GEORGIA TECH

ENGINEERS

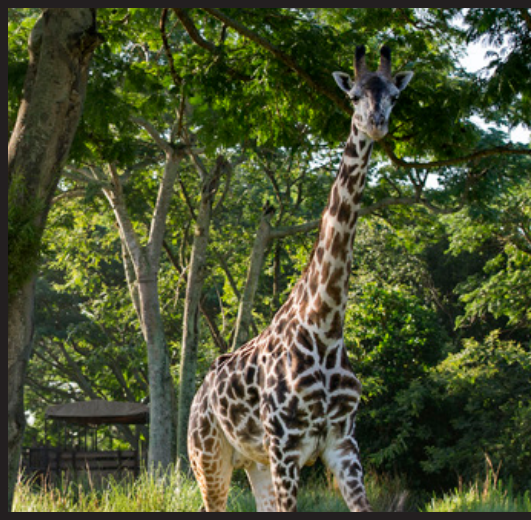
Vol. II, Issue I

Summer/Fall 2014

ME alum Trevor Larsen has worked on every Disney attraction on this page.

How'd he get a job like that?

Page 16



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,

A year has passed since we launched this magazine. I have heard from a number of you about how much you like the format, the stories, and more important, the connection to your alma mater. I cannot say that I am amazed at your devotion and pride in Georgia Tech. As an alumnus, I feel the same way. Being an engineer from Tech set me on an amazing path, and I have turned to lessons learned here time and time again.

At Tech's spring graduation, I shook the hands of more than 1,500 engineering students who crossed the stage and took their place as alumni of the college. One of the speakers at graduation was Admiral James Winnefeld, a 1978 graduate of the Guggenheim School of Aerospace Engineering. In his remarks, Winnefeld called upon the graduates to "have a good idea in which you believe, and then… push that idea through whatever poor, unsuspecting system it is in which you operate."

While listening to Winnefeld talk, I began to think of what message I would like to leave with graduates. Winnefeld spoke about making things happen — to go forward within the system, around the system, and at times, outside the system. Adding to his words, I would like to remind graduates (and even those who have some years on us) of a few things.

Humans are unlike other animal life; we are not content to merely live and reproduce. We are purpose-seekers by nature. There is a Thomas Paine quote that goes, "I do not choose to be a common man. It is my right to be uncommon… if I can." I think that ties in nicely with Winnefeld's remarks. Common often means going with the status quo, not rocking the boat, accepting the "what is" rather than trying for the "why not." Being uncommon is one of the hallmarks of engineering graduates from Tech.

Georgia Tech engineers are full of purpose and potential. These new graduates join a wonderful legacy of alumni who have accomplished great things. They will add to that list in so many ways, and this is why I am so proud to be an alumnus of this great institution.

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.

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GEORGIA TECH
ENGINEERS

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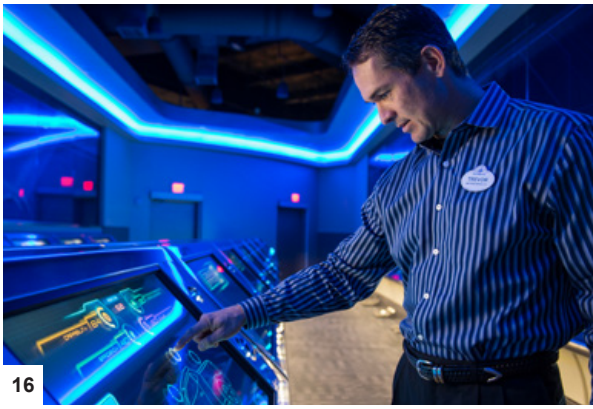
FEATURES



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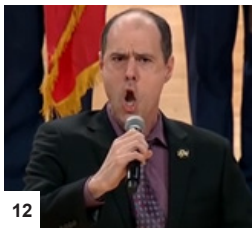

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DEPARTMENTS

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.

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

SMARTER THAN
Test yourself with exam questions faced by CoE students.

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

MAKING IT HAPPEN
We look at how CoE alumni turn their lofty ambitions into reality.

POP QUIZ
A brief interview that won't count against your final grade.

AE's Bobby Braun Named to National Academy of Engineering

JENNIFER TYNER

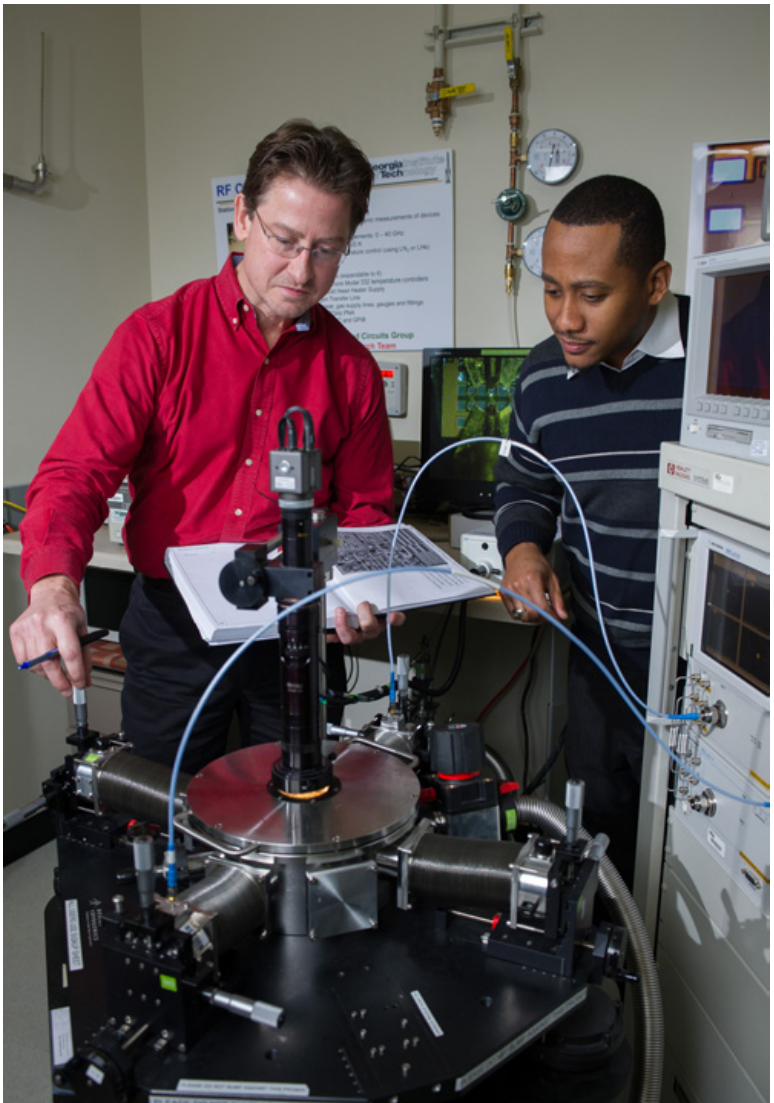
Professor Robert "Bobby" Braun was recently elected to the National Academy of Engineering, one of the most prestigious honors an engineer can receive.

A member of Georgia Tech's aerospace engineering faculty for over a decade, Braun has more than 25 years of experience performing design and analysis of planetary exploration systems — as a researcher and as a member of the technical staff of the NASA Langley Research Center.

His research has focused on systems' aspects of planetary exploration, where he contributed to the design, development, test and operation of several robotic space flight systems. At Georgia Tech, Braun is the David and Andrew Lewis Professor of Space Technology, and is co-director of the Space Systems Design Laboratory.

Braun has led the design and technology maturation of multiple space systems. He was a member of the Mars Pathfinder design and landing operations team from 1992 to 1997 and has been part of development teams for the Mars Microprobe, Mars Sample Return and Mars Surveyor 2001 projects. From 1998 to 2000, he managed the development of the Mars Sample Return Earth Entry Vehicle, an innovative, risk-based entry system design.

– Kay Kinard



ROB FELT

Silicon-Germanium Chip Sets New Speed Record

A research collaboration between IHP-Innovations for High Performance Microelectronics in Germany and Georgia Tech has demonstrated the world's fastest silicon-based device to date. The investigators operated a silicon-germanium transistor at 798 gigahertz (GHz) fMAX, exceeding the previous speed record for silicon-germanium chips by about 200 GHz.

Although these operating speeds were achieved at extremely cold temperatures, the research suggests that record speeds at room temperature aren't far off, said Professor John D. Cressler of the School of Electrical and Computer Engineering (ECE), who led the research for Tech.

"The transistor we tested was a conservative design, and the results indicate that there is significant potential to achieve similar speeds at room temperature — which would enable potentially world-changing progress in high data rate wireless and wired communications, as well as signal processing, imaging, sensing and radar applications," said Cressler, who holds the Schlumberger Chair in Electronics in ECE.

IHP, a research center funded by the German government, designed and fabricated the device. Cressler and his Georgia Tech team, including graduate students Partha S. Chakraborty, Adilson S. Cardoso and Brian R. Wier, performed the work of analyzing, testing and evaluating the novel transistor.

– John Toon

ROB FELT

Scholarship Named to Honor ISyE's First Female Chair

The Stewart School of Industrial and Systems Engineering has established the Jane Chumley Ammons Scholarship to honor the service, research and leadership of its namesake chair.

Ammons' tenure at Georgia Tech has been marked by many firsts and successes. She was the first female ISyE Ph.D. recipient (1982) and the first female ISyE faculty member. She previously served as associate dean for faculty affairs in the College of Engineering, and in 2011, she was appointed to H. Milton Stewart and Carolyn J. Stewart School Chair in ISyE, becoming the first female school chair in CoE.

The new scholarship made its debut at the 2014 Women in Engineering Banquet and was awarded to Breona Jenkins, an industrial engineering graduating senior. She was selected to receive the award for her motivation, abilities, and leadership in the engineering world and beyond.

– Barbara Christopher

Egerstedt Brings Robots to the People in Revamped MOOC

GARY MEEK

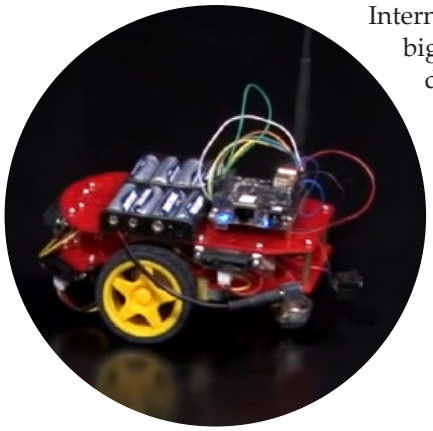
Last year, Professor Magnus Egerstedt taught thousands of people how to make robots move.

In his online class, "Control of Mobile Robots," Egerstedt demonstrated the basics of control theory with a collection of robotic sidekicks that shimmied, scurried and skittered at his will. With students from around the world watching videos and taking exams, the course was embraced as a success.

How to top that? Easy: Do it all over again and put students in charge of robot-building.

That's what Egerstedt, the Schlumberger professor at the School of Electrical and Computer Engineering, did for the second version of his massive open online course (MOOC), offered in spring through Coursera. Using low-cost, open-source hardware, Egerstedt and a cadre of his graduate students gave MOOC participants the chance to bring their own robots to life.

"In my mind, it's a game changer," Egerstedt said.



COURTESY OF COURSERA

Egerstedt's MOOCs are open to anyone with Internet access, making the new gamble even bigger. Although the first run of his class drew praise, Egerstedt was eager to throw hardware into the mix to help bridge "the practice-theory gap."

When some of his graduate students developed a robot for cheap, Egerstedt decided to follow through with the idea. He partnered with SparkFun Electronics, Texas Instruments and MathWorks to bring low-cost parts to students, who were eventually able to build a machine named the QuickBot for about $140 to $220 each (depending on how advanced their robots were).

In all, Egerstedt said, well over a thousand MOOC students built robots.

– Lyndsey Lewis

JEFF WALTON

Karen Feigh Will Serve on Influential Aeronautics Board

The National Research Council selected Professor Karen Feigh, of the Guggenheim School of Aerospace Engineering, to serve on its prestigious Aeronautics and Space Engineering Board.

A former Marshall Scholar who earned her undergraduate and doctoral degrees in aerospace engineering at Georgia Tech, Feigh will be the youngest member ever to serve on the influential board. She officially joined the board at its April meeting.

"The most exciting thing about this appointment is the opportunity to work with engineers and industry leaders to advance the impact of aeronautics and aerospace on our world," said Feigh, whose research has focused on two broad areas: decision support system design and computational cognitive modeling for engineering design.

"I am looking forward to being part of the process to define research agendas in areas like autonomy in civil aviation."

– Kathleen Moore

Study Questions Aspirin's Effectiveness in Preventing Blood Clots

A new microfluidic method for evaluating drugs commonly used for preventing heart attacks has found that while aspirin can prevent dangerous blood clots in some at-risk patients, it may not be effective in all patients with narrowed arteries.

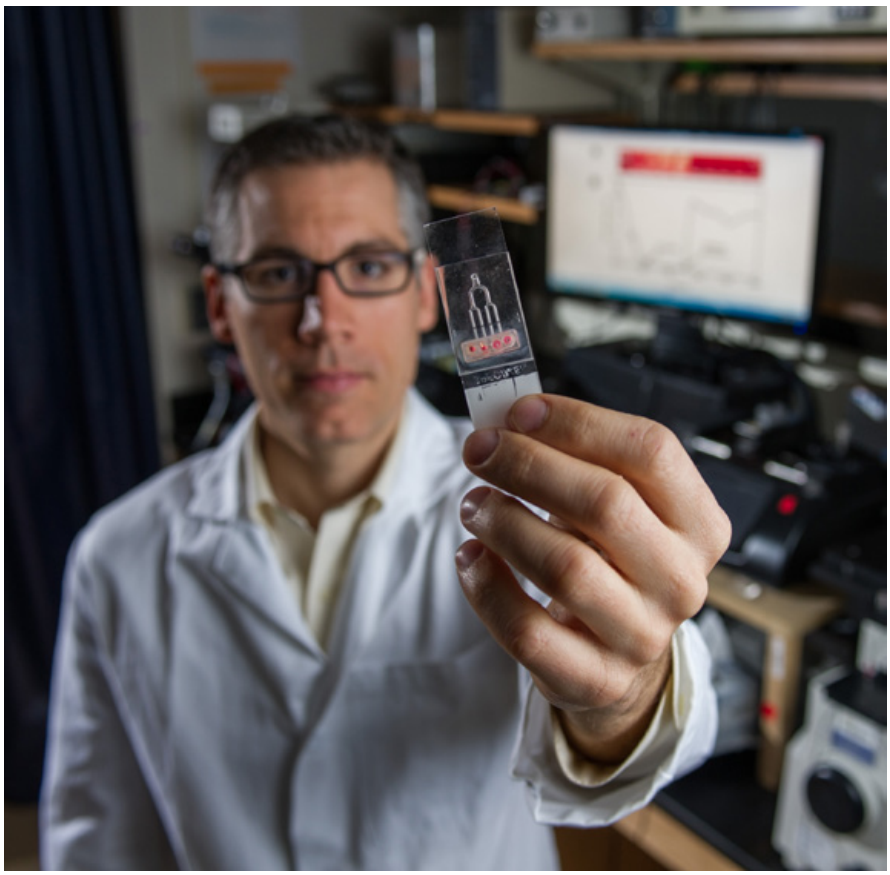
The study was led by Craig Forest, assistant professor of bioengineering in the Woodruff School of Mechanical Engineering, in collaboration with David Ku, a medical doctor and mechanical engineering professor at Georgia Tech.

The study, which involved 14 human subjects, used a device that simulated blood flowing through narrowed coronary arteries to assess effects of anti-clotting drugs.

Patients' blood was tested in a patent-pending microfluidic device with narrow passageways to simulate the coronary arteries. The data is consistent with clinical findings showing that physiology has a major influence on the effectiveness of drugs used for heart attack prevention.

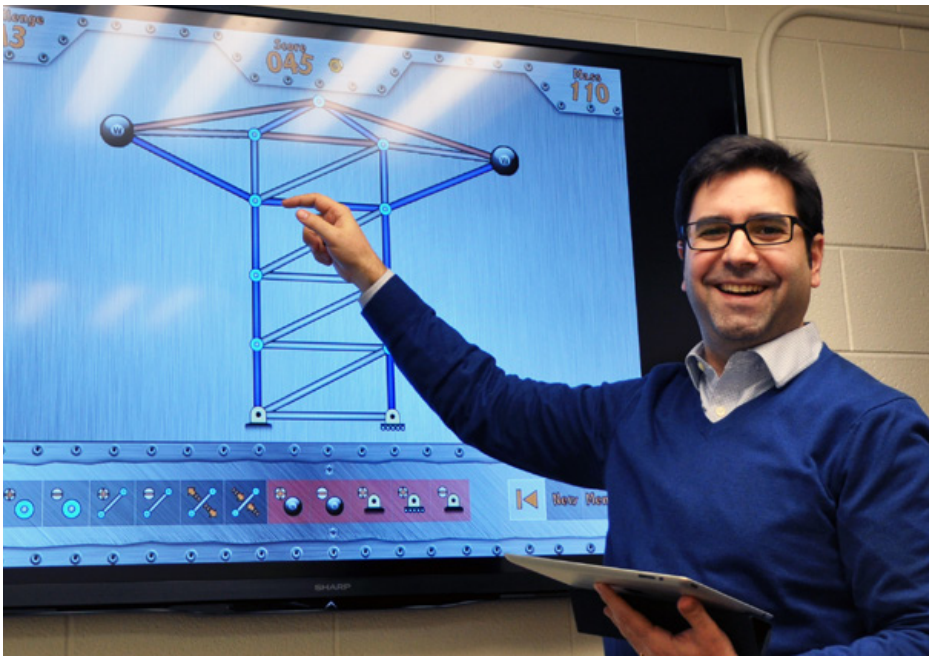
The researchers believe that a benchtop diagnostic device, like the one used in this study, could save lives by preventing heart attacks and help lower healthcare costs by giving physicians better guidance on how drugs may affect individual patients.

– Brett Israel



ROB FELT

Julian Rimoli's Truss Me! App is Making a Splash



KATHLEEN MOORE

Aerospace engineering professor Julian Rimoli developed an app called Truss Me! to aid him in teaching basic concepts to his statics students. But since its debut in the iTunes store in November 2013, it's gained a huge following.

More than 3,000 people in more than 40 countries have downloaded the app, which challenges players to employ scientific principles to design the most efficient and dependable "moon lander" vehicle. With 15 different challenge levels, the app has become a favorite among a generation of teens and college students raised in a computer gaming culture.

But it has also attracted the attention of serious educators, including the prestigious university ETH-Zurich, which has incorporated Truss Me! into its curricular activities for mechanics of materials classes. For his part, Rimoli is happy that an app he programmed in his spare time has helped educators around the world; however, the real pay-out is in his own classes, where the app is helping Georgia Tech students gain an intuitive understanding of truss behavior.

– Kathleen Moore

BARBARA CHRISTOPHER

SCL Collaborates to Develop Supply Chain Operations Certifications

The Georgia Tech Supply Chain & Logistics Institute (SCL) is teaming with Broward College to lead a lead a consortium of 12 universities and colleges, which will develop eight industry-recognized supply chain operations and logistics certifications.

The $25 million grant, sponsored by the U.S. Department of Labor, was designed to enhance the skills of entry- and middle-level employees in supply chain operations. The eight certifications are Supply Chain Principles, Inventory Control, Warehousing Operations, Transportation Operations, Customer Service Operations, Demand Planning, Procurement, and Manufacturing & Service Operations.

Seven states have been targeted for the initial roll-out of the certifications, and an estimated 3,000 jobs will be filled by program participants. Target students for the certification programs include veterans, the long-term unemployed, and people impacted by significant industry-specific downsizing and outsourcing.

"Over the years, supply chain operations has become more integrated and more complex," said Tim Brown (left), SCL's academic program director, who serves as the Georgia Tech principal investigator on the grant. "To meet the ever-increasing demands of industry and to stay on top of distinct trends in the field, it is imperative to develop and offer standard professional education in the field."

– Barbara Christopher

Taking the Long View in Materials Science

A look at the PTFE-MSE merger four years in

by Alyssa Barnes

July 1, 2010: The rumors were true. President G.P. "Bud" Peterson announced the merger of the School of Materials Science and Engineering (MSE) and the School of Polymer, Textile, and Fiber Engineering (PTFE).

Talks of the merger began in January of that year, as the need for separate schools was questioned. Don Giddens, dean of the College of Engineering at the time, said, "The merger will allow us to move in a direction that will respond to industry, academic, and research needs and trends of the future. The opportunities for students and faculty alike will be broadened and go far beyond what is currently available."

After long and intensive meetings to revamp the curriculum, a reshuffling of offices, and even a T-shirt design contest to mark the merger, the new curriculum was launched in fall 2010. PTFE students were allowed to complete their degrees or transfer to the new program, and the polymer and fiber engineering degree was phased out in fall 2011.

The merger created the largest MSE program in the country, which has climbed in well known national rankings in the years since. But combining the two schools also improved MSE — for students and professors alike — in numerous ways that have drawn less attention.

The major change is the creation of the new curriculum, which covers the fundamentals of all forms of materials and provides areas of concentrations in structural and functional materials (i.e., ceramics and metals), biomaterials, or polymers and fibers (including textiles).

"Materials is such a large field," says Renita Washington, MSE academic advising manager. "Adding the concentrations really gives students the chance to specialize their courses of study and gain advantages in their job searches."

Andrew Bulecza thought the PTFE degree was too focused on polymers and textiles for his interests. Bulecza, who switched to the new curriculum and graduated in spring 2013, says the concentration helped him secure his current position at Ethicon, a Johnson & Johnson medical device company.

"Being able to rattle off the words 'bio-material concentration' during the interview helped justify why I was academically prepared to fulfill the job requirements," he adds. Other students who have recently graduated (or are graduating soon) mention similar experiences.

The new curriculum was designed to produce graduates who are well-rounded in the fundamentals of materials science and engineering, making them prepared to meet the needs of industry and government. By having a firm foundation in the fundamentals, students can supplement their knowledge with the concentration of their choice.

Entrepreneur and MSE external advisory board member Yancy Riddle (M.S. MSE '98, Ph.D. MSE '01) says the addition of concentrations is producing the desired results.

ROB FELT

"Bringing us together provides natural pathways for collaboration," says MSE Associate Professor Meisha Shofner.

"The traditional silo mentality of education does not prepare students for industry," he says. "The merger has uniquely positioned MSE to produce graduates that are well versed in a variety of materials and are prepared to solve real world problems with great commercial potential."

The merger also resulted in an increase in interdisciplinary research. Associate Professor Meisha Shofner explains that a larger school means a faculty with a wider range of expertise, reflecting "the inherent interdisciplinary nature of materials science and engineering."

"Bringing us together provides natural pathways for collaboration that builds upon the fundamental processing-structure-property-performance paradigm," Shofner says.

An example of such interdisciplinary research that might not have happened without the merger is the collaboration among several professors on the concept of smart and responsive textiles. Traditionally involved with "soft" materials, Professor Satish Kumar is working with Professor Eric Vogel and others, who work in "hard" materials, on smart and responsive textiles that can combine the functionality of separate materials into a single system.

Kumar describes a concept involving "embedding today's smartphone technology into the collar or sleeve of a shirt, and using energy harnessed from the environment — light, sound, motion — to power the device integrated in the fabric itself." The thickness of the device would be in the sub-millimeter range and virtually undetectable.

Professor Naresh Thadhani, MSE's current chair, was also involved in the merger and is proud of the school's new direction. "We now have the opportunity," he says, "to be a model program and define the future of our discipline."

But what does Peterson himself think of the merger now, four years after he announced it?

"When we first discussed a possible merger of PTFE and MSE," he says, "we decided that the motivation should not be to save money, but rather to only make this change if we felt it would strengthen the national reputation, the quality of scholarship and the clarity of educational objectives of both programs. Now, nearly four years later, while there is still some work to be done, there is little doubt that we have been able to make significant progress in all three objectives." ▪

The View from the Top

Lee Burrell found ISyE's top-ranked program a bit intimidating — at first

by Lee Burrell, ISyE '12


JOHN LAU

"There are very few monsters who warrant the fear we have of them."

- André Gide, French author and winner of the Nobel Prize in Literature (1947)

I'm confident that at the essence of every student's experience at Georgia Tech is the fact that our prestigious institution pushed the boundaries of our comfort zones beyond what we previously thought possible.

My experience of how Tech's College of Engineering stretched, pulled, yanked, and drove me to be better — personally, professionally, and academically — began on my very first day.

That day started in a packed and ice-cold conference room in the ISyE building, across from the CRC.

As I sheepishly strolled into the room, it finally hit me that I was at the No. 1 industrial engineering program in the entire country (for 23 years in a row, I was keenly aware). I was as tense as someone deathly afraid of heights naively stepping out onto the ledge of the Chicago Skydeck.

My palms felt like a soaked yellow Georgia Tech basketball jersey. My mind raced around in circles like Jeff Gordon's car at Atlanta Motor Speedway, with questions exploding like those little popper fireworks being thrown on the ground.

What happened if I failed out? How did I even get in? Maybe I should have just gone to the University (sic) of Georgia.

So what does one instinctively reach for when faced with uncertainty and crippling fear? Familiarity, of course! I quickly hashed out a plan to seek someone, anyone, who was feeling as I was — I surely could find someone feeling these same uncomfortable emotions, right? — and we would together wallow in our certainly ill-fated decision. A genius plan, I thought, under the circumstances.

Although I was admittedly a little rusty in my advanced math skills, I was able to calculate after a quick scan of the 42 fresh-faced strangers in the room that I was, in fact, the only one visibly panic-stricken — that or my new friends were all professional poker players. My genius plan was crashing faster than the stock market in 2008.

There I sat, just a country boy from the South with a slight drawl in a room full of sagacious and worldly people, certain I had gotten myself into something that was clearly over my head.

Oh well, I thought — I'm not going down without a fight, fear be damned.

One by one I mustered the courage to introduce myself to these strangers, getting to know each of them.

Like magnets being drawn together, it was these same strangers who quickly became my closest comrades as we toiled over countless sleepless nights on the treacherous front lines of global logistics problems. Our time spent together both in and out of the classroom allowed me to

gain a better understanding of vastly different countries and cultures, loves and languages, histories and hopes, and interestingly enough, myself.

Beyond the classroom, I mustered the wherewithal to join numerous campus groups, make new friends through weight training and intramurals (and win the graduate basketball championship, it must be noted), suspend myself on the on-campus ropes courses, and apply my startup to Georgia Tech's Advanced Technology Development Center startup incubator (and get accepted). And ironically enough, I wasn't too shabby in the classroom either. That failure that I feared so much never came to pass; I was able to pass every class, making my mother proud by graduating with a respectable 3.45 GPA.

Since graduating in 2012, I've worked on global logistics projects for some of the world's top companies in a multitude of industries. From Singapore to San Francisco, China to the Czech Republic, India to Indiana, I've used the skills I learned at the College of Engineering to positively influence the 3Ps (People, Profits, and Planet).

I've also been able to call amazing cities like Chicago, Detroit, and now Calgary home. Each time I've relocated for a new role, I've moved into cities where I knew no one and had no idea how things might turn out, similar to my first experience at Georgia Tech. Yet each time I've met amazing people, gained lifelong friends, had amazing experiences, and grew as a human being.

Over the course of all my new and sometimes scary adventures since that fateful first day at Tech, I've come to realize that the unknown is not a cause for fear, but a potentially incredible opportunity to be embraced.

We all experience doubts at times, but what might we miss if we concede control to the monster called fear that lives within each of us? I certainly would have missed out on one of the most enjoyable and enriching experiences of my life — becoming a helluva engineer. ▪

JOHN LAU

The Professor *of the* Opera

A mild-mannered academic leads a secret life on the stage

by Van Jensen

Professor Anthony Yezzi describes his presence in the classroom as "mild-mannered and matter-of-fact." So it was likely quite a surprise when his students in the School of Electrical and Computer Engineering (ECE) discovered Yezzi's passion outside of academia.

In 2012, students and coworkers ventured off campus to watch Yezzi perform his first operatic role in a production of Puccini's "Gianni Schicchi" with the Capitol City Opera Company. That performance was in many ways a culmination of a passion for music that goes back to Yezzi's earliest memories.

"My mother sang to me from the day I was born," he says. "She passed down her own love of singing to me by constantly encouraging me to sing myself. As I became older, we would both sing together in our church choir."

His family's lineage traces to southern Italy; his grandparents would put on recordings of opera singer Mario Lanza, and Yezzi's father would play traditional Italian music on the accordion. "One of my favorite memories from childhood was the tradition of the whole family sitting around the table singing together at my grandparents' house after dinner was over," he says.

In high school, Yezzi began to sing classical choral music, and he formed a barbershop quartet with friends. He recalls visiting a music store with friends and discovering a recording of famed Swedish tenor Jussi Bjorling and listening to it straight through, speechless.

"That night, my friends and I listened to these recordings and were completely stirred and amazed by both the masterful level of singing that was so impossibly beyond our reach as well as the deeply expressive music itself that was being sung," he says. "That was the night that my deepest passion for opera was born. I began taking voice lessons for the first time, and my enjoyment of classical singing has only continued to grow since then."

But when it came time to choose a major in college, Yezzi knew that he would be competing with other singers with years of formal training. He opted for an engineering major and a music minor, a choice he said was "disheartening" but "realistic."

"I most definitely enjoy my chosen career. It has brought me a tremendous sense of satisfaction and has afforded me opportunities that I had never even imagined," Yezzi says. "So I have no regrets, but I will admit to fantasizing about what a successful career as an opera singer would be like."

From left: Anthony Yezzi in his professorial form; singing the national anthem at a Georgia Tech basketball game; and posing for an opera headshot.

GARY MEEK

GEORGIA TECH ATHLETIC ASSOCIATION

COURTESY OF ANTHONY YEZZI

With the demands of graduate school and then a tenure-track position at Georgia Tech, Yezzi no longer had time for singing, aside from singing off and on in the chorus at his church. He enjoyed success as a researcher, making breakthroughs in image processing and computer vision, particularly in 3-D medical imaging. Recently, he has applied the research in new directions, including reconstructing subterranean structures using aboveground surface-wave measurements.

After Yezzi became a full professor — he's now the Julian T. Hightower Chair Professor in ECE — he decided to commit more time to music. He began to take weekly voice lessons and dedicated an hour per night to singing. After three years, he started auditioning for operas, leading to his first role with Capitol City Opera Company. He's had a steady stage career since, although his academic work forces him to turn down roles on occasion.

Yezzi also has reconnected with his Italian roots. He first visited Italy while a postdoc at MIT. Then, while at Tech, another opportunity came to travel to Italy. During the trip, Yezzi took his father to visit the family's home region of Abruzzo.

"That visit was a pivotal moment in my life, making all of those childhood memories now connected to something now real," he says.

Yezzi started working to build relationships with Italian universities, which resulted in a dual-degree program between Tech and Politecnico di Torino and Politecnico di Milano. Over the past decade, Yezzi has visited Italy regularly, even working as a visiting professor at the University of Bologna. In Bologna, he studied under Francesca Pedaci, who was one of Luciano Pavarotti's protégés, and performing with Corale Lirica di San Rocco, an operatic choir.

Last fall while in Italy, Yezzi was offered a role in Verdi's opera "Attila" with the Circolo Lirico di Giuseppe Verdi at the Teatro Rossini di Lugo in Ravenna. It was a full-circle moment, a performance of one of his favorite composers in a historic venue in the home of his ancestors. Yezzi stepped to the stage and — just as he had with his Italian family around the dinner table decades earlier — opened his mouth and began to sing. ▪

Soylent Is *(for)* People

Alumnus Rob Rhinehart is the mastermind behind a liquid food

by Van Jensen

After graduating from Georgia Tech in 2012 with degrees in electrical engineering and computer science, Rob Rhinehart was living the frugal life of a startup entrepreneur. One morning in early 2013, while frying eggs, he realized how much time and money he spent on food.

Each month, hundreds of dollars and dozens of hours were draining away simply to provide sustenance. There had to be a better way.

Rhinehart had never studied nutrition, but that didn't deter him. He studied up online, researching the basic nutrients the human body needs: protein, calcium, phosphorous, manganese, etc. He began assembling these nutrients into a liquid food that he nicknamed "Soylent." Then he began testing the recipes on the only subject he had: himself. Rhinehart began eating this new food and nothing else, and he detailed the process on his blog. The experiment was a success in expected ways (it saved money and time) and in some less expected ways (Rhinehart had more energy and lost weight). Another bonus: It actually tasted good.

"I was convinced it was a good product because I personally enjoyed it so much," Rhinehart says. "Soylent increased my quality of life substantially more than any new piece of software or hardware I had received in years. I figured food is essentially hardware, and I see vast potential in biology as the next platform for innovation."

Steadily, the blog entries built a following, especially in the tech community. And then media outlets like Vice and the Washington Post picked up the story about the engineer who wanted to reinvent food.

"Writing about it was essential to its success," Rhinehart says. "I think clear, accessible writing is undervalued in the technical fields."

As attention grew surrounding the project, Rhinehart realized this was more than just a personal endeavor. Soylent had a future.

"Unlike an app that requires an expensive smartphone, everyone has the tools to use Soylent," Rhinehart says. "The potential market is every living human on earth and above it."

COURTESY OF ROB RHINEHART

Soylent raised $2.1 million by taking pre-orders via a crowd-funding platform. Since then, the company has relocated to California and has received an additional $1.5 million in venture capital funding from prominent investors including Andreessen Horowitz. The Soylent team has grown to five employees, including fellow Tech grad Matt Cauble, who earned an industrial and systems engineering degree in 2011.

Now the group is working to manufacture Soylent in much larger quantities to fulfill initial orders, which meant that Rhinehart needed to partner with a food manufacturer — his kitchen wouldn't cut it.

The name Soylent comes from "Make Room! Make Room!," a satirical 1966 sci-fi novel that featured a replacement food

called Soylent. The book was adapted into the film "Soylent Green," which famously featured Charlton Heston's character shouting, "Soylent Green is people!" Rhinehart said investors and advisers had pushed back against the name, but he's sticking with it.

While Rhinehart's background in engineering has surprised some, he sees Soylent as a natural outgrowth of his background and interests. Growing up, he always was building things, moving from blocks to Legos to models to computers to robots.

"Electrical engineering was a natural progression," he says. "I chased the complexity."

Georgia Tech was a natural progression as well. Rhinehart's father, Robert Rhinehart Sr., graduated from Tech with an electrical engineering degree in 1963, and the Rhineharts were regulars at Tech sporting events.

At Tech, Rhinehart joined WREK. But rather than angle for a hosting job, he worked on the technology and systems of the radio station, searching for ways to make the operation more efficient. Efficiency is the current that runs through much of his work, including Soylent, which holds its ultimate goal as making food as efficient as possible.

"There are inefficiencies everywhere," Rhinehart says. "I am confident Soylent will eventually be cheap and ubiquitous enough to revolutionize hunger, health and agriculture."

COURTESY OF ROB RHINEHART

The product is all nutrition with no wasted calories or weight, and could be used as a meal replacement to be sent into an area hit by a disaster. But Rhinehart is convinced it has a broader market. "Soylent is designed for a healthy, active person, and designed to be cheap, easy and nutritious," he says.

While Rhinehart tested out the Soylent recipe by consuming it and nothing else, he recognizes that food is more than just fuel.

"I was never much of a cook and never cared for grocery shopping and dishes," Rhinehart says. "I do enjoy eating, especially socially, I just don't want to all the time. I really miss the sweet tea and BBQ in the South." ▪

The Magic of Engineering

CoE alumnus Trevor Larsen has helped shape Disney engineering

Story by **Lyndsey Lewis**

Photography by **Disney**


TREVOR
DAYTONA BEACH, FL

LAKE BUENA VISTA, Fla. — If you've vacationed at a Disney park over the past two decades, you've probably already seen Trevor Larsen's work.

Remember when your kids talked you into riding Space Mountain? Larsen developed parts for your car. That time you screamed your way through the Twilight Zone Tower of Terror? Larsen was one of its designers.

Now he's senior vice president for facilities and operations services at Walt Disney World Resort, meaning he influences engineering all over the Orlando property. His past work at Disney has led him to glamorous cities, like Paris and Hong Kong, in the name of one Mickey Mouse.

But it all began, as many careers do, on North Avenue.

Trevor Larsen — engineer, executive, Disney cast member — is a two-time College of Engineering alumnus. He earned both a bachelor's and master's degree in mechanical engineering from Georgia Tech, the only university he ever applied to.

"I was convinced that Georgia Tech was the very best engineering college for me," he says, "and that's where I wanted to study."

Since finishing his education, he's spent his entire career at Disney, where he climbed from "Imagineer," in company parlance, to the leadership role he holds now. Creations and designs from his earliest days at Disney are still in use today.

If you think Larsen is living an engineer's dream, well, you're exactly right.

To Space Mountain and Beyond

Tucked in a quiet corner of Walt Disney World, there's a warehouse whose bland exterior belies the treasures within.

This is Central Shops, Disney World's main manufacturing and maintenance site. Explore its departments and you'll find everything from ride vehicle construction to figure painting and sculpting. It's a Disneyphile's dream, and it's where Larsen came up as an engineer in the early '90s.

In his current job, he has responsibility for this factory as well as others scattered across Disney World's property. But in his earliest days with the company, Larsen was working here himself as a ride engineer, providing ride support for the manufacturing and maintenance teams.

"As I walk through the shops, it's like a little trip down memory lane," Larsen says now.

In one section of the warehouse are a few pieces from Space Mountain. There's a carbon fiber tub, which serves as the bottom to one of the ride's cars, as well as a tow bar that Larsen himself designed during those first days at the company. Space Mountain has seen a lot of changes since then – including a cosmetic revamp in 2009 – but that tow bar is still in use on the attraction today.

Which doesn't mean Disney engineers rest on their laurels. Like all engineers, they seek ways to improve their work and boost efficiency. Larsen's resume also includes work on Spaceship Earth (the attraction housed in Epcot's famous silver sphere), where he helped design better wheels for the ride's vehicles.

The Space Mountain posting, though, was formative for Larsen's career. He was assigned to its cycle program, an important part of any Disney attraction but especially high-intensity ones. It works like this: After a car has been through a certain number of "cycles," its nuts and bolts are removed and replaced, and the vehicle undergoes testing to ensure it's safe and functioning properly.

This is no small feat. Larsen points out that in a decade of use, a regular automobile door may go through 25,000 "cycles," measured in openings and closings. A door on a Twilight Zone Tower of Terror car, meanwhile, will see more cycles than that in less than two weeks.

Stakes are high for Disney engineers, and in his earliest years, Larsen says, he was grateful to work with and learn from the more seasoned engineers around him. He was also glad for a job that melded both the theoretical and hands-on sides of engineering.

Larsen has spent his entire working life at Disney now, but his enthusiasm for Disney and engineering itself remains undimmed. He speaks of the company's namesake, Walt Disney himself, like an old friend, and frequently mentions Disney's philosophies to illustrate his own relationship to his work.

"Walt Disney used engineering and technology as a core medium to his storytelling," Larsen says. "Even the name Imagineering embodies the essence of how engineering fits into Disney's culture."

Engineering Roots

When his elementary school classmates fantasized about becoming police officers and firefighters, Trevor Larsen was already telling teachers he hoped to be an engineer.

His roots in the field run deep: His grandfather was a tool-and-die designer, his uncle is a millwright

In the early 1990s, Trevor Larsen honed his engineering skills at Central Shops, Disney World's main manufacturing and maintenance site.

and machinist, and his father is a mechanical engineer.

"I grew up in a household where my curiosity and creativity were encouraged," he says.

Disney figured into his childhood, too. His first exposure to it was through a TV show, "The Wonderful World of Disney."

"What captivated me then, and what continues as one of our core elements today, was Walt Disney's ability to tell stories," Larsen says. His first time in one of Disney's parks was as a youngster celebrating his father's graduation with a mechanical engineering degree.

At Georgia Tech's College of Engineering, Larsen focused on work but found time for extracurricular activities. He was a member of the Barbell Club and a founding member of Georgia Tech's rowing club. When he began considering graduate school, the College of Engineering quickly became an enticing option.

Offering generous scholarships, Georgia Tech's mechanical engineering program allowed him to take upper-level classes that counted toward both Larsen's degrees.

"Having both a bachelor's and master's degree in mechanical engineering from Georgia Tech," he says, "made me extremely competitive when it came time to interview for fulltime positions."

His path to Disney wasn't particularly unusual or glamorous. The company attended a Georgia Tech career fair, and Larsen stopped by. He spoke with Disney's director of engineering, which led to a subsequent interview and then a job offer – a full quarter before Larsen's graduation.

"These types of early job offers are quite common at Georgia Tech," he says, "because companies realize how demanding the program is."

These days, his life looks very different from when he entered the workforce. Larsen has had a part in some of Disney's marquee attractions: He was a designer for Test Track Presented by Chevrolet at Epcot, and he served on the opening team for Disney's Animal Kingdom.

But some things have stayed the same. He believes in staying in touch with the "guest experience" and so he takes strolls through Disney parks and resorts to see things from a visitor's point of view.

"Seeing things first hand, in the field, is very important in our business and to every engineer," he says.

Nothing but Blue Skies

Every attraction at Disney begins with a story.

The first step in developing a new ride is called the blue sky phase. At this stage, only the story is real, and it will create the foundation for everything that comes after.

Larsen stresses the value of "show" at Disney parks and the idea that an attraction is more than mechanics. It's a well-planned, meticulously detailed piece of entertainment – a show infused with magic.

At Central Shops, Larsen's old stomping grounds, the commitment to show is visible in every department. Scattered across the warehouse are bits and pieces of a new roller coaster. Bound for the Magic Kingdom, these pieces will eventually become part of Seven Dwarfs Mine Train (which opened in May).

What Larsen talks up aren't the workings of the ride itself, but character details and artistic touches. For example, the ride's vehicles – its "mine trains" – were crafted to appear authentically wooden.

In another part of the warehouse, an artist is hand-painting the bottom half of a small, stout figure that will be one of the ride's namesake dwarfs. Larsen asks the artist which character he's working on.

It's Happy, of course.

Disney, Larsen says, is "a company you can really have a career with." Through the twists and turns of his own career there, he's found guidance in Disney principles.

At Test Track, the Epcot attraction Larsen helped design, riders are rocketed through a course at up to 65 miles an hour. It's one of the most popular rides at Epcot, and Larsen is proud of the rigorous safety checks it undergoes.

As Disney's former vice president for worldwide safety, he's an expert on them. The Test Track garage, its dedicated maintenance facility at Epcot, is open 24 hours a day. Larsen references the philosophies of Walt Disney again when he talks about it, explaining that while show was one of Disney's core values, his No. 1 priority was always safety.

"Everything we design, build, operate, and maintain," Larsen says, "is done with a focus on excellence."

This is one of the fundamental challenges of Disney: how to fuse the creative vision its reputation is built on with the needs of millions of visitors and a constant vigilance for safety.

It's a challenge best suited, of course, for an engineer. ▪

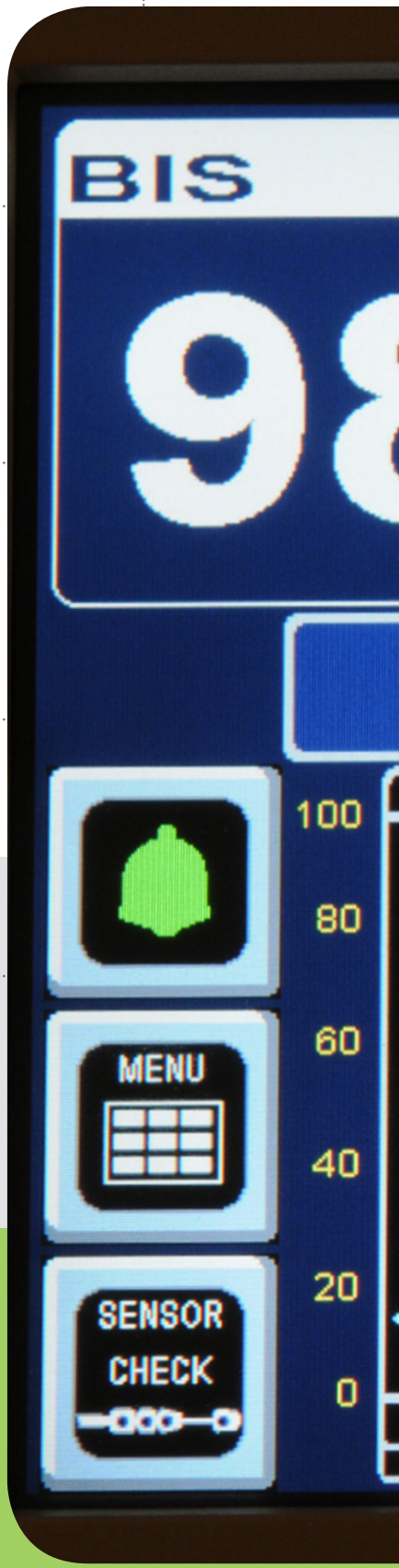
Interested in a career with Disney?

Trevor Larsen encourages current Georgia Tech students to consider careers at Disney, which has an internship program for college students. His advice?

"Study hard, make good grades, learn to work well with others, put the video game controller down and get your hands dirty."

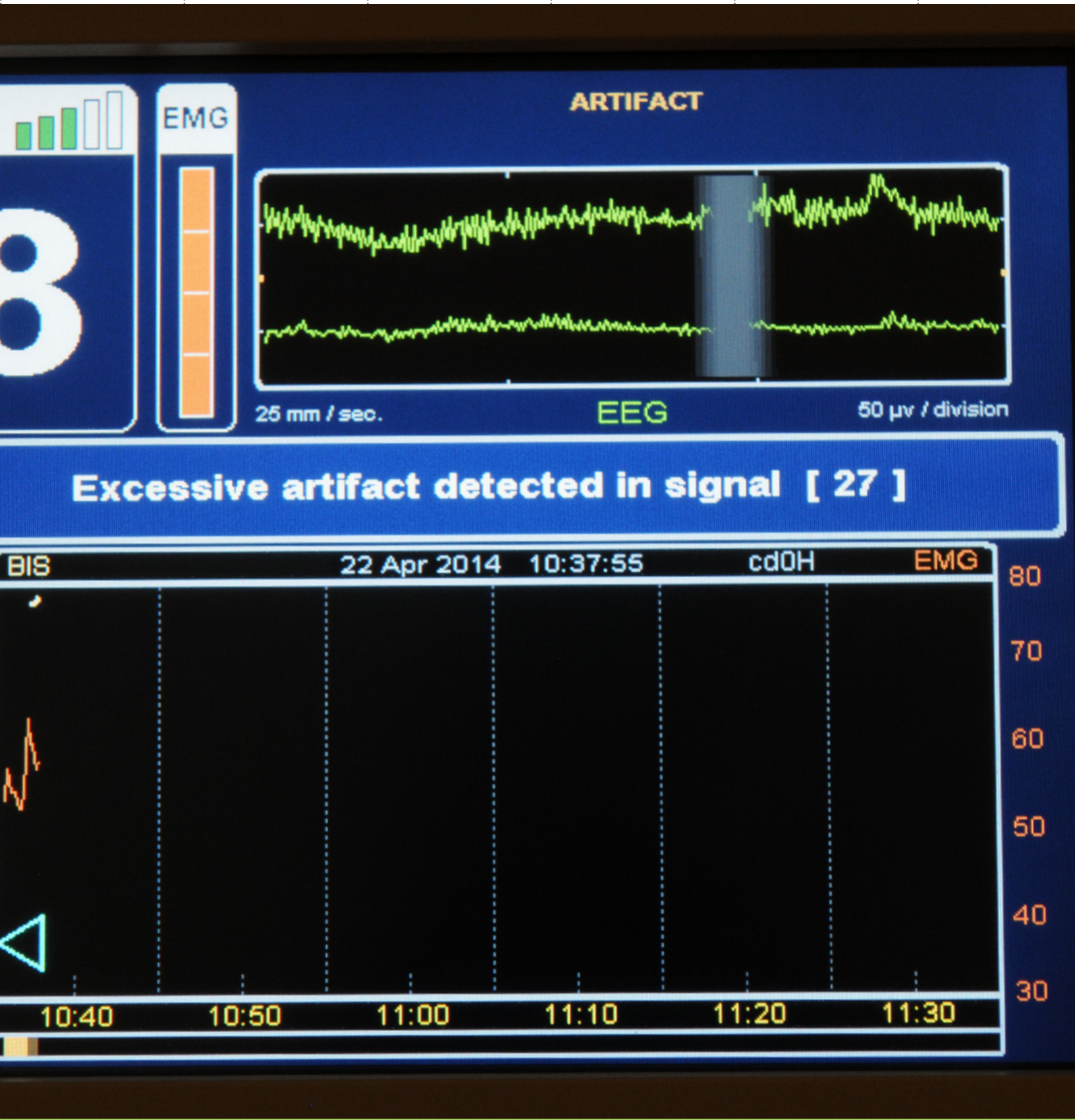
Opposite page: The Twilight Zone Tower of Terror is one of the attractions Larsen helped design.
Above: Larsen is proud of the artistic detail that goes into Disney rides like Seven Dwarfs Mine Train, which opened in May.

A BETTER WAY TO MANAGE PAIN



AE Professor Wassim Haddad wants to eliminate over- and under-sedation in surgical patients.

By KATHLEEN MOORE



The BIS Monitor is one of several inputs used to provide information on sedation levels of critically ill ICU patients.

Wassim Haddad will be the first to tell you that he's no businessman. The author of numerous books and papers on subjects ranging from mathematics and philosophy to dynamical systems and thermodynamics, he is a scholar first and foremost.

But when his interest in dynamical system modeling and control led him repeatedly into the realm of pharmacology and neuroscience, the aerospace engineering professor could not ignore the obvious. That's how AreteX Engineering was born.

KATHLEEN MOORE

"We are using machine learning, Bayesian networks, and dynamical system modeling to assess sedation and pain levels," says Professor Wassim Haddad.

Launched in 2012, the NYC-based company is developing a technology that could eliminate over- and under-sedation, a problem that currently affects thousands of hospital and nursing facility patients each year. Already studied in surgical settings, the AreteX technology seeks to improve anesthesia delivery by drawing upon an expanded database of behavioral and physiological indices to guide dosage levels.

The research — and the philosophy — behind it have been building critical mass in Haddad's mind for more than a decade. He is excited that they are both, now, coming together.

"I have always maintained that there are many connections between thermodynamics — the science of large-scale dynamical systems with interconnected components or parts that exchange energy and matter among subsystems — and neuroscience," he says.

"I realized that with a suitable reinterpretation of system variables in one discipline, we can transition and develop new theories in another to solve pressing problems," he continues.

"And that's what we are doing with AreteX. We are using machine learning, Bayesian networks, and dynamical system modeling to assess sedation and pain levels as well understand patient outcomes in the ICU."
In addition to receiving startup grants from the National Science Foundation and the U.S. Army Medical Research and Material Command, AreteX is currently in talks with the NYU Langone Medical Center to begin clinical trials on a new suite of technology and protocols that will use physiological and behavioral data to more precisely calibrate patient drug dosages in the ICU. With a more robust database, the system better addresses sedation and pain management. The company started a pilot study at the Northeast Georgia Medical Center (NGMC) earlier this year.

Another grant, currently in the works, could bring AreteX's prototype to market within a year.

Haddad is joined in this venture by his longtime research partner Dr. James Bailey, an NGMC anesthesiologist, and Dr. Behnood Gholami, a former AE doctoral student of Haddad's who went on to do post-doctoral research at Harvard Medical School.

"We are introducing a series of multi-modal sensors to this process so that clinicians will be able to base patient care on behavioral and physiological measurements," said Bailey. "If we can remove the subjectivity, we will be able to better use the knowledge and judgment of our medical staffs."

The problem with general anesthesia

As many as 2 percent of all surgical patients have been found to be insufficiently anesthetized, a condition that permits them to be fully aware during an operation but unable to inform their surgeon because they are paralyzed.

"That may not sound like a high percentage but, when you consider that there over 20 million surgical procedures conducted in the United States each year, the numbers are compelling," said Haddad. "It is a nightmare when things go wrong."

The problem is less traumatic but more pronounced in the nation's ICUs, where as many as 70 percent of the patients who receive sedation are either under or over-sedated, Haddad notes.

> "What we are doing for anesthesia is, essentially, what the auto-pilot did for airplanes."
>
> **Wassim Haddad**

The results of under-sedation — patient trauma, excessive movement, unnecessary pain, the accidental removal of life-support equipment — can delay patient diagnosis, prolong hospital stays, and require additional interventions. Haddad estimates that this costs the U.S. healthcare system upwards of $400 million annually.

Over-sedated patients are spared from excessive pain, trauma or muscle movement but may be harder to wean from mechanical ventilators and more likely to remain hospitalized longer. Haddad estimates that more than $4 billion could be saved annually if the average use of mechanical ventilators in ICUs were reduced by just one day.

"The problem — in the ICU and in the operating room — is that there's no consensus on the definition of adequate sedation," says Bailey.

"If there is a question as to whether a patient needs additional sedation, the common practice is to give more, to be on the safe side. But there is no clinical evidence that this is needed, and the process itself puts an undue burden on medical staff, particularly ICU nurses, who have to do everything from bathing and feeding patients to drug titration."

Lessons learned from airplanes and algorithms

If AreteX Engineering has its way, this imprecision will soon be a thing of the past.

"What we are doing for anesthesia is, essentially, what the auto-pilot did for airplanes," says Haddad.

"You would not want an airline pilot to spend all of his time manning the controls of an airplane. And you do not want an anesthesiologist to spend all of his time interpreting numerous sensors and manually titrating patient anesthetic drug doses. He should be alert and able to intervene in emergencies, not taxed by routine data interpretation. Manual control can be very tedious, imprecise, time consuming, and sometimes of poor quality."

Into this scenario, Haddad and AreteX are introducing a closed-loop controller for intraoperative anesthesia and a clinical decision support system (CDSS) to better manage sedation and pain.

The CDSS simultaneously collects a large array of behavioral and physiological data on each patient, which it feeds into a machine learning algorithm — an algorithm that determines the probability of patient pain and sedation levels.

Ultimately, in a closed-loop system, this data will be fed into an actuator (for example, an infusion pump) that

GARY MEEK

Dr. James Bailey is hooked up to a BIS Monitor, which measures specific brain waves and delivers a numeric rating of a patient's level of consciousness.

will automatically administer the right levels of medicine directly to the patient. Right now, the machine's recommendations are provided to the clinician for improving sedation management manually.

"Closed-loop control is superior to open-loop [manual] control because it allows you to maintain sedation at targeted levels throughout, rather than having to constantly correct drug dosage as the patient metabolizes the drugs," says Bailey, who has overseen more than 50 clinical trials of a similar system in the operating rooms at Emory University Hospital and the NGMC.

"My gut impression is that the closed-loop controller does as well as I do — maybe even a little better. Overall, it has tended to require a little less anesthesia. We know when to administer it and how much is needed. And we had no instances of patients waking up or having any adverse effects."

GARY MEEK

Dr. James Bailey's wife, Rachel Bailey, is a registered nurse. The anesthesiologist said his wife's experience coordinating patient sedation in the intensive care unit convinced him that more needed to be done to improve the accuracy of the system.

Bailey's faith in this system is not based solely on personal experience or gut impressions, however. Data is king. And the AreteX CDSS system collects a lot of it. Among the primary sensors for assessing pain and sedation levels:

- Electrocardiograph to detect pulse and heart rate variability;
- Electroencephalograph to determine brain activity, particularly parameters that indicate awareness; and
- Digital imaging that captures behavioral data, such as patient movement, which indicate pain or awareness.

"Any one of these indicators alone can lead to a misleading assertion, but, when basing our assessment on multi-modal sensor measurements, that minimizes the chance of assessment error," says Gholami. "We have developed performance measures [for all of these indicators] that support more accurate interpretation and decision support for sedation management."

That said, there is no one-size-fits-all interpretation when it comes to patient care. The AreteX CDSS will take this into account.

"The closed-loop controller that we developed for intraoperative anesthesia is adaptive, which means the patient parameters can change every time you hook it up to a different patient," says Haddad.

The parameters of a 98-pound female runner will be very different from those of an overweight diabetic male patient. The control system accounts for that. It senses a different level of brain activity and takes information from all sensors to determine the amount of drug needed.

Right now, Haddad, Bailey and Gholami are targeting the CDSS for deployment in ICUs, where anesthesia is routinely used to manage millions of patients who are hooked up to ventilators and other rehabilitative equipment. But they have also set their sights on the nation's operating rooms, where anesthesiologists regularly oversee operations that can last eight to 12 hours or more.

"And sometimes, they are coming into those surgeries after having just completed another one," Haddad says. "Imagine how much this control technology could improve the accuracy and quality of anesthesia administration which forms the foundation of almost all surgeries." ▪

How a Doctoral Student Was Drawn to Haddad's Work

The road from aerospace to anesthesia has been pretty straightforward for Behnood Gholami.

"I grew up in a family that was very educated, so I went down an academic path, studying math, mechanical engineering, but I always had my eye on entrepreneurship," says the Iran native, who received a Ph.D. in aerospace engineering from Georgia Tech in 2010. "I always wanted to be out there, producing something in the world."

As an undergraduate and master's student in mechanical engineering, Gholami found himself drawn to control systems theory. That interest would eventually revolutionize his studies and his career.

"I was studying control systems in airplanes, aircraft, and robotics, sure, but that's not so different from what we [at AreteX Engineering] are doing with anesthesia," he says from his New York office.

"I started to see control systems as a fundamental component of any modern system, in almost every field — aerospace, chemical, electrical engineering."

This big picture perspective shaped Gholami's decision about where to pursue his doctorate.

"I had two offers from other schools, but when I read about the work that Dr. Haddad was doing in clinical pharmacology, Georgia Tech was my first choice," he says. "His paper on this topic won a top award, and the rigor of his research was obvious."

Of particular interest to Gholami was Haddad and Bailey's work introducing a closed-loop system for anesthesia delivery in operating rooms.

"I could see it was a biomedical application of a control systems theory," he says. "That made such sense to me. Closed-loop systems are much more reliable."

Closed-loop systems are capable of continually interpreting data from difference sources, choosing an appropriate action, and executing a response to the conditions presented. The most popularly understood application of closed loop systems — airplane auto-pilots — allow pilots to conserve time and energy for decisions that require more concentration and judgment.

At Haddad's urging, Gholami earned a master's degree in mathematics before collaborating with faculty from the Coulter Department of Biomedical Engineering to pursue doctoral research on behavioral indices of pain.

"Math wasn't a pre-requisite, but if you want to be influential in control systems, you need to know math on a deeper level," he says. "I also earned a certificate in business."

In his doctoral research, Gholami sought to create a more robust database from which an algorithm could be developed that could predict pain levels. That work continued at Harvard Medical School, where he did post-doctoral research for more than a year.

Since joining AreteX Engineering in 2012, Gholami has had the satisfaction of putting an entrepreneurial spin on his research interests. He is confident that the startup will receive additional funding to bring its product to market soon. And, in the meantime, there's still a lot of math to be done.

"We are generating a lot of data — 500 data points per second from each of four sensors," he says. "The hard part, though, is not the data collection, but the extraction of patterns. That is the exciting part, too."

KATHLEEN MOORE

We tracked down five engineering finalists from past InVenture Prize competitions to ask...

WHAT HAPPENED NEXT?

The house is packed. The cameras are rolling. Your name is called, cheers erupt, applause thunders forth from the audience. Out you go, out into the hot lights of the stage and set. You're on.

The perfectly rehearsed words tumble out in an adrenaline-fueled pitch. With practiced fingers, you manipulate and demonstrate your invention – a device, a contraption, a computer animation. The judges ask why this and when did you that. You answer as precisely and concisely as you can.

Then it's over. Your seven minutes of TV fame have come and gone.

This is what it's like for an undergraduate student participating as a finalist in Georgia Tech's InVenture Prize competition. Having completed its fifth year in spring, the live television event on Georgia Public Broadcasting showcases the best student inventions, most of which are the fruits of future engineers.

But what happens after the lights go down is a much less universal experience. In the weeks and months and years that follow, hopes for market success rise or fall. Students graduate, get jobs, enroll in graduate school, move on. Some pursue commercialization of their InVenture work; others park their dreams or create new ones.

Georgia Tech Engineers caught up with five finalists from past InVenture Prize competitions to ask what happened next. Their stories illustrate the challenges that confront entrepreneurs everywhere – and prove that a College of Engineering education really does venture beyond the classroom.

By **Michael Baxter**

JENNIFER TYNER

ROB FELT

ROB FELT

A SAFER WAY TO SAVE A LIFE

Magnetic Assisted Intubation Device (MAID)

IF YOU EVER NEED A BREATHING TUBE inserted into your lungs, you'll want that procedure to go smoothly. And one out of every 10 times, it doesn't.

Chipped teeth, damaged vocal chords, cuts to the throat — all are the unfortunate results of intubations gone awry. That's mostly because intubation requires the person performing the procedure to see the trachea and thread a breathing tube through vocal chords, avoiding the esophagus. When that view is obstructed or misinterpreted, injuries or even death can occur.

A student team competing in the 2011 InVenture competition came up with a way to minimize such injuries during intubation. Their product, called MAID, won second place, and it went on to capture top honors in Georgia Tech's Business Plan Competition as well as a $50,000 grant from the Georgia Tech Research Institute (GTRI). Today, it remains a viable candidate for commercialization.

Intubations are currently performed using a laryngoscope, a device that pries open the passage to the trachea so a breathing tube can be inserted. MAID — which stands for magnetically assisted intubation device — guides the tube in place using magnetic force. A removable, magnet-tipped stylet is placed within a breathing tube, and a strong magnet is placed outside the body, by the Adam's apple. The pull from the magnet steers the tube into proper position.

"This device has the potential to make quite an impact," says Shawna Hagen (BME '12), one of the four students behind MAID. "We get very positive feedback from people in several areas of medicine. Paramedics find it intriguing. So do neonatal respiratory nurses, because intubating an infant can be especially difficult."

The challenge, says fellow team member Alex Cooper (BME '12), is getting the market to embrace a new approach to a familiar procedure.

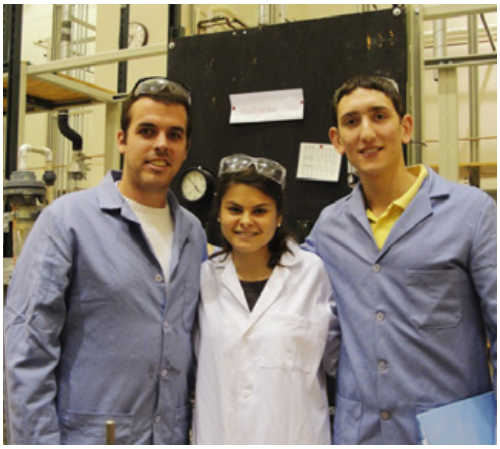
"Everyone who does intubation thinks they're better than the failure rate," Cooper says. "It's amazing how many people have told us that it'll be great for people who are bad at intubation, but that they'd never mess up the procedure."

Overcoming such a challenge, he says, will require a business partner with experience in marketing and commercialization. Securing that help as well as venture capital now falls primarily to Hagen, who is employed with GTRI. Cooper and their other teammates, Jacob Thompson and Elizabeth Flanagan, are employed full-time elsewhere.

"We're currently working with Georgia Tech's Manufacturing Institute to create prototypes of MAID to be used in efficacy testing," she says. Further proof of MAID's value may just get medical practitioners to take a second look.

WATERING THE WORLD

Tubing Operations for Humanitarian Logistics (TOHL)



PHOTOS COURTESY OF TOHL

LAYING A ONE-KILOMETER WATER LINE across hilly terrain usually takes days. But TOHL can do it in less than 10 minutes.

The student-founded company, a 2012 InVenture finalist, field-tested its water-delivery technology in July of that year. TOHL attached a spool of its high-density polyethylene tubing to a helicopter, placing one end of the tube into a tributary of the Maipo River in Chile. The spool was then flown over the hills, feeding out tube along the way, with the other end dropped in a nearby community.

When water came flowing through, the trial run proved TOHL's concept: "Mobile infrastructure" for water delivery could be installed quickly after a natural disaster.

The students behind TOHL were inspired to find a new solution for clean water after the devastating 2010 earthquake in Haiti. When they presented on the InVenture program, they believed emergency installations would be the heart of the business. Today, that focus has expanded to include installing permanent infrastructure.

"There are still almost a billion people who lack reliable access to water," says CEO Benjamin Cohen (CE '11). "They are in a permanent state of emergency. Our goal is to connect those people [to water resources]."

Since InVenture, TOHL has raised more than $500,000 in grants, awards and donations, including $80,000 awarded to Cohen, who was named a 2013 Echoing Green Fellow, and $50,000 from winning the Start Something That Matters contest sponsored by TOMS shoes founder Blake Mycoskie. The media has taken notice, too, with coverage from the BBC, Forbes and Inc. magazines, and the Discovery Channel's "Daily Planet," among others.

Cohen and Apoorv Sinha, members of the original InVenture team, remain involved in day-to-day operations. Teammates Melissa McCoy and Travis Horsley continue to work in support roles. They have been joined by fellow College of Engineering alumnus Ibrahim Sufi.

The company's biggest technical challenge now is to design a spool that can dispense larger tubes that don't twist as the line feeds out from the helicopter. Figuring out the right spool width, tube diameter and altitude for delivery is "a big optimization puzzle," says Cohen.

TOHL has operations in Chile, Kenya and Haiti. Cohen predicts that TOHL's new emphasis on long-term installations will secure multimillion-dollar annual revenues within three years.

THE NUMBER OF AMERICANS WHO UNDERGO CATARACT SURGERY each year now equals the entire population of Philadelphia. And as the nation's baby boomers age, the procedure is being performed more and more.

While common, cataract surgery presents a challenging step: creating a hole in the lens capsule, a layer of tissue that protects the lens of the eye. It's like cutting cellophane with a knife. The surgeon makes an incision, then uses tweezers to tear a roughly circular opening to access the lens.

One in five surgical residents botches this part of the procedure, according to estimates. But if engineering alumni Chris Giardina (BME '11) and Shane Saunders (ME '10) are successful, those mistakes will rarely happen again.

GARY MEEK

CLEARER ACCESS TO THE INNER EYE

AutoRhexis

Giardina and Saunders were members of a six-student team that presented a surgical tool for the lens capsule procedure at the 2011 InVenture Prize competition. Their instrument, called AutoRhexis, captured the imagination of the television audience and was given the People's Choice Award that year, bringing a cash prize and help with filing a patent.

AutoRhexis is engineered to make a perfectly round incision in the lens capsule with a simple press of the thumb. The concept is certainly novel, but getting it to market reveals just how complicated entrepreneurship can be.

"We've put a lot of effort into the blade of the device," says Giardina. "At the competition, we had a stainless steel blade, which was a good start but didn't perform as well as needed for a true clinical trial. Since then, we've explored other materials, such as flexible alloys and laser-etched diamonds. But the balance between material cost and cutting efficacy is a constant struggle."

A marketable instrument, he says, must have a blade 1 millimeter in height, fashioned out of material that cuts effectively. It must also be affordable if the device is to be disposable or be able to withstand sterilization if reused.

Addressing the engineering challenges has fallen to Giardina and Saunders, who now run Rhexis Surgical Instruments in their spare time. (Their four InVenture teammates hold a small stake in the company, too.) Another obstacle involves insurance coverage – currently, the surgical step involving the cutting of the lens capsule does not have its own reimbursement code. Thus, keeping the device affordable is crucial.

Still, Giardina remains optimistic about the endeavor.

"Most of these procedures are performed in private practice, so even if there's a small cost that insurance doesn't cover, practices may choose to use AutoRhexis to advertise better patient outcomes," he says.

The business side of the company is in order, including the non-provisional patent filing. What's needed most is a $50,000 investment, which Giardina says would cover the completion of a final prototype and new pre-clinical testing with animal models.

ROB FELT

ROB FELT

JENNIFER TYNER

A SHIRT THAT'S WORTH THE WEIGHT

TITIN

THE HALLMARK OF A GOOD EXERCISE SHIRT is typically its light weight. But Patrick Whaley (ME '10) turned that notion upside down when he invented a shirt weighing eight pounds.

Marketed under the brand name TITIN, the shirt is designed to add an extra element of struggle to workouts. It's actually two shirts — one worn underneath, with a pocketed system holding hydro-gel weights; the other worn outside to compress the weights and keep them evenly distributed for the wearer.

Since winning the 2010 InVenture Prize competition, Whaley has been unstoppable in taking his product to the masses.

"I'm expecting to break $7 million in web sales alone in 2014," he says in a phone interview while waiting to board a flight to Germany, where he would introduce TITIN at a retail exposition. "I've got distribution in 13 countries already, and I'm traveling to add others. We're now selling more shirts in one day than we did in all of October 2013."

Whaley first had the idea for the shirt as a teenager. He remembers being "a skinny kid who carried extra stuff in my book bag" to gain strength. Thinking there had to be a better way to wear that weight, he began sketching superhero-like shirts.

Georgia Tech gave Whaley the foundation to build upon the idea, and winning InVenture proved to be a defining moment.

"It was really the point of validation," he says. "After the competition, people acknowledged it wasn't a hobby anymore. It was a little hard for my dad to let me continue on, because he didn't want me to lose the opportunity of a college education."

So Whaley did the opposite: He leveraged his education, managing schoolwork and entrepreneurship with the discipline needed to excel.

"I would do homework sometimes until the middle of the night, then fall on top of the covers, then wake up at 6:30," he recalls. "It was all business between 6:30 and 8 — if I didn't do it then, it didn't get done that day." Lunches were spent alone, working on the business; a spring break was devoted to vendor meetings. Friends stopped texting Whaley to see if he wanted to hang out.

But the persistence paid off. Whaley's product won "Most Fundable" in the 2011 Georgia Tech Business Plan Competition and went on to earn prize money in several other competitions. He's now training his sights on extending the product line, as well as expanding into new outlets and markets.

ANEMIA TESTING COMES HOME

AnemoCheck

MILLIONS OF PEOPLE IN THE U.S. HAVE ANEMIA — or have to be regularly checked for it by a doctor.

The doctor visits are crucial, as severe anemia can lead to organ damage and even heart failure. But they're also time-consuming and expensive. In her senior year in the College of Engineering, Erika Tyburski (BME '12) and her senior design team dreamed up a better method of detection: a disposable test people could use at home to check their hemoglobin levels.

Functioning much like the glucose monitoring tests used by diabetics, AnemoCheck requires a mere drop of blood — or less. It's faster and easier to understand than the quick-turnaround home tests currently on the market.

"The existing rapid diagnostic tests — they call them rapid, but they take 20 to 30 minutes — need three or four drops of blood," Tyburski says. "They can also be inaccurate because of user error and user interpretation error."

By contrast, AnemoCheck uses an oxidation-reduction (redox) reaction that takes about a minute to process. Based on hemoglobin levels in the blood, the final result exhibits a color, ranging from blue to red, indicating the presence or absence of anemia.

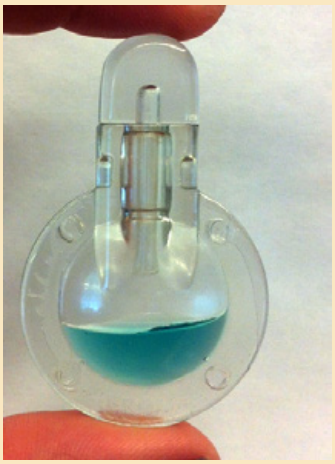
Since taking second place in the 2013 InVenture Prize competition, AnemoCheck has received $55,000 in additional funding from sources including the Georgia Research Alliance, the Georgia Center for Innovation and Manufacturing and the 2013 Ideas to SERVE competition at Tech, which AnemoCheck won. Tyburski also received a grant from the Global Center for Medical Innovation to develop a prototype device. The initial design has completed preclinical testing involving more than 200 patients, proving its stability and usability and establishing a shelf life.

Now, Tyburski is working on making the color coding more distinct so the test results will be even easier to read. Someday, she hopes to develop an iPhone app to provide foolproof readings. Her efforts are supported by Dr. Wilbur Lam, of the Coulter Department of Biomedical Engineering, and Dr. Siobhan O'Connor of the Centers for Disease Control and Prevention, who both were supervisors on the original project.

The ultimate aim is to form a corporation and begin applying for Food and Drug Administration approval. Beta testing in users' homes would follow. If all goes according to plan, Tyburski says, AnemoCheck will be on pharmacy shelves in 2016. ▪

ROB FELT


JENNIFER TYNER


COURTESY OF ANEMOCHECK

ZACH PORTER

A START IS BORN

LIKE MANY GOOD IDEAS, this one began as a simple conversation over lunch.

Flash back to September 2008. Associate Professor Craig Forest is dining with colleagues Ravi Bellamkonda, Ray Vito and Merrick Furst.

"We were talking about how Georgia Tech has the biggest career fair in the U.S., but our students don't turn to their roommates in the dorm and say, 'Let's start our own company,'" Forest recalls.

Their desire to ignite student entrepreneurship was clear. The question was, how best to do it?

One plan was to award a prize to the undergraduate student holding the patent for the most impressive invention. "The problem was, we went to the Georgia Tech Research Institute to find the undergraduates with patents, and we had none. Zero. There was nothing going on," Forest says.

So the four colleagues launched the InVenture Prize competition, which encouraged students inside and outside the classroom to dream and invent something big. Organizers drew up guidelines and launched a website, hoping to attract 20 student entrants. They got 200.

"For the first onstage competition, we had 50 people in the audience," Forest says. "Last year, we had to close the doors – we had 1,300 in the audience and another 200 in an overflow location. And 50,000 watched on TV."

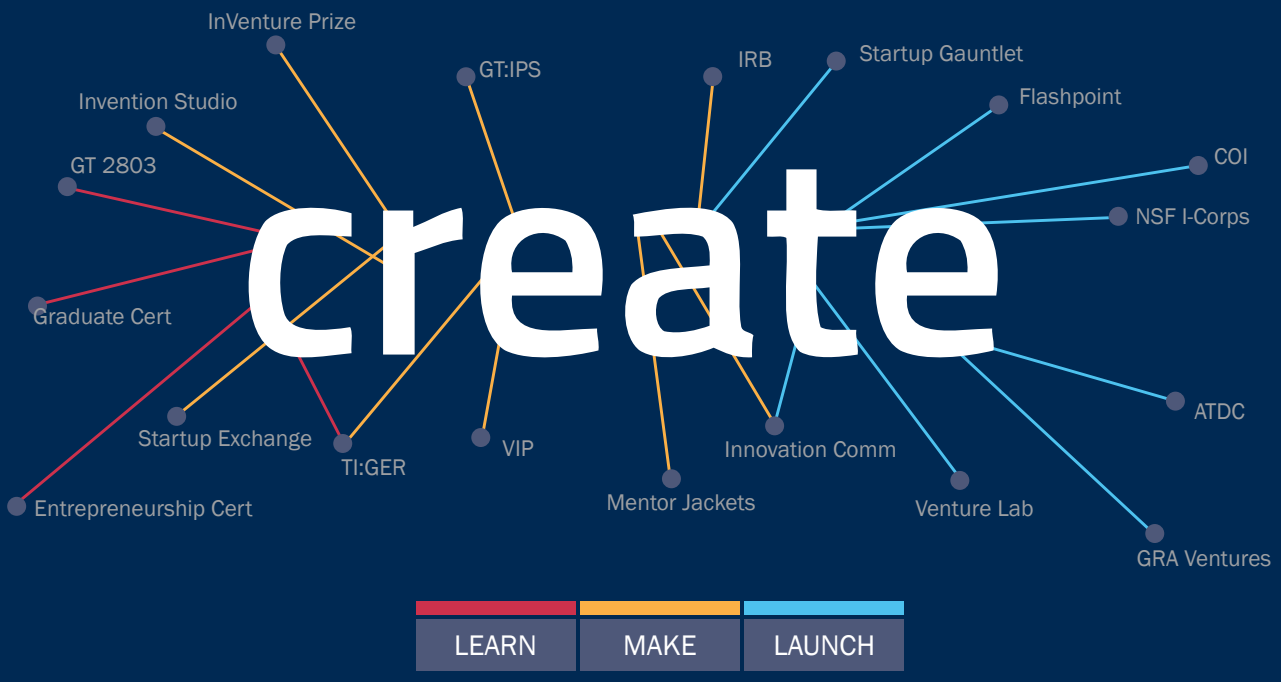
The popularity of the InVenture Prize, Forest says, mirrors the rapid growth of Georgia Tech's Invention Studio and other campus-wide efforts to encourage student entrepreneurship. Such an ecosystem, he says, serves a larger purpose: showing today's young people that there's more than one path to fortune and fame.

"You go to high schools and ask the students, what do you want to be when you grow up? And they say, Beyonce or LeBron James. They want to be celebrities," Forest says. "So this is a different way to become a celebrity."

— Michael Baxter

INSPIRED BY THESE STUDENT INVENTORS?

Make a gift to support a student team working on an invention at Georgia Tech's Startup Summer.
Email Molly Croft (molly.croft@coe.gatech.edu) for details.



STUDENT ENTREPRENEURS: Want to create a startup?

Explore GT startup resources at **create.gatech.edu**

Are You Smarter Than a...
19th Century Engineer?

You've probably heard some CoE alumni joke that if they applied to Georgia Tech today, they wouldn't get in. After all, the Institute is known for rigorous admission standards, and some of the world's brightest students now attend. But what if those students — as well the alumni — had applied in 1888?

Back then, potential students had to pass an entrance exam that looks quite different from the exams of today. The following questions were pulled right from that test. Could you have been a helluva 19th century engineer?

– Lyndsey Lewis

1. A speculator sold 18 mules for $2,148.84, thereby making a profit of 26 percent. What did the mules cost a piece?

A. $94.75

B. $92.21

C. $87.35

2. If 450 soldiers are to be furnished with clothing, each suit requiring 9 yards of cloth one yard wide, how many yards of flannel ¾ of a yard in width would be required to line the suit?

A. 15 yards

B. 12 yards

C. 10 yards

3. Write out the 3rd person singular of "to do."

A. Do

B. Does

C. Did

4. Name the principal battles of the Civil War, and give the names of the principal generals.

A. Battle of Antietam (1862) George B. McClellan; Battle of Gettysburg (1863) Robert E. Lee; Battle of Chickamauga (1863) Braxton Bragg

B. Seven Days Battles (1862) Robert E. Lee; Battle of Chancellorsville (1863) Stonewall Jackson

C. A and B

5. What is the difference between a transitive and an intransitive verb?

A. Transitive verbs take an object; intransitive verbs do not take a direct object.

B. Transitive verbs do not take a direct object; intransitive verbs take an object.

C. None of the above

6. Mention the rivers of Georgia and Texas.

A. Georgia Rivers - Ocmulgee, Savannah, Chattahoochee and Flint; Texas Rivers - Rio Grande, Red River, Colorado River

B. Georgia Rivers - Ocmulgee, Oconee, Altamaha, Savannah, St. Mary's, Chattahoochee and Flint; Texas Rivers - Rio Grande, Red River, Sabine, Brazos, Colorado and Pecos River

C. Georgia Rivers - Ocmulgee, Savannah, St. Mary's, Chattahoochee and Flint; Texas Rivers - Rio Grande, Red River, Colorado and Pecos River

Answers: 1A, 2B, 3B, 4C, 5A, 6B

POP Quiz

with Kari Watkins

ROB FELT

Are you already dreading your commute home this evening? Kari Watkins isn't, and she doesn't want you to either.

Watkins is the civil engineering professor who's been all over the news lately thanks to the app she co-created, One Bus Away. She's also a bike commuter who says you don't have to be a "super cyclist" to ride through town on two wheels. In a city where car culture is endemic, Watkins advocates easier, cheaper and more environmentally friendly ways to get around.

– Lyndsey Lewis

Can you tell us what your work at Georgia Tech focuses on?

I focus on what is often called sustainable transportation. The goal is to make the transportation system environmentally friendly, more efficient economically, and also more socially friendly by looking to other modes and trying to make multiple modes feasible options for people.

What is your daily commute like?

I live in Virginia-Highland, and I actually take a different mode on different days of the week. I am mostly a bike commuter because it is a great way to get my exercise. But I am kind of a wimpy bike commuter, so if it's a rainy day I take the bus.

If I have places to go — because of the way the city of Atlanta is sort of spread out — there are times when I have things I have to do that I can't get to, so sometimes my husband and I will trade. We only own one car in our house.

What would you suggest to drivers who are interested in other ways to commute?

I would say to ask around to other people who you have seen biking or taking transit and such, because I think it seems really overwhelming at first. You have built up this habit of using a certain mode and you have to relearn how to get around in a new way.

There are some programs that will set you up with a buddy, like a bike buddy or a transit buddy, who can help you see how it would be. You may not know the tools that are out there; you may not know that something like One Bus Away exists to tell you how many minutes until the bus is coming. Likewise with cycling, there may be some great shortcut that you don't know about that would make your bike trip really nice.

What can people who want to ease Atlanta's dependence on cars do to help?

In the transit realm, there is Citizens for Progressive Transit. They do a lot with raising awareness and helping MARTA understand the rider perspective. Atlanta Bike Coalition, on the bike side, is a fantastic organization, and having them in my corner as a cyclist has been a huge asset. I biked down Ponce [de Leon Avenue] after a lot of the snow storms, and there was so much gravel.

I am not some super cyclist — with something like the bike lanes on Ponce, I am still a little intimidated. I biked after the storm and with all this gravel, I was afraid I was going to bite it. So I wrote an email to the Atlanta Bike Coalition. They contacted the city, and those bike lanes were swept. ▪

The College of Engineering at Georgia Tech is the largest program of its kind in the country, with more than 13,000 undergraduate and graduate students enrolled. The college ranks among the top five programs in undergraduate and graduate engineering as determined by U.S. News and World Report.

Georgia Tech College of Engineering
Office of the Dean
225 North Avenue
Atlanta, Georgia 30332-0360

POINTS OF LIGHT | Shadows stretch down a hallway on a quiet day at the Blake R. Van Leer Building. Constructed in 1962, Van Leer is home to the School of Electrical and Computer Engineering.

GARY MEEK