week-long summer program for incoming first-year students that aims to improve the enrollment and persistence of women in Michigan's computer science program.

The student organizers of the program were co-founder Katie Hennells, Rebecca Andrews, Sage Renstorm-Richards, Meghana Somsaale, and Sree Jambunathan. Through the program, they strove to demonstrate how women can have a voice in shaping the future of technology, the importance of leveling the playing field in terms of academic and career opportunities, and how the field of computer science will benefit from the development of a talented and diverse workforce.

During the week, the program organizers facilitated conversations about diversity, helped build a community for the first-year students, taught participants the basics of programming, provided them with campus resources, and showed them the applications of computer science in academia and industry.



Diversity, Equity, and Inclusion Events



Members of Revolution Chinese Yo-Yo perform for ECE's Lunar New Year celebration.



ECE participated in Spirit Day, showing our support for the LGBTQ+ community and taking a stand against bullying and harassment.



ECE celebrated Nowruz, the Persian New Year, with a symbolic tabletop arrangement and plenty of food.

M | MiBYTES

Detroit High School Students Explore CS at MiBytes

MiBytes, the annual series of week-long computer camps for high school students run by the CSE Division, was held at the Michigan Engineering Zone in downtown Detroit in 2018. Students who attended the camp were able to learn, from the ground up, how to create their own working Android mobile app using MIT App Inventor.

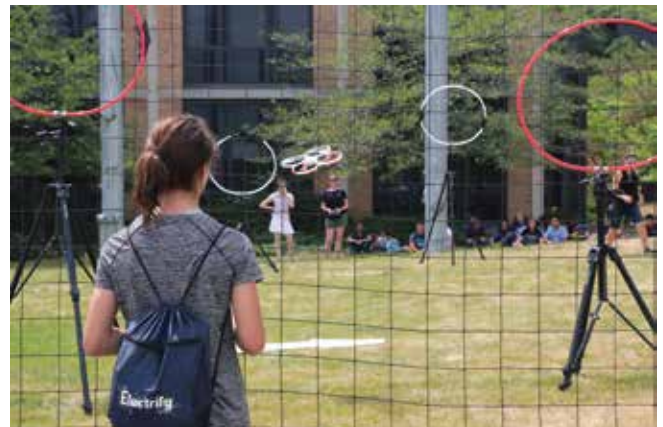
To get a taste of campus life, they made a day-long field trip by bus to CSE's home in the Bob and Betty Beyster Building in Ann Arbor, where they worked in the building and took a tour of North Campus. The campers were led in their explorations by faculty member Marcus Darden, who designed the camp content.



High School Students Experience High Tech at Electrify Camps

High schoolers took over the EECS building this summer, filling the hallways and labs as they designed circuits, built holograms, and whirled around on segways. In ECE's Electrify Summer Tech Camps, students from near and far gathered for three five-day sessions to learn the basics of electrical and computer engineering.

The three camps each focused on a different field of study: power and energy, optics and photonics, and wireless sensors. The participants explored the basic concepts driving these different technologies through lab work, group projects, and lectures. Profs. Heath Hofmann (Power Up), P.C. Ku (Nano-Size It), and Jamie Phillips (Sense It) planned and oversaw the camps.





Prospectives Explore Grad Studies in CSE

Undergraduate students from around the country with an interest in the pursuit of graduate studies in computer science and engineering visited Michigan in September to participate in the department's *Explore Graduate Studies in CSE* workshop. The workshop, which takes place each year, provides a firsthand look at the prospects and challenges that await CSE graduate students.

The day-long agenda gave attendees an overview of research in the field of CSE, advice and assistance on the application process, and included presentations on careers in academia. The event put the students face-to-face with CSE faculty and alumni, giving them the opportunity to discuss their particular interests in research and careers. About 40 students attended.



Kids Check Out Work at CSE

CSE's Bring Your Child to Work Day 2018 gave kids the run of the building, on a mission to find all the activities the department had to offer.

Faculty and staff collaborated to make the day fun and educational for the visitors. Kids got to take a server room tour, see disassembled computers, hunt down graduate student offices and labs, control Prof. Chad Jenkins' robot, and check out their parents' workstations. They learned about the ENIAC display in the building, which is a portion of one of the world's first general-purpose computers, built in part by department founder Arthur Burks. The kids took home a mini robot of their own once they checked out all the sights.

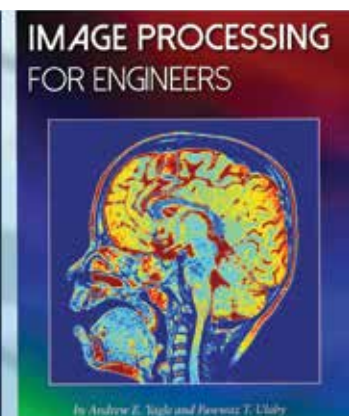
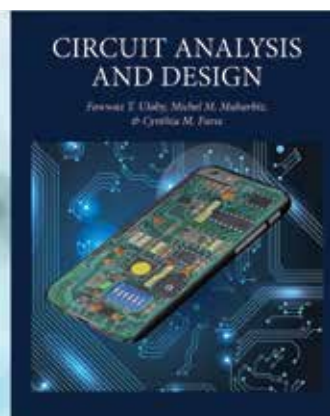
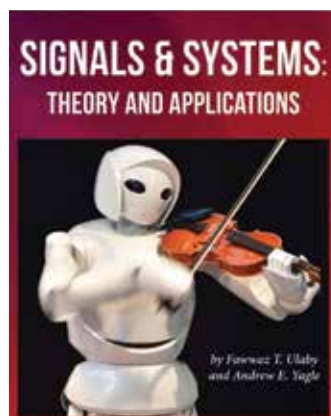
Free Electrical Engineering Textbooks for Students

A new textbook initiative spearheaded by faculty at University of Michigan, UC Berkeley, and University of Utah aims to ease the financial burden of college students in engineering courses by offering newly-published books for free online, and "at cost" in hardcover.

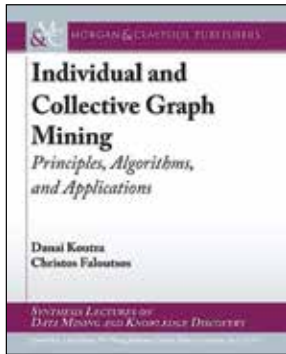
The financial savings for students in 2018-2019 is expected to eclipse \$2.5M with just these three textbooks (including book resales). The individual faculty are foregoing approximately \$100K in royalties. The goal is to have about 25,000 students taking advantage of the free textbooks this year.

"We are starting with textbooks in electrical engineering," said Fawwaz Ulaby, Emmett Leith Distinguished Professor of Electrical Engineering and Computer Science at the University of Michigan. "But I am hoping the initiative spreads to other disciplines."

The three textbooks: *Circuit Analysis and Design* by Ulaby, Michel M. Maharbiz, Cynthia M. Furse; *Signals & Systems: Theory and Applications* by Ulaby, Andrew E. Yagle; and *Image Processing for Engineers* by Yagle and Ulaby, cover as many as five undergraduate courses in electrical engineering.

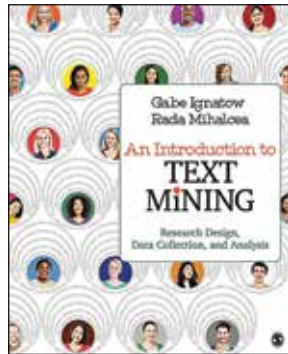


NEW BOOKS



Individual and Collective Graph Mining: Principles, Algorithms, and Applications

Prof. Danai Koutra has co-authored a new book on collective graph mining, which is a part of Morgan & Claypool's Synthesis Lectures on Data Mining and Knowledge Discovery, which addresses how to find, summarize, visualize, and analyze huge sets of interconnected data.



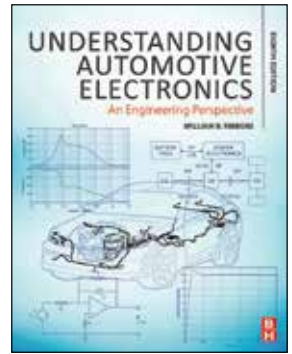
An Introduction to Text Mining: Research Design, Data Collection, and Analysis

Prof. Rada Mihalcea has co-authored a new book on Text Mining, published by Sage Publishing, which is designed to provide a foundation for readers seeking a solid introduction to the practice of mining text data.



Handbook of VLSI Routing Techniques: Serial and Parallel Models

Prof. Pinaki Mazumder has co-authored a book on routing interconnects inside a VLSI chip, which has been published in both English and Chinese by Tsinghua University Press. The book provides mathematical models of important classes of wiring techniques for students interested in gaining insights in integrated circuits layout automation techniques and for practicing engineers working in the field of electronic design automation.



Professor Emeritus Ribbens Publishes 8th Edition of Understanding Automotive Electronics

William Ribbens, professor emeritus of electrical engineering and computer science in addition to professor emeritus of aerospace engineering, recently published an 8th edition of his textbook *Understanding Automotive Electronics*.

This 8th edition adds information on the latest in automotive technology, including autonomous vehicles, camera systems, hybrid control, and software networks.



Duncan Steel Co-Editor-in-Chief of Encyclopedia of Modern Optics, 2nd edition

Duncan Steel, Robert J. Hiller Professor of Engineering and Professor of Electrical Engineering and Computer Science, is Co-Editor-in-Chief of the second edition of the *Encyclopedia of Modern Optics*, published by Elsevier. The encyclopedia was first published in 2005.

According to the publisher, "The *Encyclopedia of Modern Optics*, Second Edition, provides a wide-ranging overview of the field, comprising authoritative reference articles for undergraduate and postgraduate students and those researching outside their area of expertise."

As technology changes and advances, so does our coursework. In addition to constant upgrades to core courses, the following new courses have been introduced over the past year.

NEW COURSES

ANALYSIS OF SOCIETAL NETWORKS

(EECS 444; Prof. Vijay Subramanian)

This course serves as an introduction to networks such as Twitter, trade networks, supply-chain networks, road networks, and more. It covers how these networks are connected, how processes and transactions take place on them, and how they are being transformed and interconnected in the modern world.

COMPUTATIONAL DATA SCIENCE

(EECS 598; Prof. Raj Nadakuditi)

This course is an in-depth introduction to computational methods in data science for identifying, fitting, extracting, and identifying patterns in large data sets.

COMPUTER HARDWARE DESIGN FOR MACHINE LEARNING

(EECS 598; Prof. Zhengya Zhang)

This course will survey the latest architecture and circuit designs for machine learning applications, including deep (convolutional) neural nets, spiking neural nets, and neuro-inspired designs.

CONTROL AND MODELING OF POWER ELECTRONICS

(EECS 598; Prof. Al Avestruz)

This class will address the control and modeling of ac-dc, dc-ac, and dc-dc power electronic systems. Topics include small-signal models; digital and analog control; switched, sampled-data, and averaged models; and other advanced topics.

DATA MINING

(EECS 498; Prof. Danai Koutra)

Learn the various steps of the data mining process, the fundamental ideas behind data mining tools and methods, how to explore and analyze different types of data by applying the appropriate methods, and how to use big data systems for mining massive datasets.

DISCOVER COMPUTER SCIENCE

(EECS 198; Prof. Rada Mihalcea)

Interested in Computer Science? Heard about programming but not really sure how it works? Discover Computer Science!

ELECTROMAGNETIC METAMATERIALS

(EECS 598; Prof. Anthony Grbic)

The course covers engineered structures possessing tailored electromagnetic properties, or properties that are difficult or impossible to achieve using conventional materials. The course content includes classical microwave structures as well as more recent structures such as high impedance surfaces and metasurfaces and electromagnetic bandgap structures.

GREEN PHOTONICS

(EECS 598; Prof. Zetian Mi)

The course will cover the fundamentals of semiconductor photonic materials and devices, as well as new frontiers in green photonics, including integrated nanophotonic circuits and solar fuels.

INFRASTRUCTURE FOR VEHICLE ELECTRIFICATION

(EECS 598; Prof. Ian Hiskens)

The course covers the fundamentals of the physical and cyber infrastructures that will underpin large-scale integration of plug-in electric vehicles (EVs).

INTERNET FOUNDATIONS

(EECS 498; Prof. Mohammed Islam)

This course reviews various applications, such as the world wide web, Skype, and Bit-Torrent. The 4-layer internet model will be explained, which includes the application, transport, network, and link layers.

MINING LARGE-SCALE GRAPH DATA

(EECS 598; Prof. Danai Koutra)

Cover recent methods and algorithms for analyzing large-scale graphs, as well as applications in various domains (e.g., neuroscience, web science, social science, computer networks).

MMWAVE AND TERAHERTZ CIRCUITS AND SYSTEM

(EECS 598; Prof. Ehsan Afshari)

MOTION PLANNING

(EECS 598; Prof. Dmitry Berenson)

This course will cover the major topics of motion planning including planning for manipulation with robot arms and hands, mobile robot path planning with non-holonomic constraints, multi-robot path planning, and high-dimensional sampling-based planning.

NETWORK INFORMATION THEORY

(EECS 598; Prof. Sandeep Pradhan)

This course will utilize a set of mathematical tools to study communication problems that arise in networks, and develop an intuitive framework to think about these problems.

OPTICS AND QUANTUM SPECTROSCOPY OF SEMICONDUCTORS

(EECS 598; Prof. Mack Kira)

This lecture will provide a pragmatic and brief introduction to solid-state theory, many-body formalism, and semiconductor quantum optics to explore pragmatic possibilities for nanotechnology.

ORGANIC ELECTRONIC DEVICES AND APPLICATIONS

(EECS 598; Prof. Stephen Forrest)

In this course, we will trace the history, science and modern applications of organic electronic technology, including the basics

of the optical and electrical properties of organic semiconductors and how organics are deposited and patterned to achieve thin film.

PATENT FUNDAMENTALS

(ECS/ENGR 410; Prof. Mohammed Islam)

In this course, you will write your own patent application and learn how to shepherd it through the Patent Office. The basics of Patent Law are covered, including patentable subject matter, novelty, obviousness, specification, and claims of a patent.

POWER SEMICONDUCTOR DEVICES

(EECS 598; Prof. Becky Peterson)

This course will cover design and operating principles of semiconductor devices for discrete and integrated power electronics. We will discuss the power MOSFET, IGBT, HEMT, thyristors, Schottky and PIN diodes, as well as emerging device architectures.

POWER SYSTEM MARKETS AND OPTIMIZATION

(EECS 598; Prof. Johanna Mathieu)

This course covers the fundamentals of electric power system markets and the optimization methods required to solve planning and operational problems including economic dispatch, optimal power flow, and unit commitment.

QUANTUM NANOTECHNOLOGY

(EECS 498; Prof. Duncan Steel)

This course introduces students to basic concepts relevant to novel device concepts, including the new properties of nanovibrators, quantum LC circuits, quantum entanglement and quantum information and computing.

RANDOMNESS IN COMPUTATION

(EECS 598; Prof. Christopher Peikert)

Learn the main tools and techniques (linearity of expectation, the second moment method, Chernoff bounds, martingales, Lovasz-Local Lemma, Monte Carlo Markov Chain, etc.) used in probabilistic analysis of algorithms.

REINFORCEMENT LEARNING (RL)

(EECS 498 and EECS 598;

Prof. Satinder Baveja)

Fast-paced programming-based introduction to both the fundamentals of Reinforcement Learning (RL) as well as some of the recent advanced and exciting ideas at the intersection of Deep Learning and RL (or DeepRL).

SOCIAL COMPUTING SYSTEMS

(EECS 498; Prof. Walter Lasecki)

Experience using, designing, and building online social computing platforms, including through a significant team-based final project.

Self-Driving Cars, Drones, and Beyond: An Intro to Autonomous Electronic Systems

Profs. Robert Dick and Mingyan Liu developed a freshman-level course designed to introduce students to autonomous electronic systems. The course was offered for the first time this past year, and the faculty were delighted to see the students able to successfully build and test their team-developed quadcopters.

Autonomous systems such as quadcopters and self-driving cars are being used today in a wide range of applications; ranging from helping first responders, to smart farming, to driving you to work, to delivering goods to your home.

In this course, students developed and implemented electronic systems to manage several core actions necessary in autonomous electronic systems. These core actions include sensing, data acquisition and processing with circuits and signal processing techniques, and motion control through control algorithms.

If you want to understand how autonomous vehicles work, and make them do new things, this course was built for you.

— Prof. Robert Dick



Students in the class inspect their drone before letting it loose in the new 10,000 sq. ft. M-Air facility on North Campus built for testing of autonomous devices.

Computational Data Science

Prof. Raj Rao Nadakuditi developed a course in Computational Data Science that is designed for graduate students from any discipline. When the course was first taught Winter term 2018, it attracted students from more than 45 different majors

The course provides an in-depth introduction to computational methods in data science for identifying, fitting, and extracting patterns in large data sets. The only prerequisite to taking the course is some experience in programming – now nearly as pervasive a background as English once was among students.

Nadakuditi developed a part-lecture, part-open classroom teaching style. After providing information at the beginning of class, he lets the students work out the problems in class. They can be seen collaborating with each other, and taking advantage of the presence of various graduate teaching assistants as well as the professor to ask questions right then and there.



There were times in lecture where we would build one of the algorithms and we would apply it, and you would just hear people gasping at the results.

— Daphna Raz, graduate student

New Master's Program in Data Science

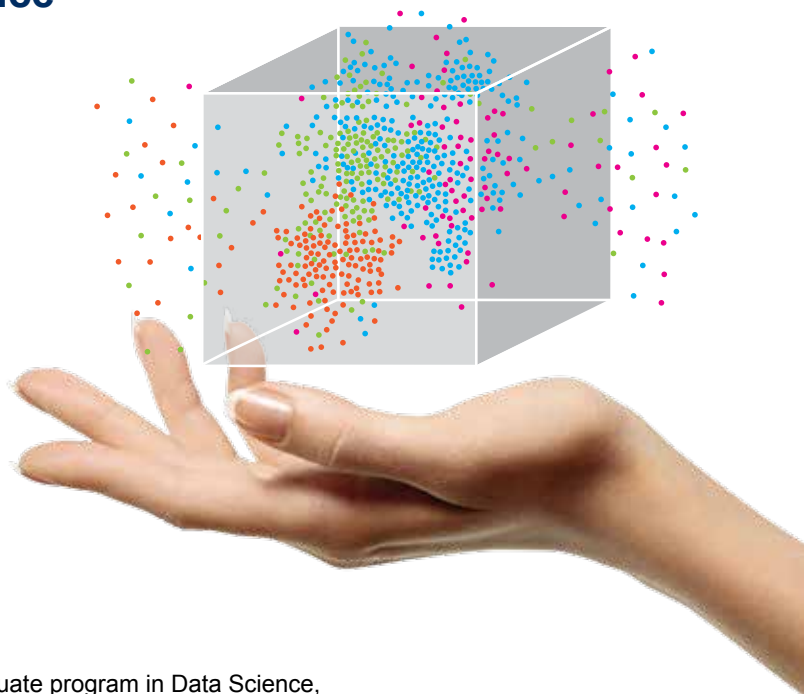
Students looking to use computational and statistical techniques to extract actionable knowledge from big data can now apply to the University of Michigan's Master's Program in Data Science.

Developed and taught collaboratively by the faculty of the CSE Division of EECS in the College of Engineering, the Department of Statistics in the College of LSA, the Department of Biostatistics in the School of Public Health, and the School of Information, the Data Science master's program welcomes its first students in Fall 2018.

The field of Data Science offers excellent career paths for people with the right skills, ranging from business analysts across a variety of industries, to novel IT careers, to working on scientific research teams. For such careers, students require solid training in an array of computational and statistical analysis.

In addition to developing expert core methodologies, students in the program will gain practice in applying their skills to address problems in specific application domains.

The Data Science Master's Program joins the University's undergraduate program in Data Science, which was launched in 2015. That program is jointly offered and administered by CSE and Statistics.



EECS 183 Expands Participation in CS

EECS 183, Elementary Programming Concepts, is expanding broader participation in the CS undergraduate program. Offered for non-majors, the course was reimaged in 2014 in a more engaging project-based format (it was previously lecture-based). In addition, every effort has been made over the years to remove barriers to success for populations who may not have as much previous experience with computing.

As a result, the number of female students taking the course through the college of LSA has increased by a factor of over 5X, and through the college of Engineering by a factor of over 2X. Overall, 40% of EECS 183 students are now women. Many are choosing to go on in CS.

According to lead instructor Dr. William Arthur, the final project format in EECS 183 is also a better indicator of whether students will succeed in CS than the test scores were.

The popular course has grown overall, from 554 students in Fall 2013 to 997 in Fall 2017. As such, it has become a case study within the department for how

to teach very large classes while elevating the overall student experience. In Fall 2017, Arthur and two other instructors taught the course, assisted by 32 IAs and GSIs and 18 graders. The methods being used to manage the course are being shared with other large courses.



A student team at the EECS 183 project showcase.

**Discover
Computer
Science**
New for Fall 2018



CS for the Curious

A new one-credit course, Discover Computer Science, allows undergraduates without formal programming experience to learn more about CS. The course is designed to be welcoming and to potentially expand further participation by student segments that have historically been underrepresented in the discipline, particularly women.

Throughout the semester, students will work with Prof. Rada Mihalcea and CSE PhD student Laura Wendlandt to see how computers connect to real-world applications in many disciplines. The class will teach core computer science concepts, code writing basics, and give hands-on experience in several computer science areas.

Outside the classroom, they'll get to meet researchers and computing professionals and hear about their experiences, visit a local computer science company, and explore the interdisciplinary applications of computer science.

Discover Computer Science is being offered for the first time in Fall 2018.

COMPUTER GAME DESIGN AND DEVELOPMENT COURSE EVOLVES



Attendees try out games at the Fall 2017 Computer Games Showcase.



Austin Yarger led the changes in EECS 494.

EECS 494, Computer Game Design and Development, has long been a popular major design experience course for CS seniors. After working in teams to develop their final projects, students are able to demo their games at the well-attended Computer Games Showcase.

The students develop their games over the course of a six-week time period using the Unity game engine. But according to instructor Austin Yarger, the course has now become about

much more than learning the tools and practices for building videogames.

"Early in the term, we hold off campus field trips in order to introduce the students to Ann Arbor's entrepreneurial scene and to demonstrate for them the potential impact and non-gaming applications of what they will be learning in the course," said Yarger.

And because game design (and other real-world CS projects) requires teamwork, Yarger encouraged students to participate in a virtual town-building exercise in Minecraft. "For extra credit, we asked students to build homes in our shared Minecraft world,

494Ville," he said. "Those who built their homes with a fellow classmate got bonus points. The purpose was to get students to meet one another early on as a precursor to the teamwork required to build final projects in EECS 494." An alternate team-building exercise was provided for students who didn't own the game.

EECS 494 is both a technical and design course. In the past, lectures have been devoted almost exclusively to teaching design at a high-level, leaving students to master the technical challenges of game-development on their own. To better serve students with the technical aspects of game development, Yarger this year devoted a minimum of 30 minutes of each lecture (and often much more) purely for technical demonstrations.

In one final experiment, Yarger combined forces with Eastern Michigan University's game design program to hold a combined end-of-term showcase of projects from both programs.

"The games this year were fantastic, and the students really had a great time despite the difficulty of the course," said Yarger. "Their work is something to be proud of, and many of the games will be archived for anyone to play in the Michigames Arcade on the first floor of the Beyster Building."

FACULTY NEWS

New Faculty

**ELAHEH AHMADI**

Assistant Professor
PhD, Electrical and Computer Engineering, 2015
University of California, Santa Barbara

Elaheh's research interests include epitaxial growth and characterization of III-N and oxide semiconductor materials for electronic and optoelectronics devices, sensing and MEMs applications

as well as electron transport modeling. For her doctoral work at UCSB, she worked on the growth and characterization of (In,Ga,Al)N-based electronic devices. After graduation she joined the Materials Department at UCSB as a post-doctoral researcher, working on the growth and characterization of β -Ga₂O₃ for high power and sensing applications. Elaheh joined the department in January 2018.

**NIKOLA BANOVIC**

Assistant Professor
PhD, Human-Computer Interaction, 2018
Carnegie Mellon University

Nikola's research broadly focuses on understanding and modeling human behavior to support innovative information technology, changing how we study and design interactive user experiences with the goal of improving

the quality of people's lives. Nikola joined the department in September 2018.

**KIMBERLY KHALSA DIAZ**

Lecturer
PhD, Biomedical Engineering, 2011
University of Michigan

Kim has been an intermittent lecturer in the department and previously taught at Concordia University. She has experience as a primary instructor for EECS 203 and EECS 351 and has also taught courses in linear algebra,

calculus, and modern algebra, amongst others. Kim joined the department in September 2018.

**DAVID FOUHEY**

Assistant Professor
PhD, Robotics, 2016
Carnegie Mellon University

David's research interests include computer vision and machine learning, with a particular focus on scene understanding. David's PhD work at CMU was supported by NSF and NDSEG fellowships. He has also spent

time at the University of Oxford's Visual Geometry Group and at Microsoft Research. David was previously a postdoctoral fellow at the University of California, Berkeley. He is currently visiting INRIA Paris. He joins the department in January 2019.

**DANIEL GENKIN**

Assistant Professor
PhD, Computer Science, 2016
Technion – Israel Institute of Technology

Daniel's research interests are in cryptography and systems security. He is interested in both theory and practice with particular interests in side-channel attacks, hardware security, cryptanalysis, secure multiparty computation (MPC),

verifiable computation, and SNARKS.

Daniel was previously a Postdoctoral Fellow at the University of Pennsylvania and the University of Maryland. Daniel joined the department in September 2018.

**BRENT GRIFFIN**

Assistant Research Scientist
PhD, Electrical Engineering:Systems, 2016
University of Michigan

Brent's research interests include robotics and autonomous systems, computer vision, and control systems. His doctoral work focused on bipedal locomotion for the robot known

as MARLO. His current research focuses on video object segmentation. He is currently principal investigator of a robotics project called Interactive Learning for Manipulating Piles of Stuff, funded by Toyota Research Institute. He joined the department as a research fellow in 2016, and assistant research scientist in 2017.

New Faculty



MARK GUZDIAL

Professor
PhD, joint degree, Education and
Computer Science, 1993
University of Michigan

Mark joins the department from the School of Interactive Computing at Georgia Institute of Technology, where he has been Director of the Contextualized Support for Learning

Lab. His research is in computing education. He co-founded the ACM International Computing Education Research conference in 2005. His research projects include Media Computation, an approach that emphasizes context to make learning programming both authentic and relevant. His Media Computation course has been taught at Georgia Tech since 2003 and has dramatically increased retention rates, especially for female students. Mark joined the department in September 2018.



JUSTIN JOHNSON

Assistant Professor
PhD Candidate, Computer Science
Stanford University

Justin's research interests lie at the intersection of computer vision and machine learning, including topics such as vision and language, visual reasoning, and image generation. At Stanford he co-taught CS 231N, a

popular introductory course on deep learning. Justin is currently a research scientist at Facebook AI Research. He joins the department in September 2019.



JOHN KLOOSTERMAN

Lecturer
PhD, Computer Science and
Engineering, 2018
University of Michigan

John's research interests are in computer architecture and compilers. His work in architecture has provided static analysis data to hardware, which can then make more intelligent run

time decisions. He has also leveraged static and dynamic code analyses to detect software security vulnerabilities. His teaching in large undergraduate courses seeks to engage and support students even as class sizes grow. John joined the department in September 2018.



SINDHU KUTTY

Lecturer
PhD, Computer Science and
Engineering, 2014
University of Michigan

Sindhu joined the department in January 2018 and has taught EECS 376 and 445, and will be focused on machine learning and theory courses going forward. Her research interests

lie in the design and analysis of social computing systems, with a focus on market mechanism design and its connections to statistical machine learning. Prior to Michigan, Sindhu was a visiting Assistant Professor in the Computer Science Department at Swathmore College.



RODRIGO MUNIZ

Research Investigator
PhD, Physics, 2011
University of Southern California

Rodrigo's research interests include condensed matter physics, with a focus on the optical properties of materials. He is particularly interested in developing methods for calculating the optical response of materials, and identifying

novel phenomena. His current research is expected to impact the ability to control electronic processes at unprecedented ultrafast timescales. Rodrigo joined the department in 2017.



SUNG-YUN PARK

Assistant Research Scientist
PhD, Electrical Engineering, 2016
University of Michigan

Sung-Yun's research interests include mixed-signal circuit design. His current focus is on low power, low noise mixed signal processing IC and power management IC design for biomedical systems. He has co-authored five

patents. Sung-Yun joined the department as a research fellow in 2016, and assistant research scientist in 2018.

New Faculty



VERONICA PEREZ-ROSAS

Asst. Research Scientist
PhD, Computer Science and
Engineering, 2014
University of North Texas

Veronica's research interests are in natural language processing, multimodal and cross-cultural approaches for deception detection and sentiment analysis, and behavioral signal

processing. She is currently focused on exploiting different data modalities present on user-generated content for different affect recognition problems. Veronica joined the department in February 2018; she was previously a post-doctoral researcher in the department.



JONG-KWAN WOO

Assistant Research Scientist
PhD, Electrical Engineering and
Computer Science, 2011
Seoul National University

Jong-Kwan's research interests include low power analog and digital mixed-signal circuits and device and circuit co-design, especially solid-state sensor fabrications and interface and

control circuit design as a Microsystem. Jong-Kwan joined the department as a research fellow in 2012, and assistant research scientist in 2017.



SARA RAMPAZZI

Research Investigator
PhD, Electronics, Computer Science
and Electrical Engineering, 2013
University of Pravia

Sara's research interests are in embedded security, embedded systems with application to medical devices, IoT, automotive, LTE communication network, and aerospace. She is currently

applying systems simulation and modeling to investigate security risks and to design reliable devices. Sara joined the department in February 2018. She was previously a postdoctoral researcher at University of Pavia and a visiting researcher at University of Las Palmas de Gran Canaria.



AUSTIN YARGER

Lecturer
MSE, Computer Science and
Engineering, 2017
University of Michigan

Austin has led EECS 494: Introduction to Game Development since the Fall of 2017. A longtime hobbyist, Austin began professional game development in 2014 as a Gameplay Engineer on The Sims

4, the top-selling computer game of 2015. His students have achieved positions at 343 Industries, Volition, Zynga, Google, and Amazon Game Studios, among others. Austin leads the International Game Developers Association (Ann Arbor Chapter) as co-founder, and Arbor Interactive (a game and education firm) as President. His research interests include gamification and the application of gaming technology to non-gaming tasks. Austin joined the department in September 2018.



ALANSON SAMPLE

Associate Professor
PhD, Electrical Engineering, 2011
University of Washington

Alanson's research interest lies broadly in the areas of human-computer interaction, wireless technology, and embedded systems with the goal of tackling the critical bottlenecks that limit interactive sensing systems with an eye

towards reducing deployment barriers and ensuring scalability. Before joining EECS, Alanson was an Executive Lab Director at Disney Research and led the Wireless Systems group which focused on created new interactive experiences. Prior to Disney, he was a Research Scientist at Intel Labs working on energy harvesting, wireless power delivery, and RFID, as well as a postdoctoral researcher in the CSE Department at the University of Washington working on wirelessly powered medical implants. Alanson joined the department in September 2018.

NSF CAREER and Young Investigator Awards



DMITRY BERENSON
NSF CAREER AWARD

Project Title: *"Towards General-Purpose Manipulation of Deformable Objects through Control and Motion Planning with Distance Constraints"*

Berenson believes the challenges involved in picking up deformable objects can be overcome by representing the object and task in terms of distance constraints and formulating control and planning methods based on this representation. Giving robots the ability to manipulate deformable objects has the potential to revolutionize the use of robots in manufacturing, medicine, and home services.



DANAI KOUTRA
U.S. ARMY YOUNG INVESTIGATOR AWARD

Project Title: *"A New Perspective on Fast Distributed Computations Over Networks."*

Koutra will introduce a new framework of intuitive and fast divide-and-conquer techniques that will enable fast mining of ever-larger datasets on large-memory or distributed systems that involve solving linear systems efficiently. This need arises when inferring missing information, classifying entities with limited supervision, identifying malicious behaviors, and making other evaluations.



NECMIYE OZAY
ONR YOUNG INVESTIGATOR AWARD

Project Title: *"Correct-by-construction Control with Non-asymptotic Learning, Estimation and Detection in-the-Loop"*

Ozay will incorporate the latest advances in learning and estimation by developing new theory and algorithms that seamlessly blend adaptability, safety, and correctness. Specific problems Ozay is investigating in her research include autonomous vehicles that encounter temporary or permanent surface changes that impact the vehicle, adapting to system failures or malfunctions, and even the problem of maintaining proper temperature of alternative fuel sources such as fuel cells.



LOUISE WILLINGALE
NSF CAREER AWARD

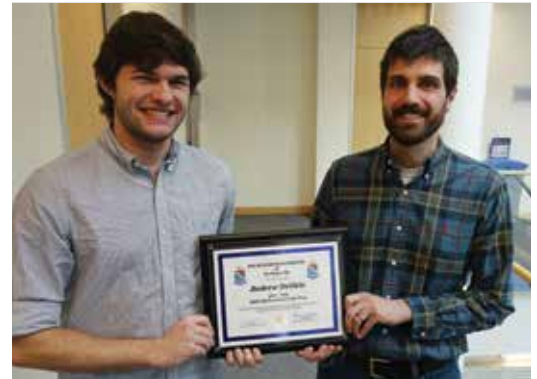
Project Title: *"Relativistic Electron Driven Magnetic Reconnection"*

Willingale plans to conduct high-energy-density laboratory experiments at the T-cubed laser facility and with the HERCULES laser to shed light onto magnetic reconnection and test the accuracy of existing theories. Better understanding the phenomenon should help us plan for events such as giant solar flares and, more importantly, mitigate their impact on GPS signals, radio communications, orbiting satellites, and power systems.

HKN PROFESSORS OF THE YEAR 2018

Each year, the U-M chapter of Eta Kappa Nu, the national honor society for electrical and computer engineers, selects two faculty for recognition, one from each division of EECS. The recipients are selected based on a vote by the students.

ANDREW DEORIO (CSE)



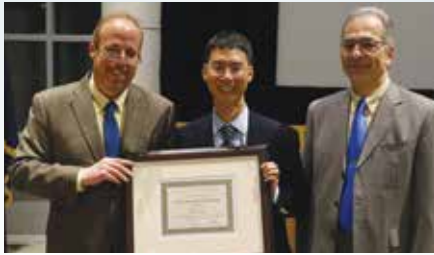
Carson Boden (HKN President, Winter 2018),
Andrew DeOrio.

FAWWAZ ULABY (ECE)



Anik Shah (HKN President, Fall 2017),
Fawwaz Ulaby.

EECS Outstanding Achievement Awards



Brian Noble (CSE Chair), Peter Chen, Khalil Najafi (ECE Chair).

PETER CHEN received the award for outstanding service and contributions as CSE Interim Chair; service to the undergraduate program as Chief Program Advisor for CS-Eng; highly-recognized research in operating systems and virtual machines; and leadership in the professional community.



Brian Noble (CSE Chair), Alfred Hero, Jason Corso, Khalil Najafi (ECE Chair).

JASON CORSO received the award for outstanding research on high-level computer vision and applications to video understanding, activity recognition, medical imaging, and robotics; and leadership in computer vision and robotics both at Michigan and the wider professional community.



Brian Noble (CSE Chair), Karem Sakallah, Jason Flinn, Khalil Najafi (ECE Chair).

JASON FLINN received the award for groundbreaking contributions in operating systems research; dedicated service as Chair of CSE Graduate Admissions; and outstanding performance as an educator and mentor of undergraduate and graduate students.



Brian Noble (CSE Chair), Jay Guo (standing in for PC Ku, who was out of town), Khalil Najafi (ECE Chair).

PEI CHENG KU received the award for his outstanding service and contribution to the EE undergraduate program, his research on strain-engineered GaN based single photon source and colored LEDs, and his service to the professional society.

College of Engineering Awards



ALFRED O. HERO

H. Scott Fogler Award for Professional Leadership and Service Award



CHAD JENKINS

Trudy Huebner Service Excellence Award



MARK J. KUSHNER

Stephen S. Attwood Award



STÉPHANE LAFORTUNE

David E. Liddle Research Excellence Award



RAJ RAO NADAKUDITI

Jon R. and Beverly S. Holt Award for Excellence in Teaching Award



NECMIYE OZAY

1938E Award



HERBERT WINFUL

Raymond J. and Monica E. Schultz Outreach and Diversity Award

College of Engineering Awards

Ted Kennedy Family Faculty Team Excellence Award



Kamal Sarabandi



Amir Mortazawi



Leland Pierce



Jack East



Stephen Forrest



Khalil Najafi



Dennis Sylvester



Euisik Yoon

University Awards



DAVID CHESNEY
James T. Neubacher
Award
U-M Council for
Disability



MINGYAN LIU
Distinguished University
Innovator
Office of the Vice President
of Research



KEVIN FU
Regents' Award for
Distinguished Public
Service



HERB WINFUL
Provost's Teaching
Innovation Prize

Other Awards



SHAI REVZEN
Robotics Institute
Teaching Award



JENNA WIENS
Morris Wellman Faculty
Development Professorship

National and Professional Honors, Awards, and Activities



MARK ACKERMAN received a Lifetime Achievement Award at the *15th European Conference on Computer-Supported Cooperative Work* in the British city of Sheffield. He served as conference organizer for the *CHI workshop on CSCW in China and Beyond*. He gave the plenary address at the *2017 Collective Intelligence Conference*.



VALERIA BERTACCO served as Program Committee Chair for the *2017 Design Automation and Test* in Europe.



TODD AUSTIN gave the keynote addresses at the *2017 International Conference on Computer Aided Design*, the *2017 ACM/IEEE International Symposium on Low Power Electronics and Design*, and the *2017 IEEE Symposium on Hardware Oriented Security and Trust*.



PALLAB BHATTACHARYA, Charles M. Vest Distinguished University Professor and James R. Mellor Professor of Engineering, gave the lecture, "Off the Beaten Track: From Glazier Way to Quantum Dot Lasers" at the bicentennial event, *Materials at Michigan Symposium*, sponsored by the Department of Materials Science and Engineering.



LAURA BALZANO co-organized the *2017 Midwest Machine Learning Symposium*, and the *Pulsar Information Processing Workshop* held in conjunction with the *2017 Signal Processing with Adaptive Sparse Structured Representations (SPARS)*.



DAVID BLAAUW was ranked as the top publishing author at *2017 IEEE VLSI Circuits Symposium* over the last 30 years of the conference with 38 publications.



SATINDER SINGH BAVEJA served as Associate Editor-in-Chief for the *Journal of Artificial Intelligence Research*.



PETER CHEN served as Program Committee Chair for the *2017 Symposium on Operating Systems Principles*.

National and Professional Honors, Awards, and Activities



MOSHARAF CHOWDHURY served as Co-chair of the *2nd Asia-Pacific Workshop on Networking*, which was held in Beijing, China.



JASON FLINN served as Program Committee Chair for the *2018 Symposium on Edge Computing*.



JASON CORSO served as Co-chair of the *2018 Midwest Computer Vision Workshop*, held in Ann Arbor, MI. He also served as Workshops Chair of the *2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*.



STEPHEN FORREST, Peter A. Franken Distinguished University Professor and Paul G. Goebel Professor of Engineering, was elected to the American Academy of Arts and Sciences, which honors “exceptional scholars, leaders, artists, and innovators,” and was named Editor-in-Chief of *Physical Review Applied* in 2017. He also gave the ECE Bicentennial Lecture, “Waiting for Act 2: What is the future of organic electronics beyond OLED displays?”

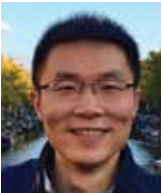


REETUPARNA DAS has been inducted into the IEEE/ACM MICRO Hall of Fame, an honor given to outstanding researchers with eight or more papers at the *International Symposium on Microarchitecture*. She was also awarded the CRA-W Anita Borg Early Career Award for significant research contributions and a

positive impact on advancing women in the computing research community by the Computing Research Association’s Committee on the Status of Women in Computing Research.



KEVIN FU has been named an IEEE Fellow, Class of 2018, “for contributions to embedded and medical device security.” He served as Cybersecurity Task Force Chair for the Computing Community Consortium Council of the Computing Research Association.



JIA DENG received a 2018 Sloan Research Fellowship from the Alfred P. Sloan Foundation for his work in computer vision and machine learning. He also earned a Google Faculty Research Award for his work in computer vision and machine learning, an Amazon Research Award, and a ZF TRW Automotive Endowed

Research Award. He served as Conference Area Chair at the *2017 Conference on Computer Vision and Pattern Recognition*.



ALMANTAS GALVANAUSKAS was elected Fellow of OSA, the Optical Society, “for contributions to the science and technology of high power fiber lasers, novel fiber structures, nonlinear interactions in fibers and fiber lasers, and fiber laser beam combining.”



YOGESH GIANCHANDANI is General Co-chair of *IEEE Sensors 2018*.



EDMUND DURFEE served as Program Committee Chair for the *2017 International Conference on Autonomous Agents and Multiagent Systems*.



JESSY GRIZZLE, Elmer G. Gilbert Distinguished University Professor and Jerry W. and Carol L. Levin Professor of Engineering, was keynote speaker at *Caltech’s Inaugural Robotics Day*.



ROYA ENSAFI received a Google Faculty Research Award for her work in security and privacy.



L. JAY GUO presented his talk, “Color Our World With Photonics,” as the William Mong Distinguished Lecturer at the University of Hong Kong.



CINDY FINELLI served as Deputy Editor for the *Journal of Engineering Education*.

National and Professional Honors, Awards, and Activities



J. ALEX HALDERMAN received the Merit Network's Eric Aupperle Innovation Award. He delivered a testimony before the U.S. Senate Select Committee on Intelligence on Russian interference in the 2016 U.S. election, and gave a congressional briefing to the Congressional Cybersecurity Caucus. He delivered the

keynote address at the *2017 Network and Distributed System Security Symposium*.



AL HERO, John H. Holland Distinguished University Professor of EECS and R. Jamison and Betty Williams Professor of Engineering was named Chair of the Committee on Applied and Theoretical Statistics (CATS), National Academy of Science, Engineering and Medicine.

In 2017, Hero became the inaugural Chair of a new research archive, arXiv/EESS (Electrical Engineering and Systems Science), that focuses on analytical and computational aspects of Electrical Engineering (including Signals, Systems, Communications, Networking, and Information Theory and Methods) and Systems Science in a broader sense that includes Dynamical Systems and Control research motivated by electrical, chemical, mechanical, aerospace and other cross-disciplinary (e.g., vehicular) engineering applications, as well as the analysis, optimization and control of cyber-physical systems such as power grids and the Internet of Things.

He also gave the distinguished university professorship lecture, "Locating the Nodes: From Sensor Arrays to Genomic Networks."

The *3rd Annual Michigan Institute for Data Science (MIDAS) Symposium* was held at Michigan on October 11, 2017. Hero serves as co-director of MIDAS.

Hero is the Conference General Chair of the *2019 International Symposium on Information Theory*.



HV JAGADISH was elected as a fellow of the American Association for the Advancement of Science for distinguished contributions to database systems and many aspects of Big Data and data science, specifically for new ways to share data. He served as Steering Committee Chair for the creation of a new

journal, *ACM Transaction on Big Data*. He also served as Editor-in-Chief for the *Morgan Kaufman Synthesis Lecture Series on Data Management*, Vice Chair for the *IEEE International Conference on Data Engineering*, and a member of the board of directors of the Computing Research Association. He was on an authoring committee of experts for two National Academy of Sciences, Engineering, and Medicine Consensus Study Reports, Federal Statistics, Multiple Data Sources, and Privacy Protection: Next Steps and Innovations in Federal Statistics: Combining Data Sources While Protecting Privacy.



CHAD JENKINS served as Editor-in-Chief of *ACM Transactions on Human-Robot Interaction* and conference organizer for the *Conference of African-American Researchers in the Mathematical Sciences*. He delivered the keynote address at the *2017 International Joint Conference on Neural Networks*.



MANOS KAPRITSOS received a Google Faculty Research Award for his work in distributed systems.



BARIS KASIKCI delivered the keynote address at the *Workshop on Resilient Systems*.



MACKILLO KIRA is Conference General Chair of the *2019 Fundamental Optical Processes in Semiconductors (FOPS) Conference*.



DANAI KOUTRA received an Adobe Digital Experience Research Faculty Award for her work in stitching together web user data. She was co-organizer of the *Workshop on Mining and Learning with Graphs* and was elected Program Director of the SIAM Activity Group on Data Mining and Analytics.



P.C. KU served as General Chair of the *2017 EITA Conference on New Materials, Nanotechnology and New Energy*, held in Ann Arbor, MI. He also received the Emerging Information and Technology Conference (EITC) Service Award.



BEN KUIPERS delivered the keynote address at: *AAAI Fall Symposium on Natural Communication for Human-Robot Collaboration*; *ICDL-EpiRob International Workshop on Ethical Issues of Open-Ended Learning in Autonomous Robots*; and *RSS Workshop on Morality and Social Trust in Autonomous Robots*.

National and Professional Honors, Awards, and Activities



MARK J. KUSHNER, George I. Haddad Professor of EECS and Director of the Michigan Institute for Plasma Science and Engineering, organized the *8th Annual MIPSE Graduate Student Symposium* in Ann Arbor, MI.



IGOR MARKOV was named a top writer for 2018 on *Quora*, the fifth straight year that he has been ranked on the site.



STÉPHANE LAFORTUNE, N. Harris McClamroch Professor of EECS, began a second 3-year term as Editor-in-Chief of the *Journal of Discrete Event Dynamic Systems: Theory and Applications*, effective January 2018.

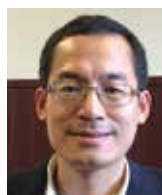


JASON MARS was named #2 on Bank Innovation's "10 Most Innovative CEOs in Banking 2017" list.

He was workshop co-organizer of the pre-conference workshop, "30 years of the Ramadge-Wonham Theory of Supervisory Control: A Retrospective and Future Perspectives," at the *2017 IEEE Conference on Decision and Control*.



JOHN LAIRD delivered the keynote address at the *AFOSR Future Directions of Machine Learning Workshop* and the *Conference on Advances in Cognitive Systems*.



ZETIAN MI was elected Fellow of OSA, the Optical Society, "for contributions to the development of high-performance III-nitride nanowire photonic devices, including full-color light-emitting diodes, electrically injected ultraviolet lasers, and artificial solar fuel technology." He was also recognized as one of

the most highly prolific authors for *Nano Letters* in the past five years, and appeared on the *American Chemical Society (ACS) Journal Stars* website.

He served as Conference Chair of the *2017 IEEE Photonics Society Summer Topicals Meeting*, and Conference Co-chair of the *11th International Symposium on Semiconductor Light Emitting Devices (ISSLED 2017)*.



WEI LU was elected Fellow of IEEE, Class of 2018, "for contributions to development of neuromorphic systems." He also organized the *2017 LNF Users Symposium*, held in Ann Arbor, MI.



RADA MIHALCEA delivered the keynote address at the following events: the *Fourth Italian Conference on Computational Linguistics*, the *IJCNLP 2017 International Joint Conference on Natural Language Processing*, the *CIKM 2017 International Conference on Information and Knowledge*

Management, and the *21st Nordic Conference on Computational Linguistics*.



HARSHA MADHYASTHA earned the Internet Research Task Force's Applied Networking Research Prize and a Google Faculty Research Award.



AMIR MORTAZAWI served as Co-chair of the Workshop and Short Course Organizing Committee of the *2017 IEEE International Microwave Symposium*. He also completed a 3-year term as IEEE Microwave Theory and Techniques Society Distinguished Microwave Lecturer.



SCOTT MAHLKE served as Steering Committee Chair for the *International Symposium on Code Generation and Optimization* and Vice Chair of *ACM SIGARCH*.



EMILY MOWER PROVOST served as Program Committee Chair for both the *2017 Conference on Affective Computing and Intelligent Interaction* and the *2018 International Conference on Multimedia Interaction*. She also delivered the plenary address at the *Frederick Jelinek Memorial Summer Workshop*.



Z. MORLEY MAO served as co-organizer of the *NSF Large-scale Networking Platforms "Communities of Practice" Workshop*.

National and Professional Honors, Awards, and Activities



BARZAN MOZAFARI served as Conference General Chair for the first *Approximate Computing for Affordable and Interactive Analytics Workshop*. He was a session chair at the *2018 ACM SIGMOD Conference*.



TREVOR MUDGE delivered the keynote address at the *2017 International Conference on Embedded Computer Systems: Architectures, Modeling, and Simulation*.



JOHN NEES was elected Fellow of OSA, the Optical Society, “for contributions to the development of short pulse high rep rate laser technology as well as to the science of high intensity short pulse laser interactions with matter.”



TED NORRIS, Gérard A. Mourou Professor of Electrical Engineering and Computer Science, served as Conference General Chair of the *2017 Conference on Fundamental Optical Processes in Semiconductors (FOPS)*.



EDWIN OLSON delivered the keynote address at the *2017 International Conference on Intelligent Robots and Systems*.



CHRIS PEIKERT received the Theory of Cryptography Conference Test of Time Award, which recognizes outstanding papers, presented at the TCC at least eight years ago, that have made a significant contribution to the theory of cryptography and beyond. His paper, “Efficient Collision-Resistant Hashing from

Worst-Case Assumptions on Cyclic Lattices,” published in *TCC 2006* with coauthor Alon Rosen, was selected “for advancing the use of hard algebraic lattice problems in cryptography, paving the way for major theoretical and practical advances.” He delivered the keynote address at the *24th Conference on Selected Areas of Cryptography* and the *15th Theory of Cryptography Conference*.



SETH PETTIE was conference organizer for the *First Symposium on Simplicity in Algorithms*.



JAMIE PHILLIPS served as Conference General Chair of the *2017 Electronic Materials Conference*.



KAMAL SARABANDI received a NASA Group Achievement Award “For outstanding contributions to the development of NASA SMAP mission and demonstration of its scientific and societal impact.”



KANG SHIN delivered the keynote address at the following events: *Samsung Research in America*, the *7th ACM Conference on Data and Application Security and Privacy*, the *2017 International Workshop on Cyber-Physical Systems*, the *NSF-Intel Workshop*, and the *IEEE Conference on Communications and Network Security 2017*.



ELLIOT SOLOWAY served as Editor-in-Chief of *Smart Learning Environments*. He delivered the keynote address at the *2017 International Mobile Learning Festival*.



LEUNG TSANG received the 2018 Hendrik C. van de Hulst Light-Scattering Award in recognition of his lifetime achievements in the area of electromagnetics.



FAWWAZ ULABY, Emmett Leith Distinguished University Professor of EECS and Arthur F. Thurnau Professor is founding Editor-in-Chief of the *IEEE Remote Sensing Code Library*.



WESTLEY WEIMER was conference organizer for the *4th International Genetic Improvement Workshop*.



THOMAS WENISCH served in the following positions: Conference General Co-chair for the *2018 IEEE International Symposium on Low Power Electronic Design*, Program Committee Chair for the *2017 International Symposium on Performance Analysis of Software and Systems*, Program Committee Chair for the *2017 IEEE International Symposium on Low Power Electronic Design*.

National and Professional Honors, Awards, and Activities



JENNA WIENS has been named to MIT Technology Review's 2017 list of "35 Innovators Under 35" for using data science to identify hospital patients at risk of contracting an infection they didn't check in with. She served as Conference General Chair for *Machine Learning for Healthcare 2017*.



KEN WISE, William Gould Dow Distinguished University Professor Emeritus, presented the ECE Bicentennial Lecture, "Microelectronics, MEMS, and Microsystems."



HERBERT WINFUL served as General Co-chair of the *2017 OSA Nonlinear Optics Conference*, and he attained the status of Life Fellow of the IEEE.



EUISIK YOON was Conference Organizer of the *2017 International Conference for Advanced Neurotechnology (2017)*. He also gave the keynote talk "Biointerface Technologies: Where Engineering Meets Science and Medicine" at the *2017 LNF Users Symposium*.

Leadership Service as Conference/Symposium/Workshop Chairs

EITA Conference on New Materials, Nanotechnology and New Energy

July 1, 2017, Ann Arbor, Michigan

General Chair: P.C. Ku

The *EITA Conference* is coordinated by the Emerging Information and Technology Association, which is dedicated to expanding the frontiers of Emerging Technologies and Services and building a creative and innovative economy – the knowledge-based, new digital economy for the 21st century.

including new phenomena, advanced materials, novel device concepts, as well as their applications in various fields of science and technology.

IEEE Photonics Society Summer Topicals Meeting

July 10-12, 2017, San Juan, Puerto Rico

General Chair: Zetian Mi

The *Summer Topicals Meeting* is the premier conference series for exciting, new areas in photonic science, technology, and applications. Attendees learn about emerging fields and interact with research and technology leaders in an intimate environment. The topic of this meeting was Integrated Photonics.

Conference on Fundamental Optical Processes in Semiconductors (FOPS)

August 27-September 1, 2017, Stevenson, Washington

Conference Organizers: Ted Norris, Xiaodong Xu (University of Washington), and Ulrike Woggon (Technical University of Berlin)

Fundamental optical processes in semiconductors (FOPS) are of central importance for both basic science and applications. The field provides the foundation for semiconductor optoelectronics and photonics by addressing fundamental problems. It encompasses enabling technologies for future-generation devices; advances in technology, materials growth, measurement techniques and understanding of quantum-optical/many-body phenomena.

OSA Nonlinear Optics Conference

July 17-21, 2017, Waikoloa, Hawaii

Conference Co-chairs: Herbert Winful, Barry Luther-Davies (Australian National University)

Nonlinear optical phenomena play a key role in many applications of photonics. They are now studied and applied over a wide range of energies and powers. This meeting provides an international forum for discussion of all aspects of nonlinear optics,

11th International Symposium on Semiconductor Light Emitting Devices (ISSLED 2017)

October 8-12, 2017, Banff, Canada

Conference Chairs: Zetian Mi, George Wang (Sandia National Labs), Zlatko Sitar (North Carolina State University)

ISSLED is a biannual international meeting for scientists and engineers worldwide, both in academia and in industry, to meet together to share and exchange the latest discoveries and progress on light emitting semiconductors, with a focus on III-nitride devices.

Approximate Computing for Affordable and Interactive Analytics Workshop

November 9, 2017, San Jose, California

General Chair: Barzan Mozafari

The goal of this new workshop is to provide an opportunity for discussion and synergy on 1) what it means to incorporate approximation in existing data analytics frameworks, 2) how to cater to a wide range of users with different levels of statistical background, and 3) how to dramatically reduce the computational footprint of an organization.



LNF Users Symposium

December 6, 2017, Ann Arbor, Michigan

Symposium Organizer: Wei Lu

The *LNF Users Symposium* brings together the LNF community to learn about each other's work and celebrate the wide variety of research being done at the LNF. The topic of this year's symposium was Biointerface Technologies: Where Engineering Meets Science and Medicine. Prof. Euisik Yoon gave the keynote address.

2018 Midwest Computer Vision Workshop

March 19-20, 2018, Ann Arbor, Michigan

Workshop Co-chairs: Jason Corso and Jia Deng

The *Midwest Computer Vision Workshop* is a gathering of computer vision researchers at institutions in the Midwest to discuss recent research findings and cultivate a community of collaboration among the attendees.



6th Midwest Workshop on Control and Game Theory

April 22-23, 2018, Ann Arbor, Michigan

Organizing Committee: Jacob Abernethy, Kira Barton, Mingyan Liu, David Miller, Gabor Orosz, Necmiye Ozay, Dimitra Panagou, Grant Schoenebeck, Vijay Subramanian

This workshop brings together researchers, students, and faculty from the midwest region of the United States, who develop and apply game and control theory to analyze, design, and assess complex systems.

Medical Device Security Leadership Conference

May 6-8, 2018, Ann Arbor, Michigan

Conference Co-chairs: Kevin Fu, Jack Kufahl (U-M Health System)

This annual conference is sponsored by the Archimedes Center for Medical Device Security, founded by Prof. Kevin Fu. The event was attended by 50 people from leading medical device manufacturers and health care providers, as well as device regulators, industry experts, and physicians.



International Conference for Advanced Neurotechnology (ICAN)

May 7-8, 2018, Ann Arbor, Michigan

Conference Chair: Euisik Yoon

ICAN 2018 brought together engineers and neuroscientists together to review the recent advancement in neurotechnology and neuroscience, define the need for next-generation tools to move neuroscience forward, and enhance translation of technology to science community.



IEEE MTT-S International Microwave Workshop Series on Advanced Materials and Processes (IMWS-AMP 2018)

July 16-18, 2018, Ann Arbor, Michigan

Conference General Chair: Amir Mortazawi

IMWS-AMP 2018 conference brought together researchers and practitioners of different backgrounds (materials scientists, chemical experts, physicists, microwave engineers, and process technologists), to share the most recent advances in new materials and manufacturing processes, which are key to the development of future RF, microwave, mm-wave and THz devices, circuits, and systems. *IMWS-AMP 2018* is organized by the IEEE Microwave Theory and Techniques Society (MTT-S) with technical co-sponsorship of the European Microwave Association (EuMA).



2018 IEEE International Symposium on Low Power Electronic Design

July 23-25, 2018, Bellevue, Washington

Conference General Co-chairs: Thomas Wenisch, with Jaydeep Kulkarni (UT Austin)

This symposium is a forum for presentation of innovative research in all aspects of low power electronics and design, ranging from process technologies and analog/digital circuits, simulation and synthesis tools, system-level design and optimization, to system software and applications.

4th International Genetic Improvement Workshop

June 2, 2018, Gothenburg, Sweden

Organizers: Westley Weimer, with Bill Langdon and Justyna Petke (University College, London), and Katie Stolee (NCSU)

This international workshop on the repair and optimization of software using computational search was co-located with the *40th International Conference on Software Engineering*.

Workshop on Mining and Learning with Graphs

August 20, 2018, London, United Kingdom

Workshop Organizers: Danai Koutra, and Shobeir Fakhraei (UCSD), Julian McAuley (UCSD), Bryan Perozzi (Google), and Tim Weninger (U Notre Dame)

This workshop is a forum for exchanging ideas and methods for mining and learning with graphs, developing new common understandings of the problems at hand, sharing of data sets where applicable, and leveraging existing knowledge from different disciplines.

ACM International Conference on Hybrid Systems: Computation and Control

April 16-18, 2019, Montreal, Canada

Co-chairs: Necmiye Ozay, with Pavithra Prabhakar (Kansas State University)

HSCC is dedicated to advancing design and analysis techniques that bridge control theory and computer science, and is expanding to new domains in security, privacy, learning and in systems biology. The conference covers the range from theoretical results to practical applications and experiences in cyber-physical systems (CPS), mixed signal circuits, robotics, infrastructure networks, and biological models.

IEEE International Symposium on Information Theory (ISIT)

July 7-12, 2019, Paris, France

General Co-chairs: Alfred Hero, and Pablo Piantanida (CentraleSupélec, France)

ISIT is the flagship meeting of the IEEE Information Theory Society. The main event of the symposium is the Shannon Lecture, given by the recipient of the Claude E. Shannon Award.

Mars Predicts Impact of AI on Banking

Banking is about to get a lot smarter – and a lot more personal. And that's a good thing, according to Prof. Jason Mars.

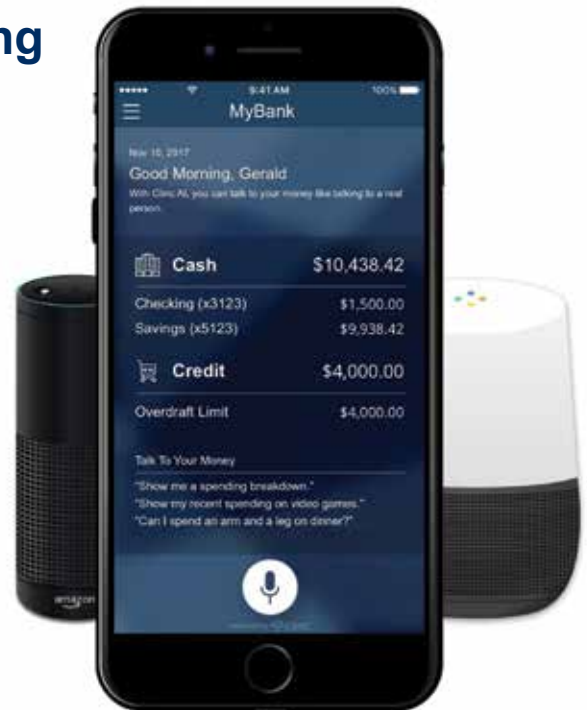
Mars, cofounder and CEO of the AI firm Clinc, has become an authority on the subject of smart banking, for which he was named #2 on Bank Innovation's "10 Most Innovative CEOs in Banking" list in 2017.

Clinc's flagship product is a conversational AI platform for financial institutions that supports the same natural language flow that you would expect to have with a personal banker.

Mars believes that we are on the cusp of a revolution where artificial intelligence begins to truly transform banking. Until this point, we have been saddled with "intelligent" chatbots, overpromising, and vaporware. Looking ahead, companies like Clinc will offer solutions that will be developed by deep efforts in computer science and will be focused not just on interactions, but on insights.

"In the realm of personal banking, customers will be able to ask questions like, 'What am I doing in terms of my restaurant spending, and how's it changing? What hotels can I afford for my trip next month?'," says Mars. "They'll be able to ask those high level, valuable questions and get the answers using AI applied to the data."

In a similar way, Mars sees AI applied to investment software and portfolio management, the banking industry will also be able to build customer support systems that are tailored to individual customer needs and preferences, and which are based on real data.



Are Three Laws of Robotics Enough for AI?

On February 13, 2018, a panel of experts was convened to explore the benefits and consequences of a future with artificial intelligence. The event was the annual *Isaac Asimov Memorial Debate*, which was held in the American Museum of Natural History and hosted by Neil deGrasse Tyson. The subject of the debate was whether we are ready for AI.

Amongst other esteemed panelists from IBM Watson, Google, MIT, and iRobot was Lynn A. Conway Professor of Computer Science and Engineering Michael Wellman. An expert in the use of AI in financial markets, Wellman commented on the dangers posed by the arms race for control that is being driven by AI in finance – but also in realms such as military applications and the spread of fake news. Overall, the discussion identified some of the challenges presented by the role of AI in autonomous transportation systems, medical decision-making, scientific discovery, public policy, and more.



STUDENT NEWS

Paul Giessner, Camille Burke, and Minna Wybrecht stand next to a new solar installation while on the GRID Alternatives Solar Spring Break on the La Jolla Indian Reservation.



Installing an Alternative on Spring Break

Students typically soak up the sun during spring break, but none like the students in GRID Alternatives Students for Sustainable Energy. This program connects students on spring break to opportunities where they can install solar systems in underserved communities. In February of 2018, a group of 25 students from U-M's GRID chapter traveled to the La Jolla Indian Reservation outside of San Diego, CA, in February 2018 to perform a solar installation of over 10kW on three homes.

This experience helped me realize that we're engineers for people. We build technologies to make communities better. To see that direct correlation was refreshing.

— Camille Burke, EE sophomore

"The opportunity to do something like this is unreal for me," says Camille Burke, an electrical engineering sophomore. "I'm extremely passionate about renewable energy and any step closer to having a career in the industry is wonderful."

"In school, you do a lot of research and learn a lot of numbers," Paul Giessner, a master's student in electrical and computer

engineering, says. "It's honestly kind of relaxing to put wires together and build something."

"They told us what we were doing and why we were doing it," adds Suliya Olagbenro, an electrical engineering sophomore. "I'm also a little afraid of heights, but the GRID staff were so straightforward with safety and made me feel so comfortable that by the second day, I was basically superwoman on the roof."

Beyond the technical training, students connected with the deeper mission of making renewable energy accessible to underserved communities, and how engineering can be a tool to benefit others.



Off-Roading with Michigan Baja Racing Team

Every February, the Michigan Baja Racing team heads north seeking snow. You might expect Baja cars, named after a desert peninsula and designed like dune buggies, to be driven more on the beaches of southern California than on the lake effect snow of Michigan's Upper Peninsula. But these cars are built specifically for their ability and durability, no matter the environment.

Winter Baja, hosted at Michigan Tech, was the first race of the year for Michigan Baja. The four hours of driving in freezing conditions allowed new team members to get up to speed on how to assemble the cars, fix any issues, or weld together solutions mid-race.

The three other races this year, starting in April and ending in June, took the team to Maryland, Kansas, and Oregon. The competitions spanned a few days, with events including acceleration, hill climb, maneuverability, and rock crawl. The team took 2nd place overall in Maryland (only .77 points behind the leader), 7th in Kansas, and 3rd in Oregon. The team also received 3rd

place in the Mike Schmidt Memorial Iron Team Award.



Shivani Shah (BSE EE 2017, MSE EE 2018 exp.) sits in the First Place-winning 2015 Michigan Baja vehicle in the Wilson Center shop.

For this year's car, Shivani Shah (BSE 2017, MSE 2018) lead the development of a completely new type of transmission, called electronically controlled variable transmission (eCVT). The eCVT relied more on microprocessors than mechanical gears and flyweights to achieve the most powerful engine output.

Team captain, Alex Gardner, called this one of the most competitive seasons in Baja history. "The team never gave up and never stopped trying. Although we were kicked and beaten down, we came back to fight again."

MASA First Team to Recover Advanced-fueled Rocket

The Michigan Aeronautical Science Association (MASA) is committed to increasing student interest in high power rocketry. Every summer, MASA participates in the Intercollegiate Rocket Engineering Competition (IREC), which now takes place at Spaceport America in New Mexico.



In the 2018 competition, MASA became the first team at the Spaceport America Cup competition to successfully launch and recover a liquid bi-propellant rocket, named Laika. The team, including Chief Engineer Nick Sterenberg and Payload Lead Madhav Goli, both juniors studying electrical engineering, focuses on designing and fabricating sounding rockets that have top altitudes of 30,000 feet.

At this year's competition, the team also took home the Sportsmanship Award out of over 100 participating teams.

Battling Drone Ships

Out on the water, a drone flies up. It beelines to the shore, scans available piers, and sends a signal to its launch boat on where to dock. With no human interaction, the boat finds its slip, and the drone lands.

This is the newest challenge in the Association for Unmanned Vehicle Systems International's (AUVSI) RoboBoat Competition. Other challenges for the five-foot autonomous boats include speeding around buoys, navigating a field of obstacles, staying in a precise formation, and docking based on an underwater pinger.

This past year, Anthony Uytingco, a junior in Electrical Engineering, led UM::Autonomy, Michigan's RoboBoat team. Benny Johnson, a junior in Computer Science will take over as president next year.

At this year's competition, the team qualified for the finals, and placed 7th overall. Also present at the competition were Rourke Pattullo (EE), Alex Skillin (CE), Yingchen Ma (CS-LSA), Charlie Light (CE), and Gregory Su (CS). The team expects to change from a fiberglass to carbon fiber hull, and include new sensors to help the boat better assess its environment for next year's competition.



Exoskeletons Compete to Boost Strength of Rescue Workers

At the first Applied Collegiate Exoskeleton (ACE) Competition, the requested attire was circuits and motors. Teams from five schools gathered to tune-up, learn, and demonstrate their powered mechanical suits, which augment the wearer's strength and abilities.

"Exoskeletons have a tremendous amount of applications," said EE student Declan Winship, president of the University of Michigan STARX (Strength Augmenting Robotic Exoskeletons) team. "There's a huge push in the manufacturing industry, with Ford, Delta, and Lowes all looking into the technology."

Kevin Rabideau (BSE CS 2016) founded U-M's STARX team three years ago, "to develop practical exoskeletons for giving extra strength and making loads lighter. This is exactly what I was hoping for, to walk into a room with all these people making fantastic machines that make you stronger."

Creating the suits, however, is a significant challenge. Last year was to be the first

year of the competition, but had to be canceled due to the lack of competitors.

"We just kept running into issue after issue with the electronics, and only got them sorted out at 4 a.m. last night [the evening/morning prior to the competition]," said CE student Owen Winship.

Out of the five teams, three were able to put forward a functioning exoskeleton to compete. "Even if a team doesn't have a suit here today to test with, they're still excited to fix things that went wrong, make improvements, and come again next year," said Rabideau.

The exoskeletons were put through tests similar to those for entry-level firefighters. Colorado School of Mines won the overall competition, edging out the U-M host team by less than a tenth

of a point on a 650-point scale. MSU took third place.

"Despite everything going wrong and everything going to pieces, as every engineering project ever has, everything pulled through in the end and we saw really great performance out of every exoskeleton," Winship said. "All we need to do is to do it again, and again, and again."



Record-breaking Second Place for Solar Car Team

In an innovative, bullet-shaped car, the University of Michigan Solar Car Team took a historic second place today in the Bridgestone World Solar Challenge, a 1,800-mile race across the Australian Outback.

Not only was U-M the first American team to complete the race, the students are celebrating the most successful finish at this event in team history. U-M – the reigning North American champion – has come in third in this international race five times in the team's 27-year history. Team members and alumni had taken to calling it “the curse of third.” It's been broken.

“This is indescribable,” said team member Patrick Irving, a senior in computer engineering, at the finish. “I’m so proud of everyone for doing something no other Michigan team has done.”

Novum, as the team named this year's car, is the smallest and most aerodynamic vehicle U-M has ever built.

Michigan arrived one hour and 59 minutes behind the Dutch winner, Nuon, from Delft University of Technology.

They successfully adjusted their race strategy in response to the weather, and that's one of the most critical component to a solar race. For this campaign, lead strategist and computer science junior Alan Li created a custom machine learning weather prediction model based on a system they developed with IBM for the 2015 race.

“What's important is that we were able to predict the entire day's average radiation,” said Li.

Other crew members included Bradley Baker and Eric Brown, both studying electrical engineering, Andrew Dickinson, studying computer science, and Nathan Silverman and Caroline Subramoney, both studying computer engineering.



M-Fly's Top-10 Season, New Autonomous Plane

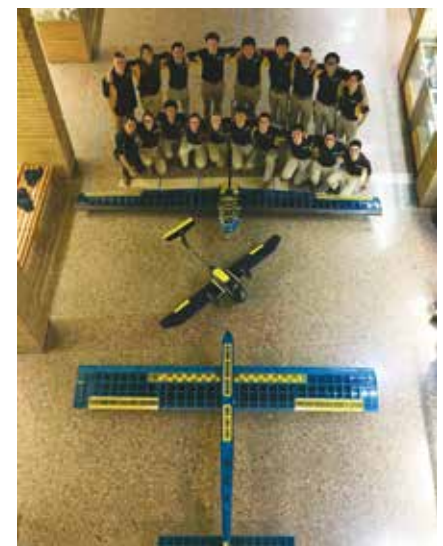
The M-Fly student aircraft design team provides undergraduates the opportunity to design, build, present, and test real-world aerospace projects. This year was extremely productive, with the team building more planes than ever, including its first autonomous craft.

Two of this year's aircraft were entered in the 2018 SAE Aero Design East competition, marking the team's tenth appearance at the event. Both of the projects placed in the top 10 for their respective categories: the team's regular class M-10 placed 8th overall, including 2nd place in the design report; the team's advanced class MX-3 placed 5th overall, including 1st in the design report and 3rd in oral presentation. Both the regular class and the advanced class entries were challenged to lift the heaviest payload possible, scored on weight, while the advanced class was also required to drop a payload onto a target.

The addition of an autonomous plane to the lineup had team members tackling brand new problems in aircraft design, programming, and communications. While the plane didn't end up entering in competition its first year, students made a great deal of progress toward getting the new model ready for the Student Unmanned Aerial System (SUAS) competition.

“As this was M-Fly's first year working with an autonomous aircraft we had no conventions or prior wisdom to guide our design,” says computer science student and software team lead Justin Fu.

“Our biggest challenge was designing all of our systems from the ground up,” says electrical engineering student and hardware team lead, Mikayla Kurkjian. “This year has been a great learning experience and has helped me get a sense for engineering beyond the classroom.”



Student-built App Guides Smithsonian Gallery Visitors

Visitors to the Smithsonian's Freer|Sackler Galleries in Washington DC can now be guided through an exhibit on ancient Asian art by an app developed by a team of U-M students through the Multidisciplinary Design Program. The exhibit is entitled "Encountering the Buddha: Art and Practice across Asia," and the accompanying app is called "Hyecho's Journey." Together, they trace the historic pilgrimage of 8th century Korean monk Hyecho to provide context for the exhibit.

Under the guidance of Prof. Sugih Jamin, the student team worked with experts at the gallery to create an interactive map, an iPhone app, and an iPad app. The app consists of eight chapters that users can progress through, helping them to learn more about the Buddhist world Hyecho encountered during his pilgrimage. The exhibition will run through 2020 and then will likely travel to other galleries, including the U-M Museum of Art.



Hyecho's Journey, an app developed by a team of U-M students, traces the historic pilgrimage of 8th century Korean monk Hyecho.

Student app developers include: Elijah Sattler (CS), Eric Yeh (CS), Ha Nul Jun (Asian Languages and Cultures), Bailey Case (CS), and Sindhu Giri (SI/Art & Design).

Not pictured: Rebecca Henry (SI), Wei Cai (SI), and Anders Boberg (CS).



Project Music Builds Public Transit Instrument

Project Music, a student group based around revolutionizing music and the way we create it, participated in the 2018 Moog Hackathon at Georgia Tech. In 48 hours, the team of Sophia Mehdizadeh (VP of Build Team, EE student), Ethan Brown (Treasurer, CE student), and Kiran Thawardas (President, CE student) created an instrument, the MARTAphone that incorporates live data from the Metropolitan Atlanta Rapid Transit Authority, known as MARTA. Based on how far the centroid of all busses are from the city center, the instrument changes the amount of delay added to a note. The instrument received a Judges' Mention award. The team, which also includes Adam Schmidt (EE and sound engineering) and Kit Ng (EE/CE student), is currently working on a bicycle-based instrument and a musical staircase.



Kiran Thawardas, Ethan Brown, and Sophia Mehdizadeh show off their creation, the MARTAphone, at the competition.

Team Aquador Furthers Water Projects



After a 7.8 magnitude earthquake in Ecuador, many coastal communities dealt with destroyed water infrastructure and an increase in cases of waterborne diseases, such as leptospirosis and echinococcosis.

In response to these water issues, and poor water sanitation all around Ecuador, students across disciplines formed Team Aquador to create a sustainable water treatment system. The team includes students from six engineering disciplines, including electrical engineering undergraduate Katie Lastoskie, who traveled to Ecuador with other team members to learn first-hand about both the communities and design constraints.

"Using what I've learned in my circuit design and semiconductor classes enabled me to come up with solutions to the UV-purification portion of our design," Lastoskie said. "The best part of our experience was seeing the people we want to help, hearing their interest in us, and giving us feedback."

Honors GO Travels to Costa Rica

Honors GO! Volunteer Abroad program students co-led by Brianna Hutchison, a senior studying electrical engineering, took a volunteer trip to Costa Rica where the engineers patrolled beaches for nesting sea turtles, sorted recycling, built compost piles and a turtle-shaped garden, and learned about aquaponics. CS student Richard Teng traveled with Hutchison.

Hutchison said the trip changed her perspective on the world, and that she will forever remember the experience of releasing a baby turtle nest. "Sea turtle conservation indirectly relates to my professional interests which are empowering people with brain and/or nervous system damage to gain their ability," said Hutchison. "In the academic research setting, I am contributing to a lab developing brain machine interfaces for spinal cord injury patients to gain dexterous finger movement. My internship experience is developing machine learning algorithms for wearable, wireless sensors monitoring stroke patient recovery."



SHPE'd Abroad to Guatemala

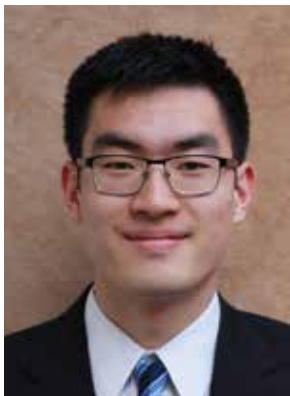


Michigan's Society of Hispanic Professional Engineers (SHPE) chapter took 12 members on their annual service trip to Guatemala this year, where they teamed up with a organization called FUNDEGUA to build LED devices with students.

"I was thrilled by the opportunity to bring STEM education to an all-girls school in Antigua," said computer science student Jazmyn Rivera. "Many of the girls there had little to no experience with electrical circuitry, so we taught them, from the very beginning, what electricity and voltage is and how to solder."

"After we finished the projects, we had a science fair with great inventions for utilizing an LED light," said electrical engineering student Nancy Hernandez. "I also learned to solder, learned more presentation skills, and got to interact with the students."

Student Blog About CS Reaches a Big Audience



Undergraduate Arthur Shi has shared his thoughts on the highs and lows of majoring in CS on his Medium blog, "Arthur's Blog." With over a thousand claps, it's clear that his reflections resonate with others.

Arthur's posts include "Dealing with Imposter Syndrome," where he describes how he gets through difficult times. In "A Valentine's Letter From a Single CS Student," he expresses his love for CS on a day that is usually focused on love between two people. In it, Arthur says, "Sometimes my friends make fun of me, saying, 'how come you never have a human date on Valentine's Day?' But they just don't understand what we've been through together."

Arthur became interested in CS during his freshman year after taking EECS 183. He decided to try writing in the summer of 2017 after his description of an internship through the Center of Entrepreneurship earned him positive feedback from readers.

Society of Women Engineers Travels and Teaches in India

EE undergrad Raheida Khaliq traveled with four other Society of Women Engineer (SWE) members on a two-week service trip to India. The group taught engineering at the Bharat Children's Academy, and led STEM activities such as building a balloon-powered car.

Khaliq said the most poignant moment came when a student said he was disappointed his team's car failed, but that failure shouldn't be discouraging because it is a part of success.

With her interest in sustainable engineering, Khaliq also enjoyed visiting Walchandnagar Industries, a global manufacturing company.

"I was so moved by the people I met and interacted with throughout my time in India," said Khaliq. "This experience has motivated me to always try harder and be grateful for the opportunities that are provided to me."



Agnieszka Jachimska (ChemE student), Arthi Nadhan (ChemE student), Simrun Buttar (CS student), Alyssa Blunt (ME student), Raheida Khaliq (EE student).

Student's Digital Art Makes the Cube Even More Interactive

The spinning metal art installation nestled on central campus draws a lot of curious eyes, but CE junior Keenan Rebera thinks he can take the experience to the next level.

Rebera has designed a small sensor array and display device that attaches magnetically to the Cube. When active, it can detect the velocity of the Cube when a person spins it and generate any number of fun factoids to show off. How fast did you just spin this thing? How many times has it been spun today?

The project, funded by an Arts Engin micro-grant, is a continuation of Rebera's honors physics project, which had him developing the math behind these metrics. After he had that figured out, he built a simple prototype on his own for fun.

This project represents a lot of what Rebera loves about computer engineering as a whole.

"There's something very satisfying making something with your hands, something digital and advanced, and seeing it work," he says.



U-M Programming Team Competes at Highest Level in ACM-ICPC Competition

The Victors, a U-M student programming team, competed in the 2018 ACM International Collegiate Programming Contest World Finals in Beijing, China, in April 2018.

The ACM-ICPC is the largest and most prestigious computer programming competition in the world. It pits teams of three university students against complex, real-world problems, with a grueling five-hour deadline. Huddled around a single computer, competitors race the clock in a battle of logic, strategy, and mental endurance.

The U-M team, including undergraduates Nathan Fenner (CS), Aman Karunakaran (CE), and Lawrence (Larry) Wu (CS) placed 56th out of the 120 teams that advanced to the world finals. Over 46,000 students worldwide had competed in regional competition for the honor of participating in the world finals.

To reach the world finals, the Victors competed in the 2017 ACM East Central North America Regional Programming Contest, where they placed fourth out of the 140 teams that participated.

During the world finals, the teammates collaborated to rank the difficulty of the problems, deduce the requirements, design test beds, and build software systems that solve the problems under the intense scrutiny of expert judges. The Victors were able to solve four out of nine problems correctly.

The U-M programming team was coached by longtime programming team coach Prof. Compton. Assistant coaches were CSE graduate student Yujie An (who was on U-M teams that advanced to World Finals in 2014 and 2015) and U-M alumnus Dennis Matveyev, who has assisted with training for many years.



Aman Karunakaran, Nathan Fenner, and Larry Wu.



Mars Rover Team Tackles Major Redesign, Places in Top 10 at Competition



The U-M Mars Rover Team brought a new remote astronaut assistant to the University Rover Challenge in the desert of southern Utah, pulling off a 9th place finish out of 36 competing international teams and 3rd out of the U.S. teams. This year's model, called "Phoebe," received a major design overhaul.

With the largest number of programmers in MRover history, the team undertook the task of rewriting the

rover's entire codebase to create a maintainable codebase that they can adapt for future models. This time, instead of using the popular Robot Operating System, they developed simpler software more focused on the team's particular needs. This included developing their own simulators to rapidly test code without a finished rover, as well as implementing an "edge computing" approach that divides computing between many small computers and microcontrollers on the rover. The Software Team's chief engineer this year was computer science student Nathan Moos, who also led the Autonomy Team.

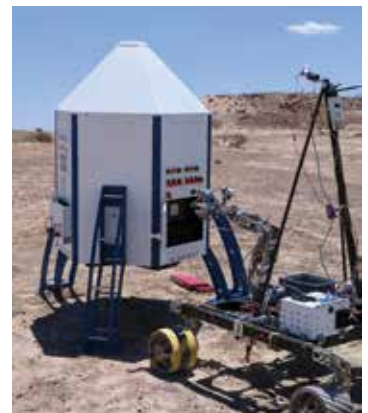
The electrical team, led by Computer Engineering student Matthew Price, took on the challenge of making their own custom PCBs for the rover. The team had never attempted this before, and the new designs allowed them to greatly reduce the size of their sensor package.

"None of us had any experience designing a PCB, so it was interesting to learn a new skill together as a team," says Price.

The University Rover Challenge tasks teams with maneuvering through unpredictable, rocky terrain using only the cameras on their rovers, simulating the experience of driving a rover on Mars. In light of recent interest in autonomy, the URC implemented an autonomous navigation task in 2017, adding an additional software challenge to the competition.



Electrical team members Matthew Price, Michelle Gehner, and Zach Carey.



MICHIGAN DATA SCIENCE TEAM WRANGLES BIG DATA

The impact of modern data science can be felt in every field of research. Sociologists, ecologists, computer scientists, biologists, and more are all in search of ways to better use big data to solve big problems.

The Michigan Data Science Team (MDST) brings together students from all of these fields to “get their hands dirty” with real data science problems and tools. The team gives members a place to learn from experts, form groups to tackle data science challenges, and do research that matches their interests. In 2018-19, computer science and data science undergrad Wesley Tian will lead the organization as president, with plans to focus the group’s activities and provide a better learning experience for new members.

MDST attracts hundreds of students each year with its educational events and opportunities to take on real-world problems. Members are free to form groups to tackle challenges and collaborate on research, with data science grad students on hand to help them organize. The 2017-18 school year was a record-breaking one for MDST’s membership. They welcomed 367 new members, nearly a quarter of whom were new to data science.

“Some people know data science just as a buzzword,” says Tian. “But this is a chance to actually get your hands on it – complete a project, learn the skills that you need, write the code, and work with a team.”

This year, MDST offered its second annual Data Science Tutorial Series, which consisted of 12 hours of instruction, taught entirely by volunteer graduate students, and attracted over 50 beginner data science students. The tutorials covered essential data science skills, such as data management, regression and classification models, and data visualization and communication.

One of the group’s activities that draws the most participants is its involvement in data science challenges, competitions, and projects run by companies and organizations around the country.

Students collaborated with the city of Detroit on two projects. The Vehicle Fleet Maintenance project had students predict maintenance needs for the city’s vehicle fleet, including police cars, fire trucks, ambulances, and waste management trucks. The Blight Compliance Prediction project challenged students to produce insights about their Blight ticketing program. They categorized types of property owners by their ticket compliance patterns, investigated theories about what best motivates people to pay their tickets, and evaluated how these findings could better inform policy decisions.



MDST members who won the Quicken Loan Lending Strategies Prediction Challenge visit Quicken Loans headquarters in Detroit.

Back row: Reddy Rachamalla, Alexandr Kalinin (MDST winner), Alexander Zaitzeff (MDST winner), Mark Nupnau, Brian Ball.

Front row: Jingshu Chen, Patrick Belancourt (MDST winner), Kenzie Zaitzeff, Yvette Tian, Mike Tan, and Catherine Tu.

They categorized types of property owners by their ticket compliance patterns, investigated theories about what best motivates people to pay their tickets, and evaluated how these findings could better inform policy decisions. Prof. Danai Koutra, faculty mentor for the team, worked on both of these projects.

Tian participated in one of these competitions, the ASSISTments Data Mining Competition, funded by an NSF initiative to help spur progress in educational research using big data. Tian and his team used educational data from ASSISTments, an intelligent math tutoring system for middle school students, to make long-term predictions about their careers.

“Our goal was to use that data from the math test they took when they were in middle school and predict if they would end up in a STEM field after graduation,” says Tian. “The goal was to see if they can better structure classes or this math test to encourage students to enter those fields.”

MDST placed third, and winners published their work in the *Journal of Educational Data Mining*.

As president, Tian plans to give more continuity to the group’s activities and design the tutorial series to pair with a certain challenge each semester.

“Dialing back the range of challenges will help us give more structure to the experience of the team overall,” he says. “So not only do you learn new skills, but you’re actually putting them to the test.”

Party for the People: UpNext App Lets Users Shape the Playlist

Tired of yelling song requests at the DJ until you're hoarse, and then getting shut down anyway? Turns out a lot of people are, so three U-M students are working to empower party-goers and democratize the dancefloor with their app, UpNext.

Inspired by a bad frat party playlist, app creator Raymond Sukanto, a CS and business administration student, whipped up the app's first prototype in Fall 2017 to give anyone in the house or club the power to add songs to the queue and vote on what's next. CS student Dan Kaper and business administration student Victor Mahdavi later joined in to help with development and product management, respectively.

UpNext syncs to a user's Spotify account and lets them either search for nearby parties being hosted on the app or host their own. They can kick their own party off with playlists they have saved on Spotify, or search for popular playlists and songs to create a queue from scratch. Other users joining the party then have the power to upvote, downvote, and add tracks to the playlist. The most upvoted tracks will get bumped to the front of the line, making for a crowd-sourced dancefloor set.



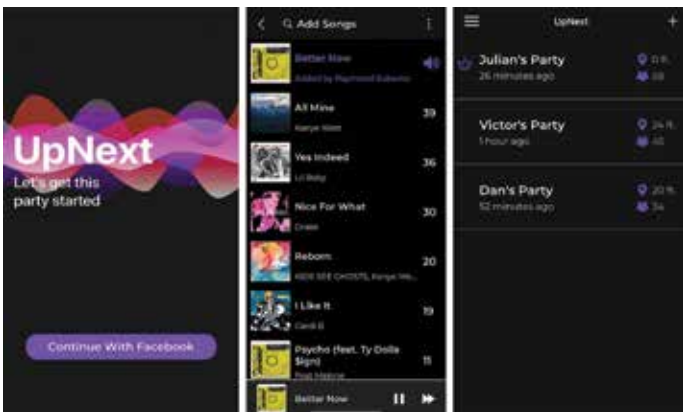
The UpNext team: Raymond Sukanto, Victor Mahdavi, and Daniel Kaper.

"Usually people will add songs, downvote songs above them, and then upvote their own," says Sukanto. "It makes it fun."

Currently, the team is focused on building a user base in Ann Arbor, with some early success. The app has been adopted and used regularly by The Blue Leprechaun and Study Hall Lounge, the latter of which hosted a launch party for the app that drew over 200 people. The team is preparing for another major push in the fall when new students arrive and tailgate season starts, and plan to branch out into other college towns once they've seen more growth. They're also gathering feedback and data from current users to refine the app's playlist-building tools.

"We adapt what we build to how people are using it," Sukanto says. "We have our own database that shows what kinds of songs users are adding, if they're repeating them, things like that."

UpNext is now in the process of incorporating, and Sukanto plans to continue development into the foreseeable future. At over 750 downloads so far, DJs may have a little more competition on the horizon.



An Alexa Skill to Help You Stay On Track

Inspired by a class on managing professional relationships, five recent graduates are developing an app for Amazon's Alexa to help nudge people when they're out of sync with what they want.

The app – or skill, as Amazon calls it – is an intention tracking voice assistant for use with Alexa-enabled devices. It works as a voice assistant that provides a structure for setting goals and tracking performance with consistency. It can set, organize, and prioritize goals, update users on metrics, and send them texts to remind them of their goals all through Amazon Alexa.

The project was first launched by recent Business School graduates Tristan Neeb and Sean Dew, who recruited CS grads Aklavya Kashyap, Reid Ovis, and Shayan Shafii to handle development. The pair pitched the idea during a class on mobile app development for entrepreneurs taught by Prof. Elliot Soloway.

Neeb, who had a busy school schedule and ice hockey practice every evening, said an app like this should be on every college student's list of must-haves.



Students Tristan Neeb, Aklavya Kashyap, Shayan Shafii, and Sean Dew talk about next steps with their instructor, Robert Pasick of the Ross School, on the goal tracking voice assistant they created for use with Amazon's Alexa.

Making Education Accessible in Rural India

CS student Divyansh Sharma is helping combat poor access to education in rural India with his non-profit startup EduTech Academy. Through EduTech, he and his team of ten developers are working to deliver video courses directly to people in need of basic education. The courses are offered entirely in Hindi, and are free of charge.

As a high school student, Sharma set out to identify the key needs of 100 different companies in the Delhi area – what, at the most basic level, were the abilities they expected of all of their workers? Using the survey data, he identified several office tools and language skills needed to be able to enter the job market and designed an introductory set of 50 videos in Hindi.

The resources available on the website range from basics in Microsoft Office to internet fundamentals and the English language, including tests and projects to help monitor progress.

The first challenge Sharma faced was delivering these courses to communities that needed them – most rural populations in India do not have easy internet access. Again, he turned to established institutions to help. This time, he reached out to several non-profits and non-government organizations (NGOs) that organized events and food distribution in impoverished areas. They took his pitch, and began offering in-person workshops presenting EduTech's courses.

By the end of 2015, the platform had 2100 users, and was featured in the leading national newspaper *Times of India*.

Sharma only sees more growth and progress for EduTech on the horizon, and he's taking advantage of U-M resources to help make it happen. In 2017, he was selected as one of the top 20 entrepreneurs on campus by the Center for Entrepreneurship as a part of the 2017 Entrepreneurs Leader Program cohort.

Sharma is hoping to return to EduTech well-equipped to take it to the next level – as well as any future endeavors that may arise.



Divyansh Sharma, back, hosts an EduTech workshop conducted for drug addicted children in a rural part of Delhi.

Student Org Brings Investors to Michigan

A new student org wants to give undergrads a look into the world of venture capital and build connections for startups in southeast Michigan along the way. Called UpRound VC and co-founded by CS undergrad Jonah Erlich, the group works with national and local firms to contribute toward the growth of the local entrepreneurial ecosystem.

UpRound began with a focus on weekly educational events and an undergraduate venture capital competition for U-M teams. For the latter, UpRound partnered with the Zell Lurie Institute to take over a smaller event from previous years. The group was able to greatly increase applications to the competition and bring in VC judges from San Francisco, New York, Chicago, and Detroit representing \$5 billion of assets.

Now, with plans for more focused efforts in the 2018-19 school year, UpRound's organizers have settled in to their vision of offering interdisciplinary undergraduate venture capital education and engaging the broader venture community with Southeastern Michigan.

The group's biggest push is building connections with VCs and firms around the country to help with the very early stage deal-flow of local startups in Ann Arbor and Detroit. They work with any companies that can benefit, including many within the university ecosystem and its accelerators and incubators. So far, they've built connections with Rock Ventures and GBeta, two firms in Detroit that will work with the local community outside of their portfolios, as well as a number of individual investors.

How does the team do it? According to Erlich, he just has to say the magic word.

"VCs love to respond to the word 'student,'" he says. "99% of the time they're happy to help with doing something educational."



In its first year, UpRound hosted Silicon Valley investor Mark Kvamme as part of its educational speaker series.



Students meet with an alum at UpRound's VC competition. JJ Wachler, Chris Scott, Chaghig Demirjian, David Kobrosky, and U-M alum Michael Copley.

Michigan's First Science Olympiad Invitational

Science Olympiad is a national organization that gives the next generation of well-rounded scientists and engineers a chance to problem solve and design their way to the top. This year, the University of Michigan offered the state's first invitational competition run by Olympiad alumni. Conceived of and organized in part by first-year student and computer science major Omar Al-Ejel, the inaugural U-M Science Olympiad gave 45 high school student teams a place to hone their craft and prep for the core competition.

Science Olympiad competitions are like academic track meets, consisting of a series of 23 team events. The specific events change each year, but always cover a wide range of disciplines. Teams typically have their first event each year in the regional circuit, with the goal of climbing to the state- and national-level competitions. The U-M invitational offered a chance for the teams to compete without the pressure of advancing to the next round looming over them.

In its first year, the U-M event attracted 45 teams from across the state, and even some from Ohio and Indiana. With teams of up to 15 students each, that means over 600 high schoolers attended the very first event.

Equipment was provided for teams to do coding exercises, to use remote sensing data to observe climate change processes, and to build elaborate gadgets like mousetrap vehicles, a wooden tower designed to carry heavy weights, and a self-propelled hovercraft.

"Some of the competitions sound simple on paper," says Al-Ejel, "but it's the quality of craft the students put into these things that makes Science Olympiad so intense and creative."

Al-Ejel began planning this event before he even started his first semester at Michigan. With fellow directors Kevin Huang (Undeclared) and Ranganath Kathawate (Cellular and Molecular

Biology), the sponsored student organization built a team of 15 core organizers and gathered over \$15,000 in funding to support the project. In just over one semester, the whole event was built from the ground up.



The U-M Science Olympiad organizing team. The organization's board of directors are in the front row, Omar Al-Ejel, Ranganath Kathawate, and Kevin Huang.



The challenges, prepared by students organizing the event, included the design and construction of many elaborate devices.

ArborHacks Mentors Help High School Students to Learn About CS

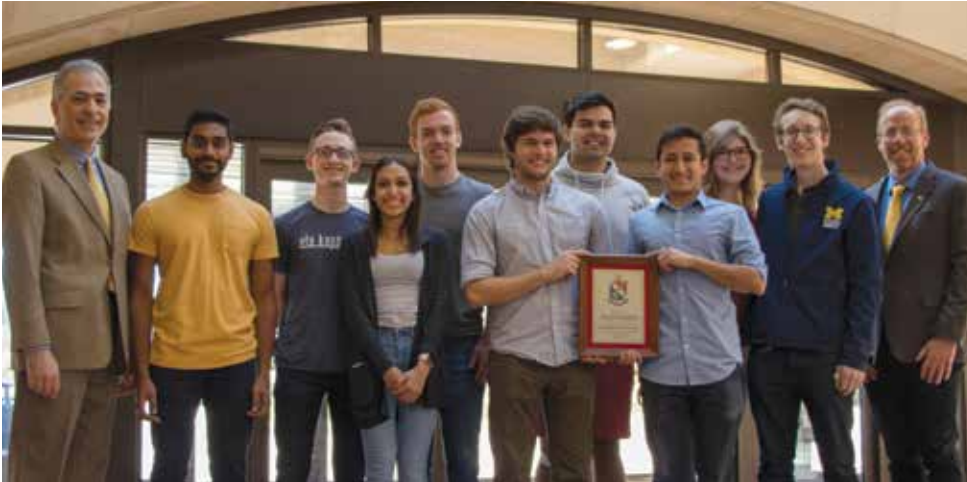
ArborHacks is a student group dedicated to increasing access to CS by mentoring high school students. For the past two years, they've run hackathon-style events. In Fall 2017, they changed it up a bit, holding an HTML workshop that was attended by about 50 high school students. The students came from schools in the Ann Arbor area, and many had no previous coding experience.



According to computer science undergraduate Brian Guo, ArborHacks President, "Our goal was for the students to have a functional web page by the end of the three-hour workshop while providing mentorship from college students on the coding and answering any questions they had about pursuing computer science after high school."

Fifteen ArborHacks mentors provided instruction on the basics of HTML, and then helped the students as needed as they developed their website projects. During lunch, some of the mentors held a panel discussion with the students about what a collegiate CS program is like and how to prepare.

By the end of the event, all participants had a working web page which they were able to show off to the other students and the mentors.

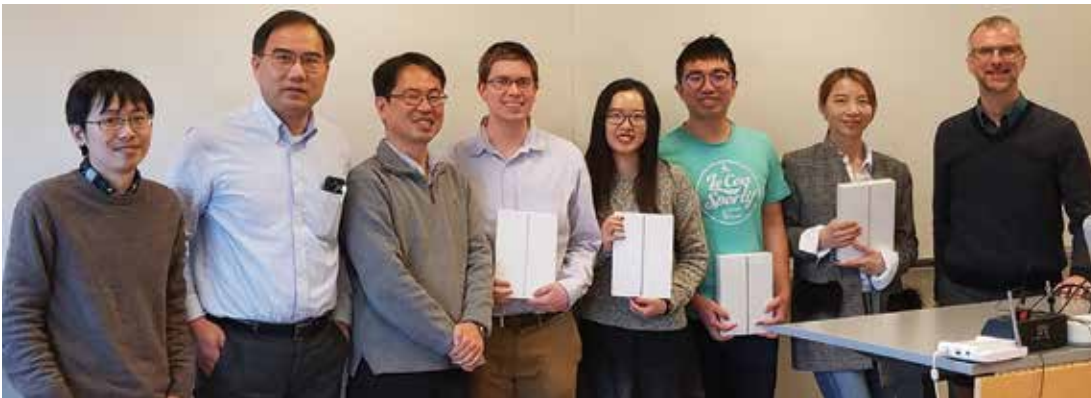


U-M HKN Receives Outstanding Chapter Award

This award is presented to IEEE-HKN Chapters in recognition of excellence in their Chapter administration and programs.

Improving Techniques to Detect Liver Cancer, and Much More

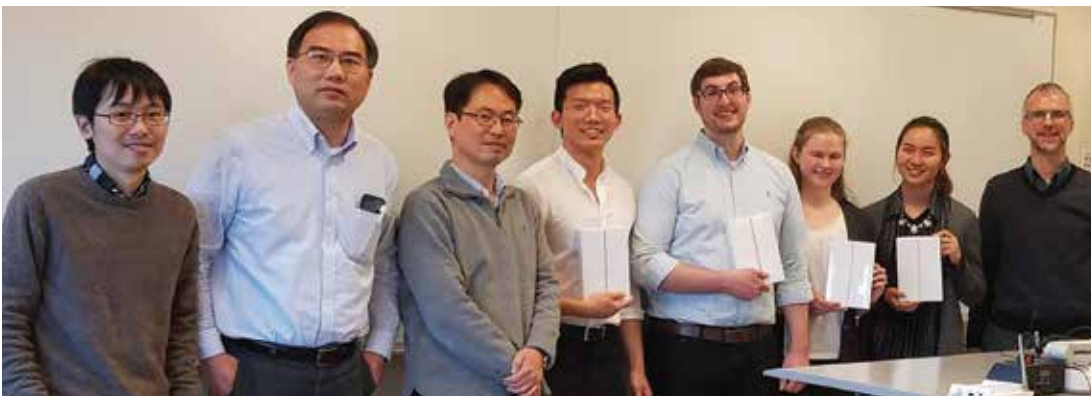
Students in EECS 556: Image Processing, explore methods to improve image processing in applications such as biomedical imaging and video and image compression. The techniques are fundamental to companies such as KLA-Tencor, which offered prizes to two teams of students. The course is taught by Jeffrey Fessler, William L. Root Professor, who is a leading expert in medical imaging with current and past projects in X-ray CT, MRI, PET, SPECT, radiation therapy, and image registration.



FIRST PLACE

Convolutional operator learning for imaging

Siying Li, Haowei Xiang, Alexander Zaitzeff, Xiyu Zhang



SECOND PLACE

Automatic segmentation of tumorous liver CT scans

Sang Choi, Caroline Crockett, Alexander Ritchie, Rebecca Shen

University and National Individual Honors and Awards



Zakaria Aldeneh (CSE graduate student) received an IBM PhD Fellowship to support his work in social signal processing.



Mohammad Amjadi (ECE graduate student) received Honorable Mention at the *2018 IEEE International Symposium on Antennas and Propagation* and *USNC-URSI Radio Science Meeting* for his research on antennas for future ultra-dense wireless networks.



Laura Andre (ECE graduate student) was elected president of the Optics Society at the University of Michigan (OSUM).



Michael Benson (ECE graduate student) was reelected student governor for Eta Kappa Nu (HKN), the honor society of the IEEE.



Raymond Fok (CS undergraduate student) was selected as finalist for the CRA undergraduate research award for his work on HCI systems.



Huanting Huang (ECE graduate student) received Honorable Mention at the *2018 IEEE International Symposium on Antennas and Propagation* and *USNC-URSI Radio Science Meeting* for her research on remote sensing of arbitrary shapes, such as trees.



Hojae Lee (ECE graduate student) received the National Science Foundation's (NSF) Graduate Research Fellowship Program (GRFP) for research on bioengineering and machine learning for single-cell analysis.



Ali Mostajeran, a visiting scholar from Cornell University working in the Radiation Laboratory, received the IEEE Solid State Circuits Society (SSCS) Predoctoral Achievement Award in recognition of his academic record and quality of publications.



Rachel Norris (ECE graduate student) received the NASA Earth and Space Science Research Fellowship for her work "Instrument Development and Science Applications for a Possible CYGNSS Follow-on Mission."



Brian Raeker (ECE graduate student) received Honorable Mention at the *2018 IEEE International Symposium on Antennas and Propagation* and *USNC-URSI Radio Science Meeting* for his research on metasurfaces for manipulation of electromagnetic waves.



Stephanie Crocker Ross (ECE graduate student) received a Rackham Predoctoral Fellowship, which supports outstanding doctoral students working on "unusually creative, ambitious and impactful" dissertations.



Tara Safavi (CSE graduate student) received an NSF Graduate Research Fellowship for her work in data mining.

University and National Individual Honors and Awards



Jean Young Song (ECE graduate student) earned a Best Student Paper Honorable Mention at the *Intelligent User Interfaces (IUI 2018)* conference in Tokyo.



Jie Song (CSE graduate student) received the Runner Up Best Paper Award at the *2018 Extending Database Technology Conference* for her paper "GeoAlign: Interpolating Aggregates Over Unaligned Partitions".



Arun Subramaniyan (CSE graduate student) received a U-M 2018 Precision Health Scholars Award for his project, "Hardware-accelerated Systems for Next-generation Sequencing Analysis."



Daniel Vial (ECE graduate student) won Best Poster at the *Midwest Machine Learning Symposium* for "Personalized PageRank Dimensionality and Algorithmic Implications."



Andrew Wagenmaker (BSE MSE EE 2016 2017) was awarded an NSF Graduate Research Fellowship to continue research on machine learning.



Tianlin Wang (ECE graduate student) received the Mikio Takagi Student Prize at the *2018 IEEE International Geoscience and Remote Sensing Symposium (IGARSS)* for his research on characterizing power and antenna patterns of GPS satellites for the CYGNSS Mission.



Xinchen Yan (CSE graduate student) was selected for Rackham Predoctoral Fellowship, and for a Google PhD Fellowship to support his work in machine learning.

Mengqi Yao (ECE graduate student) won a High Quality Paper Award at the *PowerTech Conference* for her paper, "Using Demand Response to Improve Power System Voltage Stability Margins."



Xiang Yin (MSE PhD EE:S 2013 2017) received an honorable mention for the ProQuest Distinguished Dissertation Award, which "recognizes exceptional and unusually interesting work."



Xin Zan (ECE graduate student) won a Best Poster Award at the *Workshop on Microsystems Technologies and Applications for the Internet of Things*. He also won the WoW Student Paper Competition Certification of Merit at the *2018 IEEE Power Electronics Society Workshop on Emerging Technologies: Wireless Power*.



Jiyue Zhu (ECE graduate student) won the Wiesnet Medal for best student paper at the *75th Eastern Snow Conference* for his work, "Retrieval Algorithm of Snow Water Equivalent Using SnowSAR and Scatterometer Backscatters With Both Co- and Cross-Polarizations."

Undergraduate and Graduate Student Teaching Awards

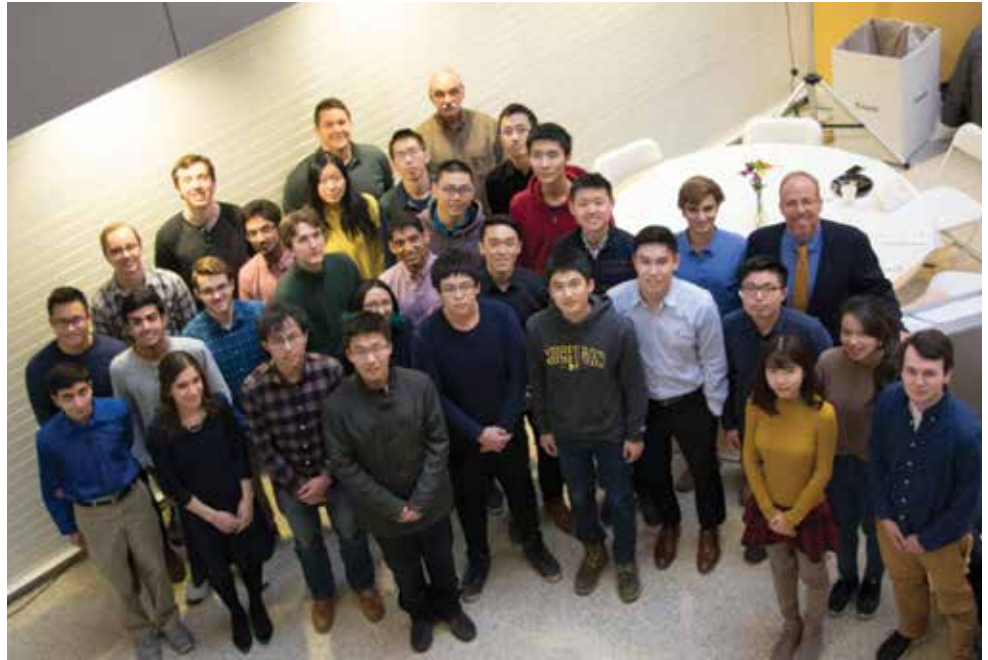
These awards are presented to outstanding graduate student instructors (GSIs) and instructional aides (IAs), based on student and faculty evaluations.

Award Winners

David Hong – GSI
Yongbum Park – GSI
Jonathan Slater – GSI
Andrew Turek – IA
Andrew Wagenmaker – GSI

Honorable Mentions

Billy Schell – GSI
Christopher Schmotzer – GSI
Morteza Sheikhsofla – GSI



EECS Awards Undergraduate

Outstanding Achievement Award

Rahul Hingorani (EE)
Sharang Karve (CE)
Abhimanyu Muchhal (CS)

William L. Everitt Student Award of Excellence

Patrick Irving (CE)
Wenhao Peng (EE)
Dean Robinson (CS)

Outstanding Research Award

Lili Chen (EE)
Justin Fu (CE)
Zijian Wang (CS)

Outstanding Service Award

Stefany Escobedo (CE)
Haley Le (CS)
Austin Xu (EE)

William Harvey Seeley Prize

Michelle Yi (EE)

Commercialization/Entrepreneurship

Aaron Chow (EE)
Rohan Dasika (CE)
Nick Shahin (CS)

Richard K. Brown Memorial Scholarship

Kit Ng (EE)

College of Engineering Awards Undergraduate

Distinguished Academic Achievement Award

Yue Dai (EE)
Ivor Huang (CS)
Steven Schulte (CE)

Distinguished Leadership Award

Akanksha Singh (CS)

Cooley Writing Prize – Fiction Division

Enya Liu (CS)

Roger M. Jones Fellowship

Paul Reggentin (EE)

Graduate

Richard and Eleanor Towner Prize for Outstanding PhD Research Award



David Hong
ECE PhD student
Research: "Optimally Weighted PCA for High-Dimensional Heteroscedastic Data"
Advisor: Prof. Jeffrey Fessler

Distinguished Leadership Award



Bryan Stearns
CSE PhD student

CoE Richard F. and Eleanor A. Towner Prize for Distinguished Academic Achievement



Sijia Geng
ECE PHD student



Kyle Min
ECE PHD student

Students and Alumni Bond over Research at the 2017 ECE Graduate Symposium

The latest in graduate research in Electrical and Computer Engineering was on display at the *9th Annual ECE Graduate Symposium*. Students presented research on a wide variety of topics, including mixed-reality for testing multiple robots, managing heat from fuel cells, predicting cancer cell movement with neural networks, and predicting water main breaks. The work was presented to prospective and fellow students, and judged by ECE faculty and returning alumni.

This year, the following ECE alumni returned to interact with students and judge the poster presentations: Vikrant Gokhale (National Institute of Standards and Technology), Scott Wright (Exponent), Matt Reyes (University of Michigan), Se Un Park (Schlumberger), Angelique Johnson (Founder, MEMStim), Jackie Vitaz (Raytheon), Mehrnoosh Vahidpour (Rigetti), Siddharth Gaba (Lam Research), Cheng Zhang, (NIST), Adel Elsherbini (Intel), Hannah Goldberg (GomSpace).

Applied Electromagnetics and Plasma Science

Nikolaos Chiotellis – 1st prize, for “Metamaterial Bessel Beam Radiator.” Advised by Anthony Grbic.

Fatemeh Akbar – 2nd prize, for “Scalable Phased Array Architectures With a Reduced Number of Tunable Phase Shifters.” Advised by Amir Mortazawi.

Omar Abdelatty – 3rd prize, for “A Position-Independent Highly-Efficient Wireless Power Transfer Based on Coupled Nonlinear Resonant Circuits.” Advised by Amir Mortazawi.

Controls, Dynamics, and Robotics

Zhen Zeng – 3rd prize, for “Semantic Mapping: Revisiting Put That There in Real Domestic Environment.” Advised by Odest Chadwicke Jenkins.

Integrated Circuits, VLSI, and Microsystems

Tal Nagourney – 1st prize, for “High Quality Factor Gyroscope Resonators Formed With Blowtorch Reflow Molding.” Advised by Khalil Najafi.

Kyuseok Lee – 2nd prize, for “A 272.49 pJ/pixel CMOS Image Sensor With Embedded Object Recognition and Bio-Inspired 2D Optic Flow Generation for Nano-Air-Vehicle Navigation.” Advised by Euisik Yoon.

Optics, Photonics, and Solid-State Devices

Soumitra Joy – 2nd prize, for “Artificial Plasmon: a Design-friendly Alternative for Micro-biosensing and High Speed Millimeter-scale Communication.” Advised by Pinaki Mazumder.

Wenzhe Zang – 3rd prize, for “A High Speed, High Sensitivity, and Universal Graphene Vapor Sensor for Both Polar and Non-polar Molecules.” Advised by Zhaohui Zhong.



Chengang Ji – 4th prize, for “Structural Color Filters: Fundamentals and Opportunities for Real-world Applications.” Advised by Jay Guo.

Zumrad Kabilova – 5th prize, for “Charge Transport in Highly Doped (010) β -Ga₂O₃ Single Crystals Made by Edge-defined Film-fed Growth.” Advised by Becky Peterson.

Power and Energy

Sung Yul Chu – 1st prize, for “Transfer-Power Measurement: A Non-Contact Method for Fair and Accurate Metering of Wireless Power Transfer in Electric Vehicles.” Advised by Al-Thaddeus Avestruz.

Stephanie Ross – 2nd prize, for “Impacts on the Local Power Network When Residential Loads Provide Energy Balancing Services to the Regional Network.” Advised by Johanna Mathieu.

Md Salman Nazir – 2nd prize, for “Addressing Synchronization and Oscillations Under Market-based Coordination of Distributed Energy Resources.” Advised by Ian Hiskens.

Systems, Software Engineering and Computer Science

Mohammad Mahdi Khalili – 2nd prize, for “Effective Premium Discrimination for Designing Cyber Insurance Policies With Rare Losses.” Advised by Mingyan Liu.

Signal and Image Processing, Computer Vision

Morteza Noshad – 2nd prize, for “Optimal Estimation of Information Measures and Their Applications.” Advised by Al Hero.

Megha Ghosh – 3rd prize, for “Predictive Models for Transitions in Brain States.” Advised by Omar Ahmed.



Congratulations to the following individuals who earned their Doctorate during the 2017–2018 academic year!

Shaizeen Aga, *Near Data Processing for Efficient and Trusted Systems* (Prof. Satish Narayanasamy, Chair), CSE

Mahdi Aghadjani, *Spoof Surface Plasmon Polariton Based THz Circuitry* (Prof. Pinaki Mazumder, Chair), EE

Dolan Antenucci, *Maximizing Insight From Modern Economic Analysis* (Prof. Michael Cafarella, Chair), CSE

Erik Brinkman, *Understanding Financial Market Behavior Through Empirical Game-Theoretic Analysis* (Prof. Michael Wellman, Chair), CSE

Bradford Campbell, *Perpetual Sensing: Experiences With Energy-Harvesting Sensor Systems* (Prof. Prabal Dutta, Chair), CSE

Michael Shih-Hua Chang, *Ka-Band and W-Band Millimeter-Wave Wideband Linear Power Amplifier Integrated Circuits at 30 GHz and 90 GHz with Greater Than 100 mW Output Powers in Commercially-Available 0.12 μm Silicon Germanium HBT Technology* (Profs. Amir Mortazawi and Gabriel Rebeiz, Co-chairs), EE

Kyong Tak Cho, *From Attack to Defense: Toward Secure In-vehicle Networks* (Prof. Kang Shin, Chair), CSE

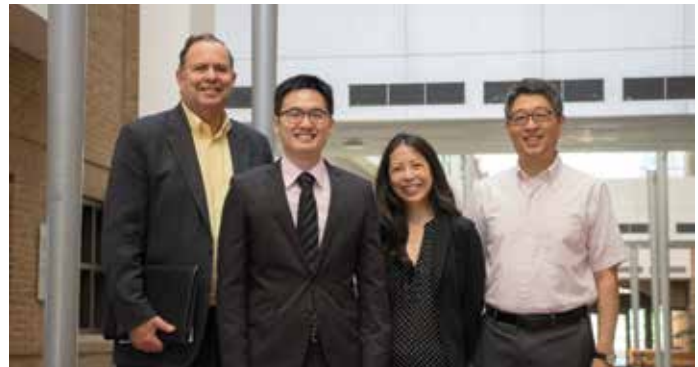
Myungjoon Choi, *Ultra Low Power Circuits for Internet of Things and Deep Learning Accelerator Design With In-Memory Computing* (Prof. Dennis Sylvester, Chair), EE

Nicholas Andrew Collins, *Mismatch-Immune Successive-Approximation Techniques for Nanometer CMOS ADCs* (Prof. Michael Flynn, Chair), EE

Efren Cruz Cortes, *Variable Weight Kernel Density Estimation* (Prof. Clayton Scott, Chair), EE:S

Oguz Hasan Dagci, *Hybrid Electric Powertrain Design and Control with Planetary Gear Sets for Performance and Fuel Economy* (Profs. Jessie Grizzle and Huei Peng, Co-chairs), EE:S

Mehmet Batuhan Dayanik, *Efficient Continuous-Time Sigma-Delta Converters for High Frequency Applications* (Prof. Michael Flynn, Chair), EE



Samuel DeBruin, *Enabling Visibility Into Building Energy Consumption Through Novel Metering Designs and Methods* (Prof. Prabal Dutta, Chair), CSE

Shiyang Deng, *Miniaturized Pumps and Gauges for Ultra-High Vacuum Microsystems* (Prof. Yogesh Gianchandani and Dr. Scott Green, Co-chairs), EE

David Devecsery, *Enabling Program Analysis Through Deterministic Replay and Optimistic Hybrid Analysis* (Prof. Peter Chen, Chair), CSE

Qing Dong, *Low-power Volatile and Non-volatile Memory Design* (Prof. Dennis Sylvester, Chair), EE

Elizabeth Frances Cloos Dreyer, *Dependence of Radiant Optical Magnetization on Material Composition* (Prof. Stephen Rand, Chair), EE

Zakir Durumeric, *Fast Internet-Wide Scanning: A New Security Perspective* (Prof. J. Alex Halderman, Chair) CSE

Ridvan Eksi, *Identification and Functional Annotation of Alternatively Spliced Isoforms* (Prof. Yuanfang Guan, Chair), EE:S

Kassem Fawaz, *Location Privacy Protection in the Mobile Era and Beyond* (Prof. Kang Shin, Chair), CSE

Catherine Finegan-Dollak, *Selecting and Generating Computational Meaning Representations for Short Texts* (Profs. Walter Lasecki and Dragomir Radev, Co-chairs), CSE

Cao Gao, *Heterogenous Mobile Platform Characterization and Design for Deep Learning Applications* (Profs. Ron Dreslinski Jr. and Trevor Mudge, Co-chairs) CSE

Robert Goeddel, *Policy-Based Planning for Robust Robot Navigation* (Prof. Edwin Olson, Chair), CSE

Yihua Guo, *Improving Application QoE With Flow-Level, Interface-Level, and Device-Level Parallelism* (Prof. Zhuoqing Morley Mao, Chair), CSE

Arnab Hazari, *III-Nitride Nanowire Based Near-Infrared Optoelectronic Devices on (001) Silicon* (Prof. Pallab Bhattacharya, Chair), EE





Parker Hill, *Bridging the Scalability Gap by Exploiting Error Tolerance for Emerging Applications* (Profs. Jason Mars and Lingjia Tang, Co-chairs), CSE

Jun Hou, *Control and Optimization of Electric Ship Propulsion Systems With Hybrid Energy Storage* (Profs. Heath Hofmann and Jing Sun, Co-chairs), EE:S

Chang-Hong Hsu, *Towards Power- and Energy-efficient Datacenters* (Profs. Jason Mars and Lingjia Tang, Co-chairs), CSE

Chun-Hung Hsiao, *Improving Software Reliability for Event-Driven Mobile Systems* (Profs. Michael Cafarella and Satish Narayanasamy, Co-chairs) CSE

Amr Alaa Ibrahim, *Phenomenology and Technology in Support of Sub-Terahertz Radar Systems* (Prof. Kamal Sarabandi, Chair), EE

Armin Jam, *A High Performance Micromachined Sub-Millimeter-Wave Radar Technology* (Prof. Kamal Sarabandi, Chair), EE

Taekwang Jang, *Circuit and System Designs for Millimeter Scale IoT and Wireless Neural Recording* (Prof. David Blaauw, Chair), EE

Nan Jiang, *A Theory of Model Selection in Reinforcement Learning* (Prof. Satinder Singh Baveja, Chair), CSE

Collin Johnson, *Topological Mapping and Navigation in Real-World Environments* (Prof. Benjamin Kuipers, Chair), CSE

Wanyeong Jung, *Low-Power Energy Efficient Circuit Techniques for Small IoT Systems* (Prof. David Blaauw, Chair), EE

Mani Kashanianfard, *Low-frequency Antennas, Transparent Ground Planes, and Transponders for Communication Enhancement in Unfavorable Environments* (Prof. Kamal Sarabandi, Chair), EE

Benjamin Kempke, *Improving RF Localization Through Measurement and Manipulation of the Channel Impulse Response* (Prof. Prabal Dutta, Chair), CSE

Hyeongseok Kim, *Millimeter-scale RF Integrated Circuits and Antennas for Energy-efficient Wireless Sensor Nodes* (Prof. David Wentzloff, Chair), EE

Sunmin Kim, *Holistic Management of Energy Storage System for Electric Vehicles* (Prof. Kang Shin, Chair), CSE

Tae Hyun Kim, *Study of Circulating Tumor Cells Using Microfluidic Technology: From Isolation to Analysis* (Profs. Yogesh Gianchandani and Sunitha Nagrath, Co-chairs), EE

Shibamouli Lahiri, *Keywords at Work: Investigating Keyword Extraction in Social Media Applications* (Prof. Rada Mihalcea, Chair), CSE

Duc Le, *Towards Automatic Speech-Language Assessment for Aphasia Rehabilitation* (Prof. Emily Mower Provost, Chair), CSE

Mai Le, *Reconstruction Methods for Free-Breathing Dynamic Contrast-Enhanced MRI* (Prof. Jeffrey Fessler, Chair), EE:S

Chansoo Lee, *Analysis of Perturbation Techniques in Online Learning* (Profs. Jacob Abernethy and Ambuj Tewari, Co-chairs), CSE

Fei Li, *Querying RDBMS Using Natural Language* (Prof. HV Jagadish, Chair), CSE

Jie Li, *Place Recognition and Localization for Multi-Modal Underwater Navigation With Vision and Acoustic Sensors* (Profs. Matthew Johnson-Roberson and Ryan Eustice, Co-chairs), EE:S

Miao-Bin Lien, *Problems in Scattering and Imaging* (Prof. Theodore Norris, Chair), EE

Yong Lim, *Energy Efficient Pipeline ADCs Using Ring Amplifiers* (Prof. Michael Flynn, Chair), EE



John Lipor, *Sensing Structured Signals With Active and Ensemble Methods* (Prof. Laura Balzano, Chair), EE:S

Lianli Liu, *Optimizing Magnetic Resonance Imaging for Image-Guided Radiotherapy* (Profs. Jeffrey Fessler and James Balter, Co-chairs), EE:S

Fei Lu, *High Power Capacitive Power Transfer for Electric Vehicle Charging Applications* (Profs. Heath Hofmann and Chunting Mi, Co-chairs), EE:S

Shengshuo Lu, *Secure and Energy-Efficient Processors* (Profs. Zhengya Zhang and Marios Papaefthymiou, Co-chairs), EE

Wen Ma, *Dynamic Memristors: From Devices to Applications* (Prof. Wei Lu, Chair), EE

Jennifer Felder Marley, *Solving Large-Scale AC Optimal Power Flow Problems Including Energy Storage, Renewable Generation, and Forecast Uncertainty* (Prof. Ian Hiskens, Chair), EE:S

Erik Miebling, *Reasoning Under Uncertainty in Cyber-Physical Systems: Toward Efficient and Secure Operation* (Prof. Demosthenis Teneketzis, Chair), EE:S

Brian Moore, *Robust Algorithms for Low-Rank and Sparse Matrix Models* (Prof. Raj Rao Nadakuditi, Chair), EE:S

David Moore, *Circuits and Techniques for Cell-based Analog Design Automation in Advanced Processes* (Prof. David Wentzloff, Chair), EE

Gopal Nataraj, *Advances in Quantitative MRI: Acquisition, Estimation, and Application* (Prof. Jeffrey Fessler and Dr. Jon-Fredrik Nielsen, Co-chairs), EE:S

Himanshu Nayar, *Application of Random Matrix Theory to Multimodal Fusion* (Prof. Raj Rao Nadakuditi, Chair), EE:S

Lars Petter Nilsson, *Correct-by-Construction Control Synthesis for High-Dimensional Systems* (Profs. Jessy Grizzle and Necmiye Ozay, Co-chairs), EE:S

Yongjoo Park, *Fast Data Analytics by Learning* (Profs. Michael Cafarella and Barzan Mozafari, Co-chairs) CSE

Mohammad Rasouli, *Cyber-Physical Systems Design: Electricity Markets and Network Security* (Prof. Demosthenis Teneketzis, Chair), EE:S

John Ruppe, *Theoretical and Experimental Foundations of Coherent Pulse Stacking Amplification* (Prof. Almantas Galvanauskas, Chair), EE

Armin Sarabi, *Quantifying Security: Methods, Challenges and Applications* (Prof. Mingyan Liu, Chair), EE:S

Abhinav Sinha, *Mechanism Design With Allocative, Informational and Learning Constraints* (Prof. Achilleas Anastasopoulos, Chair), EE:S

Sudarshan Sivaramakrishnan, *Dynamics of Passively Coupled Continuous-Wave and Mode-Locked Lasers* (Prof. Herbert Winful, Chair), EE

Byeongseop Song, *Controlling Thin-film Morphology and Incorporating Novel Semiconducting Molecules Toward High Performance Organic Optoelectronic Devices* (Profs. Jay Guo and Jinsang Kim, Co-chairs), EE

Andrew Springall, *Nation-State Attackers and Their Effects on Computer Security* (Prof. J. Alex Halderman, Chair), CSE

Yu Sui, *Low Power Autonomous Microsystem for Oil Well Logging Applications* (Prof. Yogesh Gianchandani and Dr. Tao Li, Co-chairs), EE

Shuanghong Sun, *Improve the Usability of Polar Codes: Code Construction, Performance Enhancement and Configurable Hardware* (Prof. Zhengya Zhang, Chair), EE

Raj Tejas Suryaprakash, *Data Driven Algorithms for the Estimation of Low Rank Signals in Structured Subspaces* (Prof. Raj Rao Nadakuditi, Chair), EE:S

Yemin Tang, *High Aspect-ratio Biomimetic Hair-like Microstructure Arrays for MEMS Multi-Transducer Platform* (Prof. Khalil Najafi, Chair), EE

Jahromi Hamidreza Tavafoghi, *On Design and Analysis of Cyber-Physical Systems With Strategic Agents* (Prof. Demosthenis Teneketzis, Chair), EE:S

Peng Tian, *Controlling Photon and Ion Fluxes in Low Pressure Low Temperature Plasmas* (Prof. Mark Kushner, Chair), EE:S

Yu-Chih Tung, *Acoustic Sensing: Mobile Applications and Frameworks* (Prof. Kang Shin, Chair), CSE

Muzhi Wang, *Phase Change Material Based Ohmic Switches for Reconfigurable RF Applications* (Prof. Mina Rais-Zadeh, Chair), EE

Zhaorong Wang, *Subwavelength Grating Based Microcavity and Its Applications in Many-Body Polariton Systems* (Profs. Duncan Steel and Hui Deng, Co-chairs), EE

Zhe Wu, *Cost-Effective Support for Low Latency Cloud Storage* (Prof. Harsha Madhyastha, Chair), CSE

Tianpei Xie, *Robust Learning From Multiple Information Sources* (Prof. Alfred Hero III, Chair), ECE

Kaiyuan Yang, *Circuit Techniques for Low-Power and Secure Internet-of-Things Systems* (Prof. Dennis Sylvester, Chair), EE

Abdi Zeynu, *Design and Test of Brushless, Self-Excited Synchronous Field-Winding Machine* (Prof. Heath Hofmann, Chair), EE:S

Yunqi Zhang, *Architecting Data Centers for High Efficiency and Low Latency* (Profs. Jason Mars and Lingjia Tang, Co-chairs), CSE

Zhizheng Zhang, *Optical Quartz Crystal Microbalance (OQCM) for Dual-Mode Analysis* (Profs. Duncan Steel and Xudong Fan, Co-chairs), EE

Zhe Zhao, *Spotting Icebergs by the Tips: Rumor and Persuasion Campaign Detection in Social Media* (Profs. Michael Cafarella and Qiaozhu Mei, Co-chairs), CSE

Jiabei Zheng, *Improving Image Reconstruction for Digital Breast Tomosynthesis* (Profs. Jeffrey Fessler and Heang-Ping Chan, Co-chairs), EE:S

Nan Zheng, *Algorithm/Architecture Co-Design for Low-Power Neuromorphic Computing* (Prof. Pinaki Mazumder, Chair), EE



ALUMNI NEWS

Andrew Farah, Leader at GM, Receives ECE Merit Award

Andrew Farah (BSE CE 1982; MSE Electrical Science 1984), Chief Technology Architect for Autonomous Vehicles at General Motors, was the recipient of the 2017 ECE Alumni Merit Award.



After receiving the award, he gave a talk covering the modernization of automotive electronics over his career titled “Evolution of a Career, Computers, and Cars: 40 Years of Change.”

Farah started his General Motors career in 1984 as a Product Engineer in the Electrical/Electronics Group with the Buick Motor Division in Flint, Michigan. He then worked for Johnson Controls before returning to GM. He held many positions, including Engineering Group Manager of Vehicle Propulsion Engineering for the EV1 Electric Vehicle. In 2007, he was named Vehicle Chief Engineer for the award-winning Chevy Volt, and in 2018, he was in the news for being named one of the 15 greatest minds in automobile engineering today.

As an engineer, it's important to know how to problem solve. One of the most important things, though, is you need to know how to learn. This is buried in each of the different classes at Michigan.

— Andrew Farah

Rick Flores Leads a Partnership of Automakers Into the Autonomous Future

When Rick Flores (MSE Electrical Engineering:Systems 1990) began his career at General Motors, it was still predominantly a mechanical engineering company. “There was software in vehicles at that time,” Flores said, “but it was pretty much limited to engine control and body functions.”

Now, as electrical engineering and computer science takes the driver's seat for automotive innovation, Flores is taking a leading role. As the newest Chairman of AUTOSAR (AUTomotive Open System ARchitecture), a partnership of several automakers and suppliers, he leads the development of standard frameworks for a variety of technologies including autonomous driving, connectivity, and electronic controls.

Flores, now a Technical Fellow, Model-Based Electrical System and Software Engineering, started at GM after earning his master's degree in 1990. The job was modeling systems and functions to help suppliers understand written specifications. The models proved so useful that they eventually took the place of written specifications, served as the basis for production code generation, and led to system-level models that created communication and diagnostic systems for the entire car that ran on electronic control units (ECUs).

His contributions to modeling earned him the title of technical fellow – one only given to individuals who have impacted the entire automotive industry.

With his background and experience starting from the forefront of modeling, Flores was asked to join AUTOSAR.

“We're at a point of inflection in the industry because there's so much discovery, experimentation, and development that's going on,” Flores said. “It's easy to diverge in that environment.”

In response, AUTOSAR is developing the Adaptive Platform, its new standard that will support highly automated driving, cyber security, functional safety, connectivity with the internet, and software over the air.

Armed with his degree from Michigan, Flores is now leading this alliance during one of the most dynamic moments in its history.



I got exactly the job that I wanted with my degree from University of Michigan. — Rick Flores

Garlin Gilchrist II: Committed to Public Service



Garlin Gilchrist II (BSE CE/CS 2005) was born in Detroit, and at 5 years old his grandmother, a Detroit Public Schools social studies teacher, got him his first computer.

He's been combining his love for computing and technology with a powerful drive for social change throughout his life, most recently accepting the call to be the running mate for Michigan gubernatorial candidate Gretchen Whitmer. Just this past year, he narrowly lost an election to be Detroit's City Clerk, before that serving as Director of Innovation & Emerging Technology for the City of Detroit.

In order to focus on the campaign, Gilchrist will be taking a leave of absence from his latest position as Founding Executive Director of the School of Information's Center for Social Media Responsibility. His goals at the Center are to ensure that people are connected, informed, empowered, and free to share their ideas on the internet in a way that is socially responsible.

The Center is really a response to a unique challenge and opportunity," said Gilchrist. "Social media has become the way so many people across the world have conversations. It is as diverse as humanity – there are usages of it that are positive and there are uses that can be for more nefarious purposes."

"Our job is to create tools, and to use and make our research usable to media makers, to media consumers, to platform companies, to make sure we deal with this ongoing threat of more difficult-to-understand and potential misinformation."

As one of its first initiatives under Gilchrist's leadership, the Center partnered with U-M Social to create the website, Social Integrity. Gilchrist said the website's message that "it's time to reclaim your space" is meant to empower individuals to do their part to create a positive and civil online environment.

Can we believe what we see online? Can we trust sources?

— Garlin Gilchrist

A Role Model at Raytheon: Katherine Herrick

How did Katherine Herrick (BSE MSE PhD, Electrical Engineering, 1993 1995 2000), Senior Fellow and Chief Engineer at Raytheon, become a leader at a leading company? Along with her own engineering prowess and hard work, she did it with the help of mentors. Now, she herself wants to give back to the next generation of engineers.

Following her positive childhood experiences sitting in on her father Don Herrick's (MSE, Electrical Engineering and Math, 1975) college classes, one of Katherine Herrick's formative engineering experiences came from an undergraduate research opportunity she found while taking an introductory electromagnetics class. The summer position, which was located in the Radiation Lab (Radlab), allowed her to work closely with graduate students and directly under a professor, Linda Katehi, who she continued working with in graduate school.

She recalls attending the *IEEE Microwave Theory and Techniques Society (MTT-S) International Microwave Symposium* with Katehi's group and other Radlab members, and winning a student paper award the first time that she presented.

"For me to have won that award so quickly is a credit to Linda Katehi," Herrick says. "We rehearsed, made sure the facts were right, and checked that the writing was spot on. She taught us life skills, not just electromagnetics."

With her father and PhD advisor setting the example of paying it forward, Herrick, who has had a lifelong career at Raytheon, believes in helping those who are younger that need support. By serving on the ECE Council, an advisory group that helps with key priorities of Michigan ECE, she hopes to help students understand how their research positively impacts society, as well as help them find satisfying careers.





CPU Pioneer Kunle Olukotun Aims to Move the Bar for AI Chip Development

As artificial intelligence applications multiply, researchers are racing to design a new generation of hardware that meets their unique computational needs. The market for these “AI chips” is booming even in its infancy, and Google’s parent company made its first-ever investment in the space.

Enter startup SambaNova Systems, co-founded by alumnus Kunle Olukotun (BSE EE 1985; MSE PhD CSE 1987 1991), which has earned \$56M in its series A funding round to develop a computing platform that may reimagine how we power machine learning and data analytics.

SambaNova’s approach, stemming from work by Olukotun and co-founder Christopher Ré at Stanford University, seeks to create a new platform from scratch that is optimized specifically for AI operations. In doing so, its founders hope to outclass high-efficiency graphics processing units (GPUs) in speed, power usage, and even the size of the chip.

Olukotun wants SambaNova to build the new standard for applications ranging from image processing aboard self-driving vehicles to training models for complex medical problems.

“All sorts of approaches have been tried, but they’re all facing the fundamental limit that is Moore’s Law is slowing down,” according to Olukotun. “To get more performance going forward, we need to think about a much more efficient way of doing computations.”

Olukotun, the “father of multi-core processors” and Cadence Design Systems Professor of EECS at Stanford, revolutionized computing in the 1990s with his work on Stanford’s Hydra chip multiprocessor (CMP). This project brought about multi-core technology as we know it today, where it is commonplace in consumer and high-end computing systems.

The Art of Cyber War with Isaac Porche

Isaac R. Porche III (PhD EE:S 1998) is a senior engineer at the RAND Corporation, where he currently serves as the Director of the Acquisition and Development Program in the Homeland Security Operational Analysis Center (HSOAC). As a program director, he oversees a wide range of projects supporting the Department of Homeland Security and its components.

Since 1998, when he joined RAND, he has led research projects for the U.S. Navy, the U.S. Army, the Department of Homeland Security (DHS), the Joint Staff, and the Office of the Secretary of Defense. He has served on the U.S. Army Science Board supporting a number of its cyber-related panels, and is a Senior Fellow at the Center for Cyber and Homeland Security at George Washington University. He has taught the graduate course “Policy and Technology of Cyberwar” at the Institute of Politics and Strategy at Carnegie Mellon University.



For a giant school like Michigan, it has an amazing ability to create a sense of belonging.

— Isaac Porche

Porche’s areas of expertise include cybersecurity, network and communication technology, intelligence, surveillance, and reconnaissance (ISR) systems, data mining, modeling and simulation, cybersecurity, rapid acquisition processes, and operations research techniques. In 2016, he presented testimony on emerging cyber threats and implications before the House Homeland Security Committee, Subcommittee on Cybersecurity, Infrastructure Protection, and Security Technologies. He is the author of the forthcoming book *Cyberwarfare 101: Technology, Tactics, and Techniques for Information-age Conflict* (Artech House, 2019). He returned to Michigan recently to present the inaugural Willie Hobbs Moore Lecture, “Information-age Conflict.”

Jordi Ribas: Leading AI Products at Microsoft



"We shouldn't be afraid of artificial intelligence," says Jordi Ribas (PhD EE:S 1996), Corporate Vice President of AI Products at Microsoft. "I see AI as enhancing people's lives. I think it can enhance human capability."

In the 1990's, while working on his graduate degrees, Ribas says AI was more of a niche field with few real applications. So he combined his interests in computer vision and information theory researching video encoding under David Neuhoff, Joseph E. and Anne P. Rowe Professor of Electrical Engineering.

His first job was at Microsoft, where he moved from Windows Media to media technology for Xbox, to search technology with Bing, and finally – to developing relevancy, speech, and intent aspects of AI that help power both Bing and Cortana, Microsoft's digital assistant.

Ribas is one of the newest members of the ECE Council, a prestigious group of alumni and friends who are committed to ECE's goal of being a national and global nexus of positive, transformational change across all industries.

At a reunion about 10 years after finishing at Michigan, everyone had the realization that the university had been such an important part of our lives. Michigan educated us and had been such an integral part in helping us grow and become successful.

— Jordi Ribas

The Next Medical Markets of Collin Rich

Collin Rich (MSE PhD EE 1997 2000) is a health sciences entrepreneur who has almost two decades of startup experience solving critical problems. After working at a fellow alum's startup company, he went out on his own to co-found Accuri Cytometers in 2004. Accuri developed flow cytometers to count cells and help diagnose blood disorders in a much smaller and easier to use format than previously available. After building up global annual sales to about \$20M, the company was acquired by Becton Dickinson in 2011 for \$205M.

Now, Rich is ready to repeat that success.

His latest start-up, Aquaro Histology, recently received \$9.8M in funding to revolutionize how tissue samples are handled in the lab. Aquaro Histology has automated the labor intensive process of mounting a slice of tissue onto slides, allowing pharmaceutical companies, hospitals, and research organizations to increase their efficiency and throughput in the lab.

The company recently launched their first product, an automated section mounting machine.

Meanwhile, Rich is working with two other startup companies. Sonetics, which Rich co-founded with Jennifer Baird in 2003, is focused on using ultrasound for instant blood pressure measurements. And OcuSciences, where Rich is CTO, is developing an ophthalmologic imager which, after taking a picture of the back of an eye, can help diagnose diseases like macular degeneration. He expects to bring the device, the OcuMet Beacon, to market soon.

I'm willing to take on more technical risk, because – as long as a solution doesn't violate the laws of physics – there's always a way to make it happen.

— Collin Rich



Rob Rutenbar's Pioneering Contributions to Electronic System Design

Dr. Rob A. Rutenbar (MSE, PhD CICE 1979, 1984), senior vice chancellor for Research at the University of Pittsburgh, has made pioneering contributions to algorithms and tools for analog and mixed-signal designs. As an academic, he developed a wide range of fundamental models, algorithms, and tools for analog integrated circuit (IC) designs. As an entrepreneur, he co-founded Neolinear, one of the most successful analog tool companies, to bring his research efforts to the larger design community.

To recognize these achievements, Rutenbar was honored with the 2017 Phil Kaufman Award for Distinguished Contributions to Electronic System Design, which was presented by the Electronic System Design Alliance (ESD Alliance) and the IEEE Council on Electronic Design Automation (CEDA). It is considered the "Nobel Prize" of electronic design automation.

Rutenbar grew up in the suburbs of Detroit, did his undergraduate work at Wayne State University, and his graduate work at the University of Michigan, where he was co-advised by now-Emeritus Prof. Daniel E. Atkins and Trevor Mudge, the Bredt Family Professor of Engineering.

After Michigan, he was on the faculty at Carnegie-Mellon for 25 years, during which he co-founded analog tool company Neolinear and sold it to Cadence. At CMU, he was the founder and director of the Center for Circuit and System Solutions (C2S2), chartered by major U.S. semiconductor companies and the Defense Advanced Projects Research Agency (DARPA) to pioneer a range of important technologies, notably in statistical circuit design and lithography-aware chip design.

From 2010-17, he served as Head of the Computer Science Department at the University of Illinois at Urbana-Champaign, where he made major contributions in online education and the development of UIUC's CS+X curriculum. He reworked his CMU course, "VLSI CAD: Logic to Layout," into a Massive, Open, Online Course (MOOC) in 2013, providing EDA training to thousands of engineers; to date, his course has connected with over 50,000 registered learners from more than 150 countries.



Piston Group Leader Amit Singhi



In the early 1990s, Amit Singhi (MSE EE:S 1989) led a software team developing one of the very first in-car navigation systems in America. Singhi eventually shifted from engineering into business, but the technical chops and leadership he took on in this project echo through his career. Today, Singhi is Chief Operating and Financial Officer of Piston Group, one of the largest minority-owned automotive suppliers in the country with annual revenues near \$2B.

After earning his master's degree at Michigan, Singhi joined General Motors, which sponsored his MBA at U-M. Armed with engineering and business knowledge, Singhi found a position in finance at Ford Motor Company. He eventually became CFO for Ford South America Operations, and after this, took a new position as CFO of FLIR Systems.

Last year, Singhi returned to Michigan to join Piston Group, a company founded by former Detroit Piston and CEO, Vinnie Johnson. Piston Group comprises Piston Automotive, Irvin Automotive, and Detroit Thermal Systems. The companies design, engineer, assemble, and manufacture a wide variety of automotive parts and systems, including hybrid vehicle battery systems.

Throughout all these finance-oriented roles, it was Singhi's engineering skills that gave him an edge.

"The engineering background helped me better understand and appreciate the business, the operations, the product, and the process," Singhi said. "It's very different if you understand the language, the process, and the technology. My engineering foundation was a huge plus."

Be curious, ask a lot of questions, and don't just accept the status quo.

— Amit Singhi

CS ALUM TRAVELS AFRICA BY MOTORCYCLE, PLANTING THE SEEDS OF PROGRAMMING

Levi Weintraub (BSE CS 2006) has lived on two wheels for close to two years now, putting his incredibly accomplished tech career on hold for an epic trans-African journey that's stoking his passion for travel and educating a cohort of aspiring African tech professionals.

Weintraub's wanderlust first hit him in May of 2016. He was working at Google, where he landed by way of Intel, Apple, Microsoft, and Palm. But something about his comfortable Bay-area life just didn't seem right. He'd always had a passion for two things: teaching and motorcycling. And he decided to combine them on an epic cycling trip that would take him the length of Africa, over 7,500 miles.

This wasn't his first ride — he'd ridden motorcycles with his dad in his hometown of South Haven, Michigan, and nine years ago, the two rode the length of the Americas, from Alaska to the southern tip of South America. It wasn't enough.

"As soon as I got to Patagonia, I knew I'd do Africa next," he said. "I love motorcycling because it forces you to be in the moment. When it's hot, you're hot, when it's cold, you're cold, when it rains, you get wet. You lean into turns. And you're wedded to this machine that's dramatically less reliable than a car. That forces you to learn about it and care for it."

But ultimately, it was Weintraub's passion for teaching that pushed him to hit the road. He had earned a reputation as a teacher and consensus builder at Google, and he wanted to apply those skills in Africa, though he wasn't sure exactly how. He set out from Cape Town, riding north toward Tangier.

It all came together at a hamburger stand in Dar Es Salaam, Tanzania, where Weintraub met a fellow motorcyclist who was trying to build a tech mentoring program. He didn't hesitate. He spent the next four months teaching coding and entrepreneurship to a group of students fresh out of high school.

As it turned out, he learned as much from the students as they did from him. He learned how to bridge cultural gaps and how to sort out the infinite logistical challenges that come with running a program in Africa. But most of all, he learned about himself.

"Travelling in Africa is a constant lesson that the things we take for granted are actually culturally instilled," he said. "Our perspectives are shaped on a deep level by where we grew up, and by meeting people with different experiences, you learn about yourself."



Weintraub isn't sure when his trip will end, but when it does, he plans to go to graduate school and eventually become a university professor. In the meantime, he's back on the bike, planning to ride to Tangier and then cross the Strait of Gibraltar into Spain. Coding and motorcycling might seem like wildly different pursuits, but Weintraub believes they have a lot in common.

"Riding, wrenching, and coding are about planning before you act so you don't get yourself into a situation you can't get out of," he explains. "You learn how something works, and once you know, you can go on a really amazing journey. That's the joy of engineering and the joy of travelling."



First a Unicorn, Now Cisco – Duo Security Goes Big Time

Duo Security, cofounded by Jon Oberheide (BS CS 2006, MS PhD CSE 2008 2011) and Dug Song (BS CS 1997), has had a heck of a year.

In December 2017, Duo became Ann Arbor and U-M's first-ever "unicorn" – the tech company reached a total valuation of \$1 billion – smashing records for the region and garnering national headlines. On top of that, the company brought several industry luminaries onto its leadership team and formed strategic partnerships that promised continued growth.

On August 2, 2018, Duo made another announcement: Cisco had purchased Duo for \$2.35 billion in cash. Song will continue leading Duo as its General Manager and will join Cisco's Networking and Security business, and Duo will remain headquartered in Ann Arbor.

"Our partnership is the product of the rapid evolution of the IT landscape alongside a modernizing workforce, which has completely changed how organizations must think about security," said Song. "By joining forces with the world's largest networking and enterprise security company, we have a unique opportunity to drive change at a massive scale, and reshape the industry."

Duo Security has made waves in the business of mobile two-factor authentication since its founding in 2010. The company's first product, Duo Mobile, enabled users to secure their logins and transactions when logging into remote computers or servers using their smartphones and Duo Security software in place of hardware tokens. The University of Michigan uses Duo Security for many of its two-factor authentication services.

The company has since broadened its reach in the security world with Duo Beyond, a "zero-trust" security platform that lets enterprises base application access decisions on the trust established in user identities and the trustworthiness of their devices, instead of the networks they're attempting access from. This approach lets users gain access to applications from untrusted networks without having to undergo the frustration of dealing with traditional virtual private network or network access control.



Cofounders Dug Song and Jon Oberheide celebrate Duo Security's "unicorn" status.

Evigia Founder Navid Yazdi Creates Essential Sensor Networks

There is a bit of magic inside all the devices that Navid Yazdi (PhD EE 1999) creates. This magic is what first interested him in electrical engineering, is what he explored during his PhD, and is what drives his work as Founder and CEO of Evigia Systems.

"It's fascinating, you put these chips on a board and they do all these amazing things for you," Yazdi says.

While inconspicuous, the variously-sized black boxes marked with Evigia's logo perform anything but mundane tasks. The sensor systems can help save lives, mitigate environmental disasters, and improve logistics and manufacturing, among a few of their uses as part of the Internet of Things (IoT).

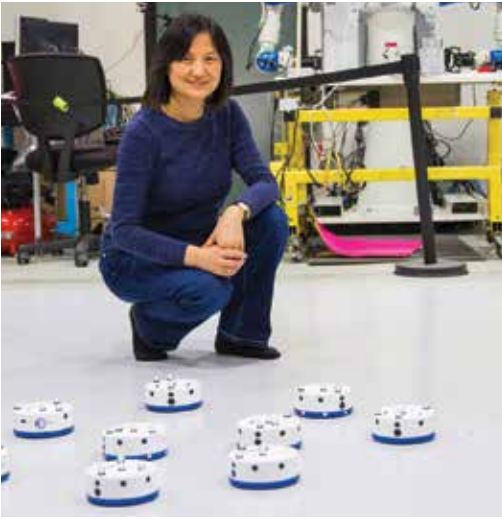
Using rugged, reliable, and low power sensors combined with an array of communications technology, including cellular, satellite, and mesh networks, Evigia's networks can relay information from harsh environments for longer than a decade without maintenance – not even a change of batteries. This enables a wide range of uses, no matter how remote, hot, cold, or wet the location.

Yazdi learned how to utilize a chip's magic in such ways when he attended Michigan, where he worked on some of the first-ever wireless integrated microsystems under Professors Khalil Najafi and Ken Wise.

After Michigan, your chances are higher to succeed in what you want to do. When you enter the workforce, you can pick up skills very quickly because of Michigan's hands-on experience, facilities, and training.

— Navid Yazdi

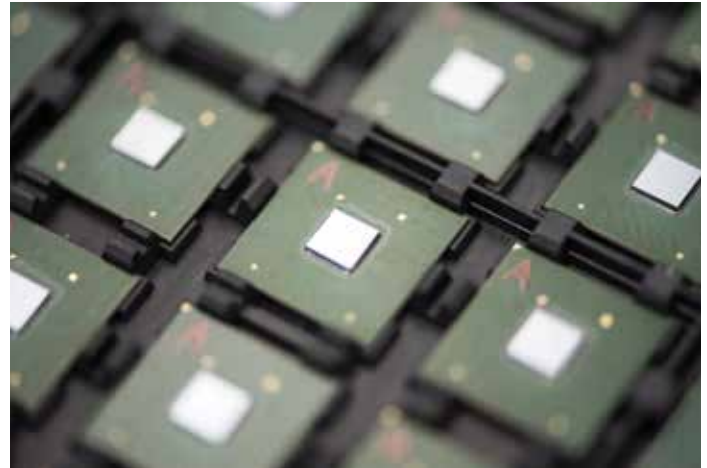




JING XIAO (MS PHD CICE 1984 1990) joined Worcester Polytechnic Institute in January as Director of the Robotics Engineering Program. Xiao previously was professor of computer science at the University of North Carolina at Charlotte, where she was director for the Center on Robots and Sensors for the Human Well-being.

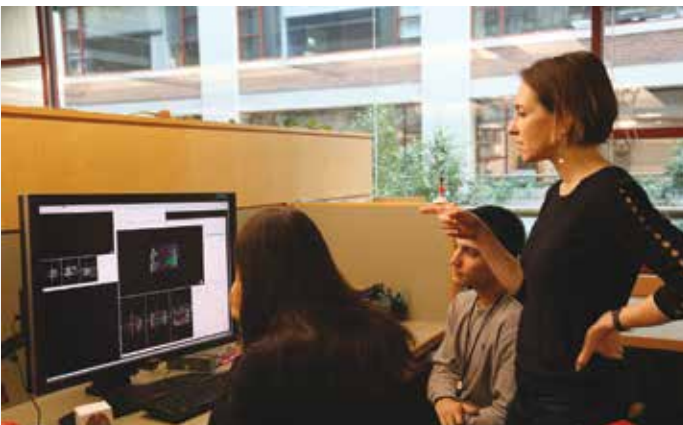


KIM MICHELLE LEWIS (MSE EE 2003, PhD Applied Physics 2004) was appointed as Associate Dean for Research, Graduate Programs, and Natural Sciences and Full Professor in the Department of Physics at Howard University.



Mythic's latest prototype chip, Athena.

ANASTASIA YENDIKI (PhD EE:S 2005), assistant professor of radiology at Harvard Medical School, was featured in *InStyle* for her work on a brain-mapping tool called TRACULA. The tools developed by her team help map white-matter pathways in brain scans, which can be used to study various diseases. Currently, these tools are being used to analyze brain scans of adolescent patients with anxiety and depression to help ease diagnoses.



ALLAN EVANS (MSE PhD EE 2007 2010), co-founder of Avegant, is now CEO of Fat Shark, which makes first-person video drone racing technology. Fat Shark released an introductory racing drone, the Fat Shark 101, to quickly get those new to the sport in the air with a premade racing set-up.

MYTHIC, a company founded in 2012 by **DAVID FICK** (BSE CE 2006, MSE PhD CSE 2009 2012), **LAURA FICK** (MSE PhD EE 2013 2017), **MALAV PARIKH** (BSE CE 2006, MSE CSE 2007), and **SKYLAR SKRZYNIARZ** (BSE MSE EE 2013 2015), raised \$40M in Series-B investment to produce custom chips created to power AI applications. This brings their total venture capital raised to \$55M.

The company had its start in the Michigan Integrated Circuits Lab (MICL), where David and Laura Fick were advised by, and Henry worked with as a postdoctoral researcher for, Profs. David Blaauw and Dennis Sylvester.

Mythic CTO David Fick says the company currently has 55 employees, including 9 alumni and 3 dogs. They plan to ship their first product in 2019.

ABHISHEK GUTGUTIA (MSE EE 2007) was named Vice President of Product for Chronicled, a blockchain-based smart supply chain solutions company. Chronicled released a platform that can help demonstrate a product's authenticity and origins, which includes secure product identifiers, mobile apps, a web dashboard, and blockchain-as-a-service.

ERAN BASHAN (PhD EE:S 2008) is CEO of Hygieia, which signed agreements to offer its digital insulin guidance in Southeast Michigan with Blue Cross Blue Shield of Michigan and in the United Kingdom with Spirit Healthcare.



Amazon Hosts Alumni Reception in Seattle, WA



Amazon hosted a reception for Michigan alumni who work at the company, as well as those who live in the surrounding area. They also invited the students who were in Seattle as part of the *2018 ECE Expeditions*.

ECE Alumni Reception at IMS 2018 Honors George Haddad



ECE hosted an alumni reception at the *2018 IEEE MTT International Microwave Symposium (IMS)* in Philadelphia, in honor of George Haddad, Robert J. Hiller Professor Emeritus. *IMS*, the premier annual international meeting for individuals involved in microwave theory and practice, had also devoted a special session honoring Haddad.

Haddad's former student, Charles Krumm (BSE MSE PHD EE 1963 1965 1970), chose this event to announce the establishment of the George I. Haddad Graduate Fellowship Fund.

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Dr. Wee Teck Ng
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Ms. Seraphin M. Nicholson
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Niffenegger
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Notarantonio
Ms. Christine S. Oldenburg
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M. McGee
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Mr. Clint Walker
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Mr. Stacy Walters
Mr. Chung-Gen Wang
Mrs. Diana M. Weber
Dr. and Mrs. Walter F.
Wegst, Jr.
Dr. Xu Chen and Ms. Wei Wei
Dr. and Mrs. Jason W. Weigold
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Charles and Patricia Krumm Endow the George I. Haddad Graduate Fellowship Fund



Charles (BS 1963, MS 1965, PhD 1970) and Patricia (BA 1964, MS 1967) Krumm have generously established the George I. Haddad Graduate Fellowship Fund to support graduate students in Electrical and Computer Engineering.

The endowment fund honors Charles Krumm's former doctoral advisor and mentor, George Haddad, Robert J. Hiller Professor Emeritus.

George Haddad chaired the department for a total of 19 years, established important research programs in microelectronics, grew the Solid State Electronics Laboratory and the Department, and graduated 57 doctoral students of his own. Among his numerous awards, he is a member of the National Academy of Engineering.

I am truly touched and deeply appreciative of Pat and Chuck's generosity. There is no doubt that their contribution will be a great source of help for many graduate students.

— George Haddad

I want to encourage Prof. Haddad's former students, colleagues and anyone else who has learned from or collaborated with Prof. Haddad to contribute and be a part of the solution.

— Chuck Krumm

Reflecting on his career after retiring in 2008, Krumm concluded that his education at Michigan was the foundation of his career. That underpinning enabled him to confidently address new opportunities. And he wanted to give back.

On a grander scale, he views education as playing a vital role in sustaining economic growth and societal progress.

"The problems electrical engineering graduate students address today require expensive equipment and facilities," Krumm says. "You don't do nanotechnology, computer networking, or robotics with just a benchtop full of electronic instruments," said Krumm, referring to equipment he used as a student at Michigan in the 1960's.

The Krumms hope that the establishment of the George I. Haddad Graduate Fellowship Fund will spur others to get involved.

Through improving access to a Michigan education, Chuck and Pat Krumm look forward to the George I. Haddad Graduate Fellowship Fund enhancing the ability of future engineers to contribute positively to society.



Khalil Najafi, Charles Krumm, and George Haddad at the ECE alumni reception at IMS2018.

Wise-Najafi Prize for Engineering Excellence in the Miniature World

An anonymous alumnus of the ECE program at Michigan and his spouse (also a Michigan alumnus) have generously provided a gift to endow the Wise-Najafi Prize for Engineering Excellence in the Miniature World.

The donors established this award in recognition of Kensall D. Wise, William Gould Dow Distinguished University Professor Emeritus, and Khalil Najafi, Schlumberger Professor of Engineering and former Chair of Electrical and Computer Engineering, and their pioneering work in the field of microelectromechanical systems (MEMS) over many decades. The award also recognizes their impact on an entire generation of engineering scholars.

The Wise-Najafi Prize for Engineering Excellence in the Miniature World recognizes outstanding research and scholarship related to engineering at the meso-scale, micron-scale, nano-scale, and beyond. Faculty from across campus who have shown exceptional creativity in the science and engineering of miniaturization are eligible for consideration of this distinguished prize.



Ken Wise and Khalil Najafi, after giving an invited talk as the University of Michigan Distinguished University Innovators for 2011. They were honored for their role developing breakthrough technologies in microelectromechanical systems (MEMS) and working with colleagues, students, and industry partners to move these innovations from university laboratories to new startups.

Cavium, Inc. Partners with Michigan on Big Data Research Computing Platform

A new partnership between the University of Michigan and Cavium Inc., a San Jose-based provider of semiconductor products, will create a powerful new big data computing cluster available to all U-M researchers.

The \$3.5M ThunderX computing cluster will enable U-M researchers to process massive amounts of data, such as data generated either by remote sensors in distributed manufacturing environments, or by test fleets of automated and connected vehicles.



The Cavium Thunder X Hadoop cluster.

In addition, the platform will enable researchers in the social, health, and information sciences to more easily mine large, structured and unstructured datasets. This will eventually allow, for example, researchers to discover correlations between health outcomes and disease outbreaks with information derived from socio-economic, geospatial, and environmental data streams.

“U-M scientists are conducting groundbreaking research in big data already, in areas like connected and automated transportation, learning analytics, precision medicine and social science,” said Eric Michielssen, Associate VP for Research/Advance Research Computing. “This partnership with Cavium will accelerate the pace of data-driven research and opening up new avenues of inquiry.” Michielssen is the Louise Ganiard Johnson Professor of Engineering and a professor of Electrical Engineering and Computer Science.

ECE alumnus Syed Ali, Cavium’s founder and CEO, added, “I know from experience that U-M researchers are capable of amazing discoveries. Cavium is honored to help break new ground in big data research at one of the top universities in the world.”

IN MEMORIAM

CLASS OF 1940–1949

Kenneth Stone (1942, 1952, 1959;
11/23/2017)
Robert Essig (1944; 2/1/2018)
Yung Hu (1944; 10/5/2017)
Ben Barton (1947, 1952, 1957;
12/16/2017)
William Gordon (1947; 4/22/2018)
James Lovell (1947, 1948; 2/25/2017)
Lawrence Lutzker (1947; 3/7/2018)
Douglas Aldrich (1948, 1949; 7/24/2017)
Frederick Meeder (1948; 1/21/2018)
Herbert Smithline (1948; 8/14/2014)
Robert Caughey (1949; 6/14/2017)
Eaton Kelly (1949, 1950; 12/7/2017)
Yuji Morita (1949, 1950; 3/16/2018)
Arthur Pears (1949; 9/20/2017)
Kenneth Smith (1949; 2/21/2018)
Keki Irani (1949, 1953; 5/2/2018)

CLASS OF 1950–1959

James Christiansen (1950; 9/20/2017)
William Husen (1950; 11/21/2016)
John Mackey (1950; 4/14/2018)
Edwin Mueller (1950; 2/9/2018)
Robert Murphy (1950; 8/12/2017)
Richard Schults (1950; 9/24/2017)
Frank Cartman (1951; 10/30/2017)
Edward Greene (1951, 1960; 1/5/2017)
Andrew Kloiber (1951; 10/2/2017)
Gerald Kuisel (1951; 6/28/2017)
Robert Reinke (1951; 4/29/2018)
Arthur Sack (1951; 4/8/2018)
Richard Seeger (1951; 1/26/2018)

Edward Greene (1951, 1960; 1/5/2017)
Robert Bockemuehl (1952; 1/30/2017)
Robert MacPhail (1952; 2/20/2018)
Albert Patrosso (1952; 1/9/2018)
John Reeves (1952; 7/22/2017)
Martin Fruitman (1953; 1/23/2018)
Bernard White (1953; 1/20/2018)
John Jacobsmeyer (1954; 5/24/2018)
Richard Tyler (1957; 8/28/2017)
Richard Webber (1957, 1959; 3/10/2018)
John Ahrens (1958; 9/11/2017)
Francis Hauke (1958; 9/2/2017)
Saul Hershenov (1958; 10/12/2017)
Nino Masnari (1958, 1959, 1964;
5/19/2018)
William Olmsted (1958; 12/13/2017)
James Podger (1958; 1/26/2007)
Carl Tresselt (1958, 1959; 10/8/2017)
William Yule (1958; 2/15/2018)
Walter Bailey (1959; 5/17/2018)
Richard Brackenbury (1959; 1/23/2018)
James Chapman (1959; 10/25/2016)
John Joyce (1959; 7/27/2017)
Charles McDowell (1959; 11/6/2017)
Marvin VerSchure (1959; 10/10/2017)

CLASS OF 1960–1969

Herman Russell (1960; 12/8/2017)
Bernard Seggerman (1960; 4/11/2018)
Richard Vanderkolk (1960, 1968;
6/26/2017)
Howard Richards (1961; 7/20/2017)
Marlin Ristenbatt (1961; 3/2/2018)
Thornton Zeigler (1961; 7/10/2017)

Gary Grim (1962, 1963; 11/3/2017)
Alan Morton (1962; 12/23/2017)
Roy Willcocks (1962; 6/21/2014)
Mahmoud Ghaneei (1963; 10/19/2017)
Thomas Trexler (1963; 1/1/2017)
John Vanlandingham (1964; 3/14/2018)
Anthony Walker (1964; 9/4/2017)
DeWitt Seward (1965; 8/5/2017)
Gerald Walker (1965; 5/18/2018)
R. Bruce Roberts (1966, 1969;
4/25/2016)
Leonard West (1968; 9/6/2017)
David Kline (1969; 8/2/2017)

CLASS OF 1970–1979

Brian Gray (1970; 3/14/2018)
Terry Tarte (1970; 1/14/2018)
James Warner (1972; 11/18/2017)
David Bakkom (1973; 10/24/2016)
Melvin Goss (1973; 7/30/2017)
Yu-Ping Liu (1973; 2/18/2018)
Dean DeGalan (1975; 12/13/2017)
James Benaglio (1976; 2/1/2018)

CLASS OF 1980–1989

Nicholas Dragiewicz (1980; 7/28/2017)
Ellen Lettvin (1988; 4/13/2018)

CLASS OF 1990–1999

Nathan Binkert (1998, 2000, 2006;
9/21/2017)

Keki Irani (1924 – 2018)

KEKI IRANI, professor emeritus of Electrical Engineering and Computer Science, passed away on Wednesday, May 2 at the age of 93.

Prof. Irani was a model faculty who made important contributions to the EECS department, was always supportive of students, and who supported the department at critical times throughout the years.

Prof. Irani was born in Bombay, India on May 20, 1924. He attended the University of Bombay, where he received BSE (Mech) and BSE (EE) degrees, in 1946 and 1947, respectively. In 1948, he came to the University of Michigan where he earned MSE and PhD degrees in EE, in 1949 and 1953, respectively.

Following employment at Philips Telecommunications Industries from 1950-56 and after serving as a faculty member at the University of Kansas from 1956-61, Prof. Irani joined the University of Michigan in 1962 as an associate research engineer. He was promoted to associate professor in 1963 and professor in 1968.

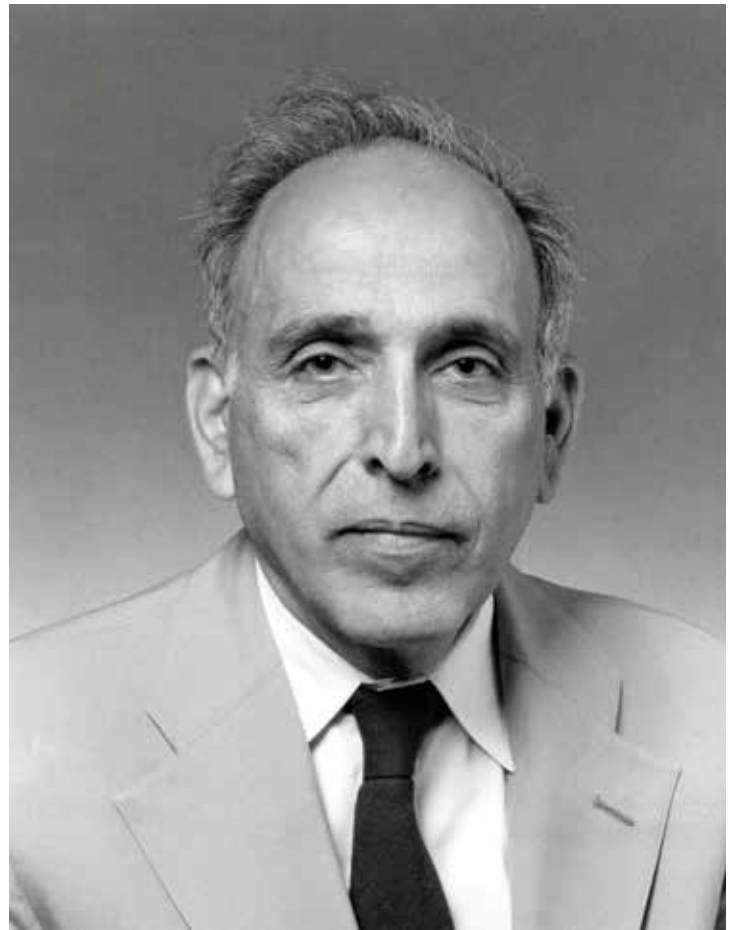
As a faculty member in a rapidly developing field, Prof. Irani was known for developing and maintaining expertise in many aspects of both computer science and computer engineering. Over the years, students praised him for his ability to present extremely complicated subjects in a clear and exciting manner. In 1992, he received the Teaching Excellence Award from the College of Engineering.

Within the college, Prof. Irani served as chief program advisor for computer engineering from 1977-86 and from 1990-96, and was instrumental in the development of the computer science and computer engineering curricula. He served as associate chair of the Department of Electrical and Computer Engineering from 1976-84 and as associate chair of the Division of Computer Science and Engineering in the newly formed Department of Electrical Engineering and Computer Science from 1986-90, both critical periods in the evolution of the department.

In particular, he played a key role in establishing the undergraduate and graduate programs in computer science and engineering. He was instrumental in faculty hiring, curriculum development, and introduction of courses and counseling services. It is largely due to his efforts that we now have a thriving program in CSE.

Prof. Irani supervised more than 50 doctoral students, many of who have gone on to positions of leadership in academia and industry. The author of more than 85 publications, he made contributions to remarkably diverse areas, including control theory, computer display and communication systems, computer scheduling, database systems, computer architecture, parallel computing, artificial intelligence, and programming languages. He was elected a fellow of IEEE and had a long-standing involvement with the ABET engineering accreditation organization.

Although he retired in 1998 in his early 70s, Prof. Irani continued to come to his office in the department for as long as he was physically able. He was also truly a life long learner, and continued to read books on mathematical logic, one of his favorite subjects, for many years after his retirement.





Nino Masnari (1935 – 2018)

NINO MASNARI, alumnus and former faculty member of Electrical and Computer Engineering, passed away May 19, 2018 at the age of 82.

Prof. Nino Masnari earned his bachelor's, master's, and doctoral degrees in electrical engineering in 1958, 1959, and 1964, respectively. He joined the department in 1963 as a research engineer, and after a leave of absence from 1967-69 to conduct research at General Electric, he returned as an associate professor. His area of expertise was in solid-state microelectronics, in particular device processing, microwave devices, and integrated circuits. He served as Director of the Electron Physics Laboratory from 1977-79.

In 1979, Masnari left Michigan to become Head of the Electrical Engineering Department at North Carolina State University (NCSU). In 1988, he became the founding director of the NSF Engineering

Research Center on Advanced Electronic Materials Processing and the SEMATECH Center of Excellence on Advanced Single Wafer Processing.

He was appointed Dean of Engineering in 1996, where he was responsible for 7,500 undergraduate and graduate students, and more than 600 faculty and researchers. During his 10 years as Dean, NCSU doubled in research expenditures, became one of the largest producers of ECE degrees in the country, and quadrupled their scholarship funding.

Masnari served as General Chair of the 2000 American Society for Engineering Education (ASEE) Engineering Deans Institute, and was elected Chair of the ASEE Engineering Deans Council in 2002. He returned to the ECE department at NC State in 2006 as a Distinguished Professor of Electrical and Computer Engineering.

In 2009, Prof. Masnari returned to the University of Michigan as recipient of the CoE Alumni Merit Award for Electrical and Computer Engineering. He served on the ECE Council between 2014-17, and provided valuable perspective based on his deep knowledge of Michigan and his leadership at NCSU.

Ben F. Barton (1925 – 2017)

BEN F. BARTON, alumnus and professor emeritus of EECS, passed away December 16, 2017 at the age of 92.

Prof. Barton earned his BS degree in 1947, his MS degree in 1952, and his PhD degree in 1957, all in electrical engineering from the University of Michigan. He retired as emeritus professor of electrical engineering and computer science in 1993 after a career of 36 years at Michigan.

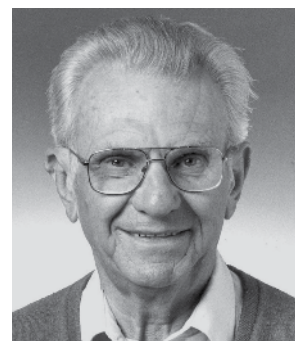


Prof. Barton joined the faculty right after receiving his doctoral degree. He served as director of Cooley Electronics Laboratory from 1961-65, when he stepped down to serve as a Technical Advisor to NATO in Paris, France. In 1966, Barton took a two-year leave to help establish an institute of technology in Kanpur, India that would be part of a nine-university consortium.

Prof. Barton was responsible for introducing several courses in circuits and electronics, with strong design and laboratory components. In later years, his research turned to the field of technical communications. He and his wife earned several best paper awards in this area.

Marlin P. Ristenbatt (1928 – 2018)

MARLIN P. RISTENBATT, research scientist emeritus in the Department of Electrical Engineering and Computer Science, passed away March 2, 2018 at the age of 89.



Dr. Ristenbatt received his PhD degree in electrical engineering in 1961 from the University of Michigan. He joined the faculty in 1960, and was an active researcher and lecturer until his retirement in 1998. He continued to do research even in retirement, and remained closely affiliated with the Department.

His research interests included intelligent transportation systems, digital communications systems, position location techniques, microwave and fiberoptic communication systems, and local area networks. He published more than 75 articles and technical reports, and authored the books *Transistor Physics and Circuits*, and *Semiconductor Circuits: Linear and Digital*.

Dr. Ristenbatt taught numerous EECS courses, and developed two senior level courses: "Digital Communication Systems and Signals" and "Microwave and Fiber Optic Communication Systems." He received the United States Activities Board Citation of Honor from the IEEE for helping to advance the careers of young engineers.



Thomas B.A. Senior (1928 – 2017)

THOMAS B.A. SENIOR, professor emeritus of Electrical Engineering and Computer Science, passed away peacefully November 24, 2017 at the age of 89.

Prof. Senior was a devoted member of the department for 41 years as an active faculty member, and another 19 as an emeritus faculty. He was known for his fundamental contributions to electromagnetic and acoustic scattering, his remarkable legacy of service and leadership to the department and professional community, and his excellence as an educator.

Born June 26, 1928 in Yorkshire, England, Prof. Senior received his MSc and PhD degrees in Applied Mathematics from Manchester and Cambridge Universities in 1950 and 1954, respectively.

He joined the University of Michigan in 1957 as a researcher at the famed Willow Run Laboratories. His research related to the detection of stealth aircraft in the 1960's directly impacted their design in the U.S.

During the 1970s, Prof. Senior and his group were the first to recognize how large wind turbines can cause interference to electromagnetic systems, such as televisions. He developed procedures that are now part of all environmental assessments of wind turbines.

He authored three books, including *Electromagnetic and Acoustic Scattering by Simple Shapes*, a foundational work that emerged from Willow Run research on the radar detection of aircraft and missiles.

Prof. Senior served as Acting Chair for the EECS Department in 1987; Associate Chair for Academic Affairs from 1988 to 1998; Associate Chair of the former Electrical Science and Engineering Division, from 1984 to 1998; and as Director of the Radiation Laboratory (RADLAB) from 1974 to 1987, and Associate Director from 1962-74.

In the professional community, Prof. Senior was active in the International Union for Radio Science (URSI) for almost 50 years. He was an Associate Editor and later Editor of *Radio Science* (then a URSI journal) from 1970 to 1979, and Secretary then Chair of USNC/URSI from 1979 through 1984. He was Vice Chair then Chair of URSI Commission B, 1987-1992, and Vice President then President of URSI itself from 1993-1999.

Prof. Senior's devotion to education and his students was recognized through numerous teaching awards, including being named Arthur F. Thurnau Professor, an honor bestowed on the best University educators. He also received the CoE Teaching Excellence Award, the University of Michigan Teaching Excellence Award, the Eta Kappa Nu Award Teacher of the Year Award for two years in a row, and the Tau Beta Pi Outstanding Faculty Award. He chaired more than 20 PhD committees.

In addition, he received the IEEE Antennas and Propagation Society Distinguished Achievement Award, the URSI van der Pol Gold Medal, and the IEEE Electromagnetics Award, which is the highest technical field award given in this area.

Prof. Senior was an icon at the Radiation Laboratory of the University of Michigan and in the Electromagnetic Community at large. I will certainly miss our enlightening discussions and his enthusiasm for science.

— Kamal Sarabandi, Director of the Radiation Laboratory



Tom Senior initiated St. George's Day in 1987, a day when the faculty would serve lunch to all EECS students. Images of the faculty marching in a parade wearing their St. George aprons and blowing horns, and most importantly, then serving them, is a favorite memory of many EECS alumni.

This list includes active faculty (tenure-track, research scientists, and lecturers) as of September 2018. The primary departmental affiliation (either CSE or ECE) for each faculty member is listed first, followed by any secondary appointments in other departments (a key for the acronyms is found on page 111).



Ackerman, Mark S.
George Herbert Mead
Professor of HCI;
Professor of Information, SI
Professor (courtesy), LHS
CSE



Afshari, Ehsan
Assoc. Professor
ECE



Ahmadi, Elaheh
Asst. Professor
ECE



Aktakka, Ethem Erkan
Asst. Research Scientist
ECE



Anastasopoulos, Achilles
Assoc. Professor
ECE



Arthur, William
Lecturer III
CSE



Austin, Todd
Professor
CSE, ECE



Avestruz, Al-Thaddeus
Asst. Professor
ECE



Balzano, Laura
Asst. Professor
ECE



Banovic, Nikola
Asst. Professor
CSE



Baveja, Satinder Singh
Professor
CSE



Berenson, Dmitry
Asst. Professor
ECE



Bertacco, Valeria
Arthur F. Thurnau Professor;
Assoc. Dean for Academic
Programs and Initiatives,
Rackham Graduate School
CSE



Bhattacharya, Pallab K.
Charles M. Vest Dist. Univer.
Professor; James R. Mellor
Prof.; Prof. (courtesy), AP
ECE



Blaauw, David T.
Professor
ECE



Brehob, Mark
Kurt Metzger Collegiate
Lecturer IV
CSE, ECE



Cafarella, Michael J.
Assoc. Professor;
Assoc. Prof. (courtesy), ISR
CSE



Chen, Peter M.
Arthur F. Thurnau Professor
CSE



Chen, Yu-Chih
Asst. Research Scientist
ECE



Chesney, David
Lecturer IV
CSE



Cho, Jae Young
Asst. Research
Scientist
ECE



Chowdhury, Mosharaf
Asst. Professor
CSE



Compton, Kevin J.
Assoc. Professor
CSE



Corso, Jason
Assoc. Professor
ECE, CSE



Darden, Marcus
Lecturer IV
CSE



Das, Reetuparna
Asst. Professor
CSE



DeOrio, Andrew W.
Lecturer IV
CSE



Deotare, Parag B.
Asst. Professor
ECE



Diaz, Kimberly Khalsa
Lecturer I
CSE



Dick, Robert
Assoc. Professor
ECE



Dreslinski, Ronald
Asst. Professor
CSE



Durfee, Edmund H.
Professor;
Co-director, TIKTOC
CSE



England, Anthony W.
Dean, U-M Dearborn;
Professor, EECS;
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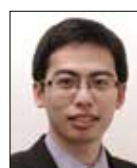
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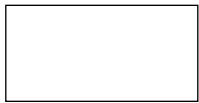
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Cassie Blue visits the University of Michigan Museum of Art