

GEORGIA INSTITUTE OF TECHNOLOGY

INDUSTRIAL AND SYSTEMS ENGINEERING

FALL 2019

THE H. MILTON STEWART SCHOOL ALUMNI MAGAZINE



ISYE: SHAPING THE FUTURE

**Pascal Van Hentenryck
Brings Public Transit
into the 21st Century**



The Future of
Energy in Rwanda

ISyE Alumna
Shares Innovative
Technologies
with India's Farmers

Meet Your Newest
Job Recruiter:
The Algorithm



On behalf of all of us at the H. Milton Stewart School of Industrial and Systems Engineering (ISyE), I am pleased to share the latest edition of the ISyE alumni magazine with you. In this issue we highlight the many ways in which our students, alumni, and faculty are shaping the future through their groundbreaking work.

Our faculty continue to lead the way in innovative research collaborations. In the following pages, you will read about some of the exciting projects they are working on that will revolutionize entire industries and change the way we live. These projects include A. Russell Chandler III Chair and Professor Pascal Van Hentenryck's current work to bring public transportation into the 21st century, and Assistant Professor He Wang's research to create an on-demand logistics platform that will transform the freight transportation industry.

Likewise, many of our students and alumni are creating companies that use ISyE methodologies for social good. You will read about ISyE alumna Maithili Appalwar's company, Avana, which has worked with Indian farmers to develop affordable farming technologies and save an estimated 200 billion liters of water since December 2016. In addition, two current students are in the early stages of creating an app, Mentra, to help people with disabilities find employment.

I am honored to work with such an inspirational, innovative, and engaged community of faculty, students, alumni, and staff. If you are in the Atlanta area, I encourage you to stop by ISyE to see the many changes that are taking place on campus and to learn about the various opportunities for alumni to get involved with the school. I hope you enjoy this year's alumni magazine, and please stay in touch.

Go Jackets!

Edwin

H. Edwin Romeijn, Ph.D.

H. Milton and Carolyn J. Stewart
School Chair and Professor

H. Milton Stewart School of Industrial
and Systems Engineering



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ISyE by the numbers

Rankings

ISyE is the No. 1 program of its kind, as ranked by U.S. News & World Report.



29 Number of consecutive years the ISyE graduate program has been ranked No. 1

25 Number of consecutive years the ISyE undergraduate program has been ranked No. 1

Degrees Offered

1 B.S. in IE Degree

WITH 7 CONCENTRATIONS IN:

- Advanced Studies in Operations Research and Statistics
- Analytics and Data Science
- Economic and Financial Systems
- General Industrial Engineering
- Operations Research
- Quality and Statistics
- Supply Chain Engineering

8 Master's Degrees

SPECIALTY MASTER'S DEGREES:

- Master of Science in Analytics
- Master of Science in Health Systems
- Master of Science in Quantitative and Computational Finance
- Master of Science in Supply Chain Engineering

GENERAL MASTER'S DEGREES:

- Master of Science in Computational Science and Engineering
- Master of Science in Industrial Engineering
- Master of Science in Operations Research
- Master of Science in Statistics

ONLINE MASTER'S DEGREE:

- Online Master of Science in Analytics*

**same degree as on-campus program*

6 Doctorate Degrees

• Industrial Engineering with specializations in:

- Economic Decision Analysis
- Statistics
- Supply Chain Engineering
- System Informatics and Control
- Algorithms, Combinatorics, and Optimization
- Bioinformatics
- Computational Science and Engineering
- Machine Learning
- Operations Research

Enrollment

Undergraduates: **1,413***

Masters: **326** on-campus; **2,854** online/video

Doctoral: **184**

**includes co-op and study abroad students*

Faculty

60 tenured/tenure-track faculty

5 academic professionals

10 research faculty

1 professor of the practice

5 lecturers

Academic Year 2018-19



ISyE Degrees Awarded:

356 B.S. degrees + **237** M.S. degrees + **21** Ph.D. degrees

Among ISyE undergraduates...

- **43** participated in research.
- **174** participated in a registered internship.
- **105** participated in a co-op.
- **19** participated in the Denning Technology & Management Program.
- **20** were Stamps President Scholars.
- **241** participated in international experiences.

For the 356 B.S. IE degree recipients in 2018-19...

- **73%** graduated with honors.
- **21%** graduated with a co-op designation.
- **44%** were female.
- **\$70,500** was the median starting salary.

Alumni

Top 10 Alumni Job Titles*

1. President
2. Consultant
3. Industrial Engineer
4. Owner
5. Manager
6. Vice President
7. Project Manager
8. Engineer
9. Director
10. Principal



18,940

total number of ISyE alumni worldwide

**Based on self-reported alumni data from the Georgia Tech Foundation as of September 2019*

Introducing Computational and Data Science to the Next Generation of Engineers



Participants in Georgia Tech's first Seth Bonder Summer Camp in Computational and Data Science for Engineering

Increasing awareness of industrial engineering and operations research among high school students is a top priority for both A. Russell Chandler III Chair and Professor Pascal Van Hentenryck and Merrill Bonder, president of the Seth Bonder Foundation. Together they created the Seth Bonder Camp in Computational and Data Science for Engineering to help students better understand the careers and opportunities available in these fields.

“When most people think about engineering, they think of mechanical or civil, but they don’t know — until they are already in college — that they can use industrial engineering and operations research tools to analyze and solve scientific, real-world problems,” explained Bonder. “We want to introduce high school students to the field and its many applications early, so they know it is a future career option.”

Big data and data science are growing fields, and while people may have heard these terms, they typically don’t fully understand their many applications.

“It is an opportunity to rediscover the awe I felt when I realized how to use computing for solving complex engineering problems. I try to give them the confidence to dive into the field and build solutions.”

PASCAL VAN HENTENRYCK

“Data science is the idea of using computation to transform data into information, knowledge, insights, and decisions,” explained Van Hentenryck. “Data scientists are changing the world every day, and we want to help develop the next generation.”

This summer, 30 high school students gathered at the H. Milton Stewart School of Industrial and Systems Engineering on July 22 to participate in the Seth Bonder Camp in Computational and Data Science for Engineering. The five-day camp, led by Van Hentenryck, teaches basic programming and computer science skills to participants with little or no prior experience in these areas.

Each day began with an interactive lecture from Van Hentenryck, followed by an afternoon in the lab getting hands-on experience to implement the concepts learned. The camp uses Snap!, a visual programming language designed to teach basic programming concepts without the mathematical component. The lessons built on these ideas show how data science is changing social science, machine learning, medicine, biology, and engineering. The

campers even learned how to create a program to solve Sudoku in seconds.

“Pascal does a wonderful job taking a difficult concept and breaking it down so the students can understand it,” said Bonder. “He makes it fun and lighthearted, which makes it more appealing to the students who may be considering industrial engineering or operations research as a career choice.”

Van Hentenryck thoroughly enjoyed his time leading the camp. “It is an opportunity to go back in time and rediscover the awe I felt when I realized how to use computing for solving complex engineering problems,” he reflected. “I try to give them the confidence to dive into the field and build solutions.”

At the conclusion of the camp, several students told Van Hentenryck that they wanted to become engineers and asked to keep in touch. A few even asked him to serve as a mentor for high school research projects in the coming year.

To further their mission of increased awareness of data science and operations research among as many high school students as possible, Van

Hentenryck and Bonder hope to eventually create a free online version of the course that will be open to anyone interested in learning more about this growing field. • LAURIE HAIGH

Seth Bonder (1932-2011) was the founder and CEO of Vector Research, an operations research consulting firm. He served on the faculty, and then adjunct faculty, in the industrial engineering department at the University of Michigan and as the 27th president of the Operations Research Society of America. Bonder won numerous awards throughout his career and was an elected member of the National Academy of Engineering. He earned a B.S. in mechanical engineering from the University of Maryland and a Ph.D. in industrial engineering from Ohio State University.

To learn more about the Seth Bonder Camp in Computational and Data Science, visit www.isye.gatech.edu/k-12.

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ISyE-News

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Mission Possible

Before they arrive at Georgia Tech, high school students interested in STEM are often introduced to mechanical or computer engineering through afterschool activities like robotics and coding classes. Industrial engineering (IE), on the other hand, is known as a “discovery major.” This is largely because IE’s problem-solving applications are so varied that, as a field, it can be a challenge to define.

Enter Mission Possible, a week-long summer camp designed to familiarize high school students with IE. Through computer games involving disaster preparedness and supply chains, as well as presentations on “magic” math tricks, sports analytics, and how artificial intelligence recognizes human faces, 30+ students received a crash course in the many ways IE is applicable to today’s challenges. In addition, through an activity that involves assembling Lego structures, the students learned soft skills such as teamwork and

communication. Toward the end of the week the students toured Bobby Dodd Stadium, where they saw Grant Field and learned about some of the logistics of operating an NCAA Division I athletic department.

“Industrial engineers can successfully fill so many roles in the workplace that we can have a hard time defining ourselves,” explained Jon Lowe, an academic professional in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE) who oversaw the Mission Possible activities. “In contrast, when someone says ‘civil engineering,’ for example, everyone knows they build bridges and roads. The goal of Mission Possible is to show the students that there’s so much industrial engineers can do.”

Based on student feedback, this seventh iteration of Mission Possible — it was offered for the first time in 2012 — was a success.

“Learning the many applications of industrial engineering has piqued my interest, and I can definitely see myself doing something related to this as a future career,” said one participant.

The ISyE academic team plans to expand its educational outreach beyond the single summer offering of Mission Possible.

“The success of ISyE’s Mission Possible has inspired the outreach team to develop mini Mission Possible events that will take place during the school year, with the goal of introducing ISyE to students who may not have the chance to attend the summer program,” said Tuba Ketenci, an academic professional who directs ISyE’s K-12 outreach. •

SHELLEY WUNDER-SMITH

To learn more about Mission Possible and ISyE’s K-12 outreach, visit isye.gatech.edu/k-12.

High school students participating in Mission Possible toured Georgia Tech’s athletic facilities as part of the camp.



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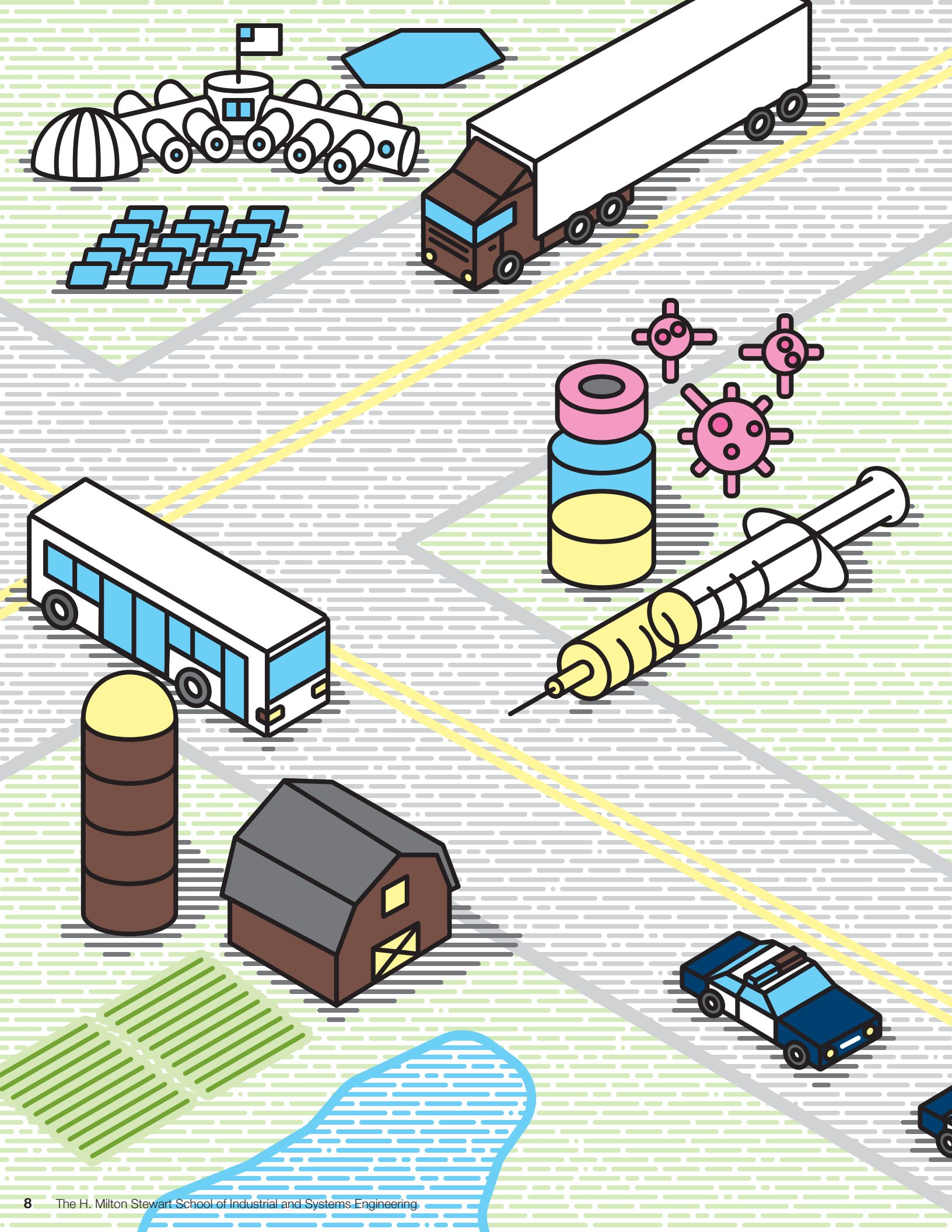
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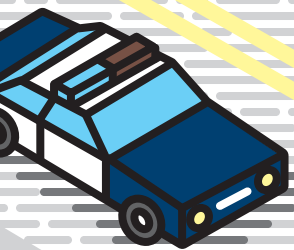
ISyE: Shaping the Future



At the H. Milton Stewart School of Industrial and Systems Engineering (ISyE), our faculty, students, and alumni are developing theories and applications that will significantly impact the future.

The stories that follow highlight a few of the impressive ways we are using industrial engineering and operations research to influence a variety of areas, including logistics, transportation, health care, education, agriculture, and even outer space.

ISyE is proud of its community and its advancements to improve the world around us by creating more efficient and environmentally friendly solutions to the problems we face.



Professor Pascal Van Hentenryck Brings Public Transportation into the 21st Century

According to the American Public Transportation Association, public transportation spurs economic development, promotes sustainable lifestyles, and provides a higher quality of life. It is also safer and less expensive than cars. However, most Americans still opt to drive personal vehicles rather than use public transit.

“In order to increase acceptance of public transportation, we need a system that gets people where they want to go in a more convenient and affordable way,” said Pascal Van Hentenryck, A. Russell Chandler III Chair and professor in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE). “If we make public transportation more attractive to riders, it will decrease traffic congestion and greenhouse gas emissions and increase accessibility to jobs, health care, education, and food.”

Van Hentenryck has done significant research in the areas of artificial intelligence, data science, and operations research — all of which are essential to address the current problems in mobility. His goal is to create an equitable system that is both efficient for everyone and decreases reliability on personal vehicles.



Most public transportation systems in the U.S. have a significant first- and last-mile problem. “If you don’t pick people up within a quarter of a mile of where they live and drop them off very close to their final destination, you lose 90% of your ridership,” he explained.

In order to address this problem, Van Hentenryck suggests a multi-modal transportation solution in which small on-demand shuttles take passengers to and from high-frequency light rail and bus hubs, which will only operate in high-density corridors. Shuttles will expand the reach of the system, so

people are picked up much closer to their homes and dropped off at or near their destinations, making it significantly more convenient for riders.

In addition to solving the first- and last-mile problem, the use of on-demand shuttles is also more cost effective and environmentally friendly. According to Van Hentenryck, most city buses are expensive to operate and drive with very few passengers on board. Replacing buses in low-demand routes with a greater number of smaller, inexpensive shuttles will increase efficiencies and lower overall costs. To further reduce greenhouse gas emissions, electric vehicles will be used whenever possible.

While the multi-modal approach may involve more transfers than the traditional model, the process will be simple and organized, allowing riders to reach their destinations in a similar amount of time to individuals driving personal vehicles. Each trip will require only one ticket, cost the same as traditional public transporta-

“Atlanta is one of the most congested cities in the world, but only about 3% of the population currently uses public transportation. There is a tremendous opportunity here if we can make public transportation easier and faster to use.”

PASCAL VAN HENTENRYCK

tion, and be completely synchronized to avoid long waits at the various transfer points. To facilitate this, Van Hentenryck and his team created algorithms that use machine learning and distributed optimization to predict ridership in real time, manage shuttle and passenger volume, and reduce wait times.

To date, Van Hentenryck has conducted successful case studies on the transit systems in the mid-sized cities of Canberra, Australia, and Ann Arbor, Michigan. In both cities, his multi-modal approach has shown a significant reduction in both cost and passenger wait times, and he hopes to apply the same strategies in Atlanta.

“Atlanta is one of the most congested cities in the world, but only about 3% of the population currently uses public transportation,” Van Hentenryck said. “There is a tremendous opportunity here if we can make public transportation easier and faster to use.”

In July 2019, Van Hentenryck and his team were awarded a \$1.7 million

National Science Foundation (NSF) grant to scale the optimization and machine-learning algorithms that were created in Ann Arbor and Canberra for a large city like Atlanta. The NSF Leap HI (Leading Engineering for America’s Prosperity, Health, and Infrastructure) grant is in collaboration with civil engineering and urban planning, the Metropolitan Atlanta Rapid Transit Authority (MARTA), the Atlanta Regional Commission, and the City of Atlanta.

ISyE students — from undergraduates to post-docs — are also getting the chance to be a part of this exciting initiative. Van Hentenryck connected with MARTA shortly after joining the ISyE faculty in 2018, and he is leading an interdisciplinary Vertically Integrated Project team that is assisting with this initiative. In addition, in spring 2019 he advised two Senior Design teams that worked with MARTA to provide greater visibility into how patrons use the transit system, and one of the teams was a finalist for ISyE’s Best of Senior Design. [See the

article on Van Hentenryck’s Senior Design team project on page 33.]

“The work that the students have done to date has been very useful,” said Rob Goodwin, MARTA’s director of research and analysis. “They are working with our data to give us a much more robust picture of how our patrons are using the system, which will allow us to see where there are opportunities as well as challenges. We look forward to a continued relationship with Pascal and ISyE.”

Van Hentenryck and his team are eager to begin work on the grant and hope to have an impact on Atlanta traffic and accessibility. “Atlanta is a daunting challenge, which is why this project is so interesting,” Van Hentenryck noted. “We are looking at this bottom up, understanding mobility in the city and then step by step developing and integrating machine-learning and optimization algorithms for various novel mobility services that we will simulate at scale and hopefully pilot at some point.” ■ LAURIE HAIGH



ALLISON CARTER

The Future of Energy in Rwanda

Energy access in sub-Saharan Africa is extremely limited, and much of the energy currently consumed is used to cook food. Most people use biomass — organic materials such as wood, plants, or waste — for this purpose. This is a widely accepted and affordable way for individuals to cook their meals, but it poses some significant problems.

“It takes people a long time to gather their firewood,” explained Valerie Thomas, Anderson-Interface Professor of Natural Systems in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE). “A lot of these areas face deforestation, which not only cuts down on wildlife but also makes it harder for people to gather firewood; as the trees get cut down, the forest gets further away from the village.”

In addition to these deforestation challenges, cooking indoors with biomass fuels (which many people do) creates air pollution, leading to negative health effects. Thomas is conducting research on solar cooking and parabolic stoves, studying how this simple technology can help people in Rwanda address both issues.

“I’m really enthusiastic about finding better ways for people to cook, especially using solar,” Thomas said. “There are limitations — for example, you can’t do your cooking when the sun isn’t out. But there are also a lot of advantages. You don’t need to gather anything, it works well, it’s very inexpensive, and there are a lot of different options.”

The cooking initiative is one part of the work Thomas has been doing in Rwanda. Since 2016, she has collaborated with industry practitioners, as well as researchers and students from ISyE, to determine the best

way to bring sustainable energy to the people of rural Africa.

“There is minimal access to grid electricity in rural Africa,” said Thomas. “We’re using operations research techniques to examine future development scenarios that will help governments make better infrastructure decisions and balance supply and demand.”

In addition to the lack of energy infrastructure, Africa also faces a shortage of Ph.D.s to help solve these complex issues. To address this problem, Thomas serves as an international advisor to graduate students at the African Center of Excellence in Energy for Sustainable Development, a pan-African program at the University of Rwanda established with support from the World Bank Group. Supporting trained Ph.D.s and students in Africa who will continue to research these issues is key to the region’s future success. ■ LAURIE HAIGH





Rwanda Study Abroad: Sustainable Development

Thomas is working with two Georgia Tech colleagues — mechanical engineering Professor Jonathan Colton and Associate Director of the Center for Geographic Information Systems Anthony Giarrusso — to create the Rwanda Study Abroad: Sustainable Development Program. This program will give Tech undergraduate students the opportunity to spend a semester working on a sustainable development project in Rwanda, including travel to the region during spring break to meet with Rwandan students, entrepreneurs, and government officials.

ISyE Alumna Maithili Appalwar Shares Innovative Technologies with India's Farmers

Acquiring an internship at a Big Four consulting company is considered quite an achievement by most undergraduate students in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE). However, this was not Maithili Appalwar's experience. "The company was actually a great place to work, but it wasn't for me," she said. "It was really confusing, because getting this internship seemed like a box I had to check to be successful, but I'd come home every day feeling empty."

Appalwar grew up in India seeing her parents successfully meet the challenges of running their own business. Additionally, she had taken a class on social entrepreneurship at Georgia Tech, in which students discussed how businesses can help solve social problems. So when Appalwar began thinking about what she really wanted to accomplish and how, pivoting to start her own company for social good seemed a natural next step.

Appalwar and her father co-founded Avana, a startup that creates affordable farming technologies. Farming in India can be an extremely challenging occupation because rainfall is so erratic, and water storage is a problem. In coordination with the farmers, the father-and-daughter duo came up with a solution.

"What's the simplest way to store water?" Appalwar said. "It's literally digging a pit in the ground." The farmers suggested the ponds, and the Appalwars — who own a family-run polymer processing plant — devised a wide polymer material to line the ponds, thus enabling farmers to store water cheaply (\$1 for 2,700 liters per year).

After she graduated in December 2018, Appalwar returned to India to



concentrate on growing Avana and expanding its impact on the country's farming communities. Avana now employs 30 people, has 150 field partners, and since 2016 has saved an estimated 200 billion liters of water.

Avana has received considerable attention for the water storage techniques you and your dad have developed. Does the organization have a larger focus? Water storage is something we are very passionate about, and it enabled us to get connected with farmers. But we came to realize that the problem of farmer poverty is very complex, and one technology — one product — is far from solving it. We are having an impact, but we need to do much more in order to disrupt Indian agriculture and make farmers prosperous, which is Avana's ultimate goal.

For example, while many people want organic food, it's generally only available in stores frequented by high socioeconomic classes. And the marketplaces involve lots of middlemen, who mark up the price. Most Indians can't afford it. We want to connect farmers directly with consumers through 100% supply chain transparency. That way

we can pay farmers more and city residents can buy organic produce more cheaply, making it available to the urban middle class. We also want to focus on precision agriculture.

What exactly is precision agriculture, and how will Avana help farmers implement it? Precision agriculture is a farm management system that relies on real-time data, rather than farmer intuition or anecdotal evidence. Currently, precision agriculture solutions in India are extremely expensive. They cost \$18,000 for 20 acres of land or smaller. This price is not viable for most Indian farmers, whose lands cover less than five acres.

We are looking at using machine learning and thermal image processing technology to help farmers use the least amount of water and get "more crop per drop." Many farmers are still using drip irrigation or sprinkler watering systems, so we divide farms up into grids, then figure out when and for how long the drip should operate based on real-time farm moisture data.

How are the devastating heat waves India has been experiencing — with temperatures above 100° F lasting for weeks — impacting your plans for Avana's development? The heat waves are a symptom of the extreme climate change that the entire world is facing. Another symptom of that climate change is intense, sudden downpours, which make water storage necessary so the water can be used later. The heat waves, however, mean that stored water will evaporate faster. To prevent this, we have designed an affordable evaporation cover that uses a floating lining filled with recycled empty water and aerated drink bottles, which reduces evaporation losses by 85%.

Right: A pond lined with Avana's wide polymer material allows farmers to store water for crop irrigation.

Appalwar and her father co-founded Avana, a startup that creates affordable farming technologies. Farming in India can be an extremely challenging occupation because rainfall is so erratic, and water storage is a problem.

We've also realized an increased urgency for better water management, so we're launching our Precision Water Management System in March 2020. This system aims to reduce water usage on farms by 20% — agriculture is a real water guzzler and uses 80% of India's water. Our goal is to bring the cost of the system down to approximately \$60/acre.

In addition to the crop optimization tool you mentioned earlier, how are you using your ISyE skills with Avana?

The optimization tool is a good example of how I use my ISyE skills, because so many ISyE classes incorporate coding, which we have to implement when looking at that tool. In addition, I'm going to get to use my industrial engineering skills when working on transforming the food supply chain.

I took a supply chain projects class as an undergraduate, where the students

were put into teams and each team had a product. Ours was snowboards, and we looked at the entire supply ecosystem for these snowboards: How was the company acquiring its snowboards? How was it providing snowboards to its customers? How do we decide where to put the distribution centers? How do we cut out the middleman?

It was a great overview of how to set up an entire supply chain to minimize costs, increase employee satisfaction, and grow the business in a sustainable and scalable manner.

What has been your biggest takeaway from growing a startup? I think the challenge for me was to

realize that the farmers we are working with live incredibly different lives from me. So going into these environments, you don't want to be patronizing and act like you're there to solve all their problems.

Avana is a brilliant solution, and the reason that it's brilliant is because it came from the community. We went in and asked the farmers, "What do you think would be a good way to save water?" And they said, "If we had a big pond on the farms, that would be helpful."

In order to get to solutions like that, you have to be able to listen. ■
SHELLEY WUNDER-SMITH



Meet Your Newest Job Recruiter: The Algorithm

When you apply for a job, chances are your resume has been through numerous automated screening processes powered by hiring algorithms before it lands in a recruiter's hands. These algorithms look at things like work history, job title progression, and education to weed out resumes. There are pros and cons to this: Employers are eager to harness the artificial intelligence and big data captured by the algorithms to speed up the hiring process. But depending on the data used, automated hiring decisions can be very biased.

"Algorithms learn based on data sets, but the data is generated by humans who often exhibit implicit bias," explains Swati Gupta, an assistant professor in the H. Milton Stewart School of Industrial and Systems Engineering whose work focuses on algorithmic fairness. "Our hope is that we can use machine learning with rigorous mathematical analysis to fix bias in areas like hiring, lending, and school admissions."

Job-related algorithms not only affect hiring; they also influence the types of jobs a candidate might see online. A LinkedIn survey found that men typically apply to jobs even if they aren't qualified, whereas women are more conservative when sending their resumes. So when someone is on LinkedIn and a message pops up saying "jobs recommended for you," a woman might see fewer job posts than a man. Those jobs also might pay less. Because men traditionally apply to jobs that pay more, the search engine algorithms are going to target them with higher-paying job ads.

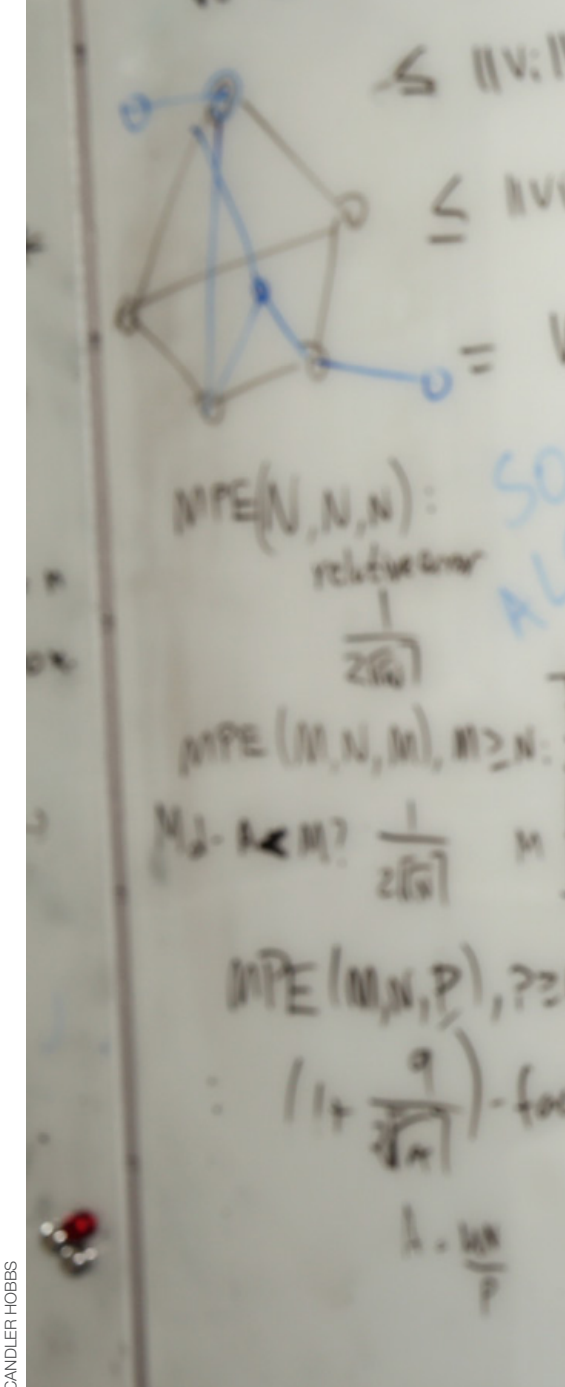
Another problem area is fairness in lending, where algorithms have learned to charge higher interest rates to people who do not comparison-shop. While lending discrimination has historically been caused by face-to-face human bias, pricing disparities are increasingly the result of algorithms that use machine learning to target applicants who might shop around less with higher-priced loans, according to a Berkeley study. Black and Latino borrowers pay roughly seven basis points higher interest on loans than white and Asian borrowers due to algorithmic bias.

So, how can computer scientists and engineers teach an algorithm to be fairer?

First, Gupta is working on defining what makes an algorithm biased — what data is going in that is creating the bias? After she determines the problematic data, adjustments can be made in the algorithm to make it fair. Then she programs the algorithm to understand that some sets of data might be biased. Knowing this, the algorithm can make fairer decisions.

"Algorithms must be adjusted to be more socially conscious," said Gupta. "We have to consider the impact these algorithms can have on our lives and ensure that discriminatory practices don't get created."

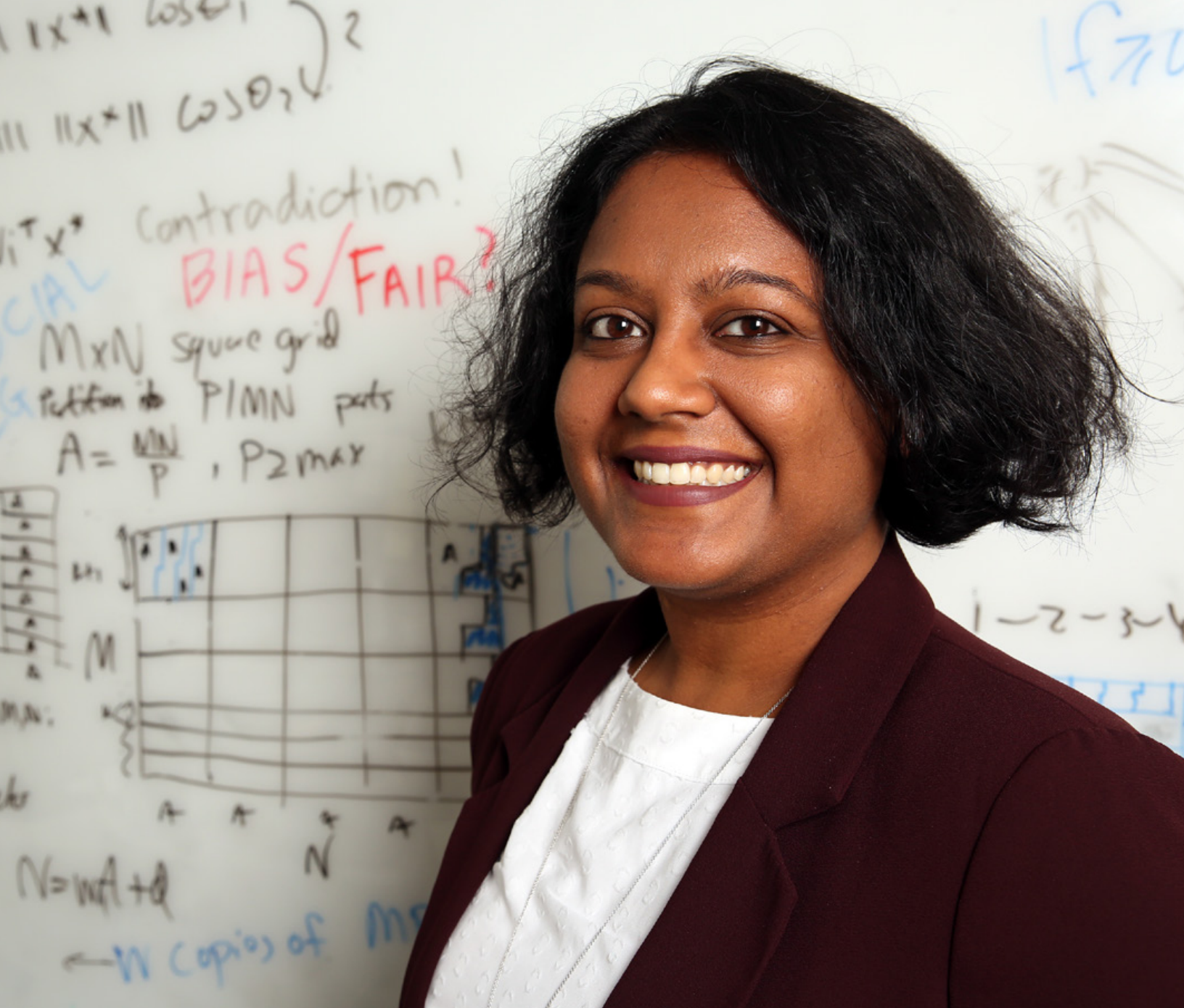
These biases are problematic in search engine functionality as well. When Google realized an image search for "CEO" brought up only male executives, the company decided something needed to change. Since algorithms learn from historical



CANDLER HOBBS

data, and most CEOs in the world are in fact male, the search engine returned images of male CEOs in the results. But Google made the socially conscious decision to adjust the algorithm to show women too. Currently, an image search for "CEO" on Bing only shows males.

For Gupta, fairness has been a battle all her life. She recalls being a young woman in India wanting to be an engineer, but would get questions



like “How will you care for a family if you’re an engineer?” “Why don’t you become an artist instead?” “Do you really want such a technical job?”

“I was constantly being told what roles I could and couldn’t have because of my gender, and I don’t want other young girls growing up with those same expectations,” said Gupta. “I love math, and I’m passionate about fairness, and the fact that I can help correct some of these algorithmic biases is really exciting.”

Gupta has noticed that the discussion of fairness in algorithms is largely missing from the computer science and engineering curriculum. In logistics classes, students are asked to focus on minimizing costs for companies, but not to consider what is ethical.

“Socially conscious problem-solving is not being taught early on, and it’s really important to breed this line of thinking into our students,” said Gupta. “One of my academic

goals is to create thoughtfulness in math. I would like my students to consider the ethical implications of their algorithms before deploying them in practice.”

Gupta’s research plan is to continue creating and correcting algorithms to drive social good, promote diversity, and shift our societal thinking in a more responsible direction. ■

GEORGIA PARMELEE

Optimizing the Flu Vaccine Supply Chain for Maximum Impact

A yearly flu vaccine is crucial for protecting yourself from the flu, according to the Centers for Disease Control and Prevention (CDC). However, because of limited vaccine supply, the demand in some regions cannot always be met, especially during a pandemic.

Health experts determine the ideal vaccine formula each season, which is then produced in small batches, leading to uneven supply and demand while vaccine production ramps up. Historically, due to fairness considerations, vaccines have been allocated pro rata, which means proportionally based on the population of a region. While this may seem like the best way to fairly distribute a limited supply, it does not take demand and “uptake” — the number of people who are willing to be vaccinated — into account.

“The uptake rate can vary by region, for various reasons,” explained Pinar Keskinocak, William W. George Chair and professor in the H. Milton Stewart School of Industrial and Systems Engineering, College of Engineering ADVANCE Professor, and co-founder and director of the Center for Health and Humanitarian Systems (CHHS). “If the limited vaccine inventory is allocated proportionally to the population in different regions without considering the uptake rate, unused vaccine inventory may pile up in some areas while other areas experience shortages.”

With the goal of better matching supply and demand, Zihao Li (Ph.D.



16), Keskinocak, and CHHS co-founder and Professor Julie Swann (BIE 1996) from NC State University proposed a new allocation strategy, where the limited vaccine inventory is allocated pro rata only to those regions that continue to experience a positive uptake rate. They developed a simulation model to compare the current and proposed vaccine allocation strategies.

“We found that the proposed strategy would benefit the entire population because it leads to a higher number of people vaccinated and less inventory leftover,” explained Keskinocak.

However, vaccine inventory visibility in public health supply chains

is limited, and accurate uptake rates may not always be available in each geographic area. Keskinocak hopes the results of the study will encourage local reporting of both the number of vaccines administered during a season and the amount that is unused, to inform future allocation decisions.

Optimizing the flu vaccine supply chain will also help when the next pandemic strikes. Historically, pandemics occur every 30-40 years, but the results can be devastating. According to the CDC, the 2009 H1N1 influenza pandemic resulted in 60.8 million illnesses and 12,469 deaths in the U.S. alone.

“Information about uptake rates is even more important during a pandemic,” added Keskinocak, “not only for the effective allocation of vaccines to slow the spread of the disease, but also to increase public awareness efforts about vaccinations in areas where uptake is low.” ■

LAURIE HAIGH

This study was supported by a seed grant from Georgia Tech and Children’s Healthcare of Atlanta. This research was also supported in part by the Harold R. and Mary Anne Nash Junior Faculty Endowment Fund and the following Georgia Tech benefactors: William W. George, Andrea Laliberte, Joseph C. Mello, and Richard “Rick” E. and Charlene Zalesky.



Mission Mars: Professor Nagi Gebraeel Helps NASA Develop Autonomous Habitats

Someday soon — perhaps sooner than we can imagine — NASA will put astronauts on the surface of Mars. And when this happens, these astronauts will need a place to live and work.

To facilitate this, NASA has awarded a \$15 million, five-year grant to the HOME Institute (Habitats Optimized for Missions of Exploration), which unites seven higher education institutions — including Georgia Tech — with several industry collaborators in one of NASA’s four Space Technology Research Institutes. The goal of HOME is to develop autonomously functioning habitats known as SmartHab that are essentially self-maintained.

What this means, according to Nagi Gebraeel, Georgia Power Early Career Professor in the H. Milton Stewart School of Industrial and Systems Engineering, is that NASA wants to initially build a lunar-based habitat that is “self-aware and self-sufficient” in its surroundings, much like a highly amplified Amazon Echo or Google Home.

Once lunar habitats have been perfected, NASA will turn its attention to Mars. For this phase of development, Gebraeel says that “the habitat will be able to determine its own state of health, particularly its physical systems — ranging from structure to ventilation to air quality to hydraulics and pneumatics — to ensure that the habitat can remain operational.”

Such autonomy is necessary because Mars-to-Earth communication (and vice versa) will have a high degree of latency. The SmartHab needs to be able to make decisions on its own without waiting for instructions from human beings on Earth (which is how, for example, the International Space Station operates).

NASA has said that its experts will use “early-stage technologies related to autonomous systems, human and automation teaming, data science, machine learning, robotic maintenance, onboard manufacturing, and more” in order to accomplish this — all fields tailor-made for an

industrial engineer, even though space issues may seem atypical.

As part of meeting this challenge, HOME needed an expert in data analytics, model predictability, and anomaly detection. Gebraeel has done such work extensively with power and manufacturing systems and is ready to turn his skills to space.

“We’re so used to developing analytical models for systems that operate on planet Earth, such as models for manufacturing facilities and power plants,” Gebraeel noted. “But this problem requires a wholly new perspective, because we are totally removing the human element and are making the analytical models completely independent and autonomous.

“This makes for very challenging and interesting problems at the same time because the space setting is unique,” Gebraeel added. “This brings a new perspective to the way we’re used to conducting data analytics and optimization.” ■ SHELLEY WUNDER-SMITH

Data-driven Policing

In an effort to reduce response times to calls for police assistance, Georgia Tech and the Atlanta Police Department (APD) partnered on a year-long project to reconfigure patrol areas across the city.

Yao Xie, Harold R. and Mary Anne Nash Early Career Professor and associate professor in the H. Milton Stewart School of Industrial and Systems Engineering, analyzed multiple data sources — 911 calls, traffic data from the Georgia Department of Transportation, and Atlanta census numbers — to identify patrol patterns and help predict future officer workloads. She then used the data to update the city's zones and beats, which determine where to allocate officers across the city.

“It’s important to design these beats and zone boundaries efficiently; this critically impacts response time,” said Xie. “Someone calls 911, how fast do police officers respond?”

Currently, average police response time to the city’s highest-priority calls is 13 minutes. Although APD hasn’t publicly discussed a target response time, it says the beat redesign will help balance workloads across zones with the goal of answering calls for assistance more quickly.

“Response time is something that you always want to manage and improve so that you’re delivering quality services to people,” said Major John Quigley, executive officer, Atlanta Police Department Strategy and Special Projects Division. “Everybody benefits from better service, whether it’s answering a 911 call or the follow-up investigation.”

The City of Atlanta is divided into six geographic areas or zones, with each



Yao Xie (second from left) with APD officers

ALLISON CARTER

zone split into 13 or 14 beats assigned to one patrol officer. Officers are responsible for responding to all 911 calls in their assigned beat, from traffic incidents to serious crime.

The redesign affects three zones: Zone 6 in East Atlanta will increase by 4 square miles, while Zone 1 in Northwest Atlanta will grow by 2 square miles. Zone 2, which covers Northeast Atlanta and Buckhead, will decrease by 7 square miles.

In a statement about the beat redesign, Atlanta Police Deputy Chief Jeff Glazier said, “It’s important that we examine our officer workload periodically, and with the help of Georgia Tech we were able to do so in a data-driven manner. We are confident these changes will balance the workload in all zones.”

Zone optimization also addresses Atlanta’s growing population, which has resulted in an increase in 911 calls and more work for the understaffed

police force — currently facing a shortage of 400 officers.

Atlanta’s City Council voted in February to approve the rezoning plan, and the police department officially implemented it in late March.

The redesign initiative is Xie’s second research project in partnership with the APD and funded by the Atlanta Police Foundation. In 2017 she developed an algorithm that quickly analyzes incident reports to find connections between crimes.

Currently, Xie is working with the city of South Fulton — which hasn’t updated its police zones since the 1970s — on a similar project. She is helping redesign the city’s police beats to improve response time and operational efficiency. She is also helping South Fulton identify the optimal locations of fire stations using data-driven methods and machine learning. This project will be completed by the end of 2019. ■ ALYSON POWELL KEY

ISyE Professors Improve Efficiency for the U.S. Marine Corps

On a 3,600-acre site about three hours' drive from Atlanta sits the Marine Corps Logistics Base Albany, home to Marine Corps Logistics Command (MARCORLOGCOM). MARCORLOGCOM has a presence on both U.S. coasts and is responsible for Marine Corps equipment and its supply chain. The base is located in Albany, Georgia, and serves as the primary sourcing location for the East Coast. (The other location is in Barstow, California.)

The large amount of equipment that passes through the command inevitably results in significant problems involving its supply chain and logistics. Three faculty members from the H. Milton Stewart School of Industrial and Systems Engineering (ISyE) — Professors Christos Alexopoulos, John-Paul Clarke, and Dave Goldsman — have been working to provide MARCORLOGCOM with models and methods that improve process efficiency throughout the depot and optimize the overall supply chain.

This project is part of a funded grant involving the Georgia Tech Research Institute and the Supply Chain & Logistics Institute. The initial focus area involves a detailed study of work flows in the facility, specifically the areas of disassembly and assembly.

“There’s a disassembly process that ground equipment coming in for major maintenance undergoes,” explained Goldsman. “So we’re developing a model that improves efficiency in the process.”

Another aspect of the project that Alexopoulos, Clarke, and Goldsman plan to tackle in 2020

is the development of a large-scale simulation that will include not only the flow of parts through the depot but also the flow of information.

“When equipment needs repair, you don’t just need the parts,” noted Alexopoulos. “You also need to schedule the people to do the work. And what happens if a part isn’t in stock and has to be ordered? We need all of the people involved in the process to communicate with each other until the problem is solved.”

“You can call this a classic industrial engineering problem,” added Goldsman. “It’s a process project, certainly, but it also involves statistics, operations research, optimization, and of course human factors.”

Alexopoulos and Goldsman are currently working with two ISyE alumni, Christopher Tipper (BIE

1996) and Jessica Walden (BSIE 04, MSIE 05), on the project. Tipper and Walden are civilian employees at the Marine Depot Maintenance Command (MDMC) in Albany, and their ISyE training has been invaluable in the modeling process.

“As a former student of both Professors Goldsman and Alexopoulos, it has been great to work with them as peers,” said Walden. “They have brought the academic thought process, as well as a fresh perspective, into what Chris and I deal with on a daily basis. Our motto at MDMC is, ‘What you do is important. Every day a Marine’s life will depend on it!’ While progressing through this project, we are able to combine our tribal knowledge of Marine Corps procedures and equipment with the modeling processes, simulation practices, and expertise this partnership affords.” ■ SHELLEY WUNDER-SMITH



NATHAN HANKS

The blank hull of a Light Armored Vehicle ready for rebuild at the Marine Depot Maintenance Command in Albany, Georgia.

Effectively Treating Hepatitis C

“My ‘aha’ moment came when I learned that as of 2006, more people are dying of the Hepatitis C virus (HCV) than of HIV,” explained George Family Foundation Early Career Professor Turgay Ayer. “Although HIV gets more attention, HCV presents a huge societal burden.”

Ayer, an associate professor in the H. Milton Stewart School of Industrial and Systems Engineering, has spent his career applying his analytics skills to health care–related problems. So this new information immediately piqued his interest. In 2014, he began examining Hepatitis C in the general U.S. population with the first of several grants dedicated to this problem.

As Ayer conducted research, he discovered that the disease has an outside presence in prisons, up to 10 times higher than in the general population, largely because HCV results from intravenous drug use. Inmates on average are incarcerated fewer than five years, during which time the majority are likely not treated for HCV. Then, upon their release, they sicken members of the general population through injection drug use (IDU).

Thus, Ayer realized that if the infected IDU prisoners — called “super spreaders” by the medical community — are successfully treated for HCV in prison, infections in the general population are much less likely to occur. At the same time, some significantly more effective HCV treatments were being approved for use by the Food and Drug Administration. Thanks to these more effective treatments, the World Health Organization (WHO) set a goal for the worldwide elimination of HCV by 2030.

Treating prisoners represents a significant step toward this larger goal. “While you’re treating inmates, you’re achieving two objectives,” Ayer said. “The first is that they’re essentially being cured, so their lives are potentially being saved. The second is that it’s cheaper and easier to diagnose HCV in prison than it is in the larger population, because the infected group is contained.”

Combating HCV in U.S. prisons, however, presents a significant challenge because treatment is so expensive. Prison systems operate on extremely tight budgets, and treatment

for a single inmate costs \$25,000 to \$70,000. As a result, treatment during incarceration is still relatively rare.

However, Ayer and his research team analyzed these constraints and found that it is still more cost effective to focus treatment on inmates rather than the general population. “From an investment perspective, an effective resource allocation perspective, it makes sense to increase prison treatments, because you will prevent so many downstream infections,” Ayer explained. “A single inmate might infect many other people in the community after release, and then some of those people might need a liver transplant or treatment for liver cancer down the road, and that represents a cost to the entire health care system.”

Now that Ayer has successfully modeled a treatment plan for U.S. prisons, he is expanding his work to a global focus — one that aims to meet the WHO goal of viral hepatitis eradication. He is working with health care partners at Harvard Medical School, Emory University’s Rollins School of Public Health, WHO, and the Centers for Disease Control and Prevention. He’s also developing a generalized decision support tool that will take into account limited treatment resources for any population.

“With the tool, you can allocate greater or lesser resources to the general population or to the prison population or to another subgroup. The tool will also consider the prevalence and spread of HCV based on each country’s data,” Ayer noted. “This is a more universal approach.” ■

SHELLEY WUNDER-SMITH

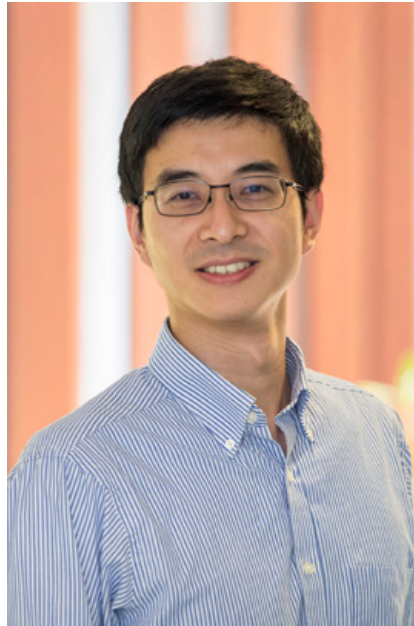


Designing the Next-generation Platform for Logistics Services

From meal delivery to lodging and transportation, on-demand marketplaces are changing the way we do business, and this technology has opened the door for other industries to follow suit.

“There is a big platform revolution going on,” said He Wang, assistant professor at the H. Milton Stewart School of Industrial and Systems Engineering. “Uber is revolutionizing the taxi industry, Airbnb is changing the hotel industry, and we want to do the same thing to logistics platforms.”

Wang is working with a startup company in San Francisco to design an on-demand marketplace for long-haul freight transportation in the U.S., an industry that generates more than \$700 billion in annual revenue. The main challenge with this market is that it is extremely fragmented — there are more than 500,000 freight carriers in the U.S. and most of these are independent truck owners or small fleets with fewer than six trucks. Because so many different companies are involved, freight brokers handle negotiations using legacy technologies like phone and email to connect drivers and shippers, while charging fees of 20% or more per load. Wang’s goal is to develop an app that will eliminate the need for brokers altogether and facilitate communications to increase efficiencies, lower costs, and better serve both parties.



In addition to these benefits, the on-demand platform will also optimize truck usage. Wang estimates that 28% of the trucks on the road drive empty, because they have dropped off their cargo at one location and are traveling to pick up the next load. This is a missed opportunity, and one he thinks he can help remedy.

“Companies have tried to build sites that connect drivers and shippers for years, but they are simply listing loads for drivers to pick. This is not very effective, because they don’t take advantage of all the information,” explained Wang. “I want to

use operations research tools to incorporate all of the information available to help define the pricing and matching mechanisms and facilitate better connections. It will go beyond information-sharing — it will be about decision-making.”

The resulting mobile app will make the best use of empty trucks by allowing truck drivers to view the various loads waiting to be delivered along the route they are traveling, including compensation for transporting the load. While on the surface this appears to be a simple problem to solve, it is actually very complex due to supply heterogeneity — load size, weight, and delivery date all need to be factored into the decision, in addition to origin and drop-off locations.

“Ride-sharing apps are simpler because they have a homogeneous supply of passengers that need to move from one location to the next, so there is not a lot of variability,” said Wang. “With cargo, not all shipment orders close to a driver’s current location will be feasible for them to transport. We need to create a model that takes all of this into account.

“By using all the data available, and creating a central decision-maker, we can make more efficient matches,” concluded Wang. “I hope my research can make an impact on this industry.” ■

LAURIE HAIGH

From the Football Field to the Boardroom:

ISyE Alumnus Kofi Smith Leads Teams to New Heights



ROB FELT

Kofi Smith in one of the airport's ISO 55001-certified utility plants

Kofi Smith (BIE 1999, MBA 09) is a born leader, which he has demonstrated both on the football field and off. He leads by example, using his “industrial engineering brain” to continuously optimize situations and create winning teams.

A high school football star from Florence, Alabama, Smith was recruited as a defensive back for the Yellow Jackets and enrolled in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE), where he was as committed to academic success as he was on the field. As graduation neared, he hoped professional football would be in his future. But an injury ended his NFL dreams, and Smith shifted his focus back to industrial engineering and corporate America. His first job was in manufacturing with Milliken & Company.

“The very first question my plant manager asked me was, ‘Do you want to sit behind a desk and do time analysis and cost studies, or do you want to go out onto the manufacturing floor and manage a team?’ I chose the team,” Smith recalled. “He said, ‘Great. I’m going to give you the worst team, C-shift, and you’ll either sink or swim.’”

Smith was ready for the challenge.

“As a kid, you don’t always realize the value of the lessons you are learning. You just want to win,” Smith explained. “[Then-football] Coach O’Leary was hard on us, but it wasn’t until after I left Georgia Tech that I understood that this man had implanted some things within our DNA. Once I hit corporate America, it came out. Come in early. Stay late. Outwork

everybody. Make no excuses. Figure out how to win. Align your team to attack a common goal. If someone is in the wrong position, put them in the right one. So that’s what I did.”

And it worked. He combined this philosophy with the education he received at ISyE and began to see success.

“Within six months, that team and I became No. 1,” Smith said with a smile. “We broke records and set new ones, and everybody was chasing us.”

Smith used the same philosophy to maximize efficiencies and lead teams in numerous industries and companies, and as he climbed the corporate ladder, the size of his teams grew. He continued to use his training as an industrial engineer to optimize

processes, look at how facilities were laid out, and understand the advantages and disadvantages of making different choices. He also earned an MBA in global business to better understand strategy, finance, operations, and other business topics that further strengthened his decision-making abilities.

Eventually, Smith's career led him to the airline industry and managing facilities for Delta Airlines. Because of his unique approach, he was noticed by senior leadership at the Atlanta Airlines Terminal Company (AATC), the facility management company for Hartsfield-Jackson Atlanta International Airport (ATL). In 2010, Smith joined AATC as the youngest president and CEO in the history of the company. His organization is responsible for managing 7.2 million square feet of terminal facilities at the world's busiest airport.

Smith's combination of leadership skills, business acumen, and industrial engineering expertise have given him the tools necessary to manage a \$119 million yearly operating budget and lead AATC. He has also seen more than \$646 million in capital improvement contracts executed for the facility since he joined the company. Smith's IE brain not only serves him in the area of

organizational improvements but also in the area of continuous self-improvement. In May of 2018, Smith graduated with his doctorate in business from Georgia State University. In August of that same year, he was recognized by the *Atlanta Business Chronicle* as one of Atlanta's Most Admired CEOs.

"IEs can go into any type of environment and assess the situation, break it down in our minds, see all of the individual processes that are happening, and then optimize each of them," Smith said. "As a CEO, I look at the various departments — finance, engineering, IT, procurement, human resources, operations, and asset sustainability — and figure out how to optimize them to create value for my shareholders."

An estimated 106 million passengers will pass through ATL in 2019, and a new \$6 billion capital improvement plan for the airport is underway. And during it all, Smith and his team will work hard to make sure that the facilities are running as efficiently as possible.

"I love leading teams, defining the win, and then achieving that win," Smith said. And he's continuing to do just that. ■ LAURIE HAIGH

"IEs can go into any type of environment and assess the situation, break it down in our minds, see all of the individual processes that are happening, and then optimize each of them."

KOFI SMITH



From left: Stephen Maceyko, Melanie Tomlinson, Donna Ahlrich, and Kofi Smith

Optimizing ATL: ISyE Alumni Collaborate to Attain International Certification

Smith understands the value that Georgia Tech industrial engineers bring to an organization and has hired numerous ISyE alumni and interns to help him continuously optimize ATL. In order to show stakeholders that the facilities are running as efficiently as possible, Smith worked with three of them — Donna Ahlrich (BIE 1982), Stephen Maceyko (BIE 1990), and Melanie Tomlinson (BIE 1989, MSIE 1991) — to obtain the prestigious ISO 55001 certification for the airport's utility plants, which in Smith's words are the "heart of the airport." Earning this certification made ATL the first international airport (and AATC the third organization) in the western hemisphere to receive this designation.

Leading the Way for Women Engineers



From left: Mahati Vavilala, Isabella Sanders, and Toral Kadakia

Since 2004, the Georgia Tech College of Engineering (COE) has been the largest producer of female engineers in the U.S. Thirty-five percent of COE's undergraduate engineering students are women, as opposed to just 17% nationally.

As such, it's only fitting that the Institute's Society of Women Engineers (SWE) is also one of the country's largest collegiate sections of the organization, serving 800+ undergraduate and 200+ graduate students.

Mahati Vavilala, who graduated in May, was SWE's president during her final year at Tech as a student enrolled in the H. Milton Stewart School of

Industrial and Systems Engineering (ISyE) and will be continuing her involvement with SWE on the executive board for SWE Atlanta. Two ISyE students serve as the group's current leaders: Fourth-year Toral Kadakia is undergraduate president, and Ph.D. student Isabella Sanders is graduate group leader, a position she has held for the past two years. Sanders is also graduate programs chair-elect at the SWE society (national) level, which means that she will assist the current graduate program chair and be responsible for developing diverse section tracks for SWE's annual conference. She will assume the position of graduate program chair in 2020.

In the following interview, Kadakia, Sanders, and Vavilala share their thoughts on leadership and how participating in SWE has shaped both their Georgia Tech experiences and their perceptions of themselves as female engineers.

What is your philosophy of leadership?

TK: I always want to be a team player. I expect honesty and hope that in turn, I gain the respect and trust of my team members. Part of that means being there for my team in any capacity I can be — whether it's answering their questions, problem-solving, or encouraging them to think outside the box and go beyond their comfort zone.

IS: My goal is to motivate and empower others to succeed. The best way to do this is to lead by example, as a leader's effort and attitude are contagious, and a group's morale is often determined by its leader.

Why is leadership important to you?

TK: A leader is someone who can bring about changes and make an impact on people. As president of SWE, I feel it's important to specifically address issues that women face by being in STEM fields. And I hope that through my various leadership roles on campus, I have contributed to getting rid of that stigma.

In addition, I want to impact younger students and give them the same great opportunities and supportive environment that I have experienced with SWE.

MV: A lot of students come to Tech having served as president or vice president of their high school organizations, and that wasn't really my experience. I came to realize that I was interested in those roles but had to forge my own path and figure out how to get involved in my own way.

I learned to be aware of other people and help them adjust to being at Tech and help make them feel at ease within various organizations. That's a really powerful leadership trait — to be able to acknowledge the different perspectives and views present in a room — and that's why being a leader is so important to me.

Why is it important to have an organization dedicated specifically to supporting female engineers?

IS: SWE is important because it provides support where it otherwise may not be found and encourages students to succeed. Particularly for

graduate students, where the number of women enrolled is even lower than it is in undergraduate programs, SWE brings students into a larger community that they can lean on.

MV: It's particularly important at Tech to have a SWE presence because engineering is so dominant. The Institute is close to achieving a 50/50 balance when it comes to female/male representation, but it's not quite there yet. SWE connects a community of women working toward the common cause of female representation.

How has your SWE experience shaped your time at Georgia Tech?

IS: SWE has given me a group of women who are not only great teammates but also are great friends. We've been able to travel the country attending SWE conferences in different states. And at the society level, SWE has given me the opportunity to present my research, earn a scholarship, and meet women from all over the world.

MV: As I became more and more involved in SWE, the more I gave to the organization the more SWE gave back to me. I grew professionally and personally. As president, I had the opportunity to engage with members and go outside my comfort zone to talk to people I wouldn't normally talk to, as I tend to be a bit of an introvert. SWE has been a constant source of motivation throughout my time at Tech, and my experience with Georgia Tech's SWE has inspired me to become involved with Atlanta's SWE section.

Has SWE impacted how you think of yourself as a female engineer?

TK: SWE has definitely made me feel like I belong here at Tech. I see the incredibly strong and successful women who are in SWE, and it

inspires me every day to work harder and continue to break boundaries. And Mahati and Isabella, who are incredible people who have done so well in their careers — I know I'm following in their footsteps and will hopefully be just as impactful as them.

IS: SWE has helped me realize that I have a community of women to lean on. I'm not alone; I'm part of a strong group of women. While we may not all be in the same fields of study, our experiences are strikingly similar, and we can support each other.

In addition, SWE has also taught me the importance of leadership. When you're one of the few women in leadership, it's important to leave a good example, because your impact can empower others and inspire the next generation.

What are you most proud of accomplishing with SWE?

MV: As president, I worked on being approachable and accessible — and correspondingly, worked on fostering connections between the exec board and our members. The organization has become more tight-knit and supportive as a community. What keeps the members coming back is their ability to stay connected with each other, and I'm excited to see this growth continue for years to come.

TK: I am very proud of my contributions to our fundraising and outreach efforts. We continue to encourage young women from local Atlanta schools to consider a STEM profession with our outreach events. I'm also proud to have co-hosted an award-winning charity Engineer's Ball that continues to raise thousands of dollars for local charities and organizations. ■ SHELLEY WUNDER-SMITH

Mentra: Developing Workforce Skills for the Autistic Community

This fall, two Georgia Tech students are beta-testing their new app, Mentra. Half its users are traditional university undergraduates; the other half comprises individuals from the Autistic Self-Advocacy Atlanta (ASAA) organization.

The app is the brainchild of Conner Reinhardt, a fifth-year student in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE), and Jhillika Kumar, a fourth-year computational media major. The pair connected at the 2018 TEDxGeorgiaTech conference, where Reinhardt was in charge of recruiting and organizing the student speakers, and Kumar was one of the presenters.

Kumar addressed the importance of accessible technology for empowering the differently abled, and shared how her relationship with her older brother, who is autistic and nonverbal, inspired her. After Kumar spoke, Reinhardt knew he wanted to be part of developing a solution for this often-marginalized community.

The two students joined forces and in early 2019 founded a startup called AxisAbility. “I’m the how, and she’s the why,” Reinhardt said. “Industrial engineers are the people who understand how to make things happen. I’m bringing the business perspective to this project. I’m trying to think of all the different things we might want to show or realize. That’s the how. But people like Jhillika — people with the biggest ideas and who inspire true change in the world — they’re the why.”



Conner Reinhardt and Jhillika Kumar have partnered to create an app that will help the differently abled connect with future employers.

It took a little while for them to decide exactly how AxisAbility could support individuals with intellectual or developmental disabilities (I/DD). From the advocacy group Autism Speaks, they learned that up to 88% of adults with autism are unemployed. Further, Accenture research shows that if just an additional 1% of differently abled people were hired by U.S. companies, the GDP would improve

by \$25 billion. Because of this, and because of Kumar’s personal experience with her brother, they decided to focus their initial efforts on the autistic community.

This is where Mentra comes in. Designed to help individuals with cognitive disabilities successfully develop job skills through mentorship, the app’s algorithm collects data on

what job skills the mentee wants help with — such as resume writing, interviewing, or professional workplace behavior — and pairs the mentee with prospective mentors, who initially will be traditional college students. The app also provides prompts for the mentor and mentee to guide their conversations. Kumar worked with ASAA to identify which topics would be most helpful. For example, ASAA President and Mentra Outreach Director Eren Niederhoffer told Kumar that he would like to practice “communication skills, executive functioning, critical thinking, and networking.”

Reinhardt and Kumar plan for Mentra to eventually be a talent pipeline between the I/DD community and employers. “Recruiters will be able to log in to Mentra, search candidates to see their rating and what employment skills they’ve worked on, and pull their resumes,” explained Reinhardt. “We’re specifically focusing on individuals with autism right now, but we plan to expand to people with other intellectual disabilities as well.”

Throughout the process of developing Mentra, Reinhardt and Kumar haven’t forgotten their original motivation: Kumar’s brother. In fact, Kumar’s family, which is originally from Dubai, United Arab Emirates, has moved to Atlanta so her brother can more easily access Mentra and other assistive programs that have been enabled by cutting-edge autism research at Georgia Tech.

“With Mentra, we are trying to create a road map for individuals with autism that will provide them with successes. We want to understand their biggest strengths and biggest weaknesses,” Kumar said. “Through the app, we’ve created a platform to facilitate that process. We’re starting with people who are currently employable, but eventually we want to assist people who are nonverbal as well, who could communicate through typing. So they might not be able to speak, but they could do their jobs via computer, which is more possible today through an increasingly digital economy.

“All of this was inspired by my brother,” Kumar added. •
SHELLEY WUNDER-SMITH

Mentra is a rapidly changing startup. The content in this article reflects the information available as of September 1, 2019. To learn more about Mentra and to sign up to be a mentor, visit www.mentra.me.

To see Kumar’s TEDxGeorgiaTech talk, visit <http://bit.ly/2KW2orJ>.

Want to hire an ISyE all-star to work at your company?



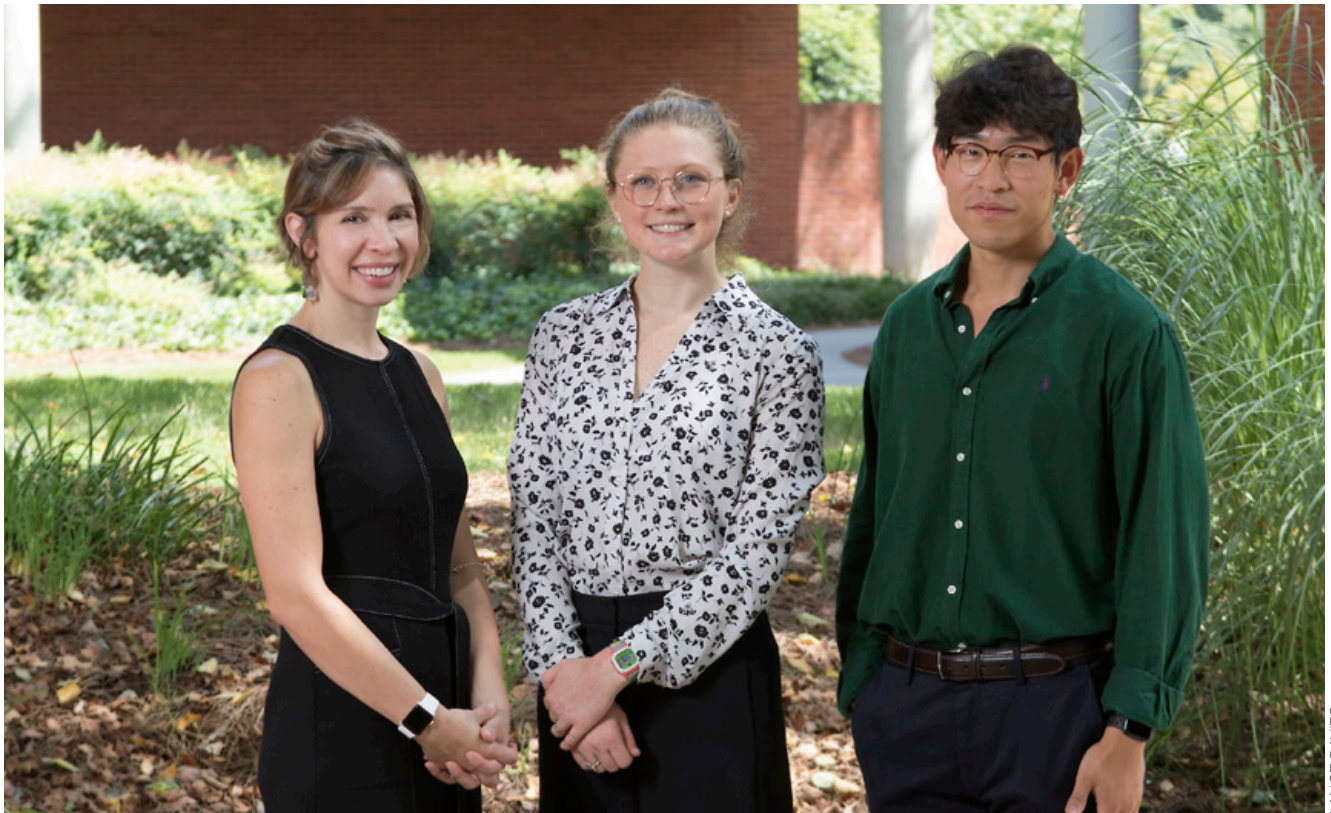
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**WANT TO
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LEGACY
AT
GEORGIA
TECH?**

Talk about philanthropic support with
ISyE Director of Development **Nancy Sandlin**.
nsandlin@isye.gatech.edu or **404.385.7458**

New Cornerstone Class Preps Students for Senior Design and Beyond



LANCE DAVIES

From left: Dima Nazzal, Emma Baubly, and Kevin Kwon

Since 1975, fourth-year undergraduates in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE) have completed Senior Design as a semester-long capstone course required for graduation. The course presents an opportunity for ISyE students to work on real-world design problems and put their ISyE skills into practice by exploring a client's problem and designing a deliverable solution.

"One challenge we see students grappling with in Senior Design is framing the problem," explained Dima Nazzal, ISyE director of professional practice and Senior Design advisor. "What are the client's motivations and

goals for this project, and what are the pain points for the client? Ultimately, the students have to make a case for their projects in terms of value to the client."

As a result, ISyE has developed a new class, Cornerstone Modeling and Design (ISYE 3803), that enables undergraduates to explore problem-framing prior to their Senior Design experience. The course, taught by Nazzal, was offered for the first time in fall 2018, and it trains students to develop, write, and present proposals to solve problems that require the use of ISyE methodology.

The class uses general case studies drawn from past Senior Design projects — from network optimization for an oil and gas company to guest flow and queues in a sports stadium to efficient patient scheduling for a health care clinic.

The students in the class are divided into small teams, and each team works on the same project for several weeks. Team members request data, conduct research, analyze the system and data in search of opportunities, and present their proposal to the whole class. The variety of teams — coupled with the non-stylized complex projects — leads to a variety of proposed solutions.

“It’s good for the students to see different opportunities identified for the same problem, because it demonstrates that creativity is part of problem-solving,” Nazzal said.

Emma Baubly, a fourth-year ISyE student, took ISYE 3803 the first time it was offered and now serves as an undergraduate teaching assistant for the course. “The teams are given problems that don’t necessarily have a single answer, which can be frustrating for Tech students,” Baubly reflected. “And as a result, while this may be one of the more challenging courses ISyE students will take, I think it’s also a class that will add tremendous value to their Georgia Tech education.”

ISyE fourth-year Kevin Kwon took the Cornerstone class in spring 2019. “This was my favorite class that I’ve taken at Tech,” he said. “We had to repeatedly draft proposals for our ‘client,’ just like Senior Design teams do. Writing the proposals gave us practice framing the problem so as to be as effective as possible for our clients.”

Kwon, who will take Senior Design in spring 2020, also appreciated that the class structure forced him to focus on important soft skills such as collaboration, giving presentations, and communicating with clients.

“I learned that teamwork is extremely important,” he said. “It’s not just about the intellectual capability of a person, but how you work within a group and if you’re able to compromise. In

addition, if an ISyE student wants to go into consulting — or any field that requires client interaction — this class will benefit them.”

Nazzal concurred. “Our students have excellent technical skills in analysis, modeling, and coding. This course challenges them in new ways when they realize that there is not one correct final proposal to solve a complex problem, and that the path to the finish line is not linear. Just as important, this course trains them to function as teams, to experience productive conflict, and to compromise to achieve a common goal. They work extremely hard throughout the semester, and it will pay off in Senior Design and in their job interviews.” ■

SHELLEY WUNDER-SMITH

SPRING 2019 GRADUATION: ISYE UNDERGRADS*

40% of graduating ISyE students went to a consulting company

» Accenture, Deloitte, and Manhattan Associates are the top employers

31% interned or co-oped at the company they accepted a job offer with



57% of those who accepted an offer will be based in Metro Atlanta

6% of graduates will go to graduate school



*Self-reported data

Spring 2019 Senior Design Features a Triple-winning Team

Twenty-four teams from the H. Milton Stewart School of Industrial and Systems Engineering (ISyE) completed capstone projects with real-world impact during the spring 2019 semester. One exceptionally strong team — Cisocean — won both the spring 2019 Capstone Expo ISyE Judges' Award and the ISyE Best of Senior Design competition. This same team went on to win the Outstanding Capstone Award from among 15 schools at the annual meeting of the Institute of Industrial and Systems Engineers in Orlando, Florida.

In addition to Cisocean, three finalist teams — working with Emory Clinic's Heart & Vascular Center, MARTA, and UPS — were selected for the

ISyE Best of Senior Design. "The finalist projects were selected because they stood out in terms of scope/challenge, methodology, and potential impact," explained Director of Professional Practice and Senior Design Coordinator Dima Nazzal. "Challenge presented itself in different forms to these four teams: having to deal with enormous data sets; lack of availability of key information; huge variability and uncertainty in processes with shared resources; and interdependence among the subsystems and the different processes. Despite the challenges, these teams developed innovative and sustainable solutions with demonstrable value to their clients. We are very proud of our students."

First Place and Capstone Judges' Choice: Team Cisocean

Team Cisocean worked with Cisco to reduce the transportation costs of shipping products between contract manufacturers in Asia and direct fulfillment centers in the Americas by proposing to increase ocean utilization while maintaining service level constraints. The team used multi-objective optimization to design an end-to-end shipment scheduling application. The tool, which Cisco intends to pilot in 2020, will reduce carbon emissions by 16% and save an estimated \$10 million annually across the highest-volume lane.

"The shipment mode optimization project is a leap toward using advanced analytics to automate Cisco's supply chain," said Hamin Oh (BSIE 18), Cisco supply chain project manager. "We have already started utilizing the model to suggest optimal mode shift targets to regional teams. This will play a key role in exceeding our annual mode shift goal, reducing our cost and CO₂. This was possible thanks to a group of industrial engineers who thought outside the box to deliver a practical yet highly sophisticated solution."

From left: Dawn Strickland (faculty advisor), Shelby Carswell, Guergana Ilieva, Trishla Chokshi, Karan Agrawal, Shaiv Gandhi, Weichao Chen, Kayla Raabe, and Pavlos Sepetas



Finalist: Team Cardiac Kids

Team Cardiac Kids partnered with Emory Clinic's Heart & Vascular Center. Team members examined provider scheduling, patient scheduling, and exam room assignments as areas of potential improvement to reduce patient wait time and increase clinic throughput. Using their solutions, Emory can expect to achieve a 10% wait time reduction per patient. Based on anticipated time savings, the team estimates Emory can see nearly 2,000 additional patients per year, which equates to an additional contribution margin (revenue less variable costs) of \$10.3 million per year.

From left: Connor Childers, Luke Allegood, Noah Rittenberg, Morgan McCombs, Gregory Wilkes, Sarah Carpenter, David Goldsman (faculty advisor), and Emily Kaukol



Finalist: Team MARTA

This Senior Design team worked with MARTA to provide greater visibility into how patrons utilize the transit system. First, it designed a trip-chaining algorithm to extract the origin-destination pairs of patrons. Then, it performed a data envelopment analysis to identify relative bus route efficiency, revealing how routes connect riders. Finally, it designed a machine-learning algorithm to predict ridership with census data and current resource allocation. Combining these capabilities, the team's Origin-Destination-Transfer (ODX) tool provides MARTA with the power to plan for the More MARTA initiative.

From left: Gideon Yuwono, Josh Morgan, Karima Alkhalid, Nick Williams, Andre Beroukhim, Adam Valletutti, Conor Stewart, and Pascal Van Hentenryck (faculty advisor)



Finalist: Team UPS

This Senior Design project created a comprehensive scheduling tool to help the UPS scheduling unit configure weekly driver schedules for commercial customer pickup and delivery. The scheduling tool utilizes advanced optimization techniques to transform UPS's existing scheduling practice into a streamlined and automated system. The tool enhances drivers' satisfaction and improves their lifestyle by ensuring consistent start times, designated meal breaks, and limits on work hours, while substantially reducing annual operating cost by approximately \$550,000 for a single hub.

From left: Karnavv Shah, Radhika Modi, Josh Rubin, Linxi Xiao, Andrew Klassen, Shreya Jain, Nick Hoover, and Daksh Varyani (not pictured: Sebastian Pokutta, faculty advisor)



Georgia Tech's MSA Program Celebrates Milestone Anniversary

It began in 2013 with 40 students, chosen from 75 applicants, as a response from one of the country's most respected academic institutions to the rapidly expanding field of analytics. Now with 86 on-campus students and more than 3,000 online learners representing nearly every U.S. state and more than 100 countries, Georgia Tech celebrates its growing Master of Science in Analytics (MSA) program.

In November 2018, MSA alumni, professors, current students, and staff gathered at the Carter Center in Atlanta, along with business leaders and other supporters, to celebrate the fifth anniversary of the MSA program and the accomplishments of its graduates.

The interdisciplinary program began as one of just a few of its kind in the country, leveraging Georgia Tech's strengths in statistics, operations research, computing, and business. It combines the world-class expertise of the Scheller College of Business, the College of Computing, and the College of Engineering.

Joel Sokol, professor in the H. Milton Stewart School of Industrial and Systems Engineering and director of the MSA program, said the interdisciplinary aspect both sets Tech's program apart and sets its students up for success.

"The program is owned equally by computing, business, and engineering, so we expose our students to all three of those perspectives of analytics," Sokol said. "Even more importantly, according to employers, we also work hard to teach the integration of those perspectives, so our students can have a significant impact in a wide variety of different job tasks and follow a wide range of career paths. Our approach also positions



Above: MSA alumni who attended the program's fifth anniversary celebration. Right: Professor Joel Sokol, who also directs the Master of Science in Analytics program, received the Outstanding MSA Faculty Award, which was voted on by MSA alumni.

our students to rise within their companies or organizations."

Students choose from more than 70 electives during the program, allowing them to tailor their education to meet their future goals. The program showcases a wide variety of learning opportunities, and the students themselves come from diverse backgrounds, Sokol said.

"We've designed our program so that even people without an analytics-related background succeed and come out prepared for professional success," he said. "Students with academic backgrounds in law, medicine, theater, astrophysics, psychology, political science, and religion have all done very well." Job placement for graduates is also an important component of the MSA program, and its staff has built relationships with more than 250 companies to aid students in the employment process. The newest addition



combines the MSA and MBA options, with four students currently enrolled.

When Sokol considers the growth of the program, he thinks of his students — and he can't wait to see the difference they make in the world.

"We're only in our fifth year, so our first graduates didn't finish until a little more than three years ago," he said. "I'm really looking forward to seeing, say, five or 10 years from now, all that our outstanding graduates have accomplished — how far and high they've risen, and how big an impact they've had." ■ ERIKA ANDERSON REDDING

Welcoming New Faculty to ISyE



Assistant Professor Mathieu Dahan

joined ISyE in August 2019. His research interests are in combinatorial optimization, game theory, and predictive analytics, with applications to service operations management and disaster logistics. His primary focus is on developing strategies for improving the resilience of large-scale infrastructures — particularly transportation and natural gas networks — in the face of correlated failures such as security attacks and natural disasters.

Dahan received a Ph.D. and M.S. in computational science and engineering from the Massachusetts Institute of Technology, an M.Eng. and B.Eng. from the École Centrale Paris, and a B.S. in mathematics from Paris-Sud University.



Academic Professional Tuba

Ketenci joined ISyE in August 2018 as a non-tenure-track faculty member. Her areas of expertise include instrument development, social network analysis, and quantitative methods in education research, such as hierarchical linear modeling and structure equation modeling. Her research focuses on improving K-12 engineering education through research on curriculum and test development, and the development of students' computational thinking in technology-enhanced environments.

She has a Ph.D. in educational technology, with a concentration in research, measurement, and statistics, from Georgia State University; an M.S. in educational studies from Edgewood College; and B.S. degrees in computer science and business administration from Bilgi University in Istanbul, Turkey.



Assistant Professor Debankur Mukherjee

joined ISyE in July 2019. Prior to that he was a Prager Assistant Professor in the Division of Applied Mathematics at Brown University. His research spans the areas of applied probability, with applications in queueing theory, randomized algorithms, and probabilistic combinatorial optimization. His primary focus is addressing fundamental theoretical challenges that arise in large-scale systems, such as data centers and cloud networks.

Mukherjee received the Best Student Paper Award at ACM SIGMETRICS 2018 for his work on asymptotically optimal load balancing topologies. He has a Ph.D. in stochastic operations research from Eindhoven University of Technology, an M.Stat. in mathematical statistics and probability from Indian Statistical Institute, and a B.S. in statistics from Ramakrishna Mission Residential College, Narendrapur, in Kolkata, India. ■

Faculty Awards, Appointments, and Promotions

FACULTY AWARDS

Anderson-Interface Chair and Professor Shabbir Ahmed

received the 2018 Farkas Prize from the INFORMS Optimization Society. The society cited Ahmed's "fundamental contributions to the theory and practice of stochastic discrete optimization." The Farkas Prize is awarded annually to a mid-career researcher for outstanding contributions to the field of optimization.

Ahmed's theoretical contributions to stochastic programming have been broad and deep. They have improved the understanding of multistage stochastic programming and consistent formulations of risk preferences, and provided bounds on sample average approximation solutions to non-convex chance-constrained optimization problems. His contributions to mathematical programming computation address some of the most difficult but important topics in the field with wide applicability in production systems, energy systems, health care, transportation, security, and more. His ability to exploit integer-programming structures that arise in stochastic programming is a recurring theme in his research.

Shabbir Ahmed passed away on June 19, 2019. An article further highlighting his impact on ISyE and the field of optimization is located on page 50.



Shabbir Ahmed

John Hunter Chair and Professor Arkadi Nemirovski

received the 2019 Norbert Wiener Prize, awarded by the American Mathematical Society and the Society for Industrial and Applied Mathematics. The societies cited Nemirovski's "fundamental contributions to high-dimensional optimization and his discovery of key phenomena in the theory of signal estimation and recovery."

The Wiener Prize is awarded for an outstanding contribution to applied mathematics in the highest and broadest sense. It was established in 1967 in honor of Professor Norbert Wiener and was endowed by a fund from the Department of Mathematics of the Massachusetts Institute of Technology.

Nemirovski's research interests focus on optimization theory and algorithms, with emphasis on investigating complexity and developing efficient algorithms for nonlinear convex programs, optimization under uncertainty, applications of convex optimization in engineering, and nonparametric statistics.

Carolyn J. Stewart Chair and Professor Jianjun "Jan" Shi was honored with both the American Society for Quality's 2019 Brumbaugh Award



Arkadi Nemirovski

and Wire Association International's Horace Pops Medal Award.

Eugene C. Gwaltney, Jr. Chair in Manufacturing Systems and Professor Ben Wang and Harold E. Smalley Professor Chuck Zhang

received a 2018 R&D 100 Award for research work on applying 3D printing to make patient-specific, tissue-mimicking heart valves for pre-surgery planning to treat heart disease.

Coca-Cola Chair in Engineering Statistics and Professor Jeff Wu

received the Statistician of the Year Award from the Chicago chapter of the American Statistical Association.

FACULTY APPOINTMENTS

Professor Natasha Boland has been appointed to a Fouts Family Professorship. Endowed by ISyE alumnus J. Louis Fouts (BIE 1990), the Fouts Family Faculty Fund is designed to enhance the ability of ISyE to attract and retain eminent teacher-scholars.

Boland's contributions to her field have spanned theory, algorithms, modeling, and applications in mining, defense, renewable energy, airline planning, freight transport, port logistics, and water management. More recently, Boland has turned her attention to projects that, in her words, "optimize happiness."

Through the Fouts Family Professorship, Boland plans to develop relationships with leading psychology and behavioral science researchers and interested operations researchers, including other ISyE faculty members.

Associate Chair for Research and Professor Alan Erera has been appointed to the UPS Professorship of Logistics, which is designed to enhance ISyE's ability to attract and retain eminent teacher-scholars to this position of academic leadership in the field of logistics.

Erera's research focuses on transportation and logistics systems planning and control, with an emphasis on planning under uncertainty and real-time operational control. His recent work has addressed dynamic vehicle routing systems for same-day distribution; resilient logistics network design for food supply chains; service network design, linehaul equipment management, and driver scheduling for consolidation freight carriers; robust container fleet management for global shipping companies; and robust and flexible vehicle routing system planning and control for distribution companies.

Through the professorship, Erera plans to continue studying high-velocity last-mile logistics systems that support rapid delivery of products to consumers.

Professor Xiaoming Huo has been appointed to an A. Russell Chandler III Professorship, which was endowed by

A. Russell Chandler III (BIE 1967) to enhance the ability of ISyE to attract and retain eminent teacher-scholars.

Huo's research interests include statistical theory, statistical computing, and issues related to data analytics. He has made numerous contributions on topics such as sparse representation, wavelets, and statistical theory and methodologies in a range of problems.

Huo is also the director of Georgia Tech's Transdisciplinary Research Institute for Advancing Data Science, which integrates research and education in mathematical, statistical, and algorithmic foundations for data science.

He plans to use resources from the professorship to support early-stage graduate students who may not have extensive research experience.

Professor Alexander Shapiro has been appointed to an A. Russell Chandler III Professorship, which was endowed by A. Russell Chandler III (BIE 1967) to enhance the ability of ISyE to attract and retain eminent teacher-scholars.

Shapiro's research interests focus on stochastic programming, risk analysis, simulation-based optimization, nondifferentiable optimization and nonsmooth analysis, sensitivity analysis and optimization of queueing networks, sensitivity analysis of nonlinear programs, and multivariate statistical analysis. The professorship will help support his continued work in these areas.

Professor Chuck Zhang has been appointed to the Harold E. Smalley Professorship, which was established in memory of Harold E. Smalley (Ph.D. 1994) and is designed to support ISyE faculty appointments within the area of health.

Zhang's research interests include additive manufacturing, bio-manufacturing, composites manufacturing, and scalable nanomanufacturing. Most recently, he has initiated new research and education programs in cell-manufacturing and composite structures maintenance. He is also developing wireless sensors for monitoring cell manufacturing for cell therapy.

Funding from the professorship will allow Zhang to continue innovating in advanced manufacturing and provide students with new opportunities for learning.

FACULTY PROMOTIONS

Santanu Dey has been promoted to professor.

Dawn Strickland has been promoted to senior academic professional.

Yao Xie has been tenured and promoted to associate professor.

WuFest: A Conference on Engineering Statistics and Related Topics

On May 10-11, 2019, more than 100 statisticians and engineers, from both academia and industry, gathered at The Historic Academy of Medicine at Georgia Tech in honor of Coca-Cola Chair in Engineering Statistics and Professor C.F. “Jeff” Wu. WuFest, a conference on engineering statistics and related topics, was hosted by the H. Milton Stewart School of Industrial and Systems Engineering (ISyE) and celebrated Wu’s impressive career and his 70th birthday.

Wu is an iconic figure in the field of engineering statistics. Throughout his career he has made fundamental contributions to the methodological and theoretical developments of a wide variety of statistical and application areas including design and analysis of experiments (optimal, sequential, and factorial); computer experiments; robust parameter design; statistical computing; re-sampling methods; complex surveys; nonlinear least squares; and uncertainty quantification.

The conference brought together top scholars in these areas — some of whom were advised by Wu during their Ph.D. studies — from Asia, Europe, and the Americas to present their new research findings. WuFest also provided an opportunity for both speakers and attendees to collaborate and discuss their ideas and visions of emerging problems in their fields. Session topics included engineering statistics, statistical applications, design of experiments, fundamentals of experimentation

“Jeff is a true leader in the field of engineering statistics. He has done impactful work in both theoretical and applied problems, and his influence has multiplied through the work of his students.”

ROSHAN JOSEPH



and inference, optimal design, and uncertainty quantification.

“It was a great honor,” Wu said. “To see so many former students and colleagues that I respect at the conference was very special.” Wu is also thankful for the support of ISyE, Georgia Tech, and the WuFest planning committee.

One of the many highlights of the conference for Wu was a talk at the banquet dinner by Xiao-Li Meng, Whipple V.N. Jones Professor of Statistics at Harvard University and founding editor-in-chief of the *Harvard Data Science Review*. In

his talk entitled “Is Jeff Wu a Data Scientist?”, Meng deconstructed Wu’s famous 1997 lecture “Statistics = Data Science” in which Wu advocated that statistics be renamed “data science.” Wu’s family — including both of his children, their spouses, and his granddaughter — also attended the tribute.

“Jeff is a true leader in the field of engineering statistics,” said Roshan Joseph, one of Wu’s ISyE colleagues and chair of the WuFest planning committee. “He has done impactful work in both theoretical and applied problems, and his influence has multiplied through the work of his



Jeff Wu (front center) with WuFest attendees

students, who have published more than 1,800 papers to date (without Wu being a co-author) in statistics and engineering.”

Wu’s professional achievements are unmatched. He is a member of both the National Academy of Engineering (2004) and Academia Sinica (2000). He is also a Fellow of the Institute for Operations Research and the Management Sciences, the American Society for Quality, the Institute of Mathematical Statistics, and the American Statistical Association. Wu has also won numerous awards, including the Committee of Presidents of Statistical Societies (COPSS) Presidents Award in 1987; the Pan Wenyuan Technology Award (Taiwan) and the Shewhart Medal by the American Society of Quality in

2008; the Fisher Lecture Award by COPSS in 2011; the Deming Lecture Award by the American Statistical Association in 2012; the inaugural Akaike Memorial Lecture Award in 2017 (Japan); and the Box Medal by the European Network for Business and Industrial Statistics in 2018.

Wu’s work is widely cited in professional journals and magazines. He has served as editor or associate editor for several major statistical journals and has published more than 175 research articles in peer review journals. He has supervised 49 Ph.D. students, of whom 21 are fellows of professional societies, and he has almost 200 “grand graduate students” that have been supervised by his former students. ■ LAURIE HAIGH

Get to Know ISyE's Newest Advisory Board Members

Catherine Cooper, Casey Hodgson, José Montero Jr., Prentis Wilson, and Marty Young joined the H. Milton Stewart School of Industrial and Systems Engineering (ISyE) Advisory Board in the spring of 2019.

These five alumni, along with 15 other distinguished professional and community leaders, serve as a sounding board for the School Chair in an advisory capacity and assist with the School's development goals. Each new member will serve a four-year term (2019-23). Dan Shinedling (BIE 1992), founder and CEO of KS2 Technologies, was named the Advisory Board's new chair, and Ronda Sides (BIE 1983), co-founder of Extreme Logic, was named vice chair. Both will serve a one-year term in these roles.

Catherine Cooper (BIE 1990) is president of World Connections, a supply chain consultancy she founded in 2006. She has dedicated her career to the logistics industry, with more than 20 years in top leadership positions.

Cooper's favorite class was Senior Design.

"It launched my entire career. I approach every project with the fundamentals I learned then — ask the right questions, gather information not just data, break problems down into manageable pieces, and all that is just half of the work. You still must sell your idea to your boss, your co-workers, your client, or your board. Thirty years later, I still work with my Senior Design partner."

Casey Hodgson (BIE 1992, MSIE 1993) is a managing partner of MCH Consulting, a supply chain management consulting firm that partners with traditional consulting firms and works directly with consumer products companies. Prior to founding MCH Consulting, Hodgson spent 25 years in the Coca-Cola system, where he most recently served as area vice president of system transformation.

Hodgson's favorite ISyE memory is the 1996 Olympic Games.

"I worked with Regents Professor Emeritus Don Ratliff in graduate school to examine transportation in and around the 1996 Olympic Village, which was the Georgia Tech campus. I was also the envoy to Aruba for the Games."

José Montero Jr. (BIE 1995) is president and founder of the Montero Group, an international strategic advisory agency that specializes in growth strategies, market development, positioning, and branding. Prior to founding the Montero Group, he worked for The Coca-Cola Company for nearly 16 years in various capacities around the globe. In addition to his ISyE degree, Montero holds an MBA from Georgetown University.

Montero's favorite ISyE memory is Commencement.

"I led an 'unofficial' ISyE group project to 'borrow' the Georgia Tech Whistle and present it to former Georgia Tech President Wayne Clough as a welcome gift from the Class of 1995 at graduation."

Prentis Wilson (BIE 1995) is president of Boxed, an online and mobile membership-free wholesale retailer. Prior to this role, he served as vice president and general manager of Amazon Business. He built Amazon Business from concept to its official launch in 2015, establishing Amazon's presence in the business-to-business e-commerce market segment. In addition to his ISyE degree, Wilson holds an M.S. in business and an M.S. in engineering, both from the Massachusetts Institute of Technology.

"I led an 'unofficial' ISyE group project to 'borrow' the Georgia Tech Whistle and present it to former Georgia Tech President Wayne Clough as a welcome gift from the Class of 1995 at graduation."

JOSÉ MONTERO JR.



From left: New Advisory Board members José Montero Jr., Catherine Cooper, Casey Hodgson, Marty Young, and Prentis Wilson

Wilson's favorite professor was John Vande Vate.

"John has a no-nonsense approach, yet always has a smile on his face. He did a great job making the real-life application of what we learned clear and inspiring."

Marty Young (MSOR 01) is managing director of M-III Partners, a premier Wall Street restructuring boutique, and the CFO/COO of Buckle, an Atlanta-based InsureTech company serving the shared economy. As a restructuring professional, he has

executed more than 50 operational turnaround and balance sheet restructuring assignments during his career. In addition to his ISyE degree, Young holds a B.S. in physics from the United States Military Academy and an MBA from New York University.

Young's favorite professor was Mark Spearman.

"He co-wrote *Factory Physics* and taught three courses I took. He opened my eyes to operations research and how thoroughly useful it is in everyday life." ■

Nailed It: How an ISyE Alumna Is Reshaping a Corner of the Beauty Industry

Brianna Cochran is remaking her world to her own specifications.

Cochran (BSIE 18) was raised in Cleveland, a small town (pop. 3,900) in the north Georgia mountains, and realized at an early age she didn't quite fit in. "It's a gorgeous, gorgeous area. But everything moves slowly, and I always felt out of place," she said.

When it came time for her to decide which university to attend and pick a major, Cochran — who is the first person in her family to attend college — wasn't sure what she wanted to do. So she enrolled at the University of Georgia and took a few classes in computer science and upper-level math. She quickly realized that she liked this combination, and began researching fields that use these skills. That exploration led her to industrial engineering. And where better to study it than Georgia Tech's No. 1-ranked H. Milton Stewart School of Industrial and Systems Engineering (ISyE)?

It was a no-brainer.

"When I transferred to Tech, I knew I was where I needed to be," Cochran said. "There's a difference in the way people think here — both the students and the teachers. Everyone is chasing really big dreams. Everyone is trying to put their best out there. So I just dove right in."

At ISyE, Cochran was solidly on a consulting career trajectory, including an internship and co-op with Delta Air Lines. Then one day her friend and fellow ISyE student, Kendall McRae (BSIE 18), came home frustrated by a sloppy salon manicure. "Her nails



LANCE DAVIES

From left: VAILS co-founders Kendall McRae and Brianna Cochran

weren't the shape she wanted, the color wasn't the color she wanted, and it took hours for the application." Cochran said. "She had spent all this money and didn't like the results."

The experience got Cochran thinking. While maintaining a solidly STEM

focus, she also saw fashion and beauty as an important means of self-expression. "Everyone's entitled to look how they want," she insisted. "It's very important for your confidence, for your sense of identity, for being comfortable in your own skin. It's something I do for me."

Cochran saw her friend's situation as a problem. And industrial engineers are problem-solvers.

At the time of McRae's unfortunate salon experience, she and Cochran were both enrolled in a mechanical engineering special topics class on additive manufacturing. Cochran had a brainstorm: If people could use an app to design and 3D-print artificial nails to their personal specifications, then experiences like McRae's wouldn't happen. When Cochran learned that the U.S. nail industry is worth \$8 billion annually, she became even more convinced that her idea had merit. By the end of the semester, she had persuaded McRae to join her, and together they founded VAILS (Virtual Nails).

She and McRae have designed VAILS to be water soluble, sealed with a waterproofing coating, and 100% personalized by the user using augmented reality. In addition, VAILS can be applied and removed without using the harsh, nail-damaging, and environmentally unfriendly chemicals common in salon applications of acrylic nails. They also intend for VAILS to be an inclusive product.

"We don't like how the nail industry typically targets women," Cochran said. "We want VAILS to be a means of self-expression for everyone."

The duo knew that to make VAILS a successful company, they would need to combine their industrial engineering knowledge with business savvy. They enrolled in CREATE-X's Startup Launch, Georgia Tech's program for student entrepreneurs, and received \$20,000 in seed funding along with the necessary legal advice to help budding entrepreneurs start their companies. As part of the process, they showed VAILS to a

celebrity nail stylist who immediately became interested in their product.

But Cochran and McRae felt that VAILS still wasn't quite ready to share with the world. They wanted to build on the Startup Launch experience. That was when Cochran discovered that the Fulbright Scholarship program funded a University College London's master's degree in entrepreneurship. The program is practical and hands on, and Cochran would be able to continue actively developing VAILS as part of her studies.

Once again, the next step seemed obvious.

McRae was the first person Cochran called when she learned she had been chosen for the prestigious award. This past September, Cochran moved to London to begin her studies. She's enrolled in the program's Technology pathway, which is for students who intend to develop high-impact services and products that take advantage of emerging technologies.

"The faculty encourage students to bring their startup ideas to class, so I won't have to separate my work from my academic life. I'll be able to integrate them, and this will make VAILS a stronger product," Cochran noted.

By the fall of 2020, Cochran and McRae expect VAILS to be ready to showcase.

"A product like this could change so many people's lives. We are reinventing how people do their nails," Cochran said.

She holds her future in her well-manicured hands. ■ SHELLEY WUNDER-SMITH

As of press time, VAILS has been patented. The product is still in the R&D phase. If you would like further information about VAILS, please contact Cochran and McRae at toughasvails@gmail.com.



Studying Sustainability in Barcelona

ISyE second-years Jacob Lewis and Hannah Whitlock spent the summer studying abroad with Georgia Tech's Spanish LBAT – Barcelona: Smart Cities program. Their classes focused on the connectivity of cities to smart technology, sustainable architecture, and how developing technologies have influenced public discourse and local identities within Spanish communities.

“The metro was the best part of the Barcelona experience — a piece of cake for foreigners to navigate! The system's

efficiency had me geeking out, making every ride a memorable one as part of our immersive experience,” noted Lewis. “Beyond this, our class content allowed us to pursue an ISyE curriculum, such as exploring how Barcelona functions as a smart city.”

Whitlock concurred. “The Science and Technology in Spain class that we took is a perfect introduction to systems, because we studied the efficiency of cities, buildings, and construction, and so much more,” she said. “As a result,

I'm even more excited to dive into my ISyE classes this year.

“One of the most beneficial aspects of a study abroad program is being able to take what you learn back to the United States and add a global context to your point of view. Barcelona's public transportation system is world class, and I can use what I have experienced here to consider how Atlanta's MARTA system — which so desperately needs reform — can be improved,” she added.

Lewis and Whitlock also welcomed the opportunity to engage fully with the Spanish language and culture. For the program's five weeks, each lived with a Catalanian family and took Barcelona-based cultural excursions during the week. They traveled to other parts of Europe — including Toulouse, Rome, Florence, and Amalfi — on the weekends.

“This program opened up a door for both of us to more deeply understand Barcelona and Spanish culture.

“Through our home stay, we were able to engage with fluent Spanish speakers every day, while eating typical Spanish meals, watching TV programs in Spanish, and participating in conversations about real-world issues,” said Lewis. “Through this program, we were able to make Spain our own, not only by exploring the landscape but also by exploring the language and getting to know the people around us.” ■ SHELLEY WUNDER-SMITH



Jacob Lewis and Hannah Whitlock visit Amalfi during a weekend trip to Italy.

Putting ISyE Skills to Good Use

Through an earth sciences class she took in fall 2018, ISyE third-year Camila Gonzalez learned about the devastating environmental impacts that will result from climate change. She began thinking about how she could apply her classroom knowledge in a way that would make a positive contribution to the environment. When she found an internship with Southface Institute offered through Georgia Tech's Serve-Learn-Sustain program, Gonzalez knew this was how she wanted to spend her summer.

Atlanta-based Southface Institute is an organization that promotes sustainable development and green building through education, research, and technical assistance. Specifically, Gonzalez worked with the GoodUse team. This particular team handles Southface's projects that help nonprofits with funding and technical assistance for energy and water efficiency upgrades, to transform facilities into greener and more self-efficient spaces while reducing the costs of energy and water consumption.

When assigned a project, the GoodUse team goes through a lengthy process of application reviews, measurements and audits, calculations, and writing reports. Gonzalez's role was to standardize this process, as well as maximize its efficiency and precision.

"I incorporated everything into a cloud-based automated system that filters all the information and then creates a sheet that contains all the immediately necessary information," she explained. Gonzalez used what she learned from



Camila Gonzalez at Southface headquarters

her college classes in statistics and data manipulation to complete this project.

Southface was pleased with the results. "Camila has a clear passion for efficiency and systems thinking, which is evident in her everyday work," said Haven Bills, the community impact program assistant. "She worked hard to bring new and innovative ideas to the table and to increase efficiency in our work at Southface. Camila always strives for success, and we are grateful for what she has brought to the company."

The internship further heightened Gonzalez's interest in climate change and sustainability. "I learned so much about how a building — or any

infrastructure — can save energy," she noted. "I also came to appreciate how certain buildings on Georgia Tech's campus, such as the Clough Undergraduate Learning Commons, are energy efficient. And of course there is the Kendeda Building, which is the most energy efficient building in the Southeast.

"Technology is not inherently an enemy of nature, but the way humans use technology can damage nature," Gonzalez added. "What I wanted to do is show that we can merge technology with nature, and that's the future. That's what I was doing in my internship with Southface, and it's something I want to continue to be a part of." ■ SHELLEY WUNDER-SMITH

Applying Data Analytics to Rail Infrastructure

Osman Ghandour, ISyE fourth-year, spent his summer completing a global internship with Siemens Mobility GmbH in Berlin. The core areas of the separately managed company of Siemens AG are rolling stock, rail automation and electrification, turnkey systems, intelligent traffic systems, and related services. Ghandour was working for the data analytics team of the rail automation R&D department. The team develops digital value-added services based on Internet of Things data coming from trains and rail infrastructure.

As an example, for automatic train operation it is important to exactly identify where the train is currently located. The trains and the train track are all fitted with sensors. Sensor data goes to the data analytics center, where the team develops a model-based solution to identify anomalies and issues in the train odometry system. Part of Ghandour's role was to facilitate this process for regional passenger trains.

"Siemens wants to be able to take all this data and know whenever a specific part of its system starts to fail, such as analyzing signs that lead to a signal or track failure. It wants to have full insight into how the system is performing at all times," Ghandour explained.

To accomplish this, he used skills he has acquired at Georgia Tech. A data manipulation class (CS 2316) that is mandatory for all ISyE students taught him Python, a programming language for data analysis. In addition, he participated in the Vertically Integrated Projects program on a team working with ISyE A. Russell Chandler III Chair and Professor Pascal Van Hentenryck to optimize MARTA's bus system. [See the article about Van Hentenryck's MARTA project on page 10.]



Osman Ghandour in front of the Brandenburg Gate in Berlin

"The optimization model for MARTA presents its own challenges. Figuring out how to configure the data that will be plugged into the model can be time-consuming and difficult," Ghandour noted. "So deciphering how to use each part of the data was very useful for what I did in my internship."

"Osman helped us evaluate a hypothesis involving new ways to analyze odometric data to identify

new patterns of anomalies," said Steven Calder, senior data scientist at Siemens Mobility. "His questions and ideas were so insightful that they were helpful for even much more experienced colleagues."

Ultimately, Siemens Mobility wants to take the model Ghandour's team worked on and implement it in trains so train drivers have the most updated information. ■ SHELLY WUNDER-SMITH

The Problem with Solutions

BY MORGAN KNOWLTON

Engineers solve problems, and we have become too content with that. We need to renew our focus toward identifying needs along with solving impactful problems.

The foundations for this reflection were laid when I started volunteering at LaAmistad, an Atlanta-based program founded by a former Georgia Tech student that offers after-school tutoring for Latino students. A semester later, a prototyping class through the Scheller College of Business served as the catalyst. When the professor tasked us with developing a product to address an unmet need, I jumped at the opportunity to leverage this assignment in support of LaAmistad. Our team decided to switch topics a few weeks into the semester, but I was able to continue the original project independently through the Ideas to Serve (I2S) competition.

The I2S competition is hosted by the Scheller College of Business, but its principles and values align with the heart of industrial engineering. This past year the competition embraced its mantra of “Know What You Don’t Know” by dedicating more than half of the competition to the Problem Discovery track. In this track, students are evaluated on their comprehensive understanding of a social or environmental issue without the pressure of generating a solution. This approach strongly echoed the prototyping course, in which the professor cautioned (much to the amusement of his students) that if we had a solution before eight weeks he “didn’t want to hear it.” I was surprised by the shift in emphasis from my typically solutions-focused engineering classes, yet I recognized that this methodology

was highly reminiscent of my extracurricular industrial engineering training. For instance, Lean Six Sigma Green Belt training focuses on root-cause analysis, and Band-Aid solutions were purported as Public Enemy No. 1 in my process improvement internship.

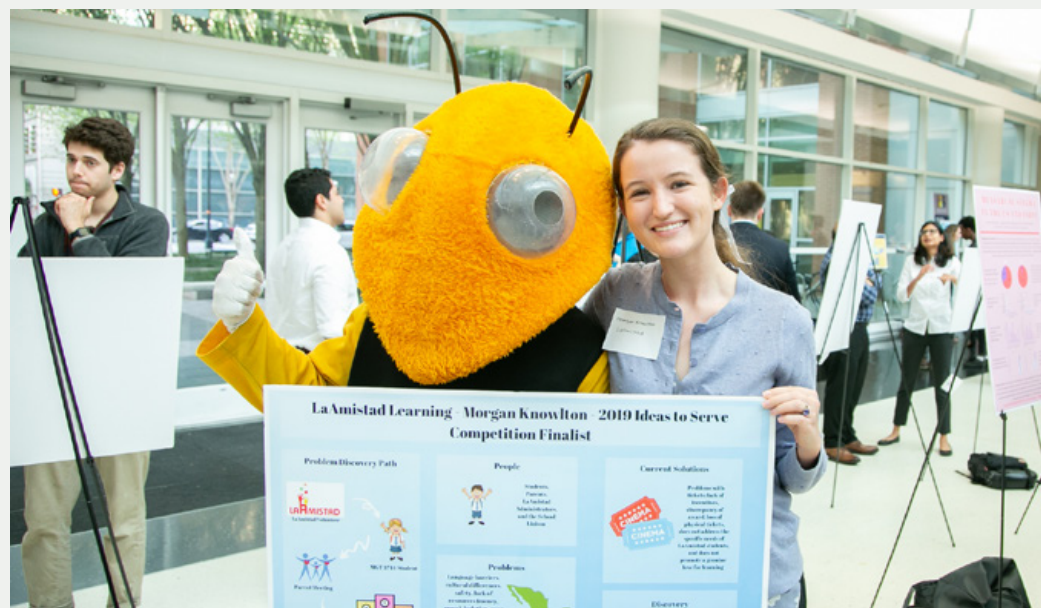
This idea plays on a common criticism of engineers today: We can design whatever we dream, but our dreams do not perform in the market because we fail to sufficiently understand consumers. As a proud engineer, I fell for the folly. The first step in my problem discovery journey was speaking with the families supported by LaAmistad. I attempted to go into the parent meeting with an open mind, but in my head I was already designing solutions to alleviate a space constraint faced by some of the students.

Pursuing that idea would have been a huge mistake because I would have missed the overarching issue. Over the nearly two-hour meeting, I repeatedly heard that the parents’ biggest frustration was truancy. The training of the

I2S competition helped me discover this underlying issue so that I can develop an impactful solution.

Ultimately the problem is not with solutions, but so-called solutions based on underdeveloped problem discovery. Most of the world rushes through the problem discovery phase, which can lead to temporary or even incorrect solutions. I love that the I2S competition is teaching students that comprehensive problem discovery is critical to problem-solving, and my goal is to spread this message to Georgia Tech and LaAmistad students. ■

Morgan Knowlton is a fourth-year ISyE undergraduate student concentrating in economic and financial systems. For the 2019-20 academic year, Knowlton is interning in the Disney costuming department in an industrial engineering role. She plans to return to Georgia Tech and to volunteering with LaAmistad in fall 2020, where she will develop solutions for the organization’s challenges.



Associate Professor Mohit Singh Leads Algorithms & Randomness Center

The Algorithms & Randomness Center (ARC) is known as Georgia Tech's "think tank" for the theory of computing and optimization. ARC is an Interdisciplinary Research Center (IRC) at the intersection of engineering, math, and computer science. Mohit Singh, H. Milton Stewart Early Career Professor and associate professor in the H. Milton Stewart School of Industrial and Systems Engineering (ISyE), is ARC's new director.

"ARC brings faculty together around common problems within the three fields," Singh explained. "The aim of the center is to utilize ISyE's strength in optimization and probability, graph theory from mathematics, and algorithms from computer science. ARC is a forum for faculty knowledge, where those of us working on similar problems can collaborate and act as a force multiplier."

Optimization has classically branched into two distinct subfields of continuous and discrete optimization progressing on close but distinct directions. Recent exciting developments have found interesting bridges between the two fields, and ARC-associated faculty have led many of these developments. Such bridges are finding applications in sampling algorithms, approximation algorithms, and classical problems such as maximum flow in networks or discrepancy problems in discrete mathematics. ARC-associated faculty are also focusing on optimization problems in machine learning that involve fairness.

"What is fairness?" asks Singh. "That's actually a major research question, and the definition of fairness is based on the different contexts in which it is studied." Fairness in classical optimization problems has been studied



LANCE DAVIES

for decades, while more recently academicians have been examining statistical notions of fairness.

For example, a data set might consist of thousands of images of both men and women, with these images represented as vectors in huge dimensions. In order to process this data more quickly, it can be reduced to much smaller dimensions, which lends itself to some loss of data. The loss is comparatively small, and on average a typical image is still well preserved, but Singh's students found that most of the images experiencing loss are images of women.

"I don't care about average loss, such as how much of my image is retained from large dimensions to small dimensions," said Singh. "But ideally I want the loss to be about equal between images of men and women. So what are the new algorithms that will accomplish this?"

Singh has been working on algorithmic problems since he was a Ph.D. student in the Algorithms, Combinatorics,

and Optimization (ACO) program at Carnegie Mellon University's Tepper School of Business. (In fact, Carnegie Mellon and Georgia Tech are the only two schools to offer an interdisciplinary ACO graduate degree.) His role as ARC's director is a natural fit.

In this capacity, he helps bring in postdoctoral students who are helping drive the center's cross-disciplinary research. Singh is planning to strengthen ARC's close partnership with TRIAD (Transdisciplinary Research Institute for Advancing Data Science); the two centers have already jointly funded six to eight research proposals from young Ph.D. students. Singh is also planning continued collaborations with other Georgia Tech IRCs, such as the Center for Machine Learning and the Institute for Data Engineering and Science.

"These centers are studying some of the most exciting and influential research areas, in alignment with ARC, and we are looking forward to continuing to work with them closely," added Singh. ■ SHELLY WUNDER-SMITH

Professor Brani Vidakovic Serves as NSF Statistics Program Director

Most weekday mornings, Brani Vidakovic gets up and walks two short blocks to the National Science Foundation (NSF), the independent federal agency “tasked with keeping the U.S. at the leading edge of discovery in areas from astronomy to geology to zoology.” With an overall budget of \$8.1 billion in FY 2019, the NSF is the main source of federal funding for many fields, including mathematics and engineering.

Vidakovic, a jointly appointed professor in the H. Milton Stewart School of Industrial and Systems Engineering and the Wallace H. Coulter Department of Biomedical Engineering, is spending two years as a rotating program director for the NSF’s statistics program at the foundation’s Alexandria, Virginia, headquarters, just a few miles from the nation’s capital.

“About half of the NSF’s program officers are ‘rotators’ from academia,” he explained. “And the rotators are a link between the academic scientific community and the NSF. This helps the vibrancy of the NSF.”

The NSF, created by Congress in 1950, is the federal government’s primary organization for advancing STEM-related fields. The NSF processes 11,000 grant proposals per year, and this total includes more than 300 within the statistics program.

One of Vidakovic’s chief responsibilities — together with the other three statistics program directors — is to put together and lead the review panels for these funding requests. The panelists act in an advisory capacity for the



statistics program directors by evaluating and ranking grant proposals.

A significant portion of Vidakovic’s time is spent recording the decision-making process, writing detailed records justifying these decisions, and communicating with grant applicants.

“This is especially important,” he said, “because the funding comes from the public. We have to be good stewards of taxpayers’ money. Every step of the award process is documented to ensure that the process is fair and unbiased and based only on the intellectual merits and broader impacts of the proposal. We take this responsibility very seriously.”

Vidakovic’s own research in applied statistics focuses on high-frequency data, Bayesian inference, and statistical learning. Examples of this are

statistical models of high-frequency atmospheric measurements, and medical diagnostic applications involving EKG signals or digital mammography. By serving as an NSF program director, he is able to observe cutting-edge research that may impact his own work.

“There is a time-honored link between the statistical and machine learning communities, and a recent opportunity is a joint effort on understanding what is going on under the umbrella of ‘deep learning,’” Vidakovic noted. “Why deep learning algorithms work miraculously well is still not well understood, and recent efforts by statisticians, mathematicians, and computer scientists aim to open this ‘black box.’”

Vidakovic has one more year as an NSF program director, and then he will return to Georgia Tech to work on some of these very questions. He’s also looking forward to sharing his expertise in terms of NSF funding opportunities and grantsmanship to help colleagues — especially new researchers and graduate students within the larger Georgia Tech community — submit more competitive grant proposals.

“The research landscape for the field of statistics is dynamic and increasingly interdisciplinary. There are emerging challenges. In addition to big data initiatives, uncertainty assessment and modeling in the areas of artificial intelligence, quantum computing, geosciences, genetic mechanisms, and data quality and privacy are likely to be hot topics,” Vidakovic concluded. ■

SHELLEY WUNDER-SMITH

In Memoriam



Shabbir Ahmed

Shabbir Ahmed

Shabbir Ahmed, Anderson-Interface Chair and professor in Georgia Tech's H. Milton Stewart School of Industrial and Systems Engineering (ISyE), passed away on June 19, 2019. Ahmed was a valued ISyE faculty member who made important contributions to optimization theory, methodology, and applications.

In particular, Ahmed led the way in integrating two challenging methodologies — stochastic and integer programming — that are essential for solving problems in energy distribution, supply chain, transportation, and finance. His most-cited paper, “A Stochastic Programming Approach for Supply Chain Network Design under Certainty,” has over 960 citations on Google Scholar. This was the first paper that designed methodology for solving large-scale stochastic supply chain design problems with a huge number of scenarios by integrating the sample average approximation scheme with an accelerated Benders decomposition algorithm.

From the earliest days of his academic career, Ahmed won accolades for his groundbreaking ideas. He received

the INFORMS Dantzig Dissertation Award (2000) and a CAREER Award from the National Science Foundation (2002).

Ahmed joined ISyE in 2000, where recognition of his accomplishments continued. He received the IBM Faculty Award in both 2002 and 2005, the 2017 INFORMS Computing Society Prize, and the 2018 Farkas Prize from the INFORMS Optimization Society. [Additional information about Ahmed's most recent award is on page 36.] In 2014 he was appointed as both an ISyE Stewart Faculty Fellow and a College of Engineering Dean's Professor. He was a Senior Member of IEEE and an INFORMS Fellow.

In addition to his academic rigor, Ahmed was regarded as a gracious collaborator and mentor. Over the course of his career, Ahmed advised a number of award-winning undergraduate Senior Design teams, as well as 26 Ph.D. students.

Ahmed earned a B.Eng. in mechanical engineering from Bangladesh University of Engineering and Technology in 1993, and his M.S. and Ph.D. in industrial engineering from the University of Illinois Urbana-Champaign in 1997 and 2000, respectively.

He was devoted to his family and is survived by his wife, Rasha, and two daughters, Raeeva and Umana.

William “Bill” Hines

Professor Emeritus William “Bill” Hines passed away on June 25, 2019.

Hines received a B.S. in mathematics from Memphis State University in 1954. After serving in the Air Force for several years, he earned both a master's degree (1958) and a Ph.D. (1964) from ISyE.

Hines served on the ISyE faculty for several decades. It was during his stint as associate chair for graduate studies — a position he held from 1968 to 1996 — that ISyE was first ranked as the No. 1 graduate industrial engineering program.

He co-authored a popular and long-used textbook, *Probability and Statistics in Engineering*. In addition, Hines served as an early editor-in-chief of *AIIE Transactions*, which eventually became *IIE Transactions*.

Hines is survived by his wife of 59 years, Gayle; his sons William and Matthew; and a grandson, Nathaniel. His daughter, Jennifer, predeceased him.

Michael “Mike” Thomas

Professor Emeritus Michael “Mike” Thomas passed away on Nov. 23, 2018. Thomas had a profound influence on Georgia Tech during his more than 24 years with the Institute. He served in various leadership roles that included chair of ISyE and provost and vice president of academic affairs.

Thomas joined ISyE as school chair in 1978 and used his exceptional faculty recruiting skills to help elevate ISyE to a top-ranked program. According to his many friends and former colleagues, Thomas’ greatest strength was his unique ability to identify and attract the right academic talent to ISyE. This included numerous faculty members who became leaders in their respective fields and many of whom were eventually elected to the National Academy of Engineering — one of the highest distinctions an engineer can achieve. The top-tier faculty, along with a revamped curriculum, helped propel ISyE to the No. 1 program of its kind.

Thomas left ISyE in 1989 to join the President’s Office as acting executive vice president, responsible for overseeing Georgia Tech’s academic restructuring. This effort resulted in the formation of three new colleges and numerous degree programs. In 1996 he was named provost and vice president for academic affairs, where he oversaw all academic and most administrative areas for the Institute. Thomas retired in 2002.

In addition to his successes as an administrator, Thomas was a leader in his field and received numerous awards. He received the George E. Kimball Medal; was elected a Fellow of both INFORMS and the Institute of Industrial and Systems Engineering; headed the Industrial Engineering Society; was made an honorary alumnus of Georgia Tech; and received the Dean’s Appreciation Award from the College of Engineering at Georgia Tech.

Thomas earned a Ph.D. in operations research at Johns Hopkins University and attended the University of Texas at Austin, where he received B.S. and M.S. degrees in chemical engineering. He is survived by his wife, Patricia; children Michelle Barber, Teresa Genoway, Kevin Gue, Rebecca Maclean, and Kathleen Pappa; and 22 grandchildren. ■



William “Bill” Hines



Michael “Mike” Thomas

ISyE Distinguished Lecture Series, Named for LeeAnn and Walter Muller, Presents Stanford's M. Elisabeth Paté-Cornell

In 2008, the H. Milton Stewart School of Industrial and Systems Engineering (ISyE) established the Distinguished Lecture Series to promote discussion on critical issues in the fields of industrial and systems engineering by bringing in prominent scholars and business leaders who engage and share their expertise with students, faculty, and alumni.

In 2018, thanks to a generous gift from LeeAnn and Walter Muller, it became the LeeAnn and Walter Muller Distinguished Lecture Series.

Walter J. Muller retired in 2017 after a 27-year career at Bank of America. In 2007, he was appointed chief investment officer for Bank of America after serving as a quantitative finance executive, where he supported the bank's quantitative finance efforts for its corporate treasury and risk management departments. Walter served as chief investment officer for 10 years.

He graduated from Benedictine Military School in 1975 and earned B.S. and M.S. degrees in economics from the University of Georgia. In 1983, he received a Ph.D. in applied economics

and finance from the Sloan School of Management at the Massachusetts Institute of Technology. LeeAnn has a BBA and an MBA, both from the University of Georgia.

The Mullers currently reside in Atlanta and their daughter, Grace, is a second-year ISyE student.

The speaker for ISyE's 2019 LeeAnn and Walter Muller Distinguished Lecture was Stanford University's M. Elisabeth Paté-Cornell. Paté-Cornell presented "Cyber Risk Analysis: Three Aspects of Model Formulation in Support of Risk Management."

She is the Burt and Deedee McMurtry Professor in the School of Engineering and was the founding chair of the department of management science and engineering (MS&E) at Stanford University. She is also a Senior Fellow (by courtesy) of the Stanford Freeman Spogli Institute for International Studies.

Paté-Cornell's specialty is engineering risk analysis, with applications to complex systems (space, medical, offshore oil platforms, etc.). Her research



M. Elisabeth Paté-Cornell

has focused on the optimization of warning systems and on the inclusion of human and organizational factors in the analysis of systems' failure risks. Her recent work is on the use of game theory in risk analysis, with applications that include counterterrorism, nuclear counter-proliferation, and cybersecurity. She is a member of the National Academy of Engineering, the French Académie des Technologies, the Naval Post-Graduate School Advisory Board, the NASA Advisory Council, and Draper Laboratory Corporation.

She holds a B.S. in mathematics and physics from Marseille (France), an engineering degree in applied math/CS from the Institut Polytechnique de Grenoble (France), and an M.S. in operations research and a Ph.D. in engineering-economic systems, both from Stanford University. She was an assistant professor of civil engineering at MIT (1978–81); a faculty member and then chair of the department of industrial engineering and engineering management at Stanford University; and chair of the new MS&E department at Stanford from 2000 to 2011. ■



School Chair Edwin Romeijn (center) with LeeAnn and Walter Muller

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Are you interested in collaborating with us? The H. Milton Stewart School of Industrial and Systems Engineering (ISyE) welcomes your engagement and offers many ways to get involved. ISyE works closely with business and industry leaders on a variety of research and projects, as well as student enrichment activities. You can also connect with ISyE through sponsorships and philanthropy that both brings the best education possible to our students and supports our faculty as they tackle research issues that improve quality of life for all.

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ISyE undergrad and Yellow Jackets cheerleader **Wilson Harmond** (BSIE 18) proposed to his girlfriend and fellow cheerleader **Dana Francisco** (ChBE 19) on Grant Field at the last home football game of the 2018 season.

Harmond and Francisco will wed on November 23, 2019.

