GEORGIA TECH

# ENGINEERS

Vol. II, Issue II

Spring 2015

## STARTUP DIARY:

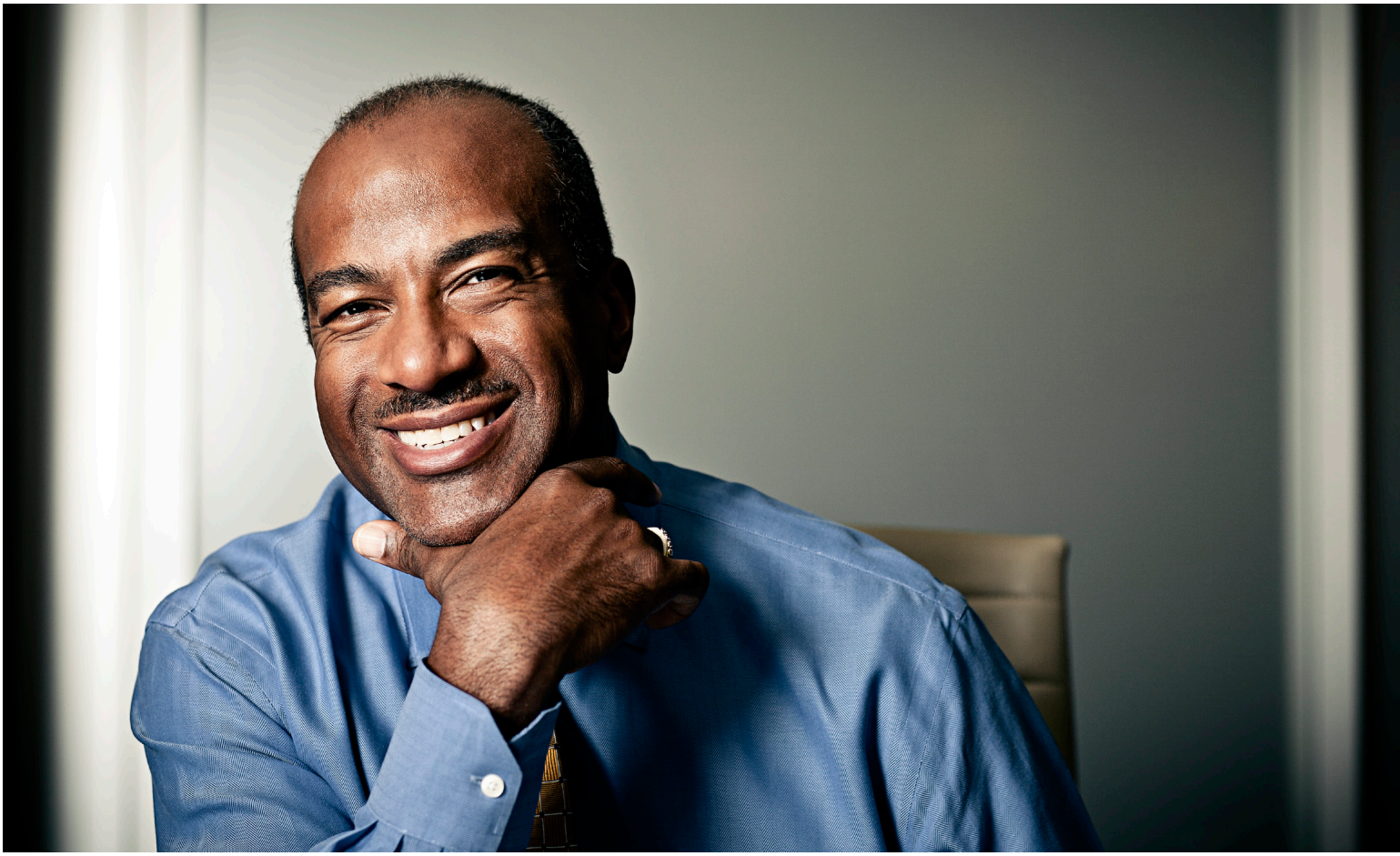
## Georgia Tech helps fuel car app FIXD

FEATURE

Chatting with Juan Carlos Varela, IE alum and president of Panama

**Mission Statement**

*Georgia Tech Engineers strengthens the bonds between CoE's students, faculty, staff, alumni and friends by sharing the stories that link them. CoE is Georgia Tech's largest college, and Georgia Tech Engineers promotes a sense of community among its diverse members. While the magazine showcases research and study, it also focuses on the people behind those endeavors, reminding everyone in the College what makes it exemplary.*



NICK BURCHELL

Dear Friends of the College of Engineering,

Every engineering student is required to complete a senior (or "capstone") design project in order to graduate. Several years ago, we decided to start displaying these projects in a Capstone Design Expo, a judged showcase of the senior projects across multiple disciplines. Recently, fall's Expo took place in McCamish Pavilion.

Three things stood out to me during the Capstone Expo. One was the increasing number of interdisciplinary teams (made up of both College of Engineering seniors and students from other disciplines). I was also impressed by the number of projects supported by both companies and individual sponsors. Finally, the essence of innovation and creativity, which is a hallmark of our curriculum, was evident in the breadth, depth, and range of the projects presented by these graduating seniors. In this issue, you can read more how innovation is making its mark within the College.

The rise in interdisciplinary teams certainly reflects what industry does in bringing together teams to solve problems. Perhaps in supporting teams, sponsors are realizing what one judge meant when he said that "if you ever want to learn what our future technology pioneers are doing, go to the next Capstone Design Expo at Georgia Tech. It will make you feel better about our newest graduates and engage you with a myriad of technological insights."

Capstone also represents one aspect of our approach to active learning, honing in on the concept that there is greater value to learning by doing. Students involved in Capstone acquire and fabricate hardware to create working prototype inventions, just as they would in a company. Beyond building something real, they learn about managing group dynamics, meeting project schedules, and providing weekly deliverables.

A good number of the students continue to work on their projects following each Expo. Some will form companies, and others will file patents. There will another Capstone Expo in the spring. As alumni and friends of the College of Engineering, you are welcome to attend the event, and I urge you to do so. I think you will be amazed at the entrepreneurial spirit that shines so brightly within the College.

Gary S. May, Dean

No matter what kind of engineering you're interested in, the College of Engineering probably has a program for you. Did you grow up dreaming about space exploration? OK, we've got you covered. Curious about the future of clean energy? We can take care of that, too. As one of the largest engineering programs in the country, the College offers specialties that cater to almost every interest.

But what I find exciting is the growing array of opportunities our engineers find — or create — after graduation. There are plenty of ways to be an engineer these days, and this issue of Georgia Tech Engineers will introduce you to a few of them.

Our cover story is about Trevor Larsen, a two-time CoE alumnus who's spent his career at Disney. He's done work for famous rides like Space Mountain, and the sheer fun in his job will leave you smiling.

You'll also meet some more recent CoE grads who are putting their skills to novel uses. Maybe you've already heard of Rob Rhinehart, who's appeared on "The Colbert Report" and been written about in The New Yorker. He created Soylent, a drink he says could change the future of food, and he's also a graduate of the School of Electrical and Computer Engineering. Meanwhile, our story on past InVenture Prize finalists features enterprising alumni from all over the college.

Whether you take a job offer from your dream company or strike out on your own to build a startup, it's a good time to be a Georgia Tech engineer.

**Lyndsey Lewis**
editor@coe.gatech.edu

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# ENGINEERS

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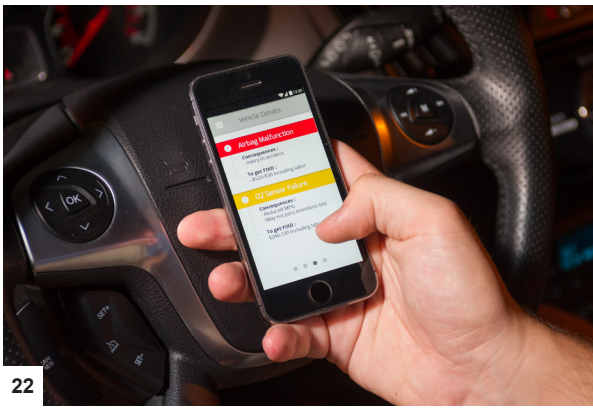
## FEATURES





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## DEPARTMENTS



## DEPARTMENT GUIDE

Here's a look at some of the sections you'll see in this issue of Georgia Tech Engineers and others:

**SYLLABUS**
CoE is a giant college spanning a broad array of disciplines. In Syllabus, we spotlight one of the College's programs.

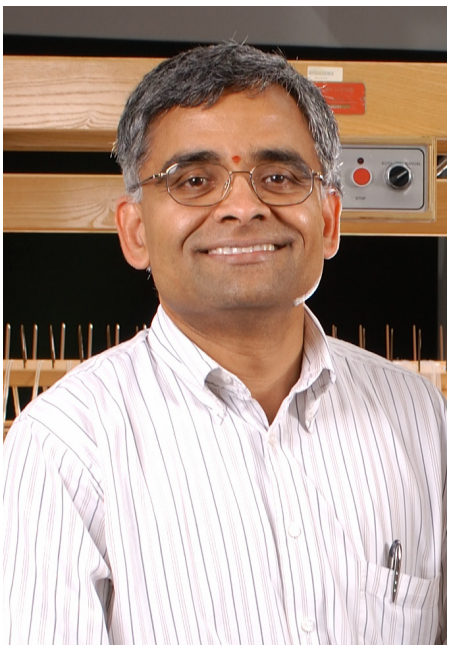
**FIRST PERSON**
A member of the CoE community speaks in his or her own words.

**OUTLIERS**
Engineers are more than just their work, and some of them have interests or hobbies you might never expect.

**BRIGHT IDEAS**
Learn about the innovations that define engineering at Georgia Tech.

**MAKING IT HAPPEN**
We look at how CoE students, alumni, and faculty turn their lofty ambitions into reality.

**GOING GLOBAL**
Our engineers work around the world, and we chronicle their successes abroad.



ROB FELT

## CRAFTed With Pride in the USA Receives $2 Million

A Georgia Tech project that would create an automated manufacturing process was recently awarded $2 million from Walmart, the Walmart Foundation and the United States Conference of Mayors.

Led by Sundaresan Jayaraman, Kolon Professor in the School of Materials Science and Engineering (MSE), the project is called CRAFTed with Pride in the USA. It is based in Georgia Tech's Center for Research in Apparel Fabrication Technologies, or CRAFT.

The award is part of Walmart U.S. Manufacturing Innovation Fund. Researchers at CRAFT are collaborating on an automated manufacturing process to create apparel, from blue jeans to T-shirts, without a person sewing. The technology plan is to use robotics, high-speed machine vision systems and materials-handling machines to create garments of a higher quality and at a lower cost than what is currently made through offshore manufacturing.

"The Walmart Foundation's U.S. Manufacturing Innovation Fund grant gives us the unique opportunity to transform the labor-intensive apparel manufacturing process into a cost-effective, automated and high-tech operation," said Jayaraman, the principal investigator on the project.

– Laura Reilly

## Pendyala Joins CEE as New Dickerson Chair


JESS HUNT

Ram Pendyala joined the School of Civil and Environmental Engineering (CEE) in the fall as the new Frederick R. Dickerson Chair in Transportation Systems.

Pendyala, a widely recognized expert in next-generation tools for transportation planning, comes east from the Phoenix area, where he was a professor at Arizona State University.

"This was an opportunity for me to join a very reputed and larger transportation group that is home to a couple of university transportation centers, has a long history of undertaking cutting-edge research, and has a very close working relationship with Georgia Department of Transportation as well as other agencies," Pendyala said. "It just seemed like a great opportunity to be able to collaborate with several colleagues working in different domains and see what might be possible."

Pendyala's work focuses on developing and refining new mathematical models that help planners decide what transportation infrastructure their communities need in the years to come. He's trying to create models to simulate the activity and travel patterns of an individual or single household.

That kind of high-resolution modeling means travel predictions would be more accurate.

– Joshua Stewart

PHOTOG?

## ECE's Ougazzaden Awarded Medal of Metz

College of Engineering professor Abdallah Ougazzaden was recently awarded the medal of the city of Metz.

The presentation of the medal was preceded by a speech that highlighted Ougazzaden's main contributions to the city over the past 10 years. These contributions included leadership in the creation of L'Institut Lafayette in Metz and 17 years of industrial experience, which prompted city growth. Ougazzaden was also part of creating the international lab UMI GT-CNRS in Metz, which allows researchers to collaborate with the best teams in other countries.

The event in honor of Ougazzaden was attended by many of his academic and industrial partners, local authorities, Georgia Tech-Lorraine colleagues and family members.

Ougazzaden joined the School of Electrical and Computing Engineering faculty in 2005 and was appointed director of Georgia Tech-Lorraine in 2010.

– Jordan Shields

## Dimitri Mavris Named Regents Professor

KATHLEEN MOORE

The Board of Regents this fall approved the nomination of longtime aerospace engineering professor Dimitri Mavris to the position of Regents Professor.

The director of AE's Aerospace Systems Design Lab (ASDL), Mavris is known for emphasizing academic excellence among the many graduate students he advises. He regularly authors journal and conference papers with his students, and, over the last 10 years alone, has involved more than 200 research faculty, master's and doctoral students in more than $125 million worth of research in new methods and tools.

"The greatest accomplishment, really, is the opportunity I've been given to develop people," said Mavris, who also holds the Boeing Professorship for Advanced Aerospace Systems Analysis. Mavris earned his undergraduate and graduate degrees from Georgia Tech. His research has focused on the formulation, development and implementation of comprehensive approaches to the design of affordable high-quality complex systems using visual analytics.

– Kathleen Moore

## CoE Alum Paves Way for Natural Gas at Anheuser-Busch

College of Engineering alumnus Billy Lawder recently led the charge for Anheuser-Busch to replace a diesel tractor fleet in Houston with compressed natural gas powered tractors.

The fleet is expected to reduce 2,000 tons of carbon dioxide emissions per year, and the lighter engines are expected to emit 23 percent less greenhouse gases compared with diesel. Lawder's team worked to lessen environmental impact while increasing cost savings.

Lawder graduated from Georgia Tech in 2002 with a B.S. in industrial engineering. He is Anheuser-Busch's director of transportation engineering.

The decision to convert the Houston fleet was made because of its central location to Anheuser-Busch's facilities and distributors as well as its proximity to fueling stations, according to James Sembrot, the company's senior director for transportation.

Anheuser-Busch collaborated with Ryder System, Inc. to make the switch, and Dennis Cooke, president for global fleet management solutions for Ryder, said, "We commend the Anheuser-Busch team for their leadership and decision to convert their entire Houston brewery fleet to cleaner, more efficient natural gas."

Lawder's team has jump-started Anheuser-Busch's plan to reduce carbon emissions in its logistics operations from network planning, transportation, and warehousing by 15 percent by the end of 2017.

– Jordan Shields

## Brand Assumes Top Post at Institute for Electronics and Nanotechnology


GARY MEEK

Oliver Brand, a professor in the School of Electrical and Computer Engineering, has been named executive director of the Institute for Electronics and Nanotechnology (IEN), one of nine interdisciplinary research institutes (IRIs) at Georgia Tech.

In his new post, Brand leads an IRI that unites a wide range of faculty, research centers and shared-user laboratories working in the complementary fields of electronics and nanotechnology. This combination of infrastructure and interdisciplinary research seeks to fortify Georgia Tech's expertise in microsystems, advanced semiconductors, photonics and photovoltaics, electronics design, microelectronics packaging, and systems integration, while stimulating new and emerging application areas in biomedicine, energy, and nanomaterials.

"I view my most important task as that of enabling our faculty — maximizing their research involvement opportunities and prospects," said Brand, who was awarded the executive position after a nationwide search. "IEN's job is to help enhance interdisciplinary research at Georgia Tech, and at the same time promote industry-sponsored projects that offer opportunities to develop applications and products in electronics, nanotechnology and related fields, while accelerating new discoveries into the marketplace."

Interdisciplinary research institutes are inclusive units that help connect and support Georgia Tech's 200-plus research centers and laboratories.

– John Toon


BARBARA CHRISTOPHER

## ISyE Professors Cofound Health Analytics Group

When deciding on a plan in the world of healthcare, there is very little room for error — so collecting and using good data to drive decision-making is important.

To meet a demand for accurate knowledge, several faculty members recently assembled to form a health analytics group within Georgia Tech. The group brings together researchers and students who share a common interest in the field.

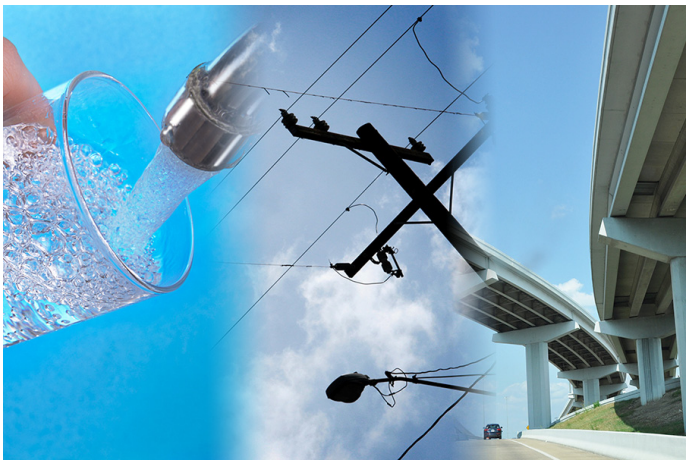
Nicoleta Serban, ISyE's Coca-Cola Associate Professor, and Julie Swann, ISyE's Harold R. and Mary Anne Nash Associate Professor, cofounded and co-lead the group. Its purpose is to conduct research and mentor students in data science methodologies to improve decision-making in healthcare delivery and public health. Approaches are based on rigorous modeling, mathematical standards, and advanced computing techniques, and they are anchored in real problems and questions in the health domain.

The team collaborates with scientists and decision-makers from many types of organizations including clinicians, large providers, public health entities, and private companies.

While the health analytics group is housed in the Stewart School of Industrial & Systems Engineering, it also has connections throughout Georgia Tech's Institute for People and Technology, the Center for Health & Humanitarian Systems, the School of Public Policy and the College of Computing.

– Barbara Christopher

# NSF Funds Project to Assess Connections between Infrastructure Systems



ISTOCK

The National Science Foundation (NSF) has awarded funding to a far-reaching multidisciplinary research project at Georgia Tech that will create a new approach to engineering the resilience of critical urban infrastructure.

The $2.5 million grant funds work stretching across nine schools at Tech, plus the Georgia Tech Research Institute. School of Civil and Environmental Engineering (CEE) Professor John Crittenden will lead the effort.

Using the metro Atlanta area as a test bed, the project will evaluate the idea that interconnected and decentralized infrastructure systems are more resilient than systems that are isolated and centralized.

The problem with current systems, according to the researchers, is that planners, officials and engineers tend to view water, energy and transportation systems as separate and independent. So there's no way to evaluate how the systems interact with each other and where problems might arise.

The project will devise a four-pronged method of assessing complex urban infrastructure as a whole. Researchers will use that method to measure how the systems respond to population growth and how they respond to the impacts of climate change.

The team also will create a simulation tool to use all of that data to forecast potential effects on services to end-users and help decision-makers choose how to invest in infrastructure.

All of the methods and models developed during the project will be incorporated into curriculum at Tech.

– Joshua Stewart

# ‘She Made Me Want to Attend Every Class’

## Encouraging women to take on engineering has personal resonance for Christine Valle.

*by* Kay Kinard

“Its math, not magic. Don’t make it harder than it is,” the instructor says. “This is all about techniques you can apply to solve a problem.” Pushing the 60 students in her statics class to overcome an obstacle, Christine Valle is formidable in front of the classroom.

Valle stands tall among the students; she is considered one of the best teachers in the College of Engineering at Georgia Tech. A circuitous route has led her from Paris to Georgia Tech to Maine and then back to Georgia Tech again (with other stops along the way). If you ask engineering faculty and students, they all would say that Tech is fortunate that Valle’s road led back to North Avenue.

In nominating Valle for a teaching award, a woman engineering student wrote: “She taught my statics class and showed a genuine interest in the subject material and the students. Every day she taught with enthusiasm and a true love for the subject. Her care for the students was contagious and she made me want to attend every class.”

Was she born to be a teacher? Actually, being an engineering professor was not originally on Valle’s professional radar.

“I really just fell into teaching. I did the Ph.D. because I had great advisors and the project was stimulating, but teaching was never my calling, never. It took me a long time to find my groove and fall in love with it,” says Valle. To this day, Valle’s family still teases her about being a professor. “I was not the kind of student you would like to have in the room. I was easily bored, I liked to sit in the back. I was not super respectful of my teachers.”

What makes Valle such a great teacher may be the fact that she was not a very nice student.

“I have sympathy for students who are disengaged, who have been pushed into engineering but whose hearts are not into it. I can relate to that,” says Valle. “As an engineering student, there is a certain ethos that if it isn’t super hard, it really isn’t engineering. I feel like it is my responsibility as a teacher to try to break the circle.”

Valle is quick to admit that when she first began teaching, all was not rosy. “I first taught mechanical engineering at the University of Maine. I was the only female professor in the department and even though I had good reviews, I had a full case of imposter syndrome, that I did not belong in the classroom,” Valle says. “I was so focused on the four or five students I was having trouble with that I forgot the 40-plus students who were doing fine.”

GARY MEEK

Giving in to doubts, Valle left Maine to work for an insurance company. During that time, she received emails from former students asking why she had left and telling her that she was a great teacher. When she left the insurance industry and came to Tech, Valle found what others had been telling her: that she is a good teacher.

Valle acknowledges that while in graduate school, she was oblivious to how women's experiences in engineering could be, but the workforce was a "real eye-opener." With this realization, Valle says that "over time I knew we can do more to support women engineers, and that might be of value."


ROB FELT

Valle presents the Helen Grenga Award to a student during the 2014 Student Honors Luncheon.

"I loved it here, and it cemented my decision to go back to teaching," Valle says.

She is still finding challenges in the classroom. She taught a statics class as a flipped classroom the past fall semester. Using the analogy of wearing a dress that you are designing at the same time, Valle explains that teaching a course differently takes adjustments.

"The traditional class feels very comfortable," Valle says. "The flipped class is more challenging. What is wonderful about the flipped class is that I get to see what the students do, how they really solve problems. The material I have to teach is so ingrained in me that I never even question that there is another way of looking at things. The students remind me that this is how a novice person sees things the first time they are going through it."

When not in the classroom, she is the director of the Women in Engineering (WIE) program, housed in the College of Engineering. While in the workforce, Valle came to the realization that there are some things that could be done to support more women engineers.

"When the WIE position opened up, I thought it would be interesting. I really want to make an impact on the pipeline. It is a sad fact: Women do as well as men or better in high school, but they still question their ability."

Valle acknowledges that while in graduate school, she was oblivious to how women's experiences in engineering could be, but the workforce was a "real eye-opener." With this realization, Valle says that "over time I knew we can do more to support women engineers, and that might be of value."

For Valle, getting more women into STEM is one of her most important challenges. She often accompanies female engineering students at K-12 schools to talk about engineering. The top question she gets from young girls is: "How hard is it, and am I really cut out for Tech?"

When Valle asks her female Georgia Tech students how they came to choose engineering, she says that "they overwhelmingly answer that it was a parent who pushed them and who said they were smart." Valle knows that boost needs to come from teachers and parents.

"Engineering is a good career for women. My advice to them is never give up and never doubt your abilities." ▪

# Life-Changing Letter Leads, Eventually, to London

## A civil engineering alumnus becomes a Marshall Scholar.

*by* Jacob Tzegaegbe, B.S. CE '11; M.S. CE '13

**I'll never forget the moment** I opened my Georgia Tech acceptance letter. Of the three schools I applied to, Tech was at the top of my list: my "reach" school. So, you can understand how surprised and elated I was to receive the news. At the time, I had no idea just how life-changing that single letter would be.

A Nigerian-Israeli first-generation American, I was daunted by the idea of enrolling in Georgia Tech's College of Engineering. I chose civil engineering as my major, despite never having actually met a civil engineer, because my father was in construction and the idea of building things seemed "cool." With this step, I not only became the first person in my family to attend college, but I ventured into an uncharted territory filled with college-level academics, athletics, student involvement, and research. Needless to say, I was overwhelmed.

After I arrived at Tech, it was not long before I began to meet exceptional faculty and staff through informal introductions and my courses. I quickly found myself surrounded by people who had accomplished more than any ambitions I held, and they were actively pushing me to strive for more.

Ultimately, it was the people — peers, advisors, faculty, and staff — at Tech who inspired me to aspire to be exceptional.

After two years on the Georgia Tech Swimming and Diving team, I gave up sports and picked up student leadership to challenge myself and grow in a different way. I learned lessons in resilience and determination as a student leader trying to make an impact on the campus through various positions — senior class president in Student Government, president of the Georgia Tech Student Foundation, and president of my fraternity, Alpha Phi Alpha.

Student leadership quickly translated to professional opportunities for internships. Before I knew it, I had already accomplished my longtime goal of becoming the first person in my family to earn a college degree and was well on my way to completing a master's degree in engineering.

From leadership experiences to internships in energy and management consulting, I've found that the skills I learned in my engineering classes carry me to success regardless of the context. While I'm not directly using my structural analysis skills to determine how a building will fail, I have an innate ability to quickly structure problems and systematically solve them. Tech trained me early on to take complex systems and break them into smaller parts I can understand. When faced with a problem that seems insurmountable to many of my non-engineering peers, I feel confident that I'll find a way forward because nothing is as complex as it first seems. And even more important, impossible is just perspective.

My engineering degrees, and my problem-solving skills learned through

ROB FELT


ROB FELT

Jacob Tzegaegbe was crowned Mr. Georgia Tech at the 2011 Homecoming game. He was the reflection speaker at a 2013 Commencement ceremony, where he received his master's degree in civil engineering.


engineering, have opened doors I never dreamed of while growing up. As I write this, I am sitting at my kitchen table in London pursuing further education on a Marshall Scholarship from the British government. Last year, I completed a second master's degree in Mega Infrastructure Planning, Appraisal, and Delivery at University College London, and I'm currently enrolled in my third (and final!) degree in Urban Economic Development.

As I learn the "softer" sides of how cities and infrastructure work to serve the public, I'm ever thankful that I decided to first pursue an engineering degree. I've found that it is rare to find people passionate about building better cities who have the technical, policy, business, and leadership experience required to understand the bigger picture. My hope is to one day be one of these rarities.

The opportunities that lie before me and my future ambitions are far loftier than any dreams I could have imagined at the moment I received my Georgia Tech acceptance letter. It's mind-blowing that a single piece of paper changed my entire world and has equipped me with the skills build our future. Cliche as it may sound, my life ambition is to literally and figuratively build a better world — one city at a time. Though it is an immense challenge, Tech taught me early on that no matter how big or impossible an obstacle may seem, there is always a way. And after "getting out" of Tech (twice!), I know anything is possible. ▪


PHOTOS COURTESY OF ROAD ATLANTA

# The Racer's Edge

Speeding around a track is the ideal respite for Professor Chris Jones. It also makes him a better driver.

*by* Michael Baxter

**On any given day you might see it**, slipping through the paved lanes of the Georgia Tech campus, sunlight glinting off its royal-blue body; or else nestled neatly between the lines in a local parking lot or deck.

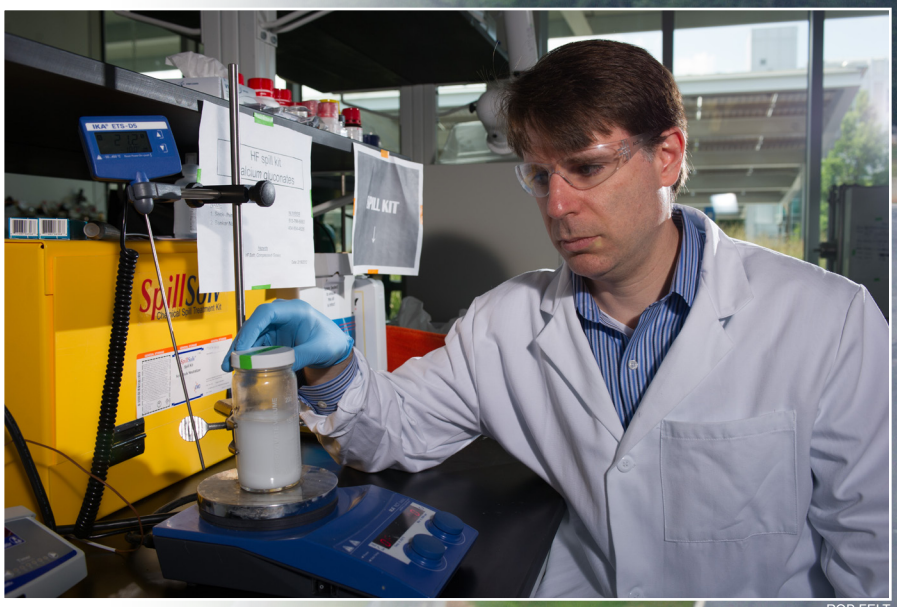
It's the kind of vehicle that can spin a head: a 2013 Audi TT RS, 430 horsepower. Only 1,400 of them exist.

The car is more than the commute vehicle of choice for Chris Jones, a professor of chemical engineering and Georgia Tech's associate vice president of research. It's also a passion. Several times a year, he hops in, buckles up and whizzes through the winding alleys of a racetrack.

"Most people drive cars well within the limits of what a car can do," Jones says. "Racing is a good way to go out and learn the limits of your car. It allows you to push those limits, but in a safe environment."

While Jones doesn't race competitively — his day job of expanding Tech's research portfolio and building bridges with industry is a demanding one — the track excursions are adrenaline-infused experiences. The two venues he most often visits provide different challenges. Road Atlanta, up Interstate 85 in Braselton, Ga., is a turkey leg of a loop that Car and Driver magazine deemed "insanely quick." Barber Motorsports, just north of Birmingham, Ala., is a momentum track — its snaking coils test Jones' ability to handle the turns.

"That's the real thrill, making that transition from high to low speeds on the turns," Jones says. "It's pushing the car to the limits of its grip. Kind of like creeping up to the very edge of something and sticking your toes over that edge, without going over." More precisely, he'll approach a 90-degree curve going 125 miles per hour, slowing down to 60 or so to make the turn. As fast as that sounds, "it's about half the speed of professional racecar drivers," Jones says.



By day, Chris Jones is a chemical engineering professor. ROB FELT

Jones first took to the track a decade ago, but his love for cars traces back to his boyhood. He grew up in the Detroit suburb of Troy, Mich., and says everyone he knew worked in the auto industry.

"I had 'gearhead' in my DNA," he says. "I've just always enjoyed cars as displays of engineering and design — as art, really."

After paying off graduate school loans and landing a salaried job, Jones purchased his first performance car — a 2006 Lotus Elise, bright white. It wasn't suitable for everyday driving, however, so he later sold it and bought the Audi TT. Since then, his automotive ardor has only deepened: Jones also owns a Cadillac CTS-V Sport Wagon, with 6-speed transmission and enough horsepower (556) to catapult him to 60 miles an hour in four seconds.

A typical day at the track, Jones explains, involves driving in groups of 20 to 30 drivers, all sharing a comparable level of experience. For those new to racing or making a first run on a particular track, an instructor rides shotgun. Passing is permitted, but novice drivers must first signal an OK by sticking an arm out the window. The experience is an exercise of intense multi-tasking — shifting gears, waving drivers and ever focusing on the road ahead, which is traveled in a blur at such high speed.

Jones is now in the company of more experienced drivers. Still, he has yet to have a track session without witnessing at least one accident.

And that raises an obvious question: *Have you ever crashed?*

"Once," Jones says. "It was during the early days when rules and regulations were a little more relaxed for solo drivers. I was only going about 40 miles per hour, but it was enough to total the car."

The lessons of the track have value in everyday driving, Jones says. "Because of driving on track, I'm a better driver on the road," he says. "On a track, you learn to look far ahead of you, and I do that more now on the road." ▪

# Health Projects Shine at Capstone Expo

## The OculoSeal team takes home the grand prize.

*by* Lyndsey Lewis

**With a project offering a new way to fix drooping eyelids**, a team of biomedical engineering majors won the top prize at the Fall 2014 Capstone Design Expo.

The OculoSeal team — Mohamad Ali Najia, Jackie Borinski, Drew Padilla and Andy Kolpitcke — designed a device that seals and cuts to correct ptosis, the drooping of the upper eyelid. The group's project, sponsored by Dr. Denise Kim at Emory University Hospital, could also have implications for laparoscopic, gastrointestinal and biopsy procedures.

Health was a common theme among the December event's winning concepts, drawn from the 105 teams competing in the expo. The biannual event showcases work from senior design courses, in which undergraduates research problems, create prototypes, and offer solutions. Previous winners have gone on to receive patents and found companies based on their research.

Held at McCamish Pavilion, the fall edition featured students majoring in mechanical engineering (ME), biomedical engineering (BME), electrical and computer engineering (ECE), industrial and systems engineering (ISyE), and industrial design.

"You taught each other; you learned from each other," Professor Bill Wepfer, chair of the ME school, reminded participants during the awards ceremony. "The sky's the limit."

As judges, volunteers and families swirled through McCamish, the event took on an air of pageantry. Several teams coordinated outfits or wore costumes to match their work's theme, with Home Depot aprons, CSX hard hats, and bright yellow suspenders standing out among the crowds.

Another health-focused winner at the event was the Stroke of Genius team, which earned accolades for a golf cart that allows children with paralysis to participate in golf. Sponsored by the Bobby Jones Foundation, the Chiari & Syringomyelia Foundation, and E-Z-GO, the team won for best interdisciplinary project.

E-Z-Go also sponsored the RED Team, which took home the award for best mechanical engineering project. The group focused on transporting injured people to medical centers via off-road vehicles, and they designed a prototype for much cheaper than anything now being sold.

"We saw a big market gap," said team member Michael Brown.

That's part of what makes the Capstone Design Expo a singular event: Some of the students carry their work beyond the semester, applying for patents and sculpting ideas into realities.

"We filed a provisional patent this morning," said Jackie Borinski, part of the winning OculoSeal team. "Two of us are graduating and accepted offers at companies, but we hope to continue working on the OculoSTAPLE."

Another health-centric concept came from an interdisciplinary team, made up of two BME majors and an ECE major. They proposed using Google Glass in emergency medicine, which could help emergency medical technicians and doctors communicate more effectively.

Watching a fellow group member don Google Glass to demonstrate the idea's potential, BME major Marnie Williams said that "seeing it actually come to life has been amazing."

Ryan Helm, who worked with a group of BME majors on an at-home cervical cancer detection kit, expressed a similar sentiment.

"It's great to actually be able to share how it works," he said. Real-life applicability and results are key to many Capstone ideas — even if the work itself is all about milkshakes.

Team Chick-fil-A, an ISyE group sponsored by its namesake company, developed a tool to more effectively forecast demand for seasonal peach and peppermint chocolate chip milkshakes. The tool could have saved the company $280,000 a year, the group said.

Team member Jordan Avery has worked at Chick-fil-A, and he asked if there were any projects available for his team. Presenting the results at the Expo, he said he was glad for the chance to apply his skills in a corporate setting.

"It made me use what I learned in the classroom in real life," he said. "It also clarified for me that I did choose the right major." ▪

*Jordan Shields and Jennifer Tomasino contributed to this story.*






PHOTOS BY CANDLER HOBBS

GARY MEEK

# After a Day of Rocket Science, Finding Solace on the Farm

AE's Bobby Braun and his wife have spent seven years managing Godspeed Farm.

*by* Kathleen Moore

**Any kid who's dreamed of touching the stars** would be thrilled to step into Bobby Braun's Georgia Tech office. The walls and shelves are covered with photos from the surface of Mars, autographs from storied astronauts like John Young and John Glenn, and wind tunnel models of systems that have flown to Mars.

Braun is not boastful by nature, but he can't deny that he's lived out a few of his childhood dreams.

"I've had some great adventures," says the soft-spoken professor, an NAE member who was recently appointed review board chair for the NASA Mars 2020 flight project, the next grand expedition to the Mars surface.

"Being a part of the team that landed the Mars Pathfinder spacecraft when I was 31 was a great moment. It was right up there with marrying my wife and the birth of my children," Braun says.

Add "gentleman farmer" to Braun's resume and he comes into clearer focus. Aerospace engineering is not his only passion.

After he leaves Georgia Tech each day, he drives 35 miles to a farm, where he is greeted by four dogs, four horses, nine cats, a donkey, and as many as 25 black Angus cows. These are the residents of Godspeed Farm, a business that he and his wife, Karen, have built up and managed for seven years. "Karen's the boss, there," says the Stanford-educated rocket scientist. "I'm just a hired hand."

Braun relishes the contrast between his Atlanta-based teaching and research duties and the myriad chores that greet him at Godspeed.

"There is no typical day — at Tech or at the farm — and that's a good thing."

Sometimes he'll come home to a coyote menacing the cows, a broken fence, or a horse that's thrown its shoe. Other days, it's a livestock auction, which he describes as a "well-oiled chaos."

"And grass — that's a whole science unto itself," he says. "If you want to raise cows that will produce good meat, you need to give them the right nutrition. The type of grass you grow and how you grow it really matters. And, though we have great weather here in Georgia, you have to figure there will be about four months where you have to hay them…"

So how did a guy who grew up on a quarter acre in suburban Maryland get schooled in haying a herd and fixing fences?

"We asked a lot of questions. Farmers are good people. If you show up at their house and ask them a question, they're usually willing to help you figure it out."

That said, it is Karen Braun who manages the day-to-day business of the farm — giving Bobby the luxury of choosing projects that complement his demanding aerospace career. When he has the choice, Bobby gravitates toward building projects.

"A few years ago, I built out our barn so we could have more horse stables. I could have hired someone, I guess, but it's cheaper to do it yourself, and it was great fun. You get to design it and cut the pieces and lay it out, and at the end of the day, you see something that wasn't there yesterday," he says.

"With my scientific research, results can take years."

The farm has not always turned a profit — the Brauns will be the first to tell you that family farming is a hard economic proposition — but there are other dividends. And no regrets.

"It was a lifestyle choice. Our children saw firsthand what Disney would call 'the circle of life.' They've learned about the importance of water and agriculture to society, the importance of an honest day's work," Bobby Braun says.

"And, for us, as parents, we never had to worry about where our kids were at night. If you're the family that has a big farm, with a lake you can boat on and fish in, horses to ride, four-wheelers, and bonfires on Friday nights, everyone's coming to your house. We had an open-door policy with friends."

These days, that door is seeing less action: Zach, 20, is a sophomore at Georgia Tech, and Allie Grace, 18, is a freshman at Furman University. But that just opens up other possibilities. While 16-year-old Jessica finishes up high school, Godspeed is taking a new direction: boarding horses.

"We just sold our last 25 cows, which will pay for about a year of my daughter's college education," Braun says. "Boarding horses will make college expenses over the next few years easier to manage as well."

In the first half of 2015, the remaining three 'farm hands' at Godspeed will take up temporary residence in Pasadena, Calif., where Braun has been invited to serve as the Moore Distinguished Scholar at Caltech.

"I plan to work on a textbook while pursuing fundamental research in the areas of hypersonics and entry, descent and landing technology," Braun says. "It will be great to focus on basic research with colleagues on the Caltech campus while collaborating with Jet Propulsion Laboratory personnel on a number of future planetary exploration mission concepts."

And when that adventure concludes, Braun will still have Godspeed Farm to ground him.

Karen Braun sums it up thusly: "Farming isn't something you can learn in a book or a computer. It is 'old school' trial and error. It's dealing with death on the coldest day of the year. It's putting your animals before your vacations, calling your friends — fellow farmers — in the middle of the night to pull a horse out of a gully because he's stuck. It's an older community that helps out day or night. It is not something we will leave or ever forget." ▪


GARY MEEK

**And when he's not tending cows…**

*Bobby Braun serves as the David and Andrew Lewis Professor of Space Technology in the Georgia Tech School of Aerospace Engineering, and he is the founding director of the Center for Space Technology and Research. A former chief technologist at NASA, Braun also founded Terminal Velocity Aerospace, LLC, a business providing atmospheric reentry services to enhance safety and promote the utilization of space. His research focuses on systems aspects of planetary exploration and the advancement of entry, descent and landing technology.*

# Alumna Aims to Bring Better Planning to a Busier World

## Josie Kressner's startup focuses on real-time travel information.

*by* Joshua Stewart

**Go back to the year 2000** and think about your typical week. Where did you go? (School, work, restaurants, stores.) How did you get there? (Driving or mass transit? Local roads or highways?) What was traffic like?

Now compare that to this week. Do you go to the same places? Do you get there the same ways? Are you even in the same city?

Transportation planners have to forecast where you and thousands of your neighbors will go and decide what infrastructure your region needs to accommodate those demands. But the data they're using today, in 2015, is probably a decade and a half old. So even though what you remember of your travels in 2000 is vastly different from your travels today, the 2000 version of you is who's accounted for in 30-year regional transportation plans.


GARY MEEK

College of Engineering Ph.D. alumna Josie Kressner has a plan to change all that.

Her idea would fix the disconnect and offer a cheaper way to do business. It grew out of her doctoral research at the School of Civil and Environmental Engineering, and now, she's started a company called Transport Foundry to figure out if her idea could really work.

"We're looking at things that are very much supposed to be current and relevant," says Kressner, who earned her doctorate in spring 2014. "We're analyzing the economy. We're projecting growth. We're trying to make decisions about huge federal infrastructure projects that directly impact people's daily lives."

With seed money from the National Science Foundation, she's working on a pilot project with the Atlanta Regional Commission that combines widely available data on consumer demographics with aggregate data from mobile phones — which are all anonymous — to create synthetic household travel data. (Hundreds of companies exist to accumulate and sell both consumer and mobile phone data.)

That means instead of governments spending millions of dollars on surveys asking people to track where they go for a couple of days — surveys that happen once a decade or less — planners would have access to almost real-time information about travel behavior.

"What we want to understand when we're ultimately using regional models is how different types of people are traveling," Kressner says. "We can use anonymous mobile-phone data by itself to understand how people are collectively moving through a region, but we don't know who those people are because of well-founded privacy laws. When we're talking about government or federal money though, we have to know that it's being spent equitably. That's why it's important to understand who those people are, and that's where merging the mobile phone data with synthetic, but representative demographic information is necessary."

Kressner has brought on three part-time employees to help with her pilot study in Atlanta and is preparing to bring on two Georgia Tech students as interns. Initially, she'll focus


GARY MEEK

on drivers, but she says the next step will be to separate trips using mass transit and trips by bicyclists and pedestrians, which have significant implications for regional planning.

She’s had help with her business plan from the Georgia Tech PhD2Consulting Club and from three professional mentors. She’s working on several other sources of grant funding and has had early conversations with investors who are interested in supporting her work.

They see broader commercial possibilities in Kressner’s models.

“Real estate firms are very interested in where people are traveling, what these people look like,” Kressner says. “[So are] business location services. If we can give them that valuable information while still protecting individual privacy, we’d be golden.”

Still, challenges remain for Kressner’s budding company.

She has to get the right companies to sell her the right data at the right price. And since every company has slightly different information, she has to figure out how to make it work all together.

Plus — no small feat here — she has to change the government’s status quo. She needs metropolitan planning organizations to use her synthetic data instead of the traditional household surveys. Then she has to show the federal government her data results in better transportation models.

“There’s all this data out there right now that governments could potentially use, but the data do not fit into the mold of how we traditionally do regional transportation planning,” Kressner says. “My main goal is to format consumer and mobile phone data in a way that protects privacy while allowing agencies to plug the data into their normal [planning] processes.”

Kressner credits her Georgia Tech professors for teaching her about that regional transportation planning process and letting her explore how she might make it better.

“Tech is one of the best transportation engineering programs,” she says. “I am where I am today because of Georgia Tech and the great professors there.” ▪

# *The* Master Plan

Which is better — an MBA or an M.S.? Alumni who have made the journey share their insights.

*by* Kay Kinard & Michael Baxter


**One road leads deeper into the field,** the other to a less defined place. The roads may diverge or be intertwined — only time will tell.

Such is the riddle confronting newly minted engineers who are deciding whether to pursue a master of business administration or an advanced degree in engineering. On the surface, unlocking such a riddle seems simple. Should you add a skill set or further immerse yourself in a field of study? Which is the better answer — breadth or depth?

But as College of Engineering graduates find, making such a decision can be complex. It involves evaluating and capitalizing on the potential for reward, personal and financial. It's figuring out how to leverage inherent strengths while venturing outside comfort zones.

And while no decision is irreversible, the stakes can be high. We asked several engineering graduates how they went about choosing their future through either an MBA or an M.S./Ph.D. What they said may be of value for those who will decide next.

### **Jake Sisley** | B.S. (CEE) '02, MBA '10 | Lead product marketing manager at AT&T

I almost went back to get an M.S. in environmental engineering after finishing my undergraduate study. Thinking hard about it, I thought that if I could get a master's in engineering, I needed to be comfortable with being an environmental engineer the rest of my life. I was 23 at that point and thought I wasn't ready to make that commitment.

A professor at Tech recommended that I go out and work first, then go back to school. So I got into real estate development. I had co-oped as an undergrad with a small company, working on the audit side of real estate development. It was a great job because I wasn't behind a desk — I was out in the field 70 percent of the time doing inspections.

After my MBA, I went to work here at AT&T and am now the in the streaming-video space. I was previously in the tower real estate group — we rent space on tens of thousands of towers, and each one is part of an overarching deal with the owner of the tower. I put together some models of where we are with each lease, what we're paying, what's driving the rent up or down, all of which involved tons of analytics.

So the analytical background of my engineering education has really helped. And it didn't come naturally to me — it was beaten into me at Georgia Tech, and I wouldn't trade it for anything. The business degree is very complementary. It was a very applied education, and now when people talk business, I understand the language. I know how to write an effective business plan and understand why decisions are made — that's big.

• • •

### **Lindsey Thornhill** | B.S. (ME) '84, M.S. (ME) '86, Ph.D. (ME) '96 | Senior director, project management at Science Applications International Corporation

Unfortunately, there is no single, simple answer to the question of whether an engineer should get an MBA degree. If your career goals are in engineering management or in starting a business of your own, an MBA education is invaluable — practically essential. If, however, your

career goals lean more toward fundamental research and development (R&D), limited time and resources are best spent pursuing advanced engineering degrees and, perhaps, postdoctoral research opportunities. In the latter case, MBA studies fall more into the would-be-nice category. There is, of course, an entire continuum of career possibilities between these two cases.

I have a Ph.D. in engineering and never pursued an MBA. Being primarily on a research and development career path, it never seemed to be a good investment to pause R&D career development in order to pursue an MBA. I managed to pick up the R&D management knowledge that I needed through company training courses and on-the-job experience.

My advice is to do some homework. Choose several people whose careers most resemble what you would like your career to become. Research their backgrounds — their degrees, when they got them, various jobs and positions they've held. If possible, interview them. Get their thoughts on how an MBA has benefited or would benefit their career. The insight gained from this information will greatly inform a decision on whether you should invest in an MBA.

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**Emily Muhlberger** | B.S. (ME) '04, MBA '09 | Senior programming manager at The Coca-Cola Company

I worked for a couple of years out of college and got to the point where it was either going to take quite a few years of experience with the company I was with to get ahead — or get a business degree. So I decided that engineering coupled with an MBA would enable me to change jobs, change careers and further my options.

My degree in mechanical engineering taught me how to approach a problem — to work through it by taking a lot of information and data and condensing it in a very usable and digestible format. I find a lot of engineers whom I work with approach things in the same way. So mechanical engineering gave me strong technical and analytical problem solving.

The MBA education further refined this by helping me think about things in a different way. The MBA allowed me to think through a lot of things and understand the business environment. It also gave me more of an international perspective, which is really important.

• • •

**Deb Kilpatrick** | B.S. (Eng Sci) '89, M.S. (ME) '93, Ph.D. (ME) '96 | Consultant and former chief commercial officer of CardioDx

After nearly 20 years in Silicon Valley, I believe that what you do with what you know is what ultimately matters. After all, it's successful execution that differentiates you in a market where pretty much everyone was top in the class academically.

But you constantly have to expand what you know to stay competitive, and there are many ways to develop that. For some, that will mean getting an MBA right on the heels of their engineering degree. For others, that will mean learning on the job and developing business acumen because you have to in order to get the next job you want — that's how I have done it, and it has worked well for me.

However engineers choose to develop their business skills, I remain convinced that doing so is increasingly important to create their own future opportunities beyond R&D. So finding a way to do it that works for them, whether in a formal MBA program or in the next job assignment, is the key.

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**Dave Frakes** | B.S. (EE) '98, M.S. (ME) '02, M.S. (EE) '03, Ph.D. (BME) '03 | Associate professor at Arizona State University

I think we over-focus on what a degree is called these days. When you go out in the world and do things, what matters most is the skills you have. I've worked with engineers who are better managers than management majors, and vice versa. At the end of the day, it doesn't matter what the title is on your diploma. What matters is what you can, and will, do with your ability.

Engineering was an appealing undergraduate degree because I love math. Here's what I realized: What I loved most about engineering is using math, modeling, design and other skills to solve problems. It's invigorating.

In my career, I wanted to work on problems I was passionate about. As soon as I finished my Ph.D., I started a company called 4D Imaging that makes image processing plug-ins for medical and military applications. Then I wanted to do something different, so I went to work on Wall Street. I used my math and software skills to come up with algorithmic strategies for trading the derivatives markets.

I loved a lot of things about Wall Street, but the motivation to solve problems wasn't as compelling as it was on the biomedical side. So I was excited to come back to an environment changing people's lives, here at Arizona State. I've been working on models for surgical planning, so we can simulate medical device-based treatments before they're applied to people.

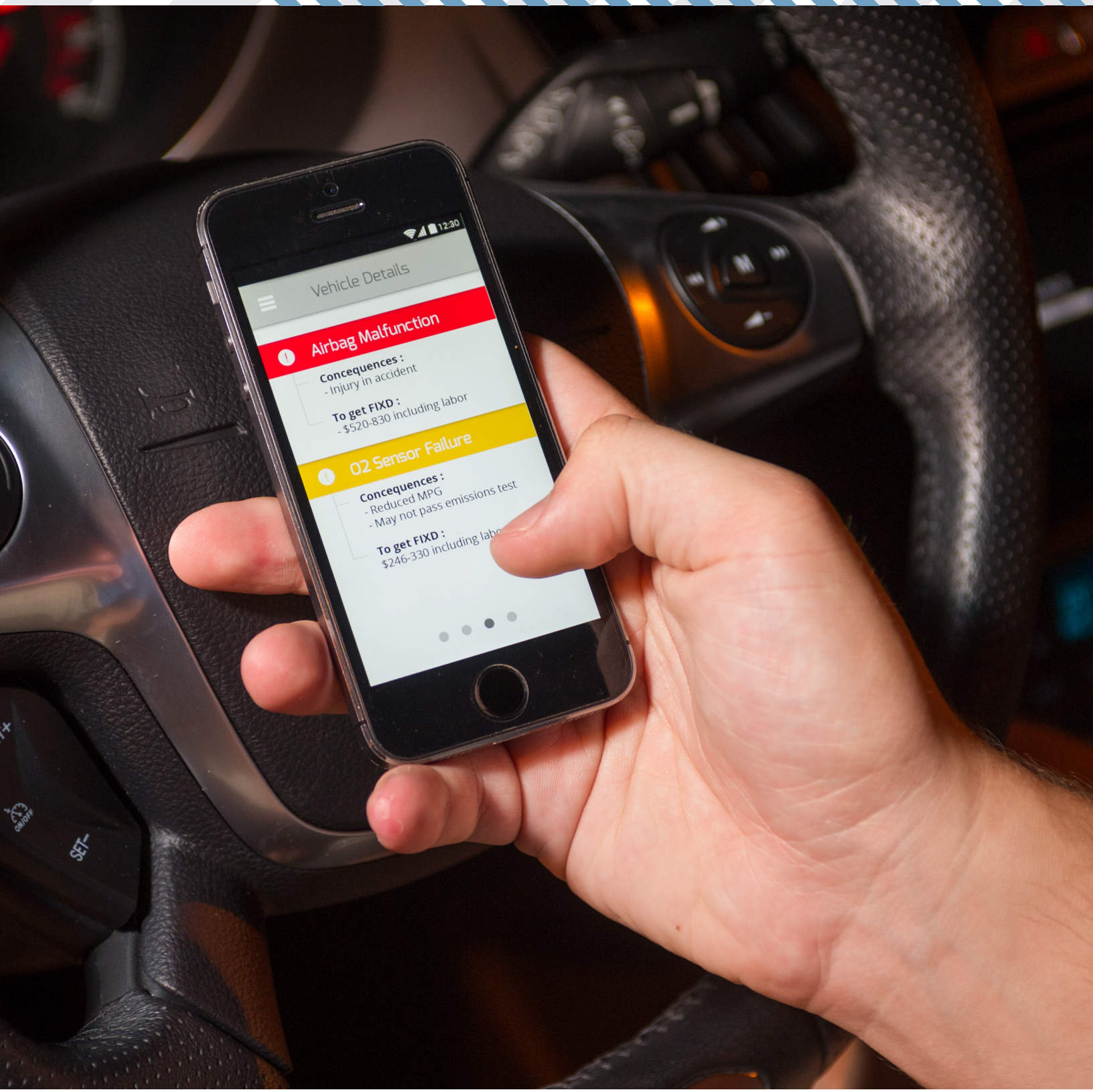
When you do what you do very well, you'll always have opportunities. ▪

# Diary of a Startup: FIXD

Story by Lyndsey Lewis
Photography by Rob Felt


**If you want to find FIXD headquarters, you'll need to trek the northern part of Georgia Tech's campus, where the company's members work out of a windowless room in a basement. There are no flashy signs directing visitors to the room, which boasts none of the amenities often associated with startups. (Sorry: That means no nap rooms or free coffee in sight.)**

But inside this spartan office, a band of students has been building a business: an app called FIXD that helps drivers better understand their cars. Its creators came up with the idea in a Georgia Tech class, and by the end of 2014, the idea had grown into a full-fledged company with beta testers and plenty of media attention.


12:30
Vehicle Details
Airbag Malfunction
Concequences :
- Injury in accident
To get FIXD :
- $520-830 including labor
O2 Sensor Failure
Concequences :
- Reduced MPG
- May not pass emissions test
To get FIXD :
$246-330 including

"It's really about giving confidence back to the driver," says Rachel Ford, a biomedical engineering major and one of the company's founders. After a whirlwind few months, the team is now seeking larger investors.

Like many startups, FIXD grew quickly, surprising even its creators with the velocity of its success. But while similar businesses often devote round-the-clock hours to launching, most members of the FIXD team had other things to worry about — like classes and finals.

The group is rounded out by CEO John Gattuso, a mechanical engineering major and self-professed "car guy," computer science major Rikin Marfatia, and mechanical engineering alumnus Kevin Miron. (Eventually, another student will join as the company's iOS developer.)

Being a student isn't necessarily a disadvantage. Over the past few years, Georgia Tech and the College of Engineering have cultivated a startup ecosystem on campus, showering students with courses, extracurricular programs, and labs to help them push their ideas to market.

FIXD's team members have taken advantage of those offerings. Through the fall semester, they juggled coursework with the usual startup struggles, establishing FIXD as a formidable force in car diagnostics. And, in between classes and business, they even managed to get a little sleep.

## Aug. 16, 2014

Today marks the beginning of an experiment that could shape the future of FIXD. The team has decided to try its luck on Kickstarter, the website where people can donate to ideas, art, and causes they find promising. FIXD wants to raise $30,000 from strangers on the Internet.

Rachel Ford and John Gattuso are members of the FIXD team — and they're also students in the College of Engineering.

The company doesn't need the money to survive, but everyone is nervous just the same.

Kickstarter will help them gauge how much interest and publicity their app will attract. And, if they don't meet their fundraising goal within a month, they won't get to keep any of the money donated.

FIXD works like this: A user plugs a vehicle sensor into her or his car dashboard, and that sensor connects with a smartphone app. The app translates data from the sensor, telling the user what might be going wrong with the car, when it needs to be fixed by, and how much repairs could cost.

Ford admits that her own knowledge of cars is lackluster. When something goes wrong, she says, she isn't always sure how to address the problem.

"I get really anxious," she says, "because I don't know how severe it is." The FIXD team is counting on other people like Ford: drivers who feel stultified by the mysteries of their vehicles.

The Kickstarter campaign launches with relatively little fanfare, but media coverage picks up fast. By the end of the monthlong effort, FIXD has not only met its goal but surpassed it: The team has raised $37,747. Hundreds of people pitched in, and some of them will become among the first users of FIXD when sensors are shipped in the coming months.

"You feel a lot more relieved once you've hit your goal on Kickstarter," Ford says.

## Sept. 22, 2014

With the success of its Kickstarter project, the FIXD team feels buoyed. But now there's other work to be done, as there always is.

The team is used to moving quickly and adapting to challenges. After banding together in Startup Lab, a Georgia Tech class that introduces students to the business side of technology ventures, they sketched a product idea very different from what they ended up with.

That initial plan involved a new tool for breast exams, which, they hoped, could make it easier for women to do self-exams at home. But when that didn't pan out, Ford says, they pivoted to car diagnostics instead. By the course's conclusion, the team had what is called a minimal viable product, and they created a video of what FIXD might look like.

"The professors were just blown away completely," Gattuso says.

Now, the group is continuing work on the product, renting a small office in the Ford Environmental Science & Technology Building for a single dollar per month. They're also now part of VentureLab, an on-campus startup incubator.

"They are just so supportive of us," Ford says, "and we can't thank them enough for that."

Over the past few years, Georgia Tech and the College of Engineering have cultivated a startup ecosystem on campus, showering students with courses, extracurricular programs, and labs to help them push their ideas to market.


FIXD works like this: A user plugs a vehicle sensor into her or his car dashboard, and that sensor connects with a smartphone app. The app translates data from the sensor, telling the user what might be going wrong with the car, when it needs to be fixed by, and how much repairs could cost.


PHOTO COURTESY OF FIXD

FIXD was one of eight student teams that completed the inaugural Georgia Tech Startup Summer Program. Team members (from left to right): John Gattuso, Kevin Miron, Rikin Marfatia, and Rachel Ford.

Mentorship is a backbone of FIXD. At VentureLab, the group has learned about how startups grow, and they've practiced pitching to potential investors. FIXD is also mentored privately by Mike Tinskey, Ford Motor Co.'s director of vehicle electrification and infrastructure (and an alumnus of the School of Electrical and Computer Engineering).

He's helping them chart the path forward, and with the Kickstarter orders in, the team has to think about shipping to beta testers. They're also planning to build a version of their app for the iPhone.

The group is hatching plans for long-term profitability. Sure, FIXD users will pay for the vehicle sensor, but there's more potential lying in "all the data generated by the consumers," Ford says.

But for the time being, FIXD needs to push out its Android app.

## Oct. 22, 2014

A little publicity can go a long way: Following a story about FIXD on Fox News, orders for its sensors are skyrocketing.

"It's still weird to hear your voice on television," Ford muses. After the appearance, the team members' phones immediately began buzzing with texts and emails. The mail application on Gattuso's computer crashed as about 2,500 pre-orders poured in.

The burst of interest is exciting, but at the same time, the group faces new hurdles. Hiring an iOS developer is proving to be more of a challenge than expected. And then there are the sensors: Huge boxes of them are stashed around the office, and all need to be packed and shipped.

It's a daunting task, and Gattuso and Ford say the FIXD team will be taking on all of the work themselves. They're focused on keeping overhead costs low as they grow their business. Though the little basement office is getting more

crowded now, FIXD is staying put for the time being as they hatch ideas for a secondary revenue source.

Once a driver has bought the app and sensor, she or he is finished paying for FIXD. Ford knows that there needs to be some recurring revenue, too, and that's where outside auto-parts and body shops might come in. For example, a FIXD user whose car battery is low might see an ad for a parts store.

Plans are still being fleshed out, though both Ford and Gattuso say they're having fun with it.

"This is what we love," Gattuso says. "We wouldn't go through it if we didn't really enjoy it."

## Dec. 5, 2014

There are whiteboards hung all over the little office's formerly bare walls, a symbol of how much is changing for FIXD. The team is in the throes of a stakeholder analysis, examining behaviors and market sizes of several companies in the auto industries.

They've also hired an iOS developer, Georgia Tech computer science major Philip Bale, and they've moved up from VentureLab. Now FIXD is backed by Georgia Tech's Advanced Technology Development Center, or ATDC, a more established presence in Atlanta.

The team's swift progress through startup programs represents just the kind of success Georgia Tech and CoE encourage. With focuses on innovation and entrepreneurship, the Institute has become a training ground for business-minded students.

Fifteen FIXD sensors have been shipped out for beta testing, and the group is now in contract with large parts suppliers. It's an impressive string of triumphs, but both Gattuso and Ford are already talking about what comes next.

In just a few months, they've raised thousands of dollars, appeared on television, hired a new developer, and advanced to a more prestigious startup program. The hunt for more investors is on and beta testing is in the works, which means, Gattuso says, a larger rollout should happen in early 2015.

"The biggest thing's going to be in the future," he says, "when people get it in their hands."

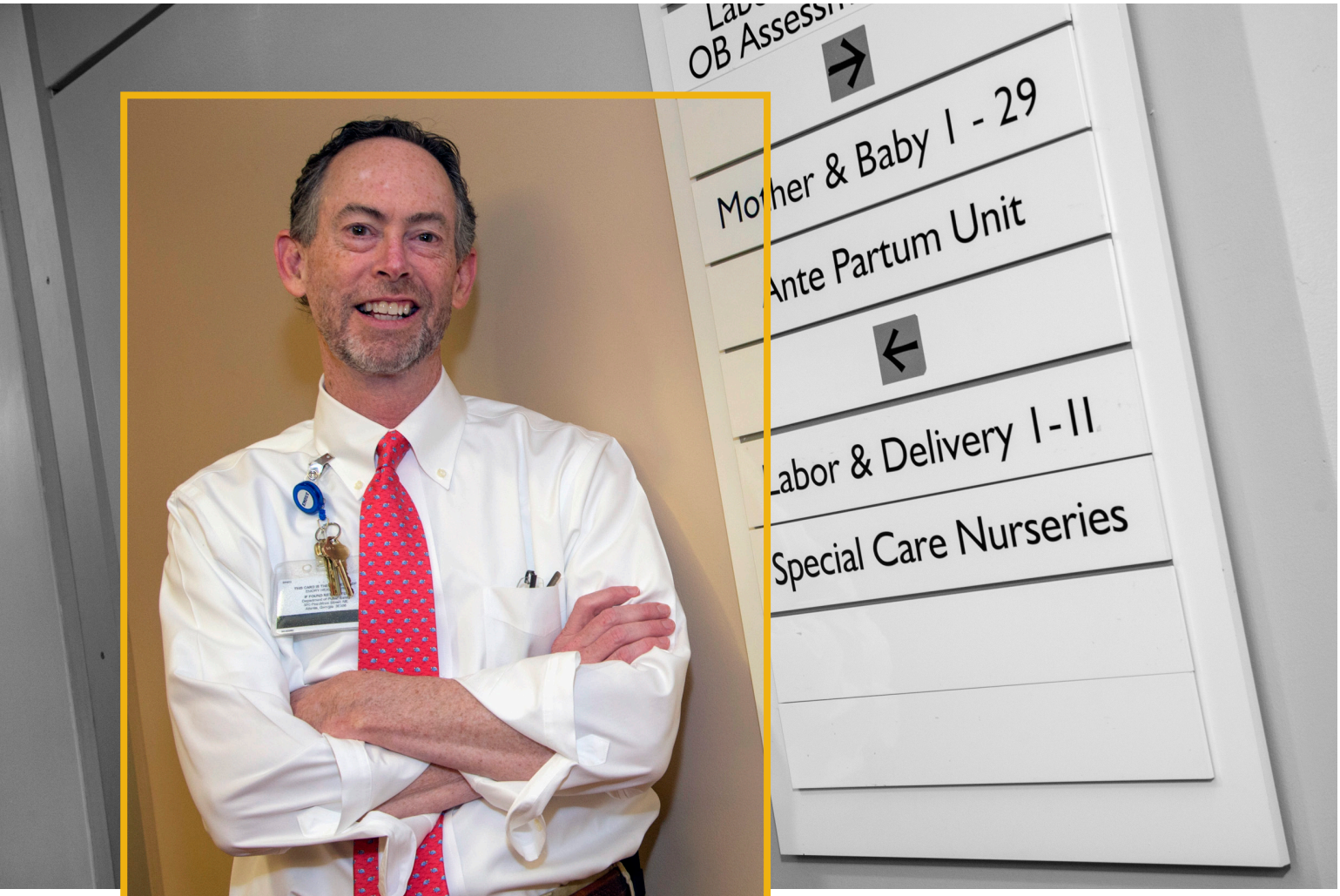
Now that it's December, there's also something else to start looking forward to: Both Ford and Gattuso are beginning a new semester of classes in just under a month. ▪


Ohmeda
Ohio® Infant Warmer
enMotion
Emergency Equipment Check
Ambu Bag (charge # 7188)
Masks (term and premie sizes)
Suction Tubing
Suction Catheter Kit
Masimo Sensor Box (charge # 29701)

# ENGINEER [redacted] with a [redacted] Medical Mission

Every hour, 50 babies in the U.S. are born prematurely. **Dr. David Carlton** (B.S. ChE '79) works to ensure that those in his care have the best chance for a healthy life.

Text & Interview *by* Michael Baxter | Photography *by* Tony Benner




For a baby developing inside of a mother, the last weeks before birth are crucial.

Connections are formed among nerves to support breathing, swallowing and other functions. Skin becomes thicker and more protective. The kidneys build their filtering capacity. The brain grows at an exponential rate; as of 35 weeks, it has just two-thirds of its volume.

Suffice to say, babies born too early enter the world at a great disadvantage. And caring for prematurely born infants — defined as having arrived at 37 weeks of gestation or sooner — is an immensely delicate and complicated mission.

In Atlanta, a prominent leader of this mission is Dr. David Carlton (B.S. ChE '79), head of Emory University's neonatal-perinatal medicine division. Carlton not only cares for preemies and babies born with undeveloped organs and other complications; he also oversees a cooperative of neonatal intensive care involving Emory, Grady Hospital and Children's Healthcare of Atlanta.

Carlton took time out of a hectic schedule to talk about his path from majoring in chemical engineering at Georgia Tech to overseeing one of the nation's most sophisticated collections of neonatal intensive care units.

Dr. David Carlton tends to a child in the neonatal ICU at Emory University Hospital Midtown. Babies in the ICU, he says, are more resilient than many people think.

***Every day, you see so many babies who were born much too early.***

That's right. We have about 100 in our care at any given time, including some who were born full-term but have serious complications.

***What would surprise people most about these infants?***

More than people think, babies in the ICU do well. They have a resilience about them that's a little counterintuitive when you see how small they are. They might weigh only two pounds, but the vast majority will survive. I'm pleasantly surprised by their inborn nature and their willingness to fight. Doctors and nurses who take care of these babies delight in it.

***Has the story of one of these babies stayed with you over time?***

When I was [on the faculty at] the University of Utah, one baby was born very, very young. Her parents had little hope for her — she weighed little more than a pound. We didn't think she would survive.

And yet, that baby was amazingly hardy. I had many conversations with her mom and dad, and I remember telling them that their daughter had an unusual degree of resilience. She spent several months in the ICU before being released. But she grew up healthy, played soccer and has lived an active life. For years, I would get Christmas cards from the family, and I was always amazed.

***Why are premature births so common?***

We really don't know. It's the focus of a lot of scientific interest right now. There's not one dominant thing that causes it — and rarely is it something the mother did herself. Lots of mothers think that if they had avoided x or y, their baby wouldn't have been born prematurely. They blame themselves. We reassure them, though, that this is not something they've triggered or caused. Premature birth in 2014 is not preventable, at least not in the sense that some other medical conditions are preventable.

The neonatal ICU at Emory Midtown is part of a cooperative that includes Emory, Grady Hospital, and Children's Healthcare of Atlanta.

***How does a chemical engineering major become head of a sophisticated neonatal intensive care unit?***

After graduation, I was looking at jobs with several oil companies, as well as a position at Oak Ridge National Laboratory. But I also began considering alternative uses of my Georgia Tech education. My thoughts turned to becoming a doctor. So I decided to go to medical school at Emory and enjoyed every minute of it.

***Do you see parallels between engineering and the practice of medicine?***

You could say so about physiology, obviously, and that was an interest of mine. But what's really important is the larger preparation Georgia Tech provides. It's an education that prepares you to do anything you want. I think the encouragement to explore is one of the greatest features of the Georgia Tech environment. There's a critical mass of folks you associate with as a student who encourage that type of broader thinking — not only faculty, but fellow students as well.

***Did anyone in particular influence you?***

I remember taking a course in cell biology and becoming fascinated with the life sciences because of my teacher. He ignited a spark intellectually — the sheer enthusiasm he had amplified my interest in medicine. I use that experience as proof of principle of the inadvertent influence teachers can have on their students. I also had a series of physical chemistry classes with a chemistry professor named Peter Sherry. I remember visiting him frequently, probably taking up too much of this time with all manner of questions about the class material. The fact that he would spend time with a student who otherwise would've been hesitant to bother a professor of chemistry really impressed me. Dr. Sherry had a generosity of spirit that I've tried to adopt in my career.

***Where did your interest in science and technology come from?***

I have always been attracted to why things work the way they do. My dad would replace the water pump on the car and re-pack the wheel bearings and repair the


"What's really important is the larger education Georgia Tech provides," Carlton says.

washing machine. Even at an early age, I was always asking him, "Why did you do it this way? What does this equipment do?" He was very patient in answering me.

***What are some of the problems in neonatal care today that need fixing?***

High on the list is a disease called necrotizing enterocolitis, or NEC. It's the most common and serious intestinal disease among preemies. The tissue in the small or large intestine is injured or begins to die off, which causes the intestine to become inflamed or, in rare cases, develop a hole. When this happens, the intestine can no longer hold waste, so bacteria and other waste products pass through the intestine and enter the baby's bloodstream or abdominal cavity. This can make a baby very sick, and it often causes a life-threatening infection.

***Might engineering play a role in addressing that challenge?***

Interestingly, I've had conversations with the Georgia Tech Research Institute on that very point. They asked us an open question: What could GTRI do that would be of value? Our response had to do with developing some kind of signal that a baby is getting sick with NEC. Right now, there are no sufficient strategies to detect NEC early.

However, we know that in other health conditions, changes occur in exhaled gases. So we wondered: Could we apply that knowledge to develop an early-warning signal for babies acquiring NEC? Sensor technology is in the wheelhouse of GTRI engineers, but they may be looking for new ways for that technology to be applied. While it would be inaccurate to say we're actively working on a project with Georgia Tech, we have opened up this dialogue. ▪

# Todd Sulchek Mentors Undergraduate Research Students with a Combination of Guidance & Freedom

This past fall semester, the biggest thrill for Kaci Crawford was meeting Pramod Khargonekar, assistant director for the Directorate of Engineering at the National Science Foundation (NSF).

"To me, considering the field I work in, it was as high an honor as meeting the president," says the fourth-year biomedical engineering student.

The occasion was Khargonekar's visit to Todd Sulchek's BioMEMS (micro-electro-mechanical) lab, to learn about a non-invasive diagnostic technique under development there that distinguishes cancer cells from healthy cells on the basis of their relative stiffness.

Sulchek, an associate professor of bioengineering, made sure that Crawford and other students who have been involved with the project were on hand to meet his distinguished guest. It was a thoughtful and inclusive gesture — and classic Sulchek, who is highly regarded as a mentor by his students.

"One of the things that sets Dr. Sulchek apart is the incredible amount of trust he places in us," Crawford elaborates. "He lets us have a lot of freedom to follow our interests, and I think that's what makes him such a good mentor."

She cites the personal attention Sulchek gives his students, like when he informed her about a scholarship and offered to recommend her for it, and the times he set up meetings with her and some of the companies he works with.

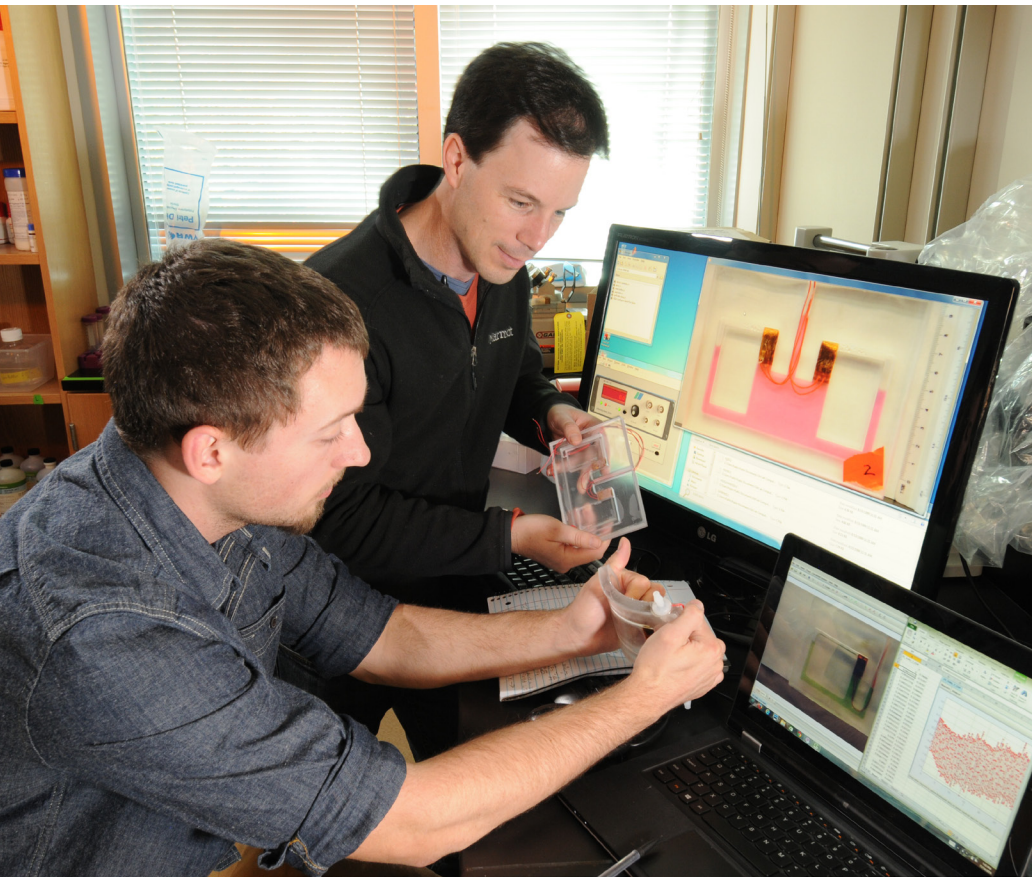
"He genuinely has our best interests at heart," Crawford says. "Working under Professor Sulchek has been the most beneficial thing I've done at Tech, academically and professionally."

When third-year mechanical engineering student Ning Yang started his first semester of research in Sulchek's lab, he expected to encounter the usual practice of working under graduate students and reporting to them.

"I was quite surprised that Dr. Sulchek let me start a research project myself, and that he wanted me to report my progress directly to him," says Yang, a recipient of a President's Undergraduate Research Award

Story *by* Gary Goettling | Photography *by* Gary Meek


"He genuinely has our best interests at heart. Working under Professor Sulchek has been the most beneficial thing I've done at Tech, academically and professionally."



(PURA), which provides a stipend to undergraduates doing research under the mentorship of a Georgia Tech faculty member or scientist. "Instead of asking for help from graduate students, I discussed my questions and difficulties with Dr. Sulchek, and we were able to brainstorm solutions."

This past fall semester, while Yang was in Germany continuing his research on the design and optimization of water-piston stirling engines, their hour-long meetings continued on a bi-weekly basis via Skype.

"Our discussions are inspiring to me," Yang continues. "Dr. Sulchek's way of thinking through details has helped me break through several bottlenecks in my research."

A native of Maryland, Sulchek grew up in the mountainous western part of the state, on his grandfather's 50-acre farm in the small town of Sabillasville, near Camp David.

"It had a little bit of everything," says Sulchek, whose parents still live in the area. "Mostly cows and pigs and some crops to support them, and some cash crops for sale as well.

"There were no engineers around me. In fact, I didn't know what an engineer was until college."

After high school, he was accepted at Johns Hopkins University, where he majored in physics and mathematics, graduating in 1996. He continued his education at Stanford, earning a master's and Ph.D., both in applied physics, in 2000 and 2002, respectively.

"My grandfather said he hoped I do well in school because I wasn't very good as a farmer," Sulchek laughs.

His physics background notwithstanding, he was drawn to the practical applications of mechanical engineering, specifically bioengineering, microengineering and nanoengineering. Sulchek's lab explores a range of areas including molecular and cellular biology, MEMS, microfluidics, signal processing and engineering design.

It was at Hopkins that Sulchek first encountered the benefits of mentoring.

"I had two physics professors who were passionate about their subjects." he explains. "They provided just enough personal interaction to spark my interest and just enough push to get me to put a lot of effort into the topic. So I view them as my role models.

"I enjoy teaching," he continues. "I try to put a lot of effort and care and thought into it. It forces me to keep my fundamentals sharp. You get in front of people, they can ask any question,

and you want to make sure you can answer them accurately, on the spot. I try my best to make these students the best they can be, and that forces me to be at my best."

Sulchek likens his mentoring style to coaching, in that he aims to guide his students as a group, while at the same time helping them develop their individual strengths.

"For example, I often organize my undergraduate research students into small teams geared toward some common topic, but each student is responsible for an individual aspect of that effort. This way, students can be part of a team and learn from each other, but each one takes ownership of a specific part."

Becky Byler was one of Sulchek's undergraduate research students for three years. She calls his mentoring approach "a perfect balance of guidance and freedom."

A 2013 biomedical engineering graduate of Georgia Tech and two-time PURA recipient, Byler worked under Sulchek on the development of the innovative cancer diagnostic tool that the NSF's engineering director learned about during his visit to the BioMEMS lab.

"Dr. Sulchek also mentored me for writing project proposals, formal research proposals and presentations for large national conferences," she adds.

Now a graduate student at Yale, Byler is pursuing an M.P.H. in epidemiology and global heath, and a Ph.D. in biomedical engineering. Her goal is to become a "humanitarian engineer" designing diagnostics, drugs and vaccines for neglected diseases.

"Dr. Sulchek encouraged all of his students to pursue mentorship opportunities," notes Byler, who mentored a student from the United Arab Emirates during her involvement with a global mentoring initiative at Tech.

"He pushed me to take a leadership role, and as a result I've become much more effective at coaching and motivating others. I've put all the mentorship skills I learned from him to good use in the way I guide and train my undergraduate students here at Yale — it's like I'm paying it forward." ▪

# A Yellow Jacket & A President

## Juan Carlos Varela's engineering training has shaped his approach to political life.

Every university brags about its alumni, but how many can call a country's president one of its graduates? Georgia Tech can.

On May 4, Tech engineering alumnus Juan Carlos Varela was elected president of Panama. Varela came to Georgia Tech in the fall of 1980 and received his degree in industrial engineering in spring 1985. He returned to Tech this fall to serve as a member of the Georgia Tech Advisory Board (and to attend a Jackets football game).

At a one-on-one interview (if you don't count the four U.S. Secret Service members and the Panamanian security detail, along with members of his staff), we had a chance to talk with Varela about Tech, engineering, and what it's like to be Mr. President.

- Kay Kinard

### ON CHOOSING GEORGIA TECH ENGINEERING:

I wanted to be an industrial engineer, and Georgia Tech is the No. 1 school for industrial engineering worldwide. Also, Atlanta at that time was becoming a vibrant city, and it was the capital of the South. My two brothers came to Tech — one graduated in industrial engineering and the second one was in industrial management. My family has a rum distillery, a family business that is 100 years old. So many things with the business involved engineering, construction, planning, designing. Since I was a kid, I liked it.

My calculus professor, Dr. Michael Barnsley, was a great professor. He gave me a life lesson. I got good grades the first part of the quarter. I came into the final with 85%. The final was worth 15%. I had four A's and one B. The Calculus I final came, and I just put my name on it. I wanted to go back to Panama to celebrate my birthday. When I came back to Tech for the winter, I got a C in calculus. The only C I got at Tech. I went to talk with Dr. Barnsley and I asked him that if I had 85%, it would be a B, so how come I got a C? He said that it was because it was not my best effort. It was not about the grades; it is in making the best effort. So he gave me a life lesson, and I will always remember that.

I also remember spending time in the Student Center and Junior's Grill. I had very good friends here that I will remember the rest of my life.

### ON EARLY POLITICAL INVOLVEMENT:

Before coming to Tech, I was involved in various social movements in my country. When I came to Tech, many countries in Central and South America were involved in civil wars. I was confused about what to do after I graduated high school. My brother said to come to Tech. I applied and was accepted. But I was worried about what was happening and followed the news every day. It was a very difficult time. I always knew I would be back in politics one day.

### ON LIFE OUTSIDE THE CLASSROOM:

To be at Georgia Tech is not easy. Chemistry, physics, statics, calculus — the first two years are very tough. I remember the classes very well. I did go to the football games, but I am not saying what else we did. We will keep that to ourselves. I always enjoyed seeing the freshmen, the RATS, on the football field. I will remember that. I still have my RAT cap.

### ON ENGINEERS AS POLITICIANS:

As president, I use daily my engineering training. As industrial engineers, we simulate the future, we see alternatives. We see the future and then come back to the present.

That has helped me a lot in my political career. I am president today because I made some decisions in my career, and I made those decisions because I was simulating the future. When you graduate from Tech and in industrial engineering, you may not remember all that was in the books, but the training of the mind lasts forever. The problems that the people in Panama and worldwide are facing today require good minds and training to solve it. An engineer's mind. Being an engineer means trying every day to improve people's lives. Engineering is a beautiful career.

Although I am not working for a technical company, I use my engineering training every day. It helps me with the design of the transportation system for our cities. I use it to help establish my budget. I use critical paths for making decisions and implementing solutions to problems. Right now, I am doing a test of 3,600 sources of drinking water in my country. The first time that someone is going to test all the drinking water sources — that is quality control. You apply your engineering training wherever you are.

### ADVICE FOR A STUDENT COMING TO TECH:

Study. Enjoy, but study, study. Spend all the time you can studying. You can have a little fun on weekends. A college degree is the first thing you get in life that truly belongs to you. Fight hard to get your college degree. You can still have fun while getting good grades. I did it. Fight hard. Don't let the system defeat you. During the first two years at Tech, the system defeats many students, but you have to keep fighting. ▪

JOSUE GARCIA

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# UPDATE

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GARY MEEK