UI3 Newsletter

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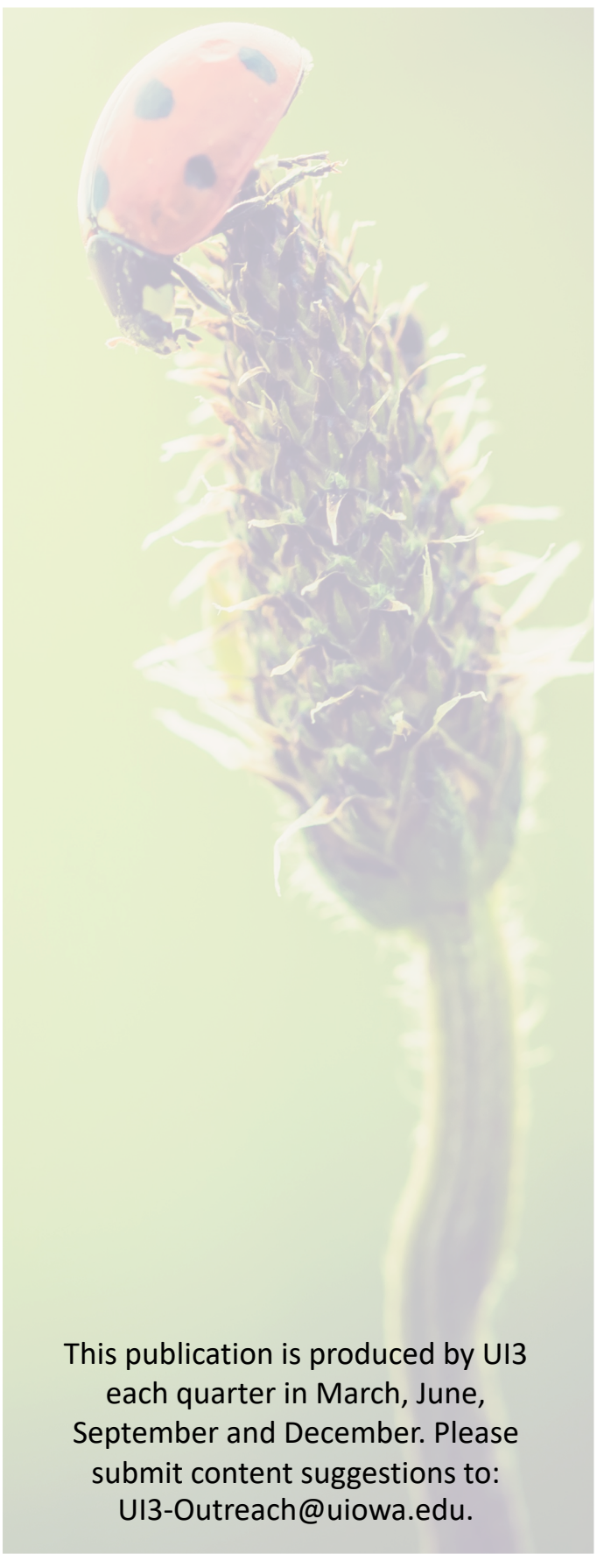
In this issue:

UI3 Director Greg Carmichael (right) with UI3 AI Symposium Presenter Ibrahim Demir Photo by Kirk Phillips (UI College of Public Health)



This publication is produced by UI3 each quarter in March, June, September and December. Please submit content suggestions to: UI3-Outreach@uiowa.edu.

Dear colleagues,

Happy Spring! In this issue are a few "seeds of innovation" that germinated at the Iowa Informatics Initiative (UI3) while we waited for the ice and snow to melt. This edition is the first of what I hope will be many "UI3 Quarterly" newsletters.

This edition features highlights from the February 15 UI3 Symposium that was organized by UI3 and the Iowa Artificial Intelligence Initiative (AII). Given our experience with past symposia, we expected to draw 50-80 attendees; a smaller crowd given February's inclement weather, but 208 registered! The College of Public Health Building, in general, and UI3 facilities on the fifth floor of CHPB offered the perfect backdrop for the poster session and luncheon. Next in queue for this venue is the Computational Psychiatry Symposium on April 24.

It's always exciting to see how interdisciplinary synergies conceive meaningful discoveries, and it's especially thrilling when the ripple effect is felt around the world. The Abràmoff (IDx-DR; UI3 AI Symposium Keynote), Dogan (Cardio Diagnostics; UI3 AI Symposium poster) and Pahl-Schaull (TXP-Chat; UI3 IGPI Student) examples are especially noteworthy. While there are many more such startups taking root in the region, these three, alone, have created ~80 Johnson County Iowa jobs. They are making important contributions to the health and wellbeing of people everywhere while building a local technical workforce that will help the university, state and country remain globally competitive.

There are now 20 UI3 Cluster Faculty, 44 students are enrolled in the Interdisciplinary Graduate Program in Informatics (IGPI), and 260 UI3 Affiliates represent every department on campus. With this and future UI3 Quarterly editions, we look forward to sharing additional news about UI3 stakeholder achievements.

Regards,

Gregory Carmichael, UI3 Director
Karl Kammermeyer Professor of Chemical and Biochemical Engineering
UI College of Engineering

UI3 Newsletter

From left: UI CIO Steve Fleagle, Nick Street (Tippee College of Business) and Milan Sonka (College of Engineering)
Photo by Kirk Phillips (UI College of Public Health)

February 15, 2019 Artificial Intelligence Symposium: Highlights

The Iowa Informatics Initiative (UI3) Artificial Intelligence (AI) Symposium was Friday, February 15, 2019 in the University of Iowa (UI) College of Public Health building. UI3 Director Greg Carmichael and UI Associate Dean for Research and Director of the Engineering Initiative for AI Milan Sonka (UI-College of Engineering) welcomed participants. More than 200 informatics professionals from UI and regional industries registered for the event that included 15 invited talks, a poster session, luncheon and co-located tours of the AI and engineering labs. A special AI session of "WorldCanvass" was held February 12.

Invited talks

Keynote **Michael Abràmoff** delivered a speech titled, "AI in Solving Diabetic Retinopathy." Dr. Abràmoff is the Robert C. Watzke, MD, Professor of Retina Research Professor of Ophthalmology and Visual Sciences in the UI Carver College of Medicine (CCOM); as well as an internationally-renowned physician, scientist and fellowship-trained specialist. He holds Master of Science degrees in Medicine and Biomedical Informatics, and a Medical Doctorate degree from the University of Amsterdam; plus, a Doctor of Philosophy degree in Biomedical Imaging from the University of Utrecht in the Netherlands. With 13 patents under his belt, he has authored more than 300 papers that have been cited more than 26,000 times. Read a full feature about Abràmoff's presentation on page five.

Ibrahim Demir's talk was titled, "Intelligent Systems and Machine Learning Applications in Environmental Sciences." Dr. Demir is an assistant professor in both UI Civil and Environmental Engineering, and Electrical and Computer Engineering departments. He is also a UI3 Cluster Faculty, directs the UI Hydroinformatics Lab, and is specialized in hydroinformatics, scientific visualization and environmental information systems. Demir's UI3 AI Symposium presentation explained the history of AI, explored a range of applications and offered a glimpse into the future. Read more about Demir's talk on page seven.

Daniel McGehee is the director of the National Advanced Driving Simulator Laboratories (NADSL) at the UI, and an associate professor in the departments of Industrial and Systems Engineering, Emergency Medicine, Public Health and Public Policy. His talk was titled, "How Self-Driving Cars Can Be Made Safer." McGehee leads a team of faculty, staff, graduate and undergraduate students in an interdisciplinary transportation research program that studies human factors, automotive safety and injury. Previously, he was the director of the Human Factors and Vehicle Safety Research Division at the UI Public Policy Center, and has worked for UI since 1993. McGehee's UI3 AI Symposium presentation focused on the history of automation in the transportation industry since 1994 when the first study was launched. Read more about McGehee's presentation on page seven.

UI3 Student Employee Mackayla Highly (left) and UI3/IGPI Program Coordinator Andrea Flaherty
Photo by Kirk Phillips (UI College of Public Health)

Michael J. Schnieders is an associate professor of biomedical engineering in the UI College of Engineering. His research involves molecular biophysics theory and high-performance computing (HPC) algorithms needed to reduce the time and cost of engineering drugs and organic biomaterials. His work takes advantage of the 100 Graphics Processing Units (GPUs) on UI's Argon supercomputer to accelerate the process of discovery. Schnieders holds a D.Sc. in Biomedical Engineering from Washington University in St. Louis, Missouri and completed postdoctoral fellowships in Chemistry at Stanford and in Biomedical Engineering at the University of Texas at Austin. Read more about Schnieders' work on page three.

Goce Trajcevski delivered a talk titled, "Deep Learning for Linking Motion and Users in Urban Settings." Dr. Trajcevski is an associate professor of Electrical and Computer Engineering at Iowa State University. He holds a Ph.D. in Computer Science from the University of Illinois, and his work with AI involves the identification of mobility patterns with neural networks. Additionally, he is concerned with mobile data management and Moving Objects Databases (MOD); Data Management in Sensor Networks; and Reactive Behavior in Dynamic and Distributed Environments.

Joseph Reinhardt is a professor and department executive officer in the UI Biomedical Engineering Analysis Center, and group leader of the Iowa Institute for Biomedical Imaging. Dr. Reinhardt has a Ph.D. in Electrical Engineering from Pennsylvania State University. He explained research involving the structural and functional evaluation of normal and abnormal lung tissue with a presentation titled, "Deep Learning for High-Throughput Lung CT Image Analysis." Much of the work was conducted by a former PhD student, Sarah Gerard, who graduated in 2018 and is now a shareholder in a local medical image analysis company. The objective of her research was to develop a fully-automated pipeline for pulmonary segmentation in thoracic computed tomography images.

Steven Baek is an assistant professor in the UI Industrial and Systems Engineering program. He holds a Ph.D. in Mechanical and Aerospace Engineering from Seoul National University. His presentation was titled, "Navigating the Space of Shapes – Through the Lens of Deep Learning." His research involves the association between physical appearance and economic outcomes. Matthew Ziegler is Director of HPC and AI Strategy and Architecture at Lenovo. His presentation was titled, "Solving Humanity's Greatest Problems with AI."

James Lynch is a principal engineer at HERE Technologies. His presentation was titled, "Big Data, Maps and HERE Technologies." HERE has been developing mapping technologies for 30 years. They collect about 28 terabytes of data every day in 200 countries that is used to inform geo-spatially explicit applications in most domains and industries.

Xun Zhou is an assistant professor of Management Science at UI. Dr. Zhou holds a Ph.D. in Computer Science from the University of Minnesota. His research involves convolutional neural networks, spatial-temporal big data analytics and mining, spatial databases, and geographic information systems. Applications for his research include urban data/smart cities, public safety and location-based business problems.

AI Symposium Invited talks, continued:

Tianbao Yang is an assistant professor of Computer Science at UI. He holds a Ph.D. in Computer Science and Engineering from Michigan State University. His research involves the development of provable and practical optimization algorithms for solving non-convex problems in machine learning.

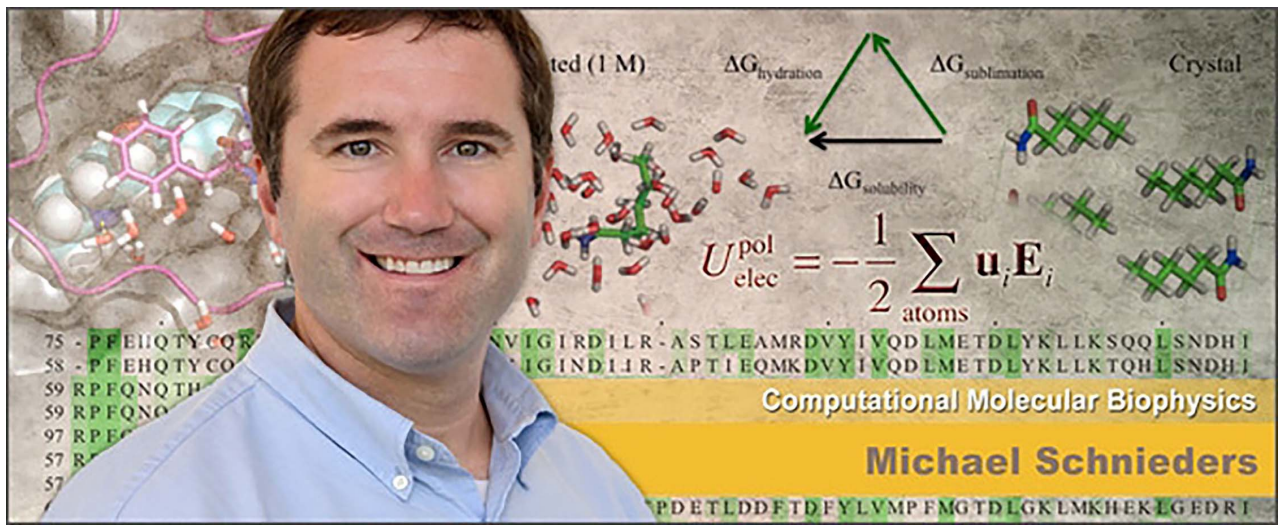
Kingston Smith is a managing director at Accenture Technology. Smith's work has focused on analytics innovation for more than 25 years, and he currently leads Accenture's Midwest Analytics Practice.

Yuchi Huang is a senior research scientist at ACTNext in Iowa City, Iowa. Huang holds a Ph.D. in Computer Science from Rutgers University. His current research involves automatic generation of multimodal educational resources, multimodal analytics for measurement of complex skills and competencies (such as communication ability and collaborative problem-solving), and automatic photorealistic avatar-generation for human-agent interaction. Biometrics are being used at test centers to verify that the test-taker is actually who they say they are; which prevents fraud (cheating).

Padmini Srinivasan is a professor in the UI computer science department. Dr. Srinivasan holds a Ph.D. from Syracuse University, and her research involves text mining and web-mining for a variety of applications. Dr Srinivasan and colleagues developed a sentence-based literature scanning system called "Ferret," which acts as a search engine to retrieve and rank sentences (and their documents) which convey gene-centric relationships of interest to researchers.

Kristina Bigsby is a visiting assistant professor in the UI Tippie College of Business. She holds a PhD in Information Science from UI, and participated in the UI3 IGPI program. Dr. Bigsby's paper titled, "Online and Off the Field: Predicting School Choice in College Football Recruiting from Social Media Data," was published by *Decision Analysis 2017.*

UI3 Cluster Faculty Highlights



Michael J. Schnieders' Need for Speed & GPUs

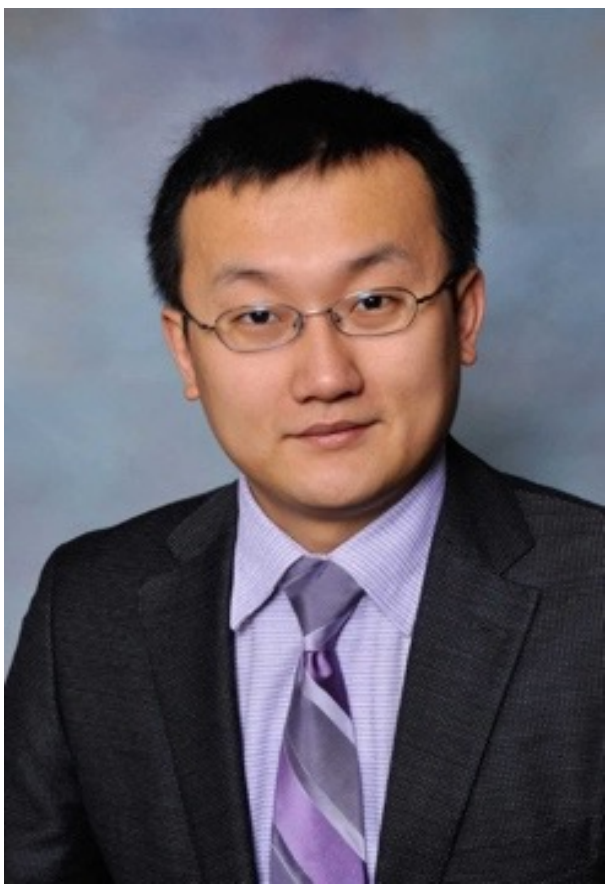
As anyone suffering from an illness knows, time is physically and psychologically their worst enemy. For the medical and insurance industries, time = money.

University of Iowa (UI) Biomedical Engineer Michael J. Schnieders' research lies at the intersection of biochemistry and engineering, with an emphasis on molecular biophysics theory and high-performance computing (HPC) algorithms needed to reduce the time and cost of engineering drugs and organic biomaterials. His work takes advantage of the 100+ Graphics Processing Units (GPUs) on UI's Argon supercomputer to accelerate the process of discovery.

Schnieders holds a D.Sc. in Biomedical Engineering from Washington University in St. Louis, Missouri and completed postdoctoral fellowships in Chemistry at Stanford and in Biomedical Engineering at the University of Texas at Austin. "During my Stanford and UT postdocs, I was exposed to a range of supercomputers including GPU computing on Folding@Home and Intel coprocessors at the Texas Advanced Computing Center (TACC). The ability to continue to use state-of-the-art computing hardware at the University of Iowa via the Argon cluster is critical to our research program."

The relationship between computational science and medicine has evolved to where patient-care decisions and drug design are increasingly reliant upon advanced computation and big data. Since the introduction of GPUs in 2010, the time to solution for many fluid and molecular dynamics challenges became 10 to 20 times faster than with traditional central processing units (CPUs) making it possible to sequence the human genome for around $1,000, where ten years ago it cost $100 million. This advent launched the science of genomics and the frontier of precision medicine.

With the ability to classify a broader range of molecular phenotypes, predictive analyses and treatments can be more accurate, and personalized care is affordable to a broader population. Non-invasive, virtual analyses that are informed by patients' genetic makeup lead to safer and earlier detection, and more effective treatment. There is less trial-and-error involved with the time-consuming task of understanding patient histories and choosing from what can often be a broad range of prospective treatments. *(Continued on page four)*



Yang Liu Joins UI3 as Twentieth Cluster Faculty Member

The Iowa Informatics Initiative (UI3) recently welcomed Yang Liu who joins the multidisciplinary team assembled by UI3 to foster research collaborations and support transdisciplinary scholarship opportunities across the University of Iowa (UI) campus.

Dr. Liu has a PhD in Biomedical Engineering, and serves as an Associate Professor in the UI Dept. of Electrical and Computer Engineering. He has spent the last decade perfecting augmented reality (AR) goggles used for medical diagnostic and surgical guidance purposes, and his specialties include AR, virtual reality, cyber-physical systems, Internet of things (IoT), computer vision, medical imaging, medical informatics, and computer-aided surgeries.

Prior to joining UI in 2019, Dr. Liu served as an assistant professor in the Department of Biomedical Engineering at the University of Akron in Ohio from 2013-2018.

UI3 Director Greg Carmichael believes Dr. Liu's strengths will complement those of incumbent cluster faculty specialists and more than 300 affiliate members from most UI colleges and departments.

"With access to unprecedented computational capacity and interfaces that make it easier for more communities of practice to command this power, the research community generates more data than ever. Our goal is to prepare the future workforce with the skills needed to transform this information into meaningful knowledge and actions," he said. "The ability to visualize data through AR/VR is useful for a variety of life-saving applications in many domains; we're pleased that Dr. Liu has joined our UI3 family," he added.

Michael J. Schnieders' Need for Speed & GPUs, Continued:

In the past, especially for cancers and neurological diseases, like Alzheimer's, Parkinson's and Amyotrophic Lateral Sclerosis (ALS, or Lou Gehrig's Disease), a diagnosis and course of treatment couldn't be offered without multiple visits to a series of specialists over a period of months—even years, in some cases. Now these steps can often be resolved in a matter of minutes on the first visit by a computationally-savvy diagnostician who has access to the right instrumentation and data. Medications are also "smarter" as they are designed to dissolve at a specific temperature and release just the right medicine at intervals without over- or under-dosing the patient for the quickest and most efficient results.

Schnieders' team is exploring solutions to all of these problems and others that are associated with an aging population. For example, hearing loss affects every octogenarian and one in 500 newborns. His team is contributing protein structures to the Deafness Variation Database (http://deafnessvariationdatabase.org) that categorizes deafness by a wide range of genetic traits and phenotypes, for example causation due to exposure to noise or aging. This will ultimately reduce the time required to identify a genetic predisposition to hearing loss so that precautions can be taken to prevent exposure to conditions that accelerate deafness.

"It once took an entire year on 20 compute nodes to optimize all of the protein structures included in the Deafness Variation Database for analysis of specific phenome-genome combinations that led to hereditary hearing loss; with GPUs, these calculations only require a week on 10 GPUs," said Schnieders.

"When optimizing legacy code to take advantage of the acceleration GPUs offer, finding the sweet spot can be challenging, at first, but it's well worth it," he added based on experience with their computer code called Force Field X. With a range of computationally-intensive research that benefits from GPUs—including the many geospatially-implicit applications for edge computing and sensors—the UI Research Services and Informatics support teams are experienced with the code optimization process and can help researchers get the most out of Argon's CPUs and accelerators.

For more information about computational resources and services available to the UI research community, visit: https://its.uiowa.edu/about/rs

Did you know?

900 UI faculty and staff have accounts on the Argon supercomputer!

UI3 Cluster Faculty Member Jun Wang & Team Awarded $1.6 Million USDA Precision Agriculture Grant

By Richard Lewis, UI College of Engineering Office of Strategic Communication as featured on the COE website.

Cover photo: Aerial view of irrigated crops over the Ogallala Aquifer, by Jan Buchholtz; used with the photographer's permission.

Researchers at the University of Iowa have been awarded funding to design and use smart technology to maximize crop yields and use water more efficiently in rural agriculture.

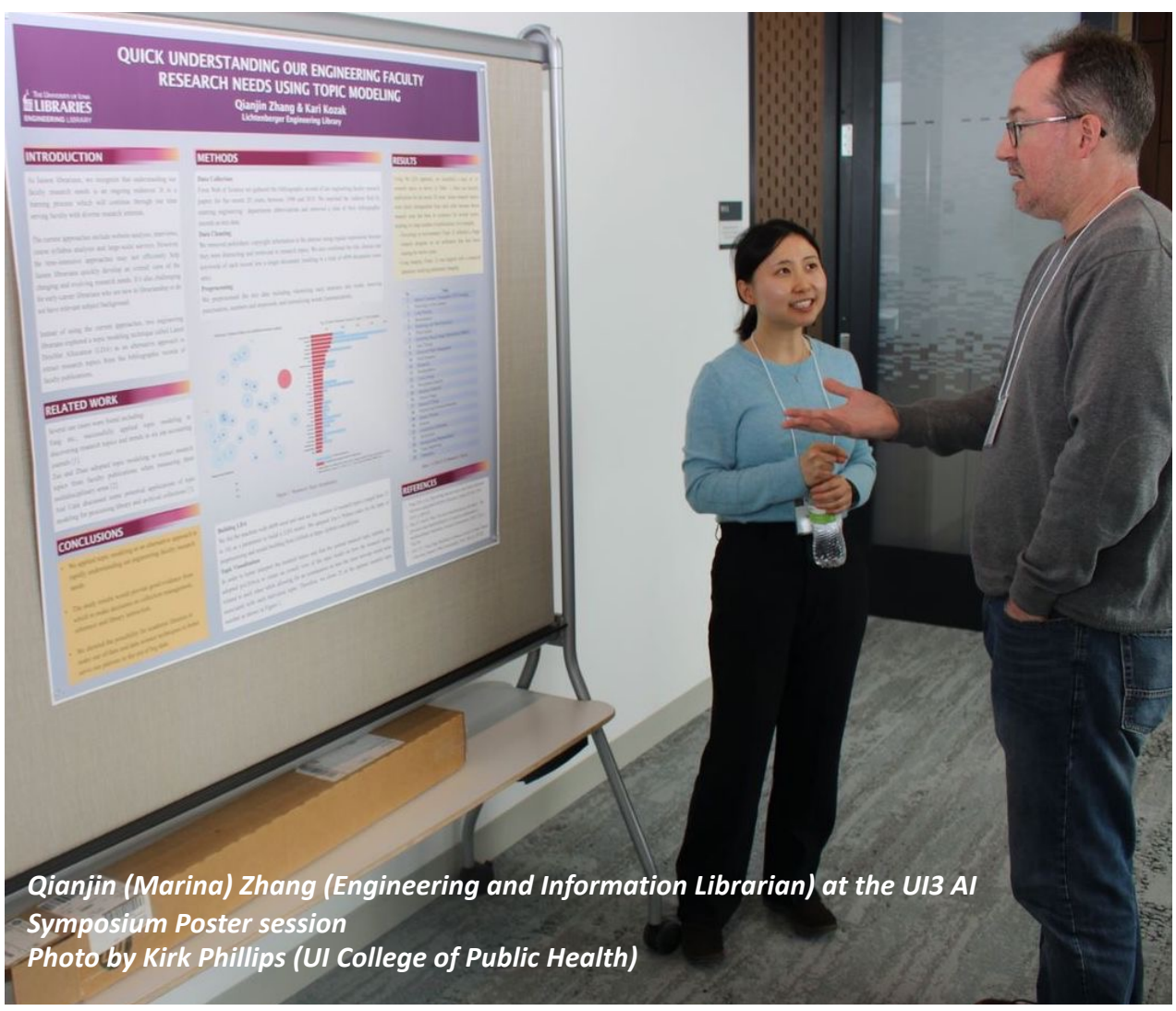
The four-year, $1.6 million grant from the U.S. Department of Agriculture calls for UI engineers to design and build smart sensors that measure soil moisture and temperature, along with air temperature and humidity levels. The data would be transmitted to a cloud-enabled, Internet-based storage system and will be accessible to farmers through an app.

The goal is to use the information from the sensors and models for weather, crop growth, and economy to decide the most efficient, sustainable use of water to maximize crop yields in areas where mostly groundwater is used — a practice known as irrigation scheduling.

The project will take place in rural, western Nebraska, where farmers have relied on drawing water from the Ogallala Aquifer as an irrigation source.

The project is led by Jun Wang, chemical and biochemical engineering professor and assistant director for the Center for Computer-Aided Design in the UI's College of Engineering. As part of the Iowa Informatics Initiative, Wang worked with UI Information Technology Services and Protostudios in Iowa City to develop the proposal.

Wang's team will partner with researchers at the University of Nebraska-Lincoln and the University of Illinois-Champaign-Urbana.



Qianjin (Marina) Zhang (Engineering and Information Librarian) at the UI3 AI Symposium Poster session
Photo by Kirk Phillips (UI College of Public Health)

UI3 AI Symposium Keynote Michael Abramoff (left) chats with UI3 Symposium attendees Dayton Trent (center) and Marcus Toral (right).
Photo by Kirk Phillips (Epidemiology Informaticist; UI College of Public Health)

From 'Retinator' to Visionary: UI3 AI Symposium Keynote Abràmoff Shares His Secret to Success

By Elizabeth Leake, UI3 Communications Manager

Symposium keynote speaker Dr. Michael Abràmoff is the Robert C. Watzke, MD, Professor of Retina Research Professor of Ophthalmology and Visual Sciences in the UI Carver College of Medicine (CCOM); as well as an internationally-renowned physician, scientist and fellowship-trained specialist. He holds Master of Science degrees in Medicine and Biomedical Informatics, and a Medical Doctorate degree from the University of Amsterdam; plus, a Doctor of Philosophy degree in Biomedical Imaging from the University of Utrecht in the Netherlands. With 13 patents under his belt, he has authored more than 300 papers that have been cited more than 26,000 times.

Abràmoff joined the UI-CCOM faculty in 2004, and has spent decades perfecting instrumentation and algorithms used to detect diabetic retinopathy, a leading cause of blindness that can be prevented with early diagnosis and treatment. Diabetic retinopathy affects more than 493 million worldwide and is the primary cause of blindness in the US working-age population. The numbers are increasing with the obesity epidemic and subsequent uptick in cases of type-two diabetes.

Beginning with his research on neural networks from 1989, by 2000 Abràmoff had described how algorithms can detect retinopathy. With a primary interest in preventing blindness, he went on about the business of perfecting the algorithms and founded his company, IDx. He presented his plan for approval of autonomous AI that diagnoses diabetic retinopathy to the U.S. Food and Drug Administration (FDA) in 2010.

The FDA didn't support Abràmoff's first proposal, and few others in 2010 understood AI's potential, in general. One colleague-editor granted him the moniker, "The Retinator." "All of this happened around the time I was going for tenure at UI," he said.

But that didn't stop him; with IDx, he kept pushing and perfecting the AI system under intense discussion with the FDA. From the beginning, he was concerned about bias in AI algorithms, and wanted to ensure that results were consistent across all ages, races and ethnicities; retinas vary in color and tone depending on the level of melanin present in the patient. As a practicing physician, it was obvious to him that biomarkers used in the clinic did not have such bias. Ensuring the most inclusive and equitable outcomes required biomarker algorithms with a broad range of imaging files and access to more computational power; a process that required years to complete with the help of Andreas Wahle (Iowa Institute for Biomedical Imaging), UI-Information Technology Services (ITS) Research Services' Advanced User Support; and the *Helium* and *Neon* supercomputing clusters.

As a pioneer in autonomous AI systems, Abràmoff realized that he would have to train his peers, policymakers, and machines at the same time. Technical barriers would be more easily overcome than human-interfaces; antiquated assessment frameworks stood in his way. With his company, IDx, he developed an awareness campaign based on a platform of transparency and patient safety, published peer-reviewed papers and lobbied to establish trust and confidence in AI among authorities who certify the safety and quality of U.S. health care. In some cases, the processes were originally established to oversee the actions of humans (physicians) and lacked an apparatus to consider autonomous AI. "It helped that a scientist from Harvard published a study about machine learning bias about the same time; their work validated what I was doing," he said.

His persistence paid off in 2018 when the FDA approved clinical trials for the use of IDx-DR—a fully-autonomous AI system for the early detection of diabetic retinopathy—by primary care physicians. In fact, it is the first fully-autonomous diagnostic AI system to be cleared by the FDA. IDx-DR is being used on patients around the country at multiple clinics, and more will be deployed in the coming weeks. The work is managed by Abràmoff's startup that employs over 50 people in Coralville, Iowa.

IDx-DR can be administered by someone with a high school education. Machine-read and delivered test results are available within minutes versus months as is often the case with traditional diagnostic procedures and workflows. Since untreated diabetic retinopathy progresses toward blindness over time, the rapid turnaround is transformative. Human ophthalmological specialists must read traditional tests, but few communities have an ophthalmologist, and consultations are costly. Therefore, IDx is especially promising for those who live in rural and impoverished regions that lack access to specialists, and where obesity, type-two diabetes and blindness occur at higher rates.

"So, today the press reports nice things about us," he said, and added, "General Electric even said we're one of the five coolest things on Earth!"

Milan Sonka (College of Engineering) asked Abràmoff why he would put so much effort into replacing well-paid specialists, adding, "Didn't you reduce your bread-and-butter?" "No," said Abràmoff. "Physicians make more money treating patients than from diagnostics. IDx-DR will reach more people and diagnose more cases that we will then treat[1]; fewer will go blind and everybody wins. We just altered the patient-care workflow for the better," he added.

During a break, Medical Student Marcus Toral, featured above (right), also paused to consider employment security. He's in his fifth year of training to become an MD/PhD specialized in ophthalmology. Toral said, "Medical AI is a scary thing to a lot of physicians and medical students. 'Will I be replaced?' is an ever-pervasive thought when it comes to automation. But it's important to look at the evidence, put patients first and focus on how AI can be developed to support over-burdened medical professionals; Dr. Abràmoff's technology does just that."

Symposium participant Dayton Trent (UI College of Pharmacy), also featured above (center), remarked about the time it took for this AI solution to progress with the FDA. He said, "Dr. Abràmoff's presentation made me realize that anything is possible and that great things do come to those who wait and have the patience to persist for eight years!"

What advice does Abràmoff have for others who wish to develop AI-empowered innovation?

"Autonomous AI is often but not always be the right solution," Abràmoff said, and added, "It's important to seek expert advice from UI3 and domain-based communities of practice. Understand what your peers are doing; educate yourself," he said.

What tips does Abràmoff have for influencing decision-makers?

"In order to foster governance (FDA/Federal Trade Commission) approval, you must be fully-transparent about your product's safety, efficacy and equity," he said, and emphasized the importance of documenting preregistered research outcomes in peer-reviewed journals. "Physicians and the public also want to know that it was the outcome of a well-developed study; why the system was built a certain way, and how the process of discovery unfolded over time," he added.

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"Pivotal Trial of an Autonomous AI-based diagnostic system for detection of diabetic retinopathy in primary care offices," by Michael J. Abràmoff et al., published in the 2018 (Nature Partner Journals) *npj-Digital Medicine*, pages 38-40: "The results of this study show that the AI system in a primary care setting robustly exceeded the pre-specified primary endpoint goals with a sensitivity of 87.2% (>85%), a specificity of 90.7% (>82.5%), and an imageability rate of 96.1%. Sensitivity is a patient safety criterion, because the AI system's primary role is to identify those people with diabetes who are likely to have diabetic retinopathy that requires further evaluation by an eye care provider. Previous studies have shown that board-certified ophthalmologists that perform indirect ophthalmoscopy achieve an average sensitivity of 33%,[27] 34%,[28] or 73%[9] compared to the same ETDRS standard."

UI Health Informatics PhD Student Eric Pahl Uses AI for Smarter Organ Transplants

By Elizabeth Leake, UI3 Communications Manager

Organ and tissue transplant candidates usually endure an excruciatingly long wait as they battle conditions that worsen with time. At some point, if they're lucky, they receive a call which triggers a frenetic rush to beat the clock, and a swell of optimism. They enter into the process with the understanding that there's a possibility their bodies will reject the tissue, that anti-rejection drugs will make them sicker, or they won't survive the procedure. It's a physical and emotional rollercoaster ride that they gladly endure for the prospect of extending time on Earth with loved ones.

According to the United Network for Organ Sharing (UNOS), there are 113,668 candidates currently waiting for organ and tissue donations, but only ~1,588 donors. The American Transplant Foundation estimates that ~20 people on the wait-list die every day. UI Health Informatics PhD Student Eric Pahl is intimately familiar with the stats; his family's history of organ disease and failure fueled a passion for the development of smarter tech to improve access, affordability and quality of organ replacement therapies.

Dalton Shaull was a UI Hawkeye linebacker in 2013 when he suffered a career-ending traffic accident that left his left arm paralyzed. With a nerve transplant at the Mayo Clinic, he has since fully recovered. Shared experience, passion and vision brought Pahl and Shaull together as undergrads, and in 2016, they co-founded a startup called OmniLife, Inc.

As OmniLife's chief technical officer, Pahl uses artificial intelligence (AI) and machine learning to predict organ transplant outcomes. "Once organs become available for transplant, there are many critical decisions that must be made in a short period of time," said Pahl. "The decision to proceed or pass can mean life or death for the prospective recipient," he added.

They raised more than $3 million from state, federal (National Institutes of Health), and private investments. With the help of 20 student interns and ten full-time software engineers (graduates of UI and Iowa State University), they developed and deployed commercially-available software products that save lives by improving transplantation in Iowa, Illinois, Ohio, Kentucky, Utah, Indiana, and Michigan. Additional states are in queue.

A mobile communication tool called TXP Chat™ is used by transplant teams. OmniLife supplemented TXP Chat™ with Ask Alan™, a clinical decision support chat-bot assistant that offers personalized and real-time data analysis about the organ that's available for transplant, and predicts whether or not it's likely to be a success.

With the help of an interdisciplinary team of mentors, including primary adviser Hans Johnson (Associate Professor of Electrical and Computer Engineering); Informaticist Nick Street (Tippie College of Business; Management Sciences), and Transplant Surgeon Alan Reed (UI Hospitals and Clinics), Pahl sustained his focus on the task of using AI to compensate for missing data, and to facilitate variables that change rapidly during chaotic clinical situations. Data that are unique to the donor, recipient, clinical team, location, time, and situation at hand are pulled from messages, users, connected APIs and file uploads in TXP Chat™. Missing data are interpolated and provided to the surgical teams. "We use these data to assemble a customized organ offer template that is unique to each clinical professional," said Pahl who added, "It gives them the most relevant, exact and timely information needed to streamline and shorten the decision-making process."

As a member of the Interdisciplinary Graduate Program in Informatics (IGPI), Pahl and his team could access the high-performance computing resource, *Argon*, and appreciate the additional speed that comes with its graphics processing units (GPUs). "We utilized the nationally-acclaimed experts who are affiliated with the Iowa Informatics Initiative (UI3)," he said, and added, "the beautiful UI3 space on the fifth floor of the UI College of Public Health Building with dedicated workstations, fast network, lab space, meeting/collaboration rooms, and kitchenette offered our team a convenient place to meet any time of day or night," he said.

"*Argon* GPUs are used to run experiments that identify which variables are more predictive of organ transplant success or failure at various post-op time intervals," said Pahl. "We were able to halve the time from initial organ offer to transplant," he said. Over the past three years, median offer to transplant times were 16, 19 and 21 hours, respectively. But during their intervention year, they observed a median time of 10 hours. "Fewer hours on ice are critical to organ transplant success; this time-savings was a significant improvement that wouldn't be possible without AI," he said.

Pahl's team demonstrated the utility of AI/machine learning compared with the status quo (using a Cox piece-wise linear regression) for predicting organ transplant success or failure. Typically, more than one in five transplant-candidate kidneys are discarded. With AI-enabled tools, Pahl's team observed a 26 percent increase in the number of viable transplants.

When asked what advice Pahl would give someone who wants to form a biotech startup, he said, "Make sure the *PROBLEM* is what you're passionate about, not a particular solution; you'll throw away and investigate many different solutions on your journey." He emphasized the importance of choosing your team wisely, adding, "Either be all-in, or find someone to drive who is." He recommends engaging with the wealth of resources and services available to help budding entrepreneurs at UI, including UI3, the John Pappajohn Entrepreneurial Center (JPEC), and the Iowa Economic Development Authority (IEDA), and reading the book, "The 7 Habits of Highly Effective People."

As for plans upon graduating in December, Pahl intends to, "continue leading the technical direction of our company and recruit many more talented informaticists and engineers who will join our life-saving mission," he said. "People interested in joining our company are invited to apply online at https://www.omnilife.ai," he added.

There are 113,668 candidates currently waiting for organ and tissue donations, but only ~1,588 donors. The American Transplant Foundation estimates that ~20 people on the wait-list die every day.

Photo: OmniLife team; Pahl is third from left, and Schall is third from right.

UI3 AI Symposium Presentation: Ibrahim Demir Explains Applications for AI in Geosciences

Ibrahim Demir is an assistant professor in the UI Civil and Environmental Engineering, and Electrical and Computer Engineering departments. He is also a UI3 Cluster Faculty member and directs the UI Hydroinformatics Lab; he is specialized in hydroinformatics, scientific visualization and environmental information systems.

Demir's UI3 AI Symposium presentation explained the history of AI, explored a range of applications and offered a glimpse into the future. He noted the shift from neural networks toward deep learning in 2014 as more domains started to engage with faster computers and produced more data. More scholarly articles about DL have been published since then, with the number spiking in 2018. While early strides were made in the field of industrial engineering with applications for autonomous transportation, Demir noted that, "Many more fields have discovered classical applications for machine learning, including geosciences."

"Holograms, augmented and virtual reality—technologies enabled by and perfected with machine learning—revolutionize our ability to train and inform first responders while reducing risk," said Demir. He presented many novel intelligent systems and machine learning applications from his lab for disasters and environmental datasets. The systems are designed to support decision-making and improve the day-to-day operation of federal and state agencies.

Demir noted that data and smart tools developed by tech giants Microsoft, Google and Amazon can be commanded via voice recognition technologies that understand a wider range of ages, ethnicities and language differences.

"When your grandmother can command complex data on affordable, intelligent systems that help her decide when to take shelter or flee to avoid a destructive storm, we begin to realize how smart devices improve personal safety and quality of life for the most vulnerable members of society—which is increasingly important for those who live in regions affected by climate change," he said.

UI3 AI Symposium Presentation: Daniel McGehee and the Future of Autonomous Transportation

Daniel McGehee is the director of the National Advanced Driving Simulator Laboratories (NADSL) at the UI, and an associate professor in the departments of Industrial and Systems Engineering, Emergency Medicine, Public Health and Public Policy. He leads a team of faculty, staff, graduate and undergraduate students in an interdisciplinary transportation research program that studies human factors, automotive safety and injury. Previously, he was the director of the Human Factors and Vehicle Safety Research Division at the UI Public Policy Center, and has worked for UI since 1993.

McGehee's UI3 AI Symposium presentation focused on the history of automation in the transportation industry since 1994 when the first study was launched. "Progress stalled on March 23, 2016 when Joshua Brown died in a partially automated Tesla crash near Williston, Florida," he said. In the 41 minutes prior to the crash, Brown ignored seven warnings issued by the car's control panel. He died instantly when his car drove under a semi-tractor trailer parked across the road. "It was a "shearing" event, unlike it would have been if he had driven into a concrete barrier, pedestrian or another vehicle traveling in the same or opposite direction (hazards that the Tesla's algorithms were trained to identify)," said McGehee. "The car didn't even brake, and traveled for another quarter mile without its top," he added.

Uber was testing autonomous vehicles, but they stopped in March, 2018 when a pedestrian was killed in Tempe, Arizona. The modified Volvo's dash-cam showed the safety driver was distracted by her mobile phone; she looked up in horror just as the car, without braking or warning, struck a woman walking a bicycle across the street. "While its algorithms were trained to identify pedestrians and bicycles as hazards, it didn't recognize the unique combination of pedestrian pushing a bike that had shopping bags," said McGehee.

Machine learning is the key to safety, and training the algorithms takes time and experience under every possible condition. Speed is sacrificed with complexity, and slowness frustrates drivers and pedestrians, alike. "In New York, if you put an autonomous vehicle on the street, traffic would grind to a halt," he said.

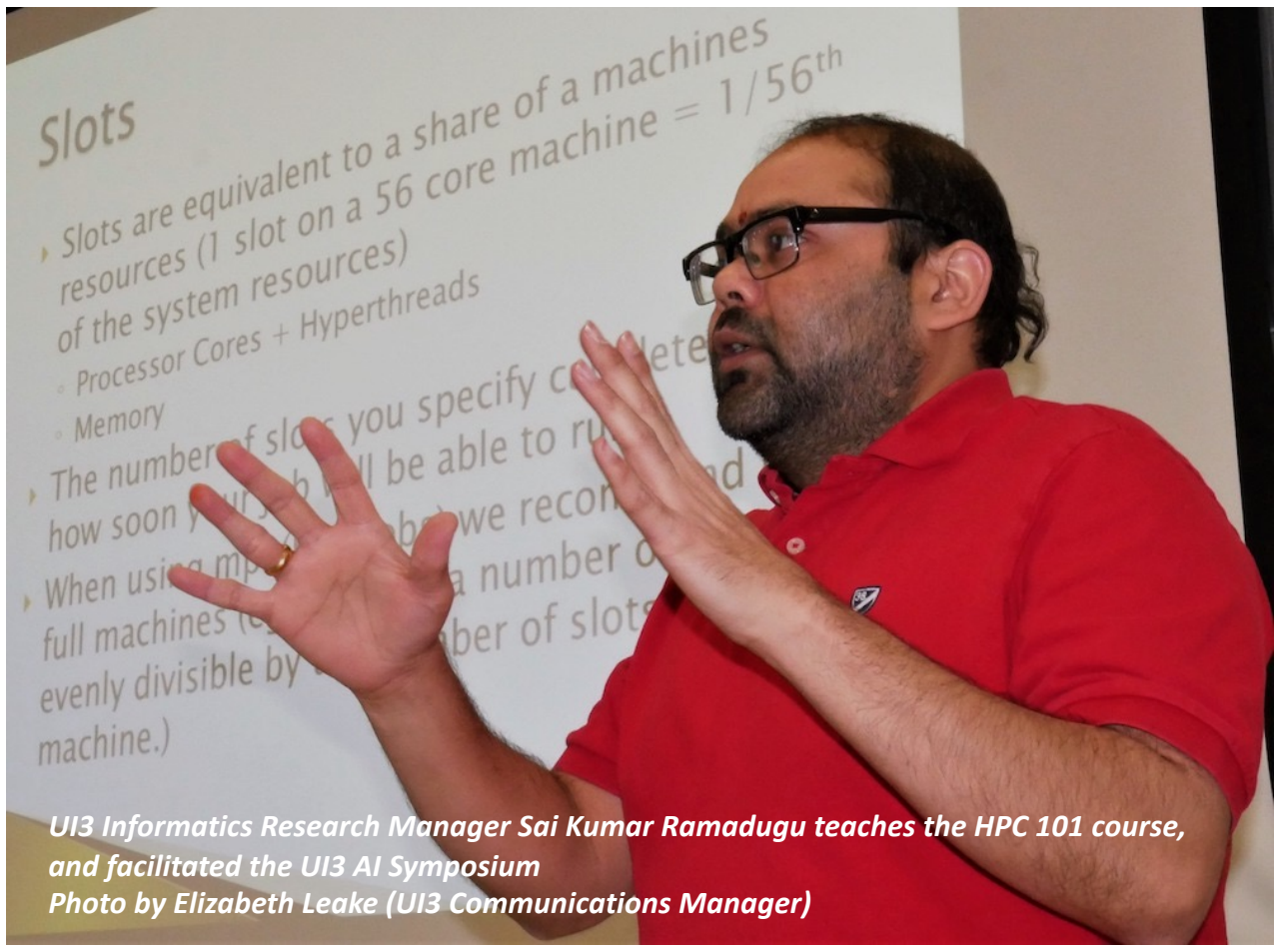
McGehee cited a case of autonomous busses at Disneyland-type resorts; they're programmed to see lots of pedestrians and vehicles. In rural areas, autonomous vehicles should be able to run faster since there are fewer hazards. But some rural hazards—deer and farm equipment in the road, for example—might be difficult to account for.

Dominos and Kroger Food are experimenting with autonomous delivery vehicles, but McGehee believes it's disingenuous of them to claim autonomy. "There are always safety drivers on board that can override the AI when a hazard presents itself," he said.

McGehee's lab is experimenting with partially automated vehicles with Iowa City/Cedar Rapids commuters. Their experience is captured with sophisticated cameras and vehicle instrumentation.

"Ethics, legal and safety considerations will govern the progress of autonomous transportation," said McGehee who predicts that full automation is decades away from ubiquity. "By 2040, ~ 90 percent of cars on the road will have today's production advanced driver assistance system technology. It is hard to predict when fully autonomous cars will be able to operate in all conditions," he added.

What's New in ITS Research Services?



UI3 Informatics Research Manager Sai Kumar Ramadugu teaches the HPC 101 course, and facilitated the UI3 AI Symposium
Photo by Elizabeth Leake (UI3 Communications Manager)