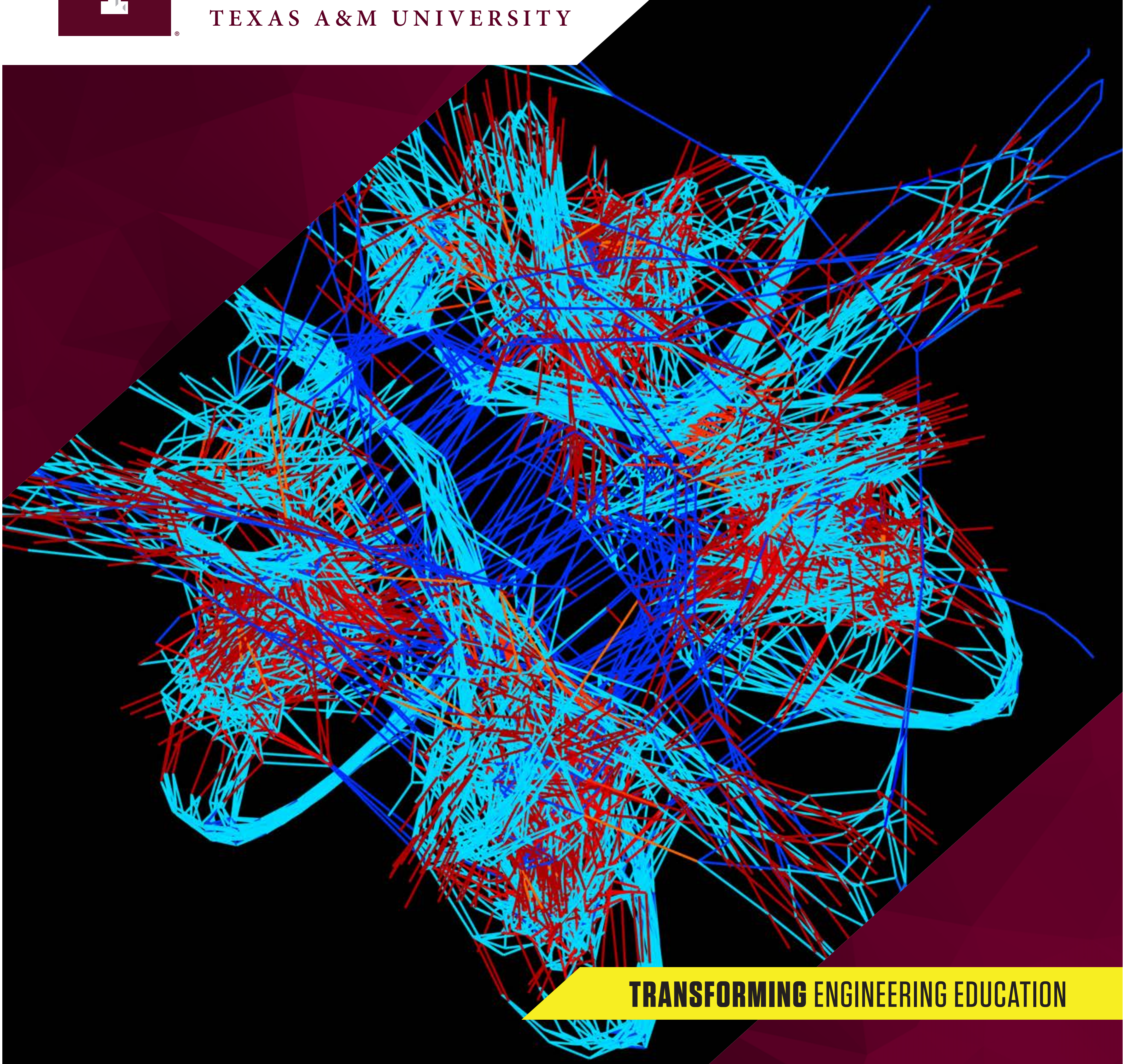
COMPUTER SCIENCE & ENGINEERING

TEXAS A&M UNIVERSITY



TRANSFORMING ENGINEERING EDUCATION

LEADERS IN ENGINEERING

The Department of Computer Science and Engineering is part of the College of Engineering at Texas A&M University, which is the largest college on the Texas A&M campus. Among public institutions in the nation, the College of Engineering was recently ranked 7th in undergraduate for 2018 and 7th in graduate programs for 2017. Our faculty are experts in a multitude of impactful areas of study such as cybersecurity, data science, digital humanities, intelligent systems, remote health and robotics.

HIGH IMPACT

The department's areas of research encompass a vast array of topics within the computing field, all of which are highly meaningful in our world today. From studying the use of robotics in space exploration to working on enhancing the resilience of crisis communications systems, our faculty members continue to make a difference in the ever-evolving field of computing.

DEPARTMENT MISSION

The mission of the Department of Computer Science and Engineering is to develop the human and intellectual resources needed to meet the future technological challenges in the field of computing. This includes developing computer scientists and computer engineers for positions of leadership in industry, government and academia.

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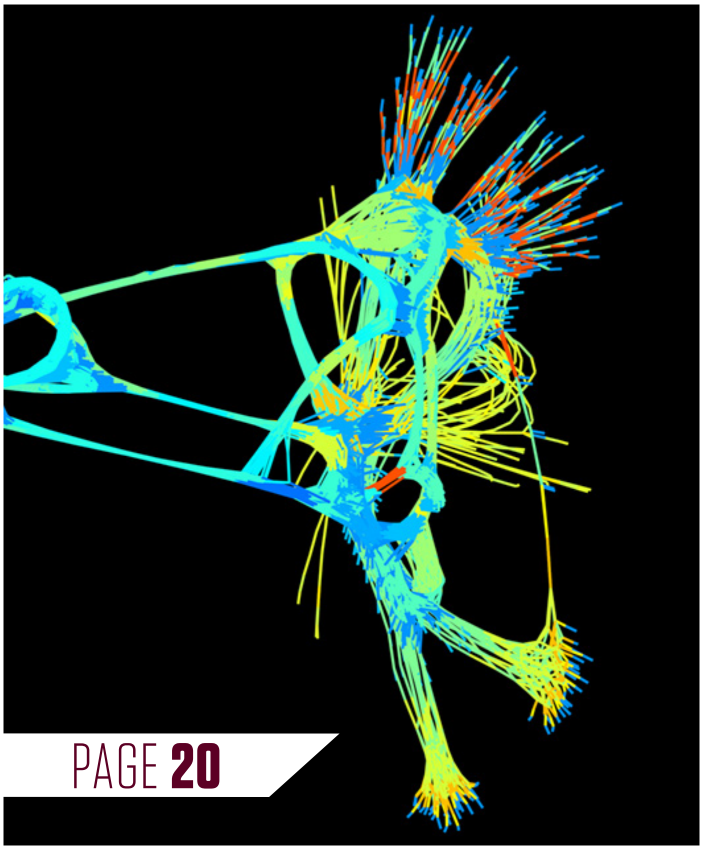

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LETTER FROM THE **DEPARTMENT HEAD**

Greetings from Aggieland!

We have had another exciting year in the Department of Computer Science and Engineering. Our department experienced significant growth yet again, with the addition of seven new faculty members who bring expertise in areas such as artificial intelligence, data science, cybersecurity and health.

In the pages that follow you will see examples of how our faculty members have pushed the boundaries of innovation to pursue novel research projects that span the many areas of computing. In addition, our faculty continue to have success obtaining major grants for their research in the multidisciplinary efforts we pursue.

Additionally, we are investing in active learning pedagogies so that we can better leverage the new learning spaces that will be available when the Zachry Engineering Education Complex opens next year. Many faculty members have experimented with “flipping” the parts of their courses that could benefit from more in-class discussion and hands-on work. This summer we offered five distance courses with a total enrollment of 195 students. This generated interest from students who aim to progress toward graduation while away for an internship. Four of the distance courses sold out immediately. We are planning to offer at least four additional courses next summer. The material produced for the distance-based delivery is also useful in improving the supporting material for the classroom-based delivery.

As we reflect upon this past year, we are proud to see the areas we have grown, and continually strive to pursue our mission to develop the human and intellectual resources needed to meet the future technological challenges in the field of computing.

We are a department that prides itself as a home for high-quality education and research, and as always, a home for our students, former students and friends.

Dilma
Da Silva, Ph.D.

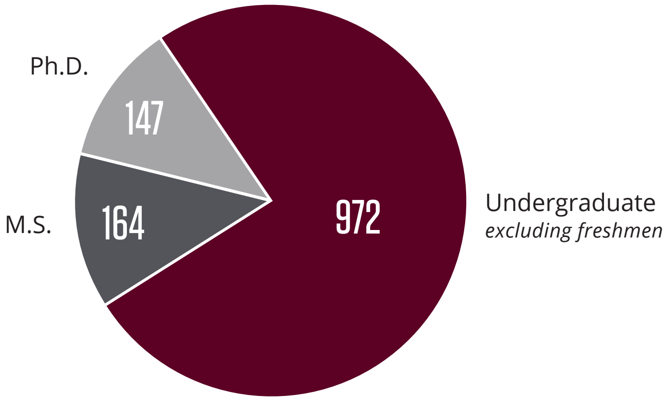
Department Head

Professor

Holder of the Ford Motor
Company Design Professorship II

DEPARTMENT OVERVIEW

ENROLLMENT (FALL 2016) • 1,283



DIVERSITY • UNDERGRADUATE

14% Female

22% Hispanic

2% African American

DIVERSITY • GRADUATE

17% Female

6% Hispanic

2% African American

DIVERSITY • FACULTY

21% Female

6% Hispanic

4% African American

FACULTY (FALL 2017)

Tenured/Tenure-Track	44
Academic Professional Track	12
Visiting Faculty	6

Professors	24
Associate Professors	13
Assistant Professors	7
Professors of Practice	3
Associate Professors of Practice	1
Instructional Assistant Professors	4

ENDOWED POSITIONS

Chairs	2
Professorships	6
Faculty Fellowships	11

AREAS OF RECENT FOCUS

- Cybersecurity
- Data Science
- Health
- Human-Computer Interaction
- Intelligent Systems
- Systems

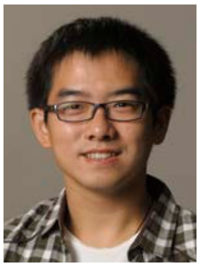
NEW FACULTY (2017)

TENURED/TENURE-TRACK

Theodora Chaspari
Assistant Professor

Bobak Mortazavi
Assistant Professor

Juan Garay
Professor



Zhangyang (Atlas) Wang
Assistant Professor

TEACHING FACULTY

Tanzir Ahmed
Instructional Assistant Professor

Paula deWitte
Associate Professor of Practice

Shawn Lupoli
Instructional Assistant Professor

FACULTY AWARDS (2016-17)

Nancy Amato

Unocal Professor, Regents Professor

ACM Fellow

IEEE RAS Distinguished Service Award

James Caverlee

Associate Professor

Faculty Fellow Award

Dean of Engineering Excellence Award – Associate Professor Level

Holleran-Bowman Faculty Fellow

Jianer Chen

Professor

CSE Graduate Faculty Teaching Excellence Award

Dilma Da Silva

Department Head, Professor and Holder of the Ford Motor Company Design Professorship II

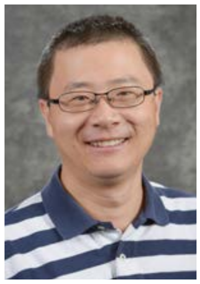
CSE Undergraduate Faculty Teaching Excellence Award

Tim Davis

Professor

Dean of Engineering Excellence Award – Professor Level

IEEE Fellow



Guofei Gu

Associate Professor

Faculty Fellow Award

Charles H. Barclay, Jr. '45 Faculty Fellow

Ricardo Gutierrez-Osuna

Professor

Dean of Engineering Excellence Award – Professor Level

Tracy Hammond

Professor

CSE Graduate Faculty Teaching Excellence Award

Jeff Huang

Assistant Professor

TEES Young Faculty Fellow Award

NSF Faculty Early Career Development (CAREER) Award

Daniel Ragsdale

Professor of Practice

Secretary of Defense Medal for Exceptional Public Service

Scott Schaefer

Professor and Associate Head for Academics

Association of Former Students College-Level Distinguished Teaching Award

Valerie Taylor

Senior Associate Dean for Academic Affairs and Royce E. Wisenbaker Professor

ACM Fellow

Aakash Tyagi

Professor of Practice

Instructional Faculty Teaching Award

CSE Undergraduate Faculty Teaching Excellence Award

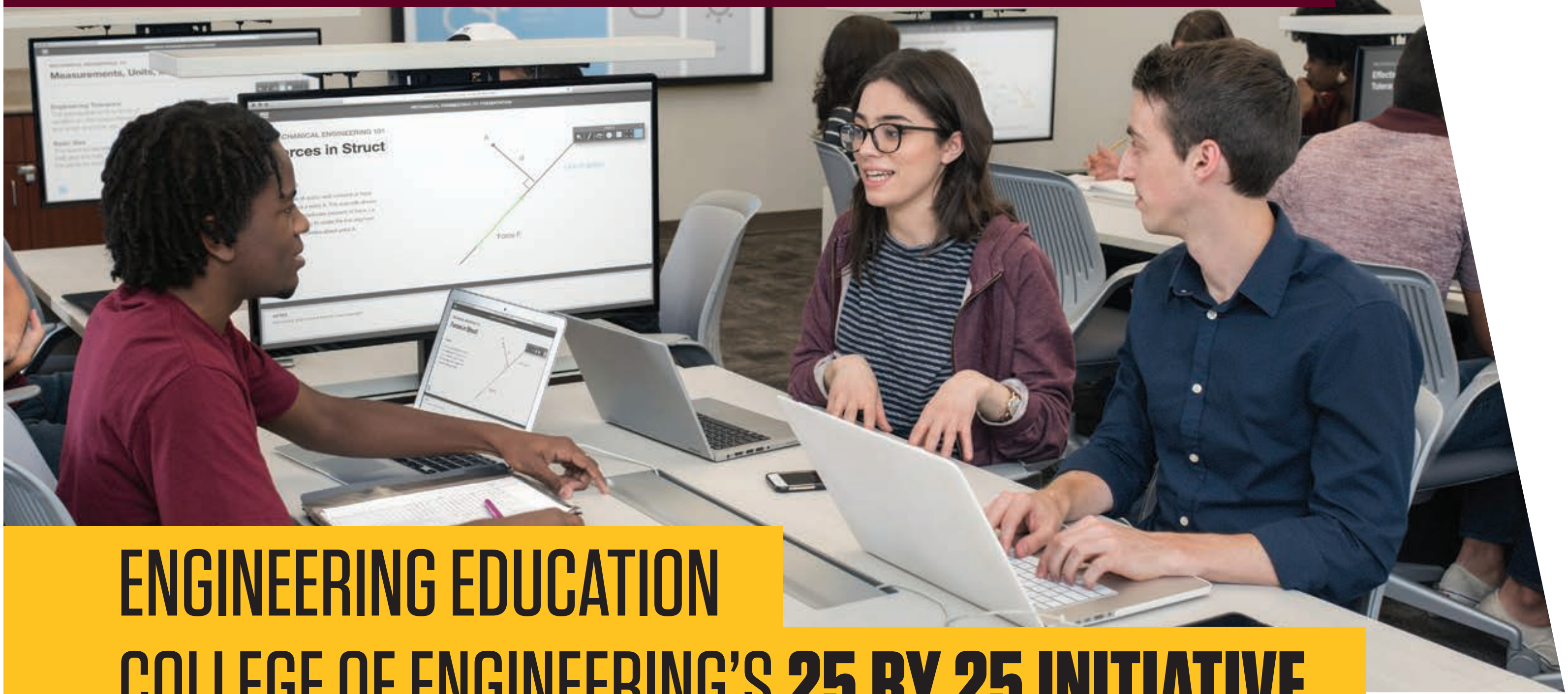
Tiffani Williams

Associate Professor

Association of Former Students College-Level Distinguished Teaching Award

ENGINEERING
TEXAS A&M UNIVERSITY

Quality
Retention
Excellence
25 BY 25



ENGINEERING EDUCATION
COLLEGE OF ENGINEERING'S **25 BY 25 INITIATIVE**

In 2013, Texas A&M University's College of Engineering embarked on a transformational program called 25 by 25. As a response to the national call for more engineering graduates, and with our engineering advisory board's strong support of the program, 25 by 25 is designed to increase access for qualified students to pursue engineering education at Texas A&M and increase our total enrollment to 25,000 students by 2025.

The 25 by 25 initiative is not just about increasing numbers; we are focusing on enhancing the quality of our students' educational experience and the excellence of Texas A&M's engineering program.

The 25 by 25 initiative is positively recognized by our academic peers and overwhelmingly supported by our former students and industry. In fact, we have raised more than $250 million in gifts in support of 25 by 25.

Q. How does the College of Engineering plan to grow?
A. The majority of future student growth from 25 by 25 will occur through the retention of our incoming students, growth at our branch campus locations and statewide engineering academies, and through the expansion of our online graduate programs.

Q. How is the college enhancing education?
A. We are improving the educational experience for our students through active learning, smaller class sizes, unique learning experiences and improved first-year engineering classes. We are expanding our learning facilities, including the 525,000 sq. ft. Zachry Engineering Education Complex. We are also growing our faculty. Our college has 578 top faculty scholars and professors of practice.

Q. Are you lowering your admission standards?
A. No. In fact, the admission standards to the College of Engineering have been enhanced. For students admitted for Fall 2017, the average SAT math score is 709, which is significantly higher than the average math score of 683 in fall 2016. And once students are admitted into Texas A&M, they now undergo a holistic review process to be admitted into the college.

For the latest information about the initiative, please see **engineering.tamu.edu/25by25**.
To get involved and support our program, contact Andy Acker at a-acker@tamu.edu or 979-458-4493.

ZACHRY ENGINEERING EDUCATION COMPLEX

COMING SUMMER 2018

- A modern, high-tech learning environment for undergraduate engineering education
- The largest academic building on campus with 525,000 sq. ft.
- Active learning classrooms
- Extensive makerspace
- Interdisciplinary learning labs
- Informal meeting and study areas
- Student career center
- Tutoring and advising center
- Technology support services
- Green roof/terrace


ROBONAUT: PERCEPTION IN SPACE

In order to remain safe, robots are commonly used to reach what human hands cannot. Often a robot is used to uncover victims from rubble or bring them safely to shore. These helpful hands can even reach a world far beyond our own – outer space.

Dr. Dezhen Song, professor, is working on a collaborative project with NASA's Johnson Space Center to develop localization and mapping algorithms for an astronaut robot (Robonaut) to make better use of the crew's time, and to perform dangerous tasks in lieu of a human.

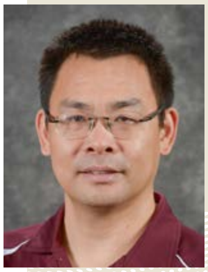
To utilize all tools and facilities developed for human astronauts, the team is working together to build a human-like robot with similar body configurations such as arms and hands. Due to the lack of GPS signals, the current Robonaut prototype cannot localize itself in the International Space Station (ISS).

Most tasks performed by Robonaut are limited to the vicinity of the robot. To enable further functionalities, such as transporting items in the ISS or performing panel maintenance, the robot needs to move around the station. This also means it must establish a mental map of the visited region and localize itself in the process. In the field of robotics, this is known as simultaneous localization and mapping (SLAM).

"SLAM is part of the robot perception capability," Song said. "Our study is to try to bring better and more accurate information to the robot to facilitate its decision process so that more smart robots can be developed for different applications. If successful, we can significantly increase the robots' ability in handling different environments, which will have significant impact on manufacturing, daily life, defense and many other areas that can benefit from the increasing capability from mobile robots."

Featured Researcher

Dr. Dezhen Song



Professor

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A reliable, low-cost SLAM capability has been an obstacle for many robotic applications in the past. A camera is a low-cost sensor compared to laser range finders, but the drawback to using a camera is lighting and baseline limits in calculating stereo information.

Since cameras measure bearing instead of absolute size, they have difficulty measuring distance.

One idea to combat this is to use two or more cameras with known baselines to provide distance reference; this is known as stereo vision. However, the joint coverage region between fields of views of the two cameras is too limited to be directly useful. Therefore, during the process, Robonaut's head will be activated from side to side. This will allow it to scan the surroundings to enlarge the field of view. By using neck encoder readings, the team can track Robonaut's head scanning motion.

There is an inertial measurement unit (IMU) installed in Robonaut that delivers body movement information. An IMU also helps establish view correspondence when Robonaut is moving. The primary challenge with this research project lies in combining the multiple camera views and other sensors with different, uncertain characteristics to provide robust SLAM results.

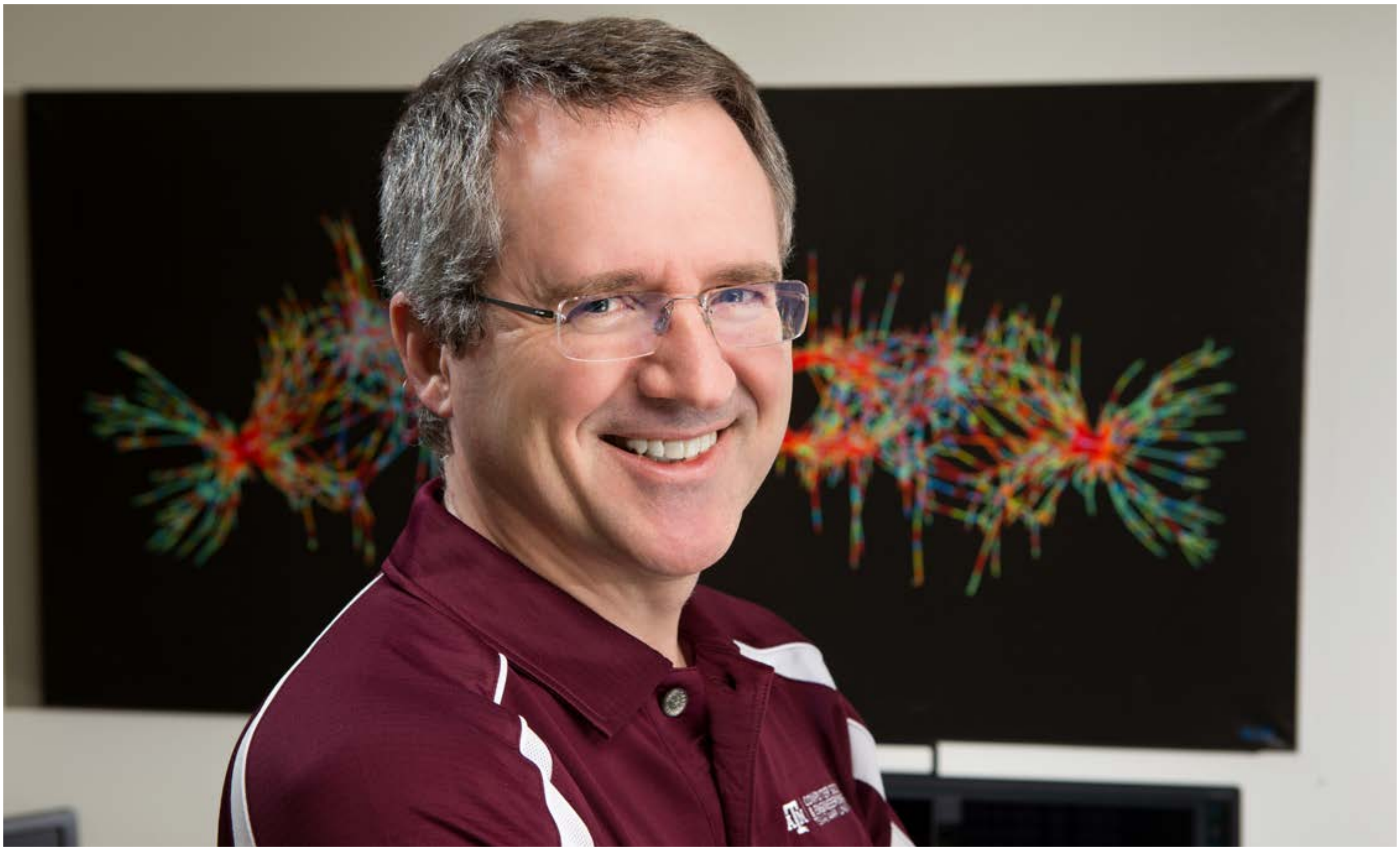
Interest in these developments extend beyond the space and aeronautics industry and into one that is a bit more grounded.

"They are interested in using our motion-sensor based technology in detecting railway status for better and low-cost railway maintenance," Song said.

This project first came about in 2005 when the group developed SLAM algorithms for vehicles while developing an autonomous motorcycle for the Defense Advanced Research Projects Agency Grand Challenge.

Along with their partnership with NASA, the group is also collaborating with industry contacts and Texas A&M faculty on their research for Robonaut. They are working with Dr. Tim Davis, a professor in the computer science and engineering department, to improve visual SLAM optimization algorithms using sparse matrices, and Dr. Jun Zou, an associate professor in the electrical and computer engineering department, to develop a new line of ranging and communication sensors for underwater robots.

ONE MAN'S UNFORESEEN IMPACT ON TECHNOLOGY



From Google Maps to planetary cartography, Dr. Tim Davis' work on algorithms and software impacts our lives every single day. This research has such a vast impact on our technology-driven world, that you have likely seen the results of his work without even realizing it.

Davis, professor, has dedicated his career to creating algorithms and software that can be used to solve large sparse matrix problems. Large matrices arise in many real-world problems in science, engineering and mathematics, and they tend to be mostly zero, or sparse. Davis constructs algorithms and software for solving these types of matrix problems.

SuiteSparse is a package of sparse matrix algorithms Davis created. His solvers are widely used in industry, academia and government labs, including Google, The MathWorks, NVIDIA, Sandia National Labs, the U.S. Geological Survey, IBM, Mentor Graphics, Cadence and in many open-source projects.

For example, every time you use Google Maps and zoom down to the street-level view, you are seeing the results of Davis' work. The photos taken by Google have GPS coordinates, but they aren't in the right place. By passing

through Davis' solvers, every photo on the planet in Google StreetView is placed in its proper position.

Similarly, the United States Geological Survey uses Davis' solvers to create maps of the moon, Mars and other planetary bodies. By simply plugging in his solvers, they are able to cut the time this would take from days down to minutes.

Many commercial engineering software packages also use his solvers. Several companies use them to analyze the design of chips that go inside cell phones or laptops before they are sent to be manufactured. There is no margin for error in these situations, so using Davis' solvers prevents potential mistakes.

Davis is currently applying his research on sparse matrix solvers to create new algorithms that rely on graphics processing units (GPUs) to accelerate the solution to these problems. GPUs are computer chips that calculate mathematical problems, primarily for rendering images. GPUs create the graphics in computer video games, but they can also be used to solve hard problems in math and science.

GPUs have many data processing cores that are very fast when they all work together doing similar work on different parts of the data. Applying sparse matrix computations on a GPU is a challenge, however, because the data layout of these matrices is irregular. With the persistent progression of high-performance computing systems comes the need for ever-increasing performance. This is where Davis aims to go beyond what is simply needed and pursue the formation of better-than-commercial-quality software.

Davis first began working on these types of problems when he was a graduate student at the University of Illinois at Urbana-Champaign studying electrical engineering. He began exploring the ways in which hardware could be created to get data from memory before the computer needed it.

"My ideas turned out to be well-suited to matrix computations, and sparse matrices in particular," Davis said. "I then got involved in the algorithms, not the hardware, and haven't looked back since. This trajectory is reflected in my research history: all my degrees are in electrical engineering, I'm in a computer science department, and I do applied math."

Davis has accomplished a rare feat – he is a Fellow of all three of the corresponding professional societies: the Institute of Electrical and Electronics Engineers (IEEE) for his work in electrical engineering, the Association for Computing Machinery (ACM) for his work in computer science and the Society for Industrial and Applied Mathematics (SIAM) for his work in applied math.

Davis works closely with many collaborators at Texas A&M, around the country and around the world. With his students, and postdoctoral student Wissam Sid-Lakhdar, he is creating new algorithms that exploit the GPU.

He is collaborating with Dr. Dezhen Song, a fellow computer science and engineering professor, on solving the sparse matrix problems that come from robotics. When a robot takes images with a camera and stitches them together to create a 3-D model of the world around it, it has to solve a sparse matrix problem. He has recently started collaborating with Dr. Simon Foucart in the Department of Mathematics on a genetics problem, and Dr. Erick Moreno-Centeno in the Department of Industrial and Systems Engineering on finding exact solutions to optimization problems.

He also works closely with researchers at the University of Tennessee, the University of Florida, Sandia National Labs, Rutherford Appleton Lab in the UK, NVIDIA, Microsoft, Yahoo! Labs, San Jose State University, and Harvard University.

"I could never have predicted the impact of my work," Davis said. "When I started creating these matrix solvers in graduate school, I saw a problem to be solved and had no idea my solutions would be so widely used. My code is out there 'in the wild', being used by so many people to solve so many problems that I'm only aware of a small fraction of the ways it's being used every day. Because the code is so robust, reliable and well documented, I get very few bug reports or requests for help on how to use it, so I don't always hear from my many users."

CRAFTING RELIABLE EMERGENCY COMMUNICATIONS NETWORKS

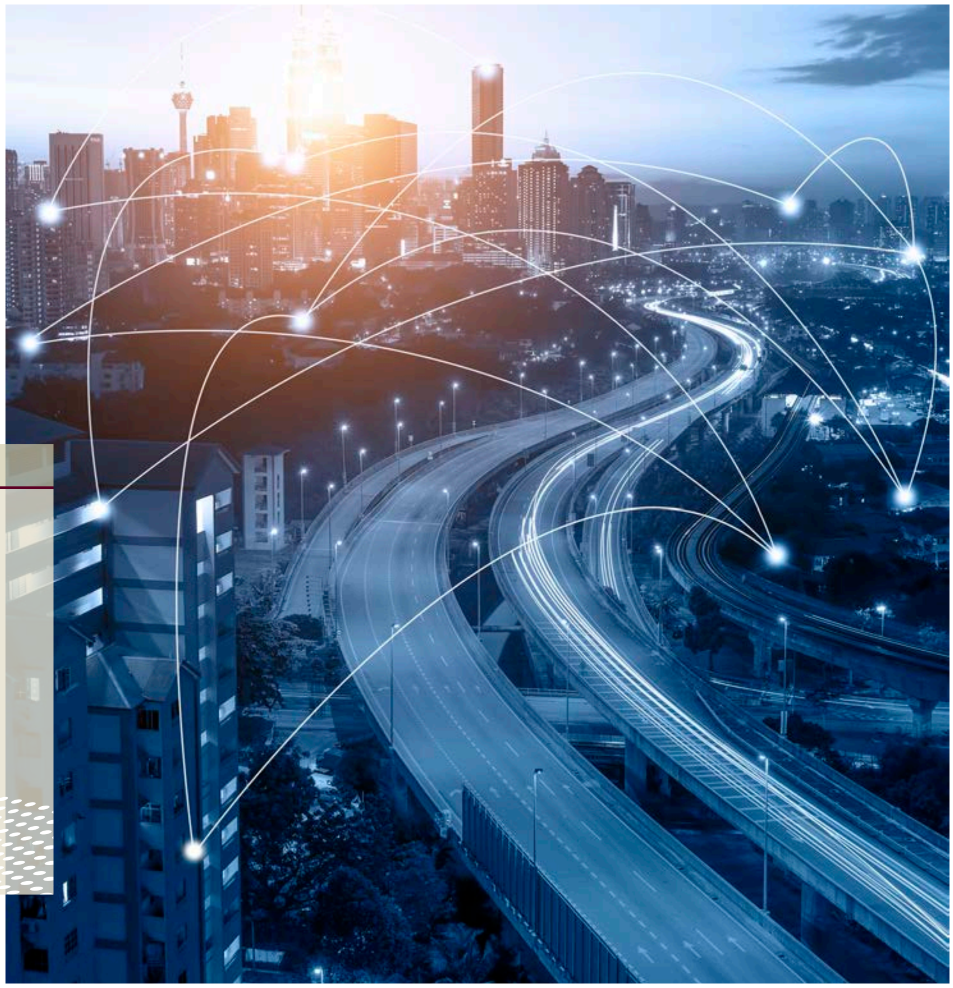
When disaster strikes, it is important for first responders to have reliable, unhindered access to a controlled network, allowing them to receive and deliver critical information while ensuring effective emergency response.

Unfortunately this is currently not the case. Due to power outages and cell tower damages, the infrastructure for communications is not readily available during the response to an incident or disaster, and furthermore, the cost of this infrastructure is unreasonable, even for large organizations.

In response to this, Dr. Radu Stoleru, professor, and his collaborators have proposed a way to enhance the resilience of public safety mission critical systems and services in the face of connectivity challenges.

The Middle Class Tax Relief and Job Creation Act of 2012 produced the First Responder Network Authority (FirstNet), which was designed to provide emergency responders with the first nationwide, high-speed, broadband network dedicated to public safety. AT&T has just been selected by FirstNet and awarded $6.5 billion to build the wireless network, with construction beginning later this year.

Stoleru's current project centers on the development of DistressNET-NG,



Featured Researcher

Dr. Radu Stoleru

Associate Professor

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which is a fault-tolerant, energy-efficient and load-balanced solution for mobile broadband communication and mobile edge computing for FirstNet. Edge/fog computing is a method of optimizing cloud computing systems by performing data processing at the edge of the network near the source of the data.

"DistressNet-NG provides a scalable and resilient wireless interconnection fabric for first responder communication equipment," Stoleru said. "Smartphones carried by first responders are capable of performing analytics using the computing and storage power of nearby devices, eliminating the need for constant high capacity connections to the internet. In order to accelerate this process, several high-performance computing nodes that are built using common-off-the-shelf components can be deployed in the area."

Stoleru, while collaborating with Dr. Robin Murphy, Raytheon Professor in the computer science and engineering department, for a National Science Foundation (NSF) Engineering Research Center proposal, developed the term fog computing. This was just the start of this ground-breaking endeavor.

"At that time, while cloud computing was still emerging, I realized that in a disaster area, a cloud environment might not be available due to the disruption in the networking/communication infrastructure," Stoleru said. "I then proposed the concept of 'fog,' which is a not well-defined cloud over an intermittently connected network infrastructure. It is rewarding to notice that CISCO recently (2013) adopted the term 'fog computing,' a concept we have been thinking about and working on since 2008."

After joining Texas A&M in 2007, he saw immediate application in the Texas A&M Engineering Extension Service (TEEX) and Disaster City and began working on fog/edge computing in 2008. In 2011, Stoleru received an NSF grant to continue his research and begin building DistressNet.

Cloud computing has been traditionally done in data centers in a physical location. Edge/fog computing moves the computations from data centers to mobile devices of end users, because data centers where cloud computing can be done might not be available shortly after a large-scale disaster.

Stoleru has also collaborated with Dr. Walt Magnussen, director of the Internet2 Evaluation Center and the Academy of Telecommunications and Learning Technologies; and Dr. Harsha Chenji, former computer engineering doctoral student, lead for the DistressNet project and assistant professor at Ohio University.

Stoleru was also recently awarded a $1.8 million grant from the National Institute of Standards and Technology (NIST), which is part of the U.S. Department of Commerce. NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards and technology in ways that enhance economic security and improve our quality of life.

DIVERSITY IN COMPUTING

Dr. Dilma Da Silva, Department Head

"Our faculty understand the value that diversity brings to advancing our field. Diverse teams foster greater results. We embrace the opportunity to nurture students from all backgrounds as they develop their talents and skills to improve the world through computing. Currently, 25 percent of our faculty members are women or underrepresented minorities."

Nancy Amato
Unocal Professor, Regents Professor

Theodora Chaspari
Assistant Professor

Dilma Da Silva
Department Head, Professor and Holder of the Ford Motor Company Design Professorship II

Juan Garay
Professor

Tracy Hammond
Professor

Ruihong Huang
Assistant Professor

Daniel Jiménez
Professor

Eun Jung Kim
Associate Professor

Robin Murphy
Raytheon Professor

Jennifer Welch
Chevron Professor II, Regents Professor

Tiffani Williams
Associate Professor

Paula deWitte
Associate Professor of Practice

Hyunyoung Lee
TEES Research Associate Professor, Senior Lecturer

Teresa Leyk
Senior Lecturer

HOW FLATTENING OUR DIMENSION CAN BRING BETTER GRAPHICS INTO THE FOLD

In order to create 3-D models in the field of computer graphics, thin sheets of material are layered together to create a single object. Dr. Scott Schaefer, professor, is focused on peeling back those layers in order to create more realistic graphics than ever before.

These types of graphics are composed of numerous triangular surfaces; however, geometry is only one aspect of how we perceive an object. Generally, we interpret surfaces by their color or how light interacts with the surface, all of which make the surface appear more realistic.

These colors are usually applied to the surface via texture mapping, which is a process that relies on the parameterization of a surface to map a two-dimensional image onto a three-dimensional surface. Parameterization is the flattening of a piece of a surface to the two-dimensional domain, which is Schaefer's current focus.

"We take a surface, cut it along a seam and then flatten it onto the floor," Schaefer said. "This flattening of a shape creates a map between the 2-D image and the 3-D shape. Colors on the image appear on the corresponding part of the 3-D surface, which is how nearly every 3-D model is colored today."

This flattening can introduce some distortion into the shape and most current parameterization methods are focused on reducing this distortion.

However, Schaefer's research centers on how the distortion that occurs is measured and optimized, as well as enforcing a mathematical property called a bijection. A bijection means that triangles do not fold over or overlap in any way during the flattening process.

"Imagine you had a piece of cloth that was cut out," Schaefer said. "You could lay it on the floor in many ways. A bijection would say that there are no folds in the cloth and that pieces of the cloth did not lie on top of each other on the floor."

While the property sounds easy, it has been nearly impossible to obtain while simultaneously minimizing distortion. Schaefer and his research team have successfully developed a method for efficiently optimizing parameterizations that produce a bijection.

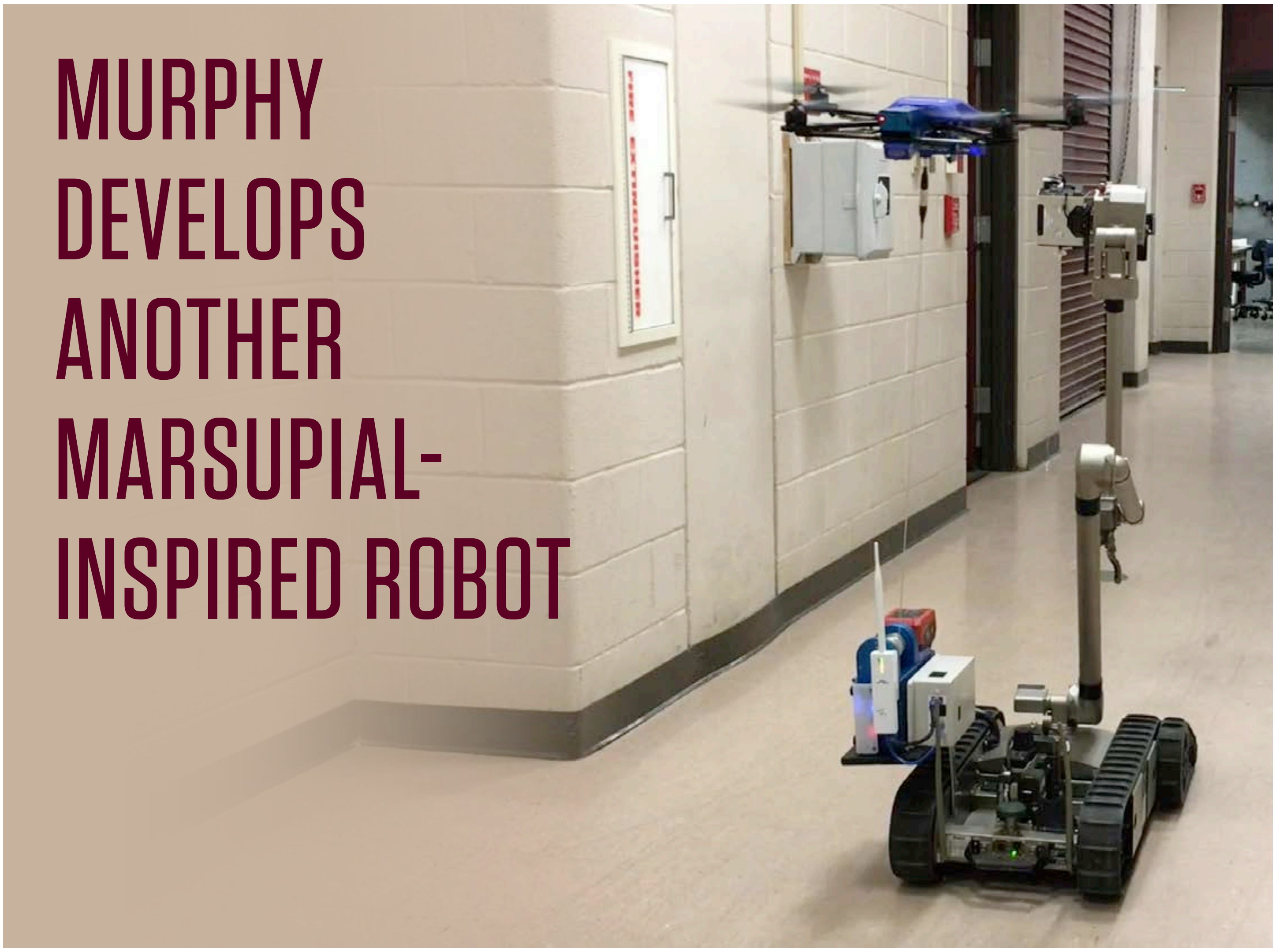
His more recent work attempts to speed up this optimization by understanding the shape of the distortion function in a higher dimensional space. By moving along low distortion, curved paths instead of straight lines, it is possible to speed up the optimization to be hundreds or even thousands of times faster. Such an advancement would make creating realistic deformations, which currently rely on expensive non-linear optimization, fast and interactive.

Schaefer began studying parameterization while teaching a game development course at Texas A&M. In the class, students were asked to build 3-D models, but ran into difficulty while attempting to paint the surfaces of the models because the methods in commercial tools did not enforce bijective maps between the 2-D and 3-D shapes.

"This became the motivation for my search for a better way of solving this problem," Schaefer said.

Parameterization is a fundamental tool in the field of computer graphics, so it is possible that the next movie you watch or video game you play will benefit from the results of Schaefer's research.

MURPHY DEVELOPS ANOTHER MARSUPIAL-INSPIRED ROBOT



Dr. Robin Murphy, Raytheon Professor and director of the Texas A&M Engineering Experiment Station's Center for Robot-Assisted Search and Rescue, saw a need for a safer, more efficient way to use quadcopter unmanned aerial vehicles (UAV) in indoor disaster environments.

Her idea for a quadcopter tethered to a home-base robot was inspired by marsupials, who have external pouches to hold their young and keep them close. Murphy has been working with marsupial robots since 1998, with ground-ground teams and boat-aerial robot teams supported by the National Science Foundation and the Office of Naval Research.

In the case of her new robots, the 'mother' provides a steady connection for the 'baby' quadcopter to safely assess the situation of a dangerous, indoor environment without the hazard of crashing into a potentially disastrous object. Not only does the mother provide stability, it delivers a steady power source for the baby to feed off of to stay in-flight longer. Fotokite is the company who developed the quadcopter robot, and Endeavor Robotics developed the PackBot-base mother robot.

The mother-daughter combination can be used in countless dangerous situations, such as nuclear power or chemical plants where it is unsafe to fly UAVs. It could be used to rapidly respond to an incident or, if used routinely, to prevent damage from occurring.

"We are very excited at how the Department of Energy and the nuclear industry have reacted to this marsupial combination," Murphy said. "They already use ground robots for inspection but can't see above six feet. The Fotokite lets them have a virtual mast, but also to see what the ground robot is doing and to help coach it through tight spaces."

The project, which is funded by the National Science Foundation and the Department of Energy, was featured on wired.com.

AMATO RECEIVES IEEE RAS DISTINGUISHED SERVICE AWARD

Dr. Nancy M. Amato, Unocal and Regents Professor, has been honored with the Institute of Electrical and Electronics Engineers (IEEE) Robotics and Automation Society (RAS) Distinguished Service Award.

The IEEE RAS Distinguished Service Award was established in 2001 and is presented to an individual who has performed outstanding service for the benefit and advancement of the IEEE RAS. Amato received the award for her innovative leadership on the RAS Electronic Products and Services Board and for her work with the International Conference on Robotics and Automation (ICRA) and International Conference on Intelligent Robots and Systems (IROS).

ICRA 2015, for which Amato served as program chair, broke many records and left a lasting impression on attendees. She introduced a number of innovations to the conference, several of which are now included in other symposiums, including IROS and the 2016 Robotics: Science and Systems Conference (RSS).

Amato's research interests lie in motion planning, computational biology, robotics, computational geometry, animation, parallel and distributed computing, parallel algorithms and performance modeling and optimization. She was named a 2015 Association for Computing Machinery (ACM) Fellow for her contributions to robotics and leadership in broadening participation in computing. She was also named a 2013 American Association for the Advancement of Science (AAAS) Fellow and IEEE Fellow for her contributions to the algorithmic foundations of motion planning, computational biology, computational geometry and parallel computing.

She has served on several committees for various conferences and as senior director of Engineering Honors, and is actively involved in building a strong program at Texas A&M University.

Dr. Nancy M. Amato

GU, COLLABORATORS RECEIVE GRANT FOR GROUNDBREAKING CYBERSECURITY PROJECT

Dr. Guofei Gu, associate professor, led a team of researchers from five universities on a collaborative project involving groundbreaking security management that has been awarded a $3 million grant. The grant is jointly presented from the National Science Foundation (NSF) and the software company VMware.

This project will make significant contributions to how enterprise, cloud and data-center networks are securely built and managed, which will transform the landscape of cybersecurity.

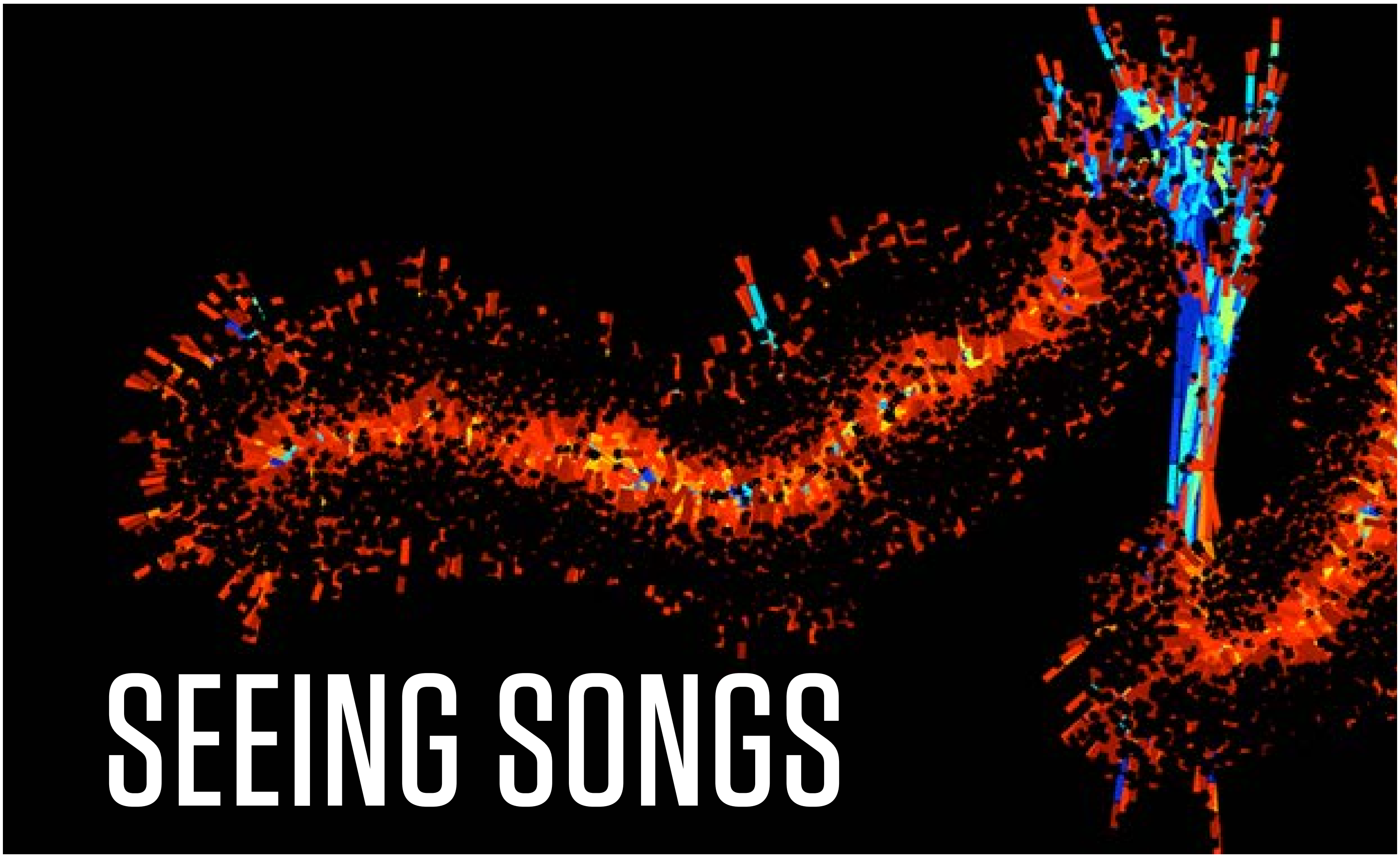
Many critical systems currently in use are not developed with an initial security consideration. Many times, security is added into a system only when a threat is anticipated; this makes it difficult to secure current systems against potential cyberattacks.

This project proposes a new security system, Software-Defined Infrastructure Security OS (S2OS), which encapsulates security capabilities at both the host operating system (OS) and network levels, and will offer an easy to use, programmable security model for protecting applications from cyberthreats. This project aims to break the mold of cybersecurity and find innovative ways to protect the entire infrastructure of a network.

"This project will build the 'holy grail' for enterprise, cloud and data-center security management," Gu said. "Cloud computing is now an essential part of our national cyberinfrastructure and the proposed work will lower the total cost of ownership for clouds, further unlocking economic and environmental benefits, as well as improving the security of today's clouds."

The other team members of this project include Dr. Don Porter, assistant professor at the University of North Carolina at Chapel Hill; Dr. Zhiqiang Lin, associate professor at the University of Texas at Dallas; Dr. Eric Keller, assistant professor at the University of Colorado, Boulder; and Dr. HongXin Hu, assistant professor from Clemson University.

This grant is part of a three-year effort. The goal of the partnership between NSF and VMware is to foster novel, transformative, multidisciplinary research that spans systems, networking and security with the aim of exploring and creating groundbreaking new approaches to security based on the concept of software defined infrastructure.



SEEING SONGS

When you think of art, mathematical algorithms may not be the first thing that comes to mind. Dr. Tim Davis set out to show the world that mathematics can, in fact, be beautiful. He is merging the two disciplines by crafting algorithms that convert songs into something you can actually see.

Davis, professor, is the creator of SuiteSparse, the widely-used package of sparse matrix algorithms.

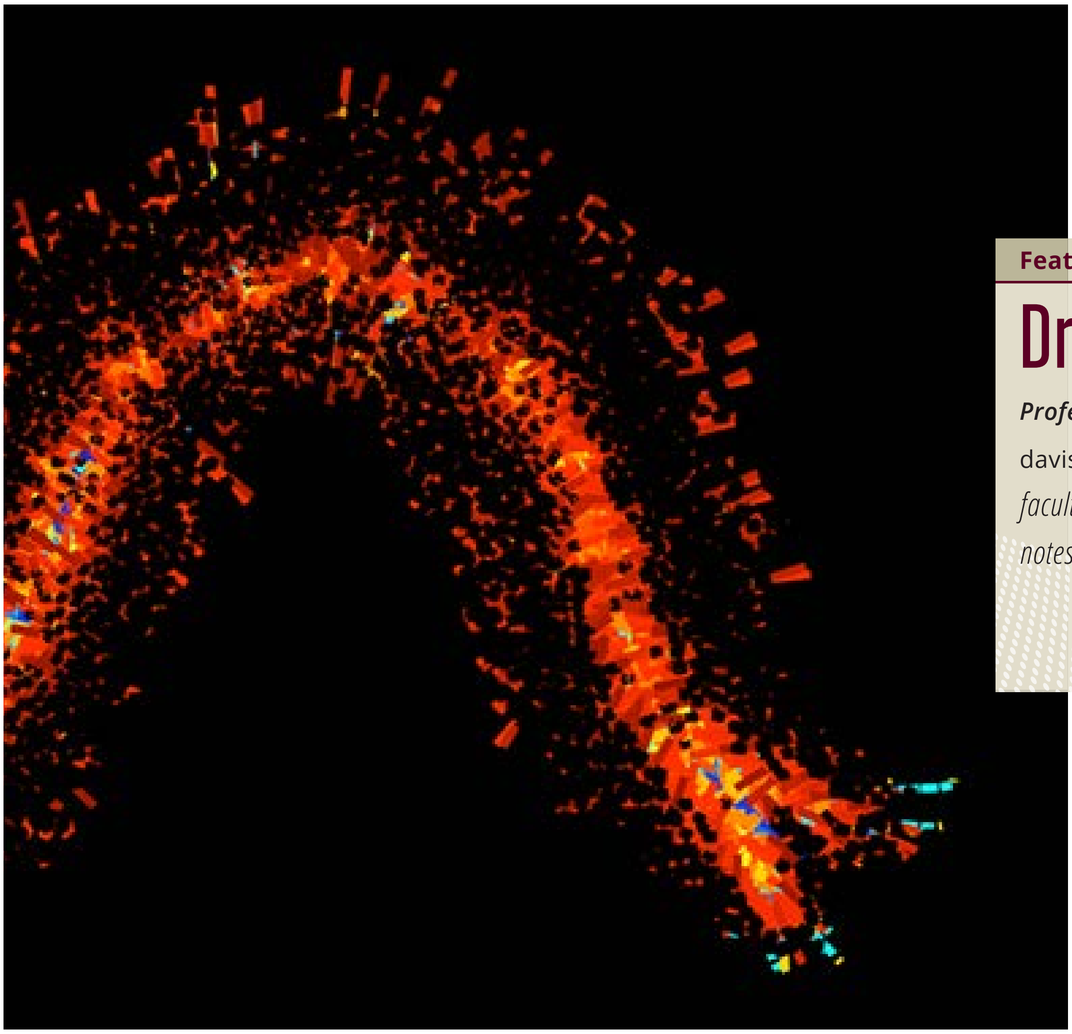
Davis collects sparse matrices from real world applications to test his solvers and to understand their performance. In collaboration with Dr. Yifan Hu, principal research scientist at Yahoo! Labs, these matrices are converted into images via the open source graph visualization package, Graphviz. For this to work, electrical charges are placed on the nodes and springs on the edges. A physics simulation is then performed to find a low-energy state. Long edges are displayed in blue and short edges in red.

These images are not only scientifically useful to gain a better understanding of how these matrices react in various scenarios, but also they are exquisite in their own right.

As a result of this work, Davis was asked by organizers of the London Electronic Arts Festival to create similar images from sound bites. He was excited to take on the challenge because of his passion to share with others his love for math and the beauty he sees within the code.

“With this algorithmic translation of music into artwork, I am able to give a glimpse into the beauty of mathematical software that everyone can see, not just me,” Davis said.

By capturing time and frequency, and remapping that into a new domain of space and color, Davis was able to build a new mathematical algorithm that captures the visual essence of an entire piece of music in a single image. Each line in an image is a note at a specific point in time in the music. Low notes are displayed in blue and high notes in red.



Davis' SuiteSparse code, which is currently being used by many institutions and organizations to solve large matrix problems, continues to be successful due to its unwavering reliability.

Featured Researcher

Dr. Tim Davis

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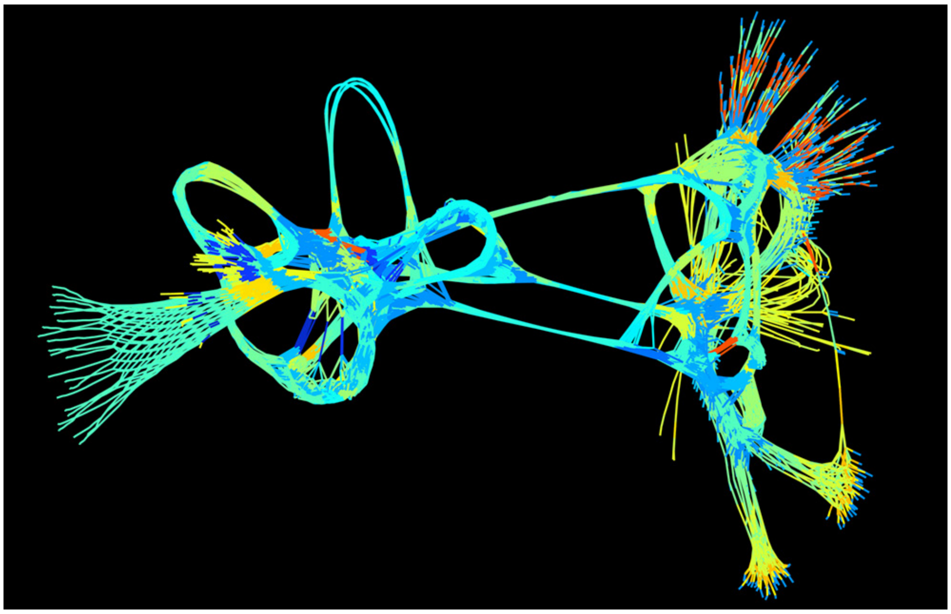
Davis said that the only way he can achieve the level of reliability for which his code has come to be known is to ensure that it is beautiful in his own eyes.

In addition to turning music into art, Davis is also a published poet. To view his artwork and poetry, visit http://faculty.cse.tamu.edu/davis and http://notesartstudio.com.

The genre of the music can be seen in the images. Regular meshes appear in some images because of the regular beat of jazz or modern music. Fuzzy complex graphs appear from very complex orchestral music.

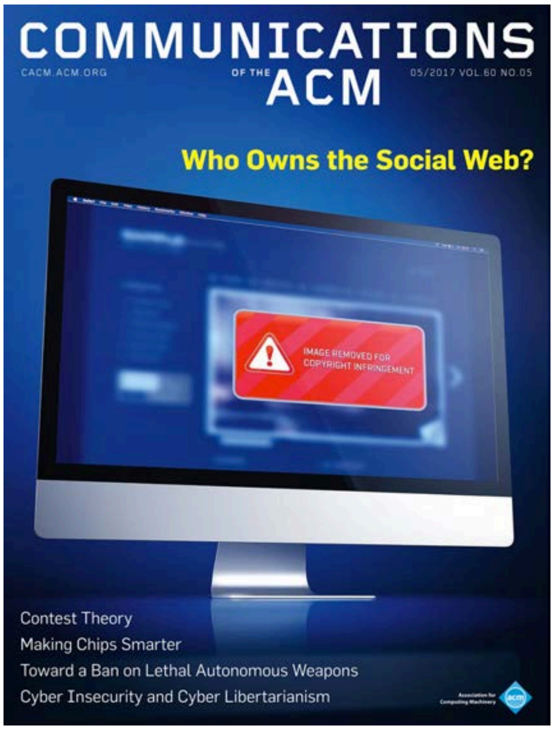
"Math is so incredibly beautiful; it just takes the right eyes to see it," Davis said, "or it needs translation into a medium that everyone can see. That is what I have tried to do with my algorithmic artwork.

"There is no true visualization of any one piece of music. Part of the artistic process resides in creating thousands and sometimes tens of thousands of images, and selecting the one that best represents the song."



COMPUTER SCIENCE AND ENGINEERING RESEARCH IS MAY COVER STORY IN COMMUNICATIONS OF THE ACM

Research led by Dr. Frank Shipman and Dr. Catherine Marshall in the Department of Computer Science and Engineering at Texas A&M University was highlighted on the May cover of Communications of the ACM, which is the flagship publication of the Association for Computing Machinery.



As more and more content is created and shared within social media applications and services, ownership is becoming increasingly difficult to determine. Twitter conversations, Amazon reviews and Facebook commentary are examples of how the creative activities of many join together in ways that challenge traditional concepts of content authorship and ownership.

Shipman, professor, and Marshall, adjunct professor, are both founding members of the Texas A&M Center for the Study of Digital Libraries, and have been exploring what social media users believe is appropriate and what should be prohibited. Surveys based on concrete realistic scenarios were used to examine the social norms surrounding saving, reusing and removing content. With an understanding that real behavior often differs from aspiration, additional questions probed users' recent social media activities.

Results showed that people have differing views about content ownership that take into account the original purpose of the content, their personal connection to that content, the particular context and goals of later uses or manipulations of that content, and the media and technology involved. While reported behaviors did not always match beliefs, explanations of behavior include similar discussions of rights, risks and goals.

To learn more about how social media users view issues of content ownership, see the cover story and associated video.

COMPUTER SCIENCE FORMER STUDENT NAMED INTEL FELLOW

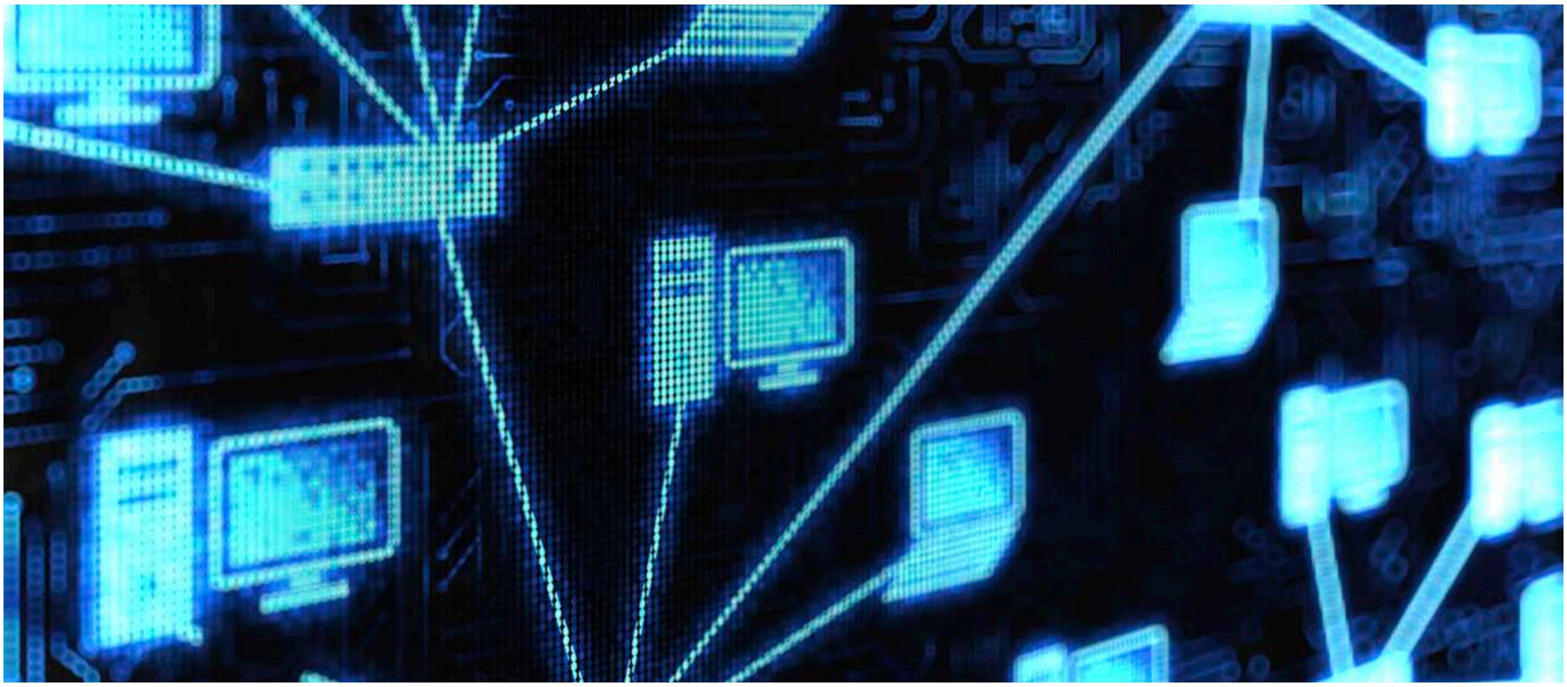
Dr. Ravishankar Iyer, a former student in the Department of Computer Science and Engineering, was recently named an Intel Fellow.

Dr. Ravi Iyer

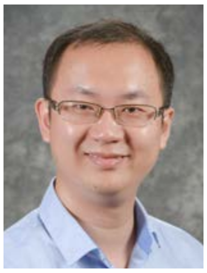
Intel Fellow is one of the highest levels of achievement one can attain within the company. This prestigious distinction is given to less than one percent of employees who exemplify tremendous technical achievement, both within the company and industry. Fellows provide strategic technical leadership and guidance, and represent the company at a variety of industry events.

Currently, Iyer is the director of datacenter technologies in Intel's Datacenter Group. He has led technology innovation and incubation efforts and has made significant contributions in low-power system-on-chip wearable/IOT devices, as well as high performance multi-core server architectures that include novel accelerators and microcontrollers, platform QoS, innovative cache/memory hierarchies, emerging algorithm, and workload characterization and performance analysis.

Iyer has published more than 150 papers, has around 40 patents granted and actively participates in conferences and journals. Most recently, he is serving as general chair for the 2017 International Conference on Parallel Architectures and Compilation Techniques, and also serves on the executive committee of the Institute of Electrical and Electronics Engineers (IEEE) Technical Committee for Computer Architecture. He received his doctorate in computer science from Texas A&M and is an IEEE Fellow. He was also presented the Computer Science and Engineering Distinguished Former Student Award in 2015.



HU RECEIVES NSF GRANT FOR RESEARCH ON NOVEL ALGORITHMS FOR LARGE-SCALE ATTRIBUTED NETWORKS



Dr. Ben Hu

Dr. Xia "Ben" Hu, assistant professor, received a National Science Foundation grant for his novel research, which centers around the development of network embedding algorithms for analyzing large-scale and complex attributed networks.

Attributed networks widely exist in various network information systems, such as social networks, academic networks and health care systems. While traditional network nodes display user-to-user relationships on social networks, paper-to-paper citations for academic networks and doctor-to-doctor relationships for health care networks, attributed network nodes also show an additional set of attributes, such as user demographics, paper contents and doctor expertise.

"While most existing studies focus on plain network embedding, in this project we propose to investigate a novel problem of attributed network embedding by tackling challenges brought by large-scale and complex attributed network data," Hu said.

There are many challenges with large-scale, complex attributed networks. First, many real-world attributed networks contain thousands of features, which translate to millions of nodes and edges. Edges are links between the vertices, or nodes, of a network. For example, Facebook users update over 600,000 pieces of information each minute; Twitter has 319 million active users and as of 2012, 20 billion edges.

Second, instances in attributed networks are connected with each other through common research interests or shared geographical locations. Existing network embedding methods are built upon the assumption that instances are independently distributed and equally weighted. This is not the case with attributed networks. Because of these challenges, traditional network embedding algorithms cannot be directly applied to large-scale and complex attributed networks.

Hu's project will complement the White House Big Data Research and Development Initiative to accelerate the emerging field of data science by generating a new class of theoretical and practical network embedding methods to analyze large and complex network data.

This research aims to successfully develop new formulations of algorithms, which will transform existing network embedding algorithms. The developed algorithms can be used in industrial applications in social computing, health informatics and enterprise systems.

STRENGTHENING THE RESILIENCE OF LARGE-SCALE SOCIAL SYSTEMS

One thing we can all agree on is social media has drastically altered the way we interact with each other and the world around us. This societal shift has brought to light the need for awareness of the risks that surround it. As quickly as the landscape of social interaction changes, new threats emerge.

While there have been extensive studies on traditional methods for targeting a mass audience such as television, print and search engine advertising, there remains a significant gap in the understanding of the vulnerability of social systems to collective attention threats.

Dr. James Caverlee, associate professor, is devoted to creating a world where every online interaction can be trusted, with assurances on who and what you are dealing with.

A few examples of collective attention threats are breaking news, viral videos and popular memes that can quickly spread misinformation, propaganda and malware. Because of these, like never before, users are involuntary accomplices to the spread and success of these new hazards.

"It is imperative to develop new techniques to detect, analyze, model and defend against collective attention threats in large-scale social systems," Caverlee said. "The overarching research goal of this project is to develop the framework, algorithms and systems for analyzing, modeling and defending against emergent collective attention threats in large-scale social systems."

Since users are typically dependent on the system operators to provide protection, Caverlee and his team are

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working to build a threat awareness application that will serve as an early-warning system for users. This countermeasure will prevent or mitigate the effects of these potential threats.

"YouTube, itself, is responsible for monitoring and expelling videos that are conduits to spam and malware; Twitter attempts to block spam accounts and messages once it collects sufficient evidence," Caverlee said. "This one-size-fits-all method ignores individual risk profiles and suffers from either blocking too much content or allowing all content. Instead, we propose to develop a personalized awareness app that will communicate to each user their exposure to collective attention threats."

The way the app will work is that on opening a user's Twitter timeline, for instance, the app will highlight tweets that are associated with a threat. This will give each user more control over their social experience.

The idea is that the app may be able to sample evidence of collective attention threats early in the lifecycle of a collective attention phenomenon, for example sampling and labeling spam tweets from a trending topic. Based on this early evidence, the app will be able to identify and eliminate developing threats.

As a result of these threats growing and changing so rapidly, Caverlee recognizes the need to have a continually upgraded design. His team will provide its initial thoughts on the most relevant features influencing and predicting threats and will continue to explore the most computationally efficient features in order to maintain the responsiveness.

Caverlee began studying this topic in the mid-2000s by looking at web spam. That led to the study of emerging social systems, such as Facebook and Twitter, and the creation of "social honeypots" to lure social spammers and content polluters.

Taking this further, Caverlee has also studied how online spaces can be manipulated by online campaigns and crowdsourced attacks.

"The ultimate goal is to build a scientific foundation for the deep understanding of these new threats, including new algorithms, frameworks and systems; give companies new tools to fight back against threats within their systems; and to give users themselves new power to make sense of their online experience," Caverlee said.

This research is conducted in collaboration with Dr. Anna Squicciarini, an associate professor at Pennsylvania State University, and is supported by the Air Force Office of Scientific Research as part of a three-year effort.

RAGSDALE ELECTED TO FACULTY SENATE 40 YEARS AFTER SERVING AS STUDENT SENATOR

Dr. Daniel Ragsdale, professor of practice, was recently elected to Texas A&M University's Faculty Senate where he will represent the Texas A&M College of Engineering. This comes 40 years after being elected student senator as an undergraduate in the department.

Ragsdale, who also serves as director of the Texas A&M Cybersecurity Center, intends to participate in Faculty Senate committees that address curriculum issues, as well as those that address student life.

"I see my service as a faculty senator as an opportunity to work with other members of our esteemed faculty to make refinements to enhance, extend and build upon the already remarkable set of educational and developmental experiences available to our highly talented students," Ragsdale said.

Ragsdale began his undergraduate degree at Texas A&M in the fall of 1976. He ultimately completed his bachelor's degree in general engineering from the United States Military Academy in 1981, where he was granted an appointment and served as a leader in a variety of teaching and research roles, culminating with his service as vice dean for education, the principal deputy to West Point's chief academic officer.

In the late 1990s, Ragsdale returned to Texas A&M to complete his doctoral degree in computer science, and was elected president of the Computer Science Graduate Student Association. In that role, a number of programs and initiatives were established, many of which are still ongoing now nearly 20 years later.

"A&M, as we all know, is very a special place," Ragsdale said. "The students, the faculty and the staff unabashedly embrace A&M's core values – in particular, excellence, selfless service and leadership. Consequently, I feel very confident that through their collective efforts they will make the world we share a better place to live in. This prevailing attitude motivates me to do whatever I can to ensure that the A&M curriculum and the holistic learning environment we provide to our students continues to be replete with high-impact, life-changing experiences."

Dr. Daniel Ragsdale

Other computer science and engineering faculty members representing the college of engineering in the university Faculty Senate are Dr. Walter Daugherity, senior lecturer; Dr. Tim Davis, professor; Dr. Daniel Jiménez, professor; and Dr. Duncan "Hank" Walker, professor and graduate advisor.

LAB **SPOTLIGHT**

Our renowned faculty members lead the way to advanced computing research in the numerous labs in our department. Through our diverse set of research areas, our faculty members have received several federal grants for the research conducted in our labs. We are devoted to bringing innovation to the field of computing and continue to study cutting-edge topics in our facilities.

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