"I see myself as a people person. I draw energy from people. A perfect day is away from email, talking to people, hearing their stories."

— STEVE MCLAUGHLIN
Meet CoE’s Newest Dean: Steven W. McLaughlin

by Kay Kinard

He is a self-described coffee aficionado, world traveler (six continents down, one to go), an entrepreneur (involved in three startups), and a Francophile (having spent three years as deputy director of GT-Lorraine and also a recipient of the Knight of the National Order of Merit from the Republic of France in 2011.) He is an avid admirer of baseball great Roberto Clemente and electrical engineer/father of the information age Claude Shannon. And he is no stranger to the campus.

He’s Steve McLaughlin, and for more than 20 years he has served the Institution as a faculty member, vice provost for International Initiatives, school chair, and now as dean of Georgia Tech’s College of Engineering (CoE). His path to Georgia Tech had some detours — teaching math in a K-12 setting and working in industry — all before getting his Ph.D. As he describes it, “My love of teaching younger kids led me to get my Ph.D. so that I could continue on this path.” While working on his doctorate at the University of Michigan, the next detour appeared. “I fell in love with research,” said McLaughlin. “Things took off from there.”

He takes the stage as dean of the largest and arguably best college of engineering in the country with his own mandate of “think bigger, act bolder, and collaborate more.” While CoE has continued to rise in prestige and impact, McLaughlin assumes the role with a list of priorities to help ensure Tech’s engineering excellence.

Continuing to champion student entrepreneurship is high on the list. As McLaughlin stated, “Students today know they need to take control of their own careers. They have to create their own jobs. So they come here, and they think maybe they can start a company. So we pour gas on any embers that are glowing.” As one of the founders of CREATE-X, his aim is to grow entrepreneurial confidence in all students, not just engineering majors.

To no surprise, global engagement is also on the list. The College already averages around 50 percent of its undergraduate students having an international experience in comparison to five percent nationwide. “I’d love for it to be 100 percent. International experience is one of the most profound experiences our students can have,” said McLaughlin. “Before joining our study abroad program, many students have not traveled much. It can be a little scary to them. Fifteen weeks later, they’re completely different people — so much more confident and aware of where they fit in the world.” One focus includes a new engineering program in Shenzhen, China — a city of 18 million and growing, as well as the home of many of China’s high-tech companies.

On a national stage, McLaughlin sees the College and Georgia Tech as a leader in access and affordability. “Our students are already technologically literate when they arrive. They come out technological superstars,” McLaughlin surmised. “But what about the other 99.99 percent who don’t have immediate access to Georgia Tech? Do we play a role in helping them become more technologically skilled? I would say yes.”

As dean, McLaughlin sees his role as a relationship builder, collaborator and facilitator. When asked what prepared him most to become dean, McLaughlin was quick to state, “I see myself as a people person. I draw energy from people. A perfect day is away from email, talking to people, hearing their stories.” That attribute may be the most important one as he settles into the position and begins overseeing more than 450 faculty, 13,000 students and 99,000 alumni. And McLaughlin just might make time to have coffee with every single one of them. •
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.

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 10 programs in undergraduate and graduate engineering as determined by U.S. News and World Report.
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SYLLABUS
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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 alumni turn their lofty ambitions into reality.

POP QUIZ
A brief interview that won’t count against your final grade.
John-Paul Clarke has track and field in his blood. Growing up in Jamaica, at the age of four he was running track results to and from the time keeper’s bench for his father. At 10, he timed his first track meet. At 16, he acted as chief timekeeper for the nation’s prep school championships. Clarke was officiating before he was even competing in throwing events, which include hammer, shot put, discus and javelin.

As Clarke grew up and started competing, he excelled in the hammer throw. MIT recognized Clarke’s talent, and accepted him to the school in 1987 based on his academic excellence and hammer throwing prowess. Sophomore year, Clarke was ranked fourth in the country in the hammer throw. He stayed on at MIT to teach and coach, and even coached a couple of national champions.

Today, Clarke serves as Tech’s College of Engineering dean’s professor in the School of Aerospace Engineering. He sees many similarities that exist between track and field and the study of aerospace engineering, as aerodynamic principles can be applied to track and field. In the discus throw, depending on the angle of release, the
athlete can generate lift. Athletes must measure the way the wind is blowing to determine when to release and at what angle to ensure the discus climbs correctly.

“The discus climbs the wind the way an airplane would,” said Clarke. “If there’s a tailwind, the discus is pushed. If it’s a quartering wind, you actually need to drop the discus a little to have it climb the wind. It’s very dependent on the wind.”

The javelin event depends on aerodynamics as well. In fact, the apparatus had to be reengineered based on modern-day stadium sizes. Javelins were being thrown too far and almost hitting spectators in the stands. So, designers moved the center of gravity forward to ensure a faster dive to make the javelin land farther back.

“What happened with the jav is a lot like what happens to airplanes,” said Clarke. “The center of pressure is where the lift generates. Designers had to flatten out the back to change the aerodynamics to put a little more drag on it.”

Clarke’s first love though, is the hammer. He held the national record in Jamaica for best hammer thrower for four years. When asked why hammer, he likened it to ballet.

“It’s like ballet in a circle,” said Clarke. “It’s the closest thing a man can do to ballet. You spin heel to toe, right down the middle of the circle, and the hammer is going up and down. You actually have to step faster and faster to accelerate the ball, like a ballerina spinning.”

Although he’s not a coach at Tech, Clark likes to pass his knowledge of track and field on to his student athletes in the aerodynamics program. He reflects that all his student athletes have been very focused, knowing what they need to do and staying ahead of the workload.

“Time management is critical for student athletes,” said Clarke. “My advice to students is always not to assume that a unit of time is too small to get something done. A 15 minute window can be incredibly useful, if used efficiently.”

Clarke also views team sports as extremely helpful as young scholars develop.

“In life, it’s not about the numbers,” said Clarke. “It’s about learning to deal with people. Team sports enable young men and women to develop people skills. They learn to make compromises for the greater good. Being on a team is all about that. It’s never about you; it’s always about the team.”

Clarke sees a number of parallels between teaching and coaching. Everything he learned about teaching, he learned from coaching. He explains: “When I teach, I encourage people to think about how to solve a problem, rather than telling them what to do. It’s the same for athletes. You have to teach them to think about their body in a certain way, so they can perform a function at the optimal level.”

For Clarke, helping students and athletes develop problem-solving and people skills is the way to create tomorrow’s leaders.
First Person: David Torello

David Torello, lecturer in the Woodruff School of Mechanical Engineering, talks to Georgia Tech Engineers about his early interest in engineering and the path that brought him to teach at Tech.

Originally, when I was applying to be a mechanical engineering student, all I knew was that I liked technology. I played with computers as a kid, and I took autoshop in high school, but I didn’t really have a firm idea of what I wanted to do within engineering. So when it came time to fill out my college application, I filled in the little bubble that sounded coolest.

I went to UC Berkeley for my undergraduate degree, and thankfully it turns out that I just love mechanical engineering. I love the whole process, but, true to my roots, I love creating things with my hands the most. My first mechanical engineering degree really solidified that for me.

After spending a year working at Garmin on their aviation technologies, I decided to become a graduate student, and came here, mostly because Georgia Tech has amazing industry connections and the sheer number of facilities is impressive. I was astounded not only by these machining and research resources, but also the human resources on campus. If you want to use a laser interferometer, you know that you can go to mechanical engineering and find one. If you need help with code, you can easily find a person in that field who will be willing to help you out. The minds here are incredible, and everyone is willing to be a resource in order to create more engineering advances.

I knew I had fallen in love with this place when I got to go play in the Invention Studio, which is essentially a student-run machine shop that has access to traditional machining tools, but also laser cutters, 3D printers, water jets and other awesome tools. It’s that intersection of really hardcore engineering technology with whatever your creativity can come up with. I’ve done fun art projects for myself in there, and I have created things that will help my team conduct cutting-edge research.

During my time here, my research was in nonlinear acoustics, dynamic systems and vibratory systems. As opposed to destructively evaluating things, in the Non-Destructive Evaluation Laboratory we want to be able to look inside of an engineering component or a structure without having to damage it in order to get relevant information. So if something is cracked or fatigue and you can see the damage, it’s already too late. It’s already failed in some way.

Using non-destructive evaluation, we catch damage before it occurs. We can evaluate where a material is in its total engineering life and make informed decisions about what to do with those components. Real-world applications of this type of engineering are boundless. Think about beams on bridges or containers used in nuclear power plants or airplane wings. Those are structures that you don’t want breaking. The research we have done attempts to prevent potentially dangerous failures from happening.

After I earned my masters, I had to make a choice: Did I want to keep going? One of the things that is amazing about Georgia Tech is the amount of exposure you get to all sorts of different fields in academia, and I found out very quickly that one of my favorite things to do was teach. I had an amazing mentor who put me in as many teaching positions as possible, and I decided that if I wanted to teach at the collegiate level, I had to get my Ph.D.

With each degree, I discovered a little more about myself and what I want to do with my life. After eight years of hard but very exciting work at Georgia Tech, I finally completed what I set out to do. I recently defended my thesis, and it feels amazing to have that “Dr.” in front of my name. I am delighted to begin teaching in the fall, because this is why I came here. It’s why I got my Ph.D. •
It’s not every day that a student pursuing a master’s degree also plays NCAA division 1 football. This fall, Matt Jordan, one of Georgia Tech’s talented quarterbacks, began the College of Engineering’s graduate program in ISyE for supply chain engineering. No small feat for someone with two-a-day practices and workouts. Despite the workload, Jordan is excited to discover new applications for supply chain management in his master’s program, which meets the growing demand for business-savvy engineers who can design and synchronize highly complex global supply chains.

“Since I started at Tech, I’ve been interested in supply chain management — moving a product from the supplier all the way to the end consumer — but there is a difference between that and supply chain engineering,” said Jordan. “With supply chain management, you are operating off a system that’s already been created. With supply chain engineering, you’re creating the supply chain. And I think that is a very interesting challenge.”

It’s not just classroom learning that has Jordan thinking about supply chain management. He also uniquely applies supply chain strategy on the football field. He notes that supply chain management is all about efficiency and optimization, focusing on the quickest way to get a product from point A to point B.

“On the football field, you want the most efficient and quickest way to score a touchdown,” said Jordan. “That’s what we aim to achieve as well with supply chain management and engineering, but with products. You want to get the product as quickly as possible to the consumer.”

While Jordan says that the strategy behind the game is ultimately all up to the coach, he does rely on it when executing.

“When I execute a play, I draw on supply chain strategy,” said Jordan. “If the ball needs to go to a certain spot, at a certain time, I envision the best way to do that with the players I have around me. It’s about optimizing the field.”

After football and earning his master’s, Jordan plans on joining the workforce in a supply chain management or engineering role. The combination of a business degree in supply chain management and a master’s degree in supply chain engineering sets him up well for a career in logistics.

“With both of my degrees, I’ll have a better understanding of why supply chain management is important, and I can put it into practice with the engineering experience,” said Jordan. “I understand why it’s important to have efficient supply chain management to run a company at optimal levels. Without good supply chain management, you don’t have a viable business.”

With companies like UPS and Delta in Atlanta, Jordan might even get to stay in the city that he’s come to love and continue cheering on Georgia Tech from the side lines.
Amber Fleeman knows what it’s like to be nervous. Prepping for an exam is one thing, but prepping for a race is an entirely different game.

She enters her car, number 98, buckles herself in and takes some deep breaths to prepare herself for a fast-paced few minutes. Fleeman’s heart races and stomach turns, but when she hears the roar of engines as the race begins, her nerves melt away, and she is left with pure confidence.

Fleeman’s life has been firmly rooted in racing since it began, thanks to her father, Russell, who has raced since childhood. She was at the track even as a toddler, watching her father race and has been in the garage for almost as long, learning from him about how to work on cars and stand up for herself as a woman in a largely masculine environment.

Fleeman, with an unwaveringly positive and optimistic mindset, never quite understood why some people would even think twice about a young girl being on the track.

“I have been in a male-dominated sport literally my entire life,” said Fleeman. “I always knew what I was doing, and I was confident in who I was, knowing that I belonged in racing. My dad always assured me that once the helmets go on, there are no differences in any of us; we are all drivers. He’s always believed in me and that has given me so much of the confidence I have in myself today.”

Just like her innate love for racing, mechanical engineering became ingrained in Fleeman’s DNA from hours spent in the garage with her father, who is an engineer by trade. She even feels that working on cars later helped her master concepts taught in her engineering classes at Tech.

“The skills I have learned from years in the race shop are the perfect hands-on complement to the knowledge I have acquired at Georgia Tech,” said Fleeman. “Things that can’t really be taught in an academic classroom, in my opinion, are some of the most valuable skills.”

Before classes started this fall, Fleeman spent her days working on her car or racing in the Thursday Thunder Legends Series at the Atlanta Motor Speedway.

“My first Thursday Thunder win this past summer was by far the top of my most memorable list,” said Fleeman. “I had been working for that win for many years. It’s a competitive series, and that win definitely wasn’t easy. It was so rewarding.”

During the academic year, classes again bubble to the top of Fleeman’s list of priorities as she works steadily towards graduation. On weekends, she visits the tracks where she is slated to race and works with her team to practice and prepare for the track’s specific conditions.

“I love to have all aspects of my life intertwined,” said Fleeman. “I love to have my friends at Georgia Tech, sisters in Phi Mu and friends from home come to the track to watch me race. It usually ends with them super interested in my racing and the sport in general. I think this is what makes balancing such a busy schedule so easy.”

Fleeman says that she is very excited to graduate in spring of 2018 and enter the workforce with her brand new degree. She says that she always dreamed of working with cars, but that her dream has evolved over the years — now, she wants to find a career within research and development in the racing industry.

One thing is for sure: racing is in Fleeman’s blood, and it’s in her future too. •
The Ups and Downs of Yoyo Engineering

by Ben Wright

He can walk the dog, shoot the moon, or go around the corner. This engineer has an unusual hobby.

Meet Darren Tan, a three-time state of Georgia yoyo champion. Fascinated with yoyos as a kid in Malaysia, he didn’t get serious about them until the of start high school in Cobb County. Tan has competed at state and regional levels for the last four years, where he has had great success. It’s a creative sport, and Tan enjoys the combination of aesthetics and technicality.

“In Malaysia, there were TV shows about yoyos,” said Tan. “One day I went to the mall and saw a group doing a yoyo demonstration. I just thought that was the coolest thing, and I got my first yoyo. Back then, I didn’t have much of an attention span, so I didn’t keep up with it. At the end of eighth grade, I needed something to do for the summer, and I walked into a toy store and found a yoyo. I tried it out for nostalgia’s sake, and I’ve been doing it ever since in my free time.”

At the same time Tan was training and competing, Tech was offering a class on design, manufacturing and implementation (ME 2110). Roby Lynn, mechanical engineering Ph.D. candidate, works under Tom Kurfess, professor and HUSCO/Ramirez Distinguished Chair in the George W. Woodruff School of Mechanical Engineering, helping manage the Kurfess lab and teaching ME 2110, Creative Decisions and Design. The class focuses on mechanical design and manufacturing, and teaches students to use computer-controlled (CNC) equipment. When the time came to choose an item for students to design and build, Lynn and Kurfess settled on something fun that most students would have a passing familiarity with – a yoyo. With the yoyo design and build, students learn how to use the machines and computer-aided manufacturing software.

When Tan heard from a staff member that his fellow mechanical engineering majors were making yoyos in class, he wanted in on it. Rather than waiting to take ME 2110, he spent several weeks this summer working with Lynn on a new design that eventually resulted in the production of several high-quality titanium yoyos.

“Coming into Tech, I didn’t really know what I wanted to major in,” said Tan. “Since I knew something about CAD and machining, I thought I’d jump into mechanical engineering. I didn’t expect to be making my own yoyo. It’s
really cool to be able to apply what I’m doing as a hobby to my academic work.”

One of the challenges for Lynn was making the design and manufacturing process as streamlined and efficient as possible. The yoyo consists of two identical pieces machined out of a solid rod of titanium, and the tool path must be optimized for efficiency to avoid wasting time and materials.

“We developed this software to make tool paths for the different machines we have at our disposal, and we’re learning that current generation CNC machines are not really sufficient for very high complexity machining projects,” said Lynn, who explained that the yoyo design involves steep angles, as well as intricate threading that connects the two halves. “Now we’re looking at developing new machines.”

In order for the yoyo to balance properly, both halves had to be identical, so getting the process right and replicating it was very important for Lynn and Tan. Working with Lynn to make the yoyo gave Tan a leg up before he takes ME 2110 later this year.

“Design is really iterative,” said Tan. “You’re not going to get it right the first time. For example, we had edges that were too sharp, and they cut the yoyo string. You have to keep refining, see what goes wrong, fix it, and then see what else goes wrong.”

With the bugs worked out, Tan will have the chance to take his custom-built yoyo inscribed with his college’s name on it with him to competitions and show that at Georgia Tech, you really can build just about anything. •
The Internet of Things (IoT) is a prevalent buzzword in today’s technology discourse, referring to the interconnectedness between everyday objects via the internet, producing massive amounts of data. But Edward Coyle, distinguished professor in the School of Electrical and Computer Engineering and director of Vertically Integrated Projects (VIP), argues that people are part of the equation too.

Coyle is referring to his VIP pilot project, Internet of People and Things (IoPT). Formerly known as eStadium, IoPT is the longest-running program in VIP’s 17-year tenure. The IoPT project aims to draw people back to the stadium and enhance the fan experience. At the same time, it allows students and faculty to design, develop, deploy and operate sophisticated systems to study and optimize multimedia traffic on wireless and cellular networks during large events, such as football games.

The mission of IoPT is to give game day attendees the ability to replay video footage right on their smart phones. Any game-day fan can visit estadium.gatech.edu and view any replay on the IoPT web app. The game footage is pulled from the video feed for the stadium jumbotron and transmitted by the web app via wireless networks. Alongside the high quality video sits...
a description of each play produced by NCAA statisticians working the game. Student volunteers involved in IoPT match up the video clips with the corresponding play description, so fans can easily scroll and discover which plays they want to watch.

Within the web app, fans have the ability to see a drive tracker depicting how the team proceeded down the field. Fans can scroll through all the drives throughout the game. The drive data also comes from the NCAA statisticians working the game. Fans can see team stats and details on offense, defense and special teams.

“Our hope is that having the ability to review any play they choose might draw fans back to the stadium, rather than watching from their living room,” said Coyle. “We want to offer them the best experience possible and grow an interactive community of Tech football fans.”

Stadiums became the test bed for IoPT in the early 2000s – before anyone else was providing replay videos on-demand. Coyle found that when the program was in its infancy, people would share certain videos that would go viral. He found that leveraging a critical mass of tech-savvy students was helpful for developing the IoPT app.

With such a large testbed, the IoPT project often runs up against challenges concerning data networking and limited Wi-Fi access. That’s where Randy Abler comes in, the associate director of VIP and leader of the Intelligent Digital Communications (IDC) team under IoPT. The IDC team focuses on examining network capability at the stadium and developing technology that can improve the environment for future generations.

“Understanding the very dense network environment is important to keep IoPT video streaming at optimal levels,” said Abler. “We are also keeping an eye on the communications spectrum to monitor for interference.”

Abler’s group leverages radio frequency sensors within the stadium. The Bobby Dodd test-bed includes 50,000 cell phone users who create a lot of traffic challenges. IDC uses three nodes positioned within the stadium in order to locate users, if needed. Real-world applications include security, as the system enables monitoring of any rogue
behavior occurring within the stadium. The team can also monitor any interference to ensure quality of communications for fans, security personnel and coaches.

IoPT has other goals past streaming video and game-day communication. The sensitive equipment installed throughout the stadium also measures structural vibration and fan movement on game days.

“We’ve gathered data when fans are jumping up and down on game days, which showed how the actions of the fans induced motion in the structure of the stadium,” said Coyle. “We are examining the data to try to understand the consequences of the motion for the maintenance of the stands.”

Coyle and his team also realized they could start measuring and monitoring what fans are excited about throughout the game. The equipment measures how much energy is generated by fans at any given moment. A correlation exists between exciting Georgia Tech touchdowns or completed passes and the amount of energy generated in the stands. Thus, a sensor network that was primarily built for structural monitoring is suddenly producing useful information that can enhance the app experience. The next phase of IoPT is to rank plays by popularity within the web app, based on the fan’s energy.

“The whole notion of IoPT is that all the data we’re sensing from everywhere in the stadium may be useful for different purposes for different people,” said Coyle. “And we want to make all of that happen.”

Commercial opportunities exist for IoPT, and some students are laser-focused on making that happen. Pedro Pinto, an undergraduate in the program studying electrical engineering, has worked on IoPT for two semesters and considers himself an avid sports fan.
The goal of VIP is very ambitious. Its aim is to achieve systemic reform of education, not only for engineering, sciences and math, but for any discipline. VIP unites undergraduate education and faculty research in a team-based context, across all disciplines. It’s a program that brings together all members of the university community to complete projects that draw on multiple research areas. Undergraduate VIP students earn academic credits, while faculty and graduate students benefit from the design and discovery efforts of their teams.

One of the main reasons Ed Coyle, director of VIP, came to the College of Engineering at Tech was to bring VIP from Purdue University (where it was founded) to another university. He found Tech to possess an innovative spirit and the resources necessary to launch the program. He also found allies, such as Randy Abler, associate director of VIP and a faculty member within the School of Electrical and Computer Engineering, and Julie Sonnenberg-Klein, VIP program manager, to champion the program.

“VIP creates a bridge between undergraduates, faculty and research,” said Coyle. “Innovation equals inspiration plus execution. That’s the true definition of VIP; it provides an arena for ideas to become reality.”

When Coyle first founded VIP, it was because he found that working one-on-one with students wasn’t scalable. VIP provides the forum to work in large groups, led by faculty. Coyle says it’s the people power needed to put ideas into action.

The program has built in succession planning, enabling research teams, such as IoPT, to continue for years or decades. Because teams are a mix of undergrads, grad students and faculty, new students are always coming in who are trained on the project and work on it until graduation. VIP is a sustainable and scalable program that serves as an incubator for innovation.

VIP is currently developing its own innovation competition to find projects that are best in class and most likely to succeed commercially. With some seed money from Cisco, the program now has an endowment for prize money to hand out to award-winning teams. The first competition is slated for Spring 2018.
For a billion dollar company like Under Armour, staying on the leading edge of innovative sports materials is critical to its growth and success. So, it’s no surprise that the company would look to Georgia Tech’s Matt Trexler (Ph.D. MSE 2007) for his expertise in materials science and engineering, a field focused on the design, selection and development of materials.

Trexler works as the director of Technology Validation at Under Armour, responsible for vetting and evaluating material pitches that the company receives regularly. These ideas might be submitted from outside industries, such as aerospace or textile. Internal employees with an entrepreneurial spirit at the company are also encouraged to pitch ideas.

“I get to see every product that we make or may make,” said Trexler. “I evaluate each material and ask, ‘Are the laws of physics being broken? Has this been done before? How are we going to pay for it?’ I’m doing that level of due diligence to ensure Under Armour is leveraging the best materials possible for our products.”

Trexler also brings quantitative techniques to Under Armour, testing the endurance of footwear material, for one.

“Testing the mechanics of materials is also a big part of my job,” said Trexler. “For a running shoe, you have to look at every step you’re unloading to that cushion. It creates a fatigue cycle that’s different from, say, a helicopter blade. So, different principles have to be applied to different materials. It’s up to me to understand the materials and make and explain decisions based on them.”

The culture at Under Armour encourages ingenuity and problem solving — ideals that most engineers hold dear. If an internal textile developer has an interesting idea that hasn’t been tested, Trexler can make that happen, ensuring that test methods are in place and the right people are involved. Encouraging a culture of exploration and teamwork helps to optimize innovation at the company.

A recent project for Trexler has been the CoolSwitch line, athletic wear designed to cool the body and skin, so an athlete can perform longer. The fabric is chemically engineered to pull heat away from the body and deliver a cooling sensation on the skin. It also wicks away sweat to keep the body dry. Trexler vetted and validated the material using field and external testing. He played an instrumental role in getting the project off the ground, citing it as a solid example of multiple teams working together to bring a new product to market.

“It was a great exercise in getting materials folks, internal lab testing and field testing together and on the same page,” said Trexler. “We also engaged the University of North Texas to validate the CoolSwitch material. We did a blind test and found that the
material was reacting to skin temperature and athletes could really feel the difference.”

Along with expanding CoolSwitch, Under Armour has launched a sleepwear line with New England Patriots quarterback Tom Brady to promote athlete recovery. According to Trexler, Brady believes the reason he’s been able to perform so well for so long is due to his recovery regimen. The sleepwear material leverages the power of far-infrared, a type of energy on the infrared spectrum with health benefits. The material is a bioceramic print on the inside of the garment that absorbs the body’s natural heat, reducing inflammation and enabling recovery while an athlete sleeps.

Trexler notes that projects like these and others have all drawn upon his Tech education and the problem solving skills he learned in the MSE program. Many of the methods and technology Trexler relies on at Under Armour are rooted in engineering principles learned at Tech.

“The MSE program at Tech gave me a fantastic base of knowledge with a general understanding of different materials,” said Trexler. “Although my research focused on metallurgy with nickel, the program exposed me to many different types of materials, like polymers, ceramics and textiles. Understanding the way the materials are made and manufactured bridged any knowledge gap I had when joining Under Armour.”

Much of the work Trexler describes happens in the Proving Grounds laboratory, where the team makes and breaks many of the materials. The lab is located in Baltimore, but there are plans underway to begin localizing research and manufacturing as well.

“At Under Armour, we are looking to change the way products are made,” said Trexler. “We are looking for a more local model, where we source the materials in the same place they are made and sold. It’s something we are working toward for sustainability. It makes sense, as we are a global brand and reaching more countries every year.”

As Under Armour continues to innovate and grow the business, Trexler plans to be on the front lines, evaluating materials and contributing to the success of the company. He knows his time at Tech has made a huge difference in his career, and credits MSE for getting him where he is today. •
When Emmy Montanye came to Georgia Tech in 1979, she started out as an underdog.

People were critical of her from day one as a woman studying engineering. And even though some said she shouldn’t be at Tech, she persevered.

“I learned it’s OK to be an underdog,” said Montanye. “It made me try even harder and made it that much more rewarding when I saw success. When I think back to the nay-sayers early on, I get a lot of satisfaction from where I am today.”

Montanye graduated with a degree in civil engineering and has since had a lifelong career in civil design. She found her niche with sports stadium engineering early on. Montanye finds the business of sports both fascinating and challenging. Now, she’s at the top of her game, working as a senior vice president at Kimley-Horn, an Atlanta-based firm that provides planning and design consulting services related to land development, urban planning, transit, stadiums, aviation, water resources and more.

“I really enjoy working in sports,” said Montanye. “The industry is on the cutting edge of technology, which is exciting. And, of course, I love the scale of stadiums. Everything is bigger and grander — you’re really producing on a different scale.”

Montanye started out working on collegiate sports stadiums, like Georgia Tech’s Bobby Dodd and Russ Chandler. From there, she has gone on to the big leagues, just wrapping the Atlanta Falcons’ new home, Mercedes-Benz Stadium, and the Braves’ SunTrust Park.

Each stadium has come with its own unique challenges, which Montanye tackles with a mantra she learned at Tech.

“Tech taught me to use people as my resources,” said Montanye. “I think about that every day I’m on the job. In the face of a problem, you find the people who can help you solve it. I even apply that principal to learning about new businesses and markets.”

Montanye and her team were challenged by community residents near the Mercedes-Benz stadium to make the surrounding area a better place to live, and she felt they were able to provide a productive solution for the area with storm water management. A similar situation arose with SunTrust Park, and again Montanye’s team was able to design a solution that managed storm water, protecting downstream water quality and mitigating erosion.

An early problem with Mercedes-Benz Stadium was downstream flooding. The stadium sits on the upper ridge of a basin in an area prone to flooding. The rain water combines with sewer water, affecting downstream outputs. When there are hard rains, the Vine City neighborhood located near the stadium is faced with environmental hazards due to sewage. Montanye and her team were able to engineer the stadium to alleviate the current flooding problem and reduce future flooding.

“The stadium is on 14 acres of land, and we leverage seven acres of roof to transport the rain water to a cistern located under MLK Boulevard,” said Montanye. “This cistern holds 687,000 gallons of storm water. We then pump it
over to the energy plant, where it’s used for cooling power. The water is put to use rather than causing flooding and backing up the sewer lines.”

Environmental challenges come with the territory, but Montanye cites the biggest challenge of all to be staying on schedule. When Kimley-Horn starts on a stadium, the sports team usually has an opening day in mind. The schedule is then backed out from that date, taking everything into account from neighborhood concerns to audio/visual to grease traps for the kitchens to traffic patterns and Uber pickup logistics. A stadium like Mercedes-Benz, for example, has 36 grease traps, where a standard building might have two.

The politics of a stadium’s hometown must be considered as well during planning, including how much support the city will provide during the permitting process. Many times, engineers must prove that the stadium will be valuable for city’s urban development and future growth.

“We’ve done a great job working with adjacent communities to our stadiums,” said Montanye. “And it’s really important that the issues the community has with any new structure are listened to and addressed. The stadiums must easily integrate into the urban environment.”

Sustainability is also a major factor that goes into stadium planning. Montanye works hard to ensure her projects stand out because of their sustainability and environmental impact. SunTrust Park has a bike pavilion that connects to sidewalks and trails, so fans can bike or walk to the games. Conservative approaches are taken with water use and demand as well. Montanye’s goal is to be a good steward of the natural resources — including planning for potential LEED green-building certification from the very beginning of the design process.

“You need to integrate mindfulness of sustainability from day one,” said Montanye. “You can’t think about it six to eight months in. The awareness has to be in the very early stages of planning. On both the Mercedes-Benz Stadium and SunTrust Park [projects], we had sustainability plans early on. I’m really proud of what we’ve done to collect and reuse water at both venues. We are truly making a difference downstream, even if fans can’t see it.”

With professional football and baseball venues open and serving Atlanta’s fans, Montanye said she suspects the next big sports projects for her company could involve a Major League Soccer team. She’s seeing soccer take off in cities all over the nation, which could mean big business for Kimley-Horn. And Montanye will be in the middle of the action, working with teams to create the next big stadium. •

"Tech taught me to use people as my resources. I think about that every day I’m on the job. In the face of a problem, you find the people who can help you solve it. I even apply that principal to learning about new businesses and markets.”

– EMMY MONTANYE
AIMING HIGH:

Two Athletes Strive to be Faster, Stronger, Smarter

Sometimes, 24 hours just isn’t enough time in a day. And no one wishes for more hours than Ben Lammers and Chanin Scott. Both play for Georgia Tech’s Division I basketball teams, and both are enrolled in the Institute’s rigorous engineering program. They pride themselves on getting up for practice at five in the morning, taking a full schedule of engineering classes, and sometimes finding a little time to be a normal college student in between. When they finish at Tech, their legacies on the court and in the classroom will speak for themselves.
BEN LAMMERS

Lammers Masters Balancing Act of Basketball and Engineering

Bleary-eyed but determined, Ben Lammers makes his way to the Zelnak Basketball Center in the early hours of the morning after a full night of toiling away on a difficult project. Basketball practice will be an entirely different kind of work, but hopefully the echo of the ball on the court and demanding drills will provide a kind of soothing and distracting relief.

This scene is not an uncommon occurrence for Lammers, who shoulders the rare responsibility of balancing the course load of a Georgia Tech mechanical engineering undergraduate with a position as center on the Georgia Tech men’s basketball team — in fact, he is the only engineer on the team.

Dealing with such a demanding and difficult schedule is no easy task, but doing something he loves makes up for the struggle. Basketball and working with machines are his passions. Lammers says that he enjoys the hands-on aspects of engineering the most.

“Ever since I was little, I have always enjoyed tinkering – taking stuff apart and seeing how it works,” said Lammers. “I enjoy being able to control the little things that make a bigger system work.”

While summer might be a welcome respite from learning for less dedicated students, many athletes at Georgia Tech take classes or research while they continue rigorous training sessions.

Summer research gives Lammers the opportunity to dive into his work. Last summer, he worked in the Non-Destructive Evaluation Laboratory under mechanical engineering professor Laurence Jacobs.

“Going into it, I didn’t know exactly what to expect,” said Lammers. “I had never done research before, so I wasn’t sure if I was just going to be in the library reading books, but I have really enjoyed that it’s really hands-on. I am able to problem solve, which I very much enjoy.”

Lammers, out of the limelight of his basketball stardom, seems perfectly content to be hidden away in a windowless lab. But it’s an entirely different scene on the court, where all eyes are on him.

Six foot, 10 inch frame aside, he played extremely well in the 2016/2017 basketball season after quietly improving during his first few years on the team. Lammers says that he is excited to enter his senior year and continue to enhance his game. He has worked on honing his academic abilities as well and sees clear-cut parallels between his two passions.

“Both require consistent, hard work,” said Lammers. “Basketball might be more physical — you have to constantly work out and shoot — but in classes you also have to put in the work, do the homework and make sure you’re actually studying to keep your skills sharp.”

Hard work and problem-solving skills have helped Lammers in a myriad of ways during his time at Tech. From defense drills to research to limited free time, managing a busy schedule has been the biggest test of those skills.

Lammers might have had an unusual college experience, but the challenges of being an engineering student are some that he shares with the thousands of classmates he has at Tech. They have prepared him for what comes next after graduation, and Lammers is very excited for it.

“My ideal future would be to play basketball professionally for as long as I am able to, and once that’s done, get a job in engineering,” said Lammers. “Obviously you can’t play basketball forever, and having engineering as a fallback isn’t too bad.”

Most would agree that a career in engineering certainly isn’t too bad at all.
In middle school, a teacher told Chanin Scott that she had the mind of an engineer. Once that seed of inspiration was planted, there was no going back; Scott was determined to be an engineer. So far, that teacher’s insightful observation has proven to be true every step of the way.

Scott enjoys challenging herself, which might be why she decided to pursue both industrial engineering and basketball upon entering Tech, rather than choosing between them. As a current sophomore, Chanin plays forward and small forward on the women’s basketball team.

“The role of basketball in my college experience is helping me form a tough mentality,” said Scott. “Basketball here is definitely challenging, and being able to do that while being an engineer feels very empowering to me. It just really boosts my confidence and lets me know that I can get through anything.”

Like any good athlete (and any good engineer, for that matter), Scott is fiercely competitive. Bent on being the smartest, strongest and best, she prides herself on making it to class after an early workout when other students can’t even manage to roll out of bed.

Scott thrives when she has an obstacle to conquer. She says that her most memorable class at Georgia Tech so far is calculus, simply because it was challenging and fun to overcome. She enjoys making herself better both academically and athletically and knows that improvement takes a lot of hard work.

“No matter what basketball threw at her, no matter what school threw at her, she finished everything and gave it her best effort,” said Scott. “She told me that it’s going to get tough, but that I have to keep going.”

Personal relationships like these are what Scott really enjoys, and she hopes to find a job with her industrial engineering degree that will allow her to engage with people and bring her engineering knowledge to a large audience. Scott has decided not to pursue a professional career in basketball after she graduates.

A few people in particular have stood out to Scott as role models, especially women in STEM (science, technology, engineering and math). Scott models her attitude after these admirable women who have come before her and served as encouragement and inspiration. Specifically, Scott remembers a former teammate who led by example.

Scott has also discovered, as have most mature and self-aware individuals, that she needs the support of other people in order to have a successful experience at Georgia Tech. She has fond memories with her teammates of beating the University of Georgia in a high-stakes game, helping each other with homework, and simply enjoying their rare downtime by playing some board games.
Georgia Tech College of Engineering alumna Alexandra Mandrycky (ISyE 2013) had no plans to work in professional sports, but a unique series of events led her to the NHL’s Minnesota Wild.

After she graduated, she wanted to keep her data analytics and programming skills sharp. Mandrycky discovered a huge set of hockey data online that she would play around with for practice, which led to her involvement in war-on-ice.com, a website dedicated to hockey analytics. When the Wild joined the growing number of NHL teams hiring in-house statistical analysts, they hired war-on-ice.com founder Andrew Thomas and Mandrycky to head up their data analytics efforts.

Historically, hockey has lagged behind other sports when it comes to data analysis. Baseball, and more recently, basketball, have long taken advantage of metrics and advanced algorithms to gain an edge over the competition, especially during the draft or in the analysis of players during free agency. Hockey has just begun to harness the vast amount of data coming off the ice, and Mandrycky is one of a handful of rising stars developing data analytics programs for NHL teams.
Mandrocy works with the Wild as a hockey operations analyst gathering and analyzing data for management, coaches and scouts to help them make better, more informed decisions. Mandrycky’s job has three components. First, she gathers data, including goals, shots, hits and faceoffs, creating a data set to pull from. She is instrumental in consolidating all the data into a single source in order to easily run queries. Second, she takes that data and analyzes it. From the analysis, management makes decisions about who to trade, how much someone should be compensated, draft rankings, coaching strategies, player usage and more.

“It’s the analysis component that draws on much of what I learned at Tech,” said Mandrycky. “Engineering principles like optimization and machine learning come in to play on a daily basis.”

In the ISyE program at Tech, students are required to take a database systems class, which has been useful for Mandrycky when setting up the data warehouse for the Wild. But what has truly helped her excel are the principles of analysis learned at Tech, allowing her to compare players, develop rankings for upcoming drafts, and analyze coaching and team patterns.

The third part of Mandrycky’s job is presenting her findings to management, mostly in the form of graphical reports. She has parameters in place to generate automated reports that create data visualizations for management and coaching staff to review and easily synthesize the information. It’s Mandrycky’s job to set up the system so staff can get answers to their questions very quickly. She will sometimes get a text or phone call at 10 p.m. asking for information about a certain player, and, thanks to her system, she can answer with just a few clicks of the mouse.

“If the general manager gets a phone call and a player is available for trade, you don’t have a lot of time to think and react,” said Mandrycky. “That’s why it’s critical to have the infrastructure set up to already have analysis at hand, so we can feel comfortable and confident making decisions.”

Mandrocy has been in her role now for over a year. She’s much more comfortable offering her opinion on matters, and feels confident in the processes she’s put in place to mine relevant information.

“If we are talking about a trade, I’m involved in those discussions,” said Mandrycky. “Or we could be analyzing a free agent. I have an opinion on these topics that management wants to hear. I have a seat at the table, which is great.”

The fact that she has a seat at the table is a bigger accomplishment than Mandrycky lets on. The hockey business is dominated by men, most of whom played the game to at least the college or minor league level. As far as she knows, Mandrycky is the only woman in a front office job in the NHL who has an influence on the on-ice product. The rest work in media relations, marketing or administrative roles. Being in the engineering field prepared her to be in an environment historically dominated by men, so she doesn’t let gender stereotypes get in her way.

“I’ve always felt that being female was an advantage,” said Mandrycky. “When you’re the only person at the table that looks like you, whether that is gender or race, it means you have a different viewpoint or a different way to approach problems. I try to use it to my advantage.”

Her advice to other women looking to get into engineering or sports is to not be discouraged by being the only woman in the room. She says
women should think of it as an opportunity and consider how they can do the job better than men. Mandrycky’s competitive spirit has helped her along the way as well.

“You have to advocate for yourself so you don’t get penned into gender stereotypes,” said Mandrycky. “As a female, you can’t wait for someone to open an opportunity up for you. You have to make one for yourself.”

Mandrycky argues that women have many of the skills necessary to work in pro sports, from time management, to organization, to effective communication skills – all strengths that she possesses that have enabled her to thrive in her role. The soft skills are just as important as the analytics and engineering skills, she concludes.

“I always say the most important part of my job is to make people want to listen to me,” said Mandrycky.

Mandrycky owes some of her confidence to the mentorship from Alisha Waller, a Tech lecturer in ISyE. Waller spoke very frankly to Mandrycky about the challenges of being a woman in the business world, as well as the balancing act of having a family.

“Dr. Waller encouraged me to pursue whatever I wanted,” said Mandrycky. “After I was introduced to the world of hockey, I just went after it. The best way to do something is to just do it. Hockey is even further behind the curve when it comes to inclusion of women, but it’s my passion. Hopefully, I’m paving the way for other women to come.”

Mandrycky plans to continue her career in hockey, and hopefully one day become an assistant general manager. She would like to be the person calling the shots for the team. Until then, she’s making a difference with her analysis and giving the Wild a competitive edge. •
Tennis elbow, a pulled hamstring, shin splints or an ankle sprain. We’ve all dealt with common sports injuries in an attempt to get in shape. Faculty at Georgia Tech’s College of Engineering are laser-focused on providing sports medicine for even the most common injury. Past that, extracellular matrix therapies, regenerative medicine and wearable joint sensory technology are just a few of their more advanced focus areas. Sports medicine today has become a specialized field with many facets. No longer just a study of orthopedics, sports medicine now encompasses new therapies and technologies that tackle all sorts of sports-related injuries and diseases, leveraging predictive analytics and wearables to keep athletes performing at their best.
Tech’s sports medicine research program continues to grow, led by faculty such as Robert Guldberg, Omer Inan, Michelle LaPlaca and Johnna Temenoff, all leaders at the top of the field.

Each of these engineers has made impactful contributions to sports medicine research, and their work is already seeing real-world application today. Each one of them is driven by a common desire to enhance the quality of life of athletes, both on and off the field. And even the occasional exerciser can reap the benefits.

**Robert Guldberg // Executive Director, Parker H. Petit Institute for Bioengineering and Bioscience and Mechanical Engineering Professor**

Baseball players today may soon benefit from Robert Guldberg’s work on treatments for rotator cuff injuries, ligament tears and osteoarthritis. Guldberg has recently worked with the likes of Dr. Gary Lourie, head physician for the Atlanta Braves, whose focus is to keep athletes safe and healthy. Lourie will deliver a keynote talk on regenerative medicine at the Major League Baseball annual meeting in December. This close collaboration with Tech brings cutting edge sports medicine therapies to baseball players across the nation, keeping athletes performing at their peak.

Much of Guldberg’s research can be applied to athletes, like baseball or football players, who have early onset osteoarthritis from trauma to their bones and joints. Guldberg
has recently focused on extracellular matrix (ECM) therapies for sports injuries and using stem cells to reduce inflammation and stimulate healing. More than 200 prohealing proteins make it one of the latest treatment options to help manage sports injuries.

“Injured athletes just want to get back to the playing field faster, as well as prolong their career,” said Guldberg. “In collaboration with MiMedx, Inc. in Marietta, GA, we have shown that an injectable form of micronized ECM can slow down and partially reverse post-traumatic arthritis in preclinical studies. We believe this will have a positive impact on athletes in the near future.”

Guldberg is also interested in biomaterials and bio-printing for injuries to cartilage like the meniscus. Bio-printing involves 3D printing but with living tissues. Currently, there is no real solution for a damaged meniscus. But in the future, a living meniscus could feasibly be printed. In the meantime, biomaterial hydrogels are used to replace cartilage tissue and speed recovery.

Working with biomaterials leverages Guldberg’s work in both BME and ME at Georgia Tech, and he’s interested in understanding how the mechanical environment in the body relates to the healing process. Guldberg sees a natural interface between mechanical engineering and the biosciences. His research helps answer questions such as, ‘if an athlete has a back injury, what is the optimal rehabilitation protocol for them to be up and moving again?’

In research published in the prestigious Proceedings of the National Academies of Science, Guldberg’s lab recently showed that stressing an injury site too early can disrupt revascularization and healing, while a delayed mechanical loading protocol stimulates more robust tissue repair. “We want to wait until the right moment to encourage blood vessels to grow and for tissue to start reforming, so timing is everything,” said Guldberg. “Mechanical loading in the healing process is crucial for a speedy recovery of functional performance.”

When asked about the future of biomedical engineering, Guldberg points to predictive modeling and data analytics.

“I think the next frontier will involve working with health data analytics,” said Guldberg. “The future for healthcare is understanding all the data and using it to predict injuries and identify the optimal personalized medicine approaches to quickly return patients to full health.”

Soon, there will be predictive models for diseases like arthritis, creating the opportunity for doctors to intervene early and stop the damage. Guldberg hopes to be on the front lines of returning athletes and others to full health.

Omer Inan // Assistant Professor, Electrical and Computer Engineering

Omer Inan was a college athlete in track and field at Stanford when his passion for sports medicine began. As a discus thrower, he became interested in quantifying the health of joints to enable higher performance and influence training regimens. Today, Inan is developing sensor-based technologies to aid the road to recovery in athletes. With pro athletes, training is occurring at a very high level, and the stress on the joints is substantial. Monitoring athletes’ bodies,
particularly the joints and ligaments, can help coaches make better training decisions. Objectively-driven decisions guided by data reduce the chance of re-injury and optimize recovery.

Inan has developed a Wearable Knee Health System (WKHS) that listens to the sounds a joint makes to determine its health. The WKHS can be used during rehab to monitor swelling and structural stability improvements. It’s creating a much more objective level of monitoring. And it’s not just for knees.

“Healthy and damaged joints sound very different,” said Inan. “This wearable knee joint sensor helps evaluate joint injuries and create healing regimens. It also has preventative applications. Pitchers for example can potentially listen to their rotator cuff and decide how much pitching they should do based on the sounds.”

When Inan was throwing discus in college with his sights set on the Olympic trials, he over extended himself, cutting his career short. If his coaches had possessed technology like this, it is likely he could have competed much longer and at a higher level.

Inan’s work also takes him to College of Sciences Professor Mindy Millard-Stafford’s lab at Georgia Tech, where he measures heart function in a high heat environment, like a summer ball field or football stadium. Many athletes suffer from dehydration in these conditions, and Inan is looking for a way to measure the body’s reaction based on cardiac response.

“If an athlete is performing when it’s hot, and the coach is worried about loss of fluids, we can potentially monitor changes in cardiovascular performance and decide when to rehydrate and rest,” said Inan. “We are measuring cardiovascular performance with wearable sensors, and the overall solution may be a great way to prevent heat exhaustion in athletes.”

In the future, Inan is interested in looking at overuse injuries, which he predicts to be the next big thing for joint health monitoring in sports medicine. Inan believes data analytics will help researchers study overuse injuries by quantifying injury risk with wearable sensors. Analytics are helping Inan build better sensors to gather more accurate data.

“Leveraging data and technology helps us sense and modulate,” said Inan. “It’s not just the physical hardware, but also the processing and interpretation of the data that comes from the sensors. Data analytics is a big component of our lab and helps us extract information from the data that we sense.”

Inan hopes to use analytics for overuse injury detection to help athletes avoid further damage and create a healing regimen to get them back to playing, and fast.

Michelle LaPlaca recently gave a TEDx talk on concussions, bringing her research and viewpoints to center stage for a large, engaged audience. In her talk, she makes the case for personalized health to transform the way doctors treat concussion injuries. For each athlete that suffers a concussion, LaPlaca argues you have to take into account any number of personal health factors, such as medication and preexisting conditions. Doctors can then make more objective decisions about concussion treatment and more accurately predict outcomes.

“Each of us has a brain fingerprint based on how many times you’ve hit your head in the past, what medications you’re on, your medical history, diet, etc.,” said LaPlaca during her TEDx talk. “We can take all these data points and use algorithms to create personalized fingerprints that allow us to tailor
LaPlaca advocates for personalized healthcare to diagnose and treat concussions. She’s leveraging technology and systems thinking from her engineering background to uncover the simplest solutions to address concussion issues. LaPlaca developed DETECT (integrated Display Enhanced TEsting for Cognitive Impairment and mTBI) alongside David Wright at Emory University as a rapid concussion assessment tool for sideline evaluation of concussions. It’s an immersive tool that uses virtual reality to objectively detect deficits from several different neurological domains in just 20 minutes, taking the guesswork out of diagnosing a concussion during a game. So no more ‘how many fingers am I holding up?’

“Every concussion is different, and we are really trying to understand the complexity of the data coming out of DETECT,” said LaPlaca. “The device allows us to test balance, motor function, reaction time, neurocognitive function and oculomotor function. After you test across all these different domains, you can then make the call whether the player should go back in the game.”

LaPlaca believes the next phase for DETECT is to leverage the data analysis to make concussion therapy even more personalized and predictive. Ideally, she would also like athletes to have access to the tools on a personal device, like a smartphone.

“We want people to have more control over their health and diagnoses,” said LaPlaca. “We want to empower them with information so they can be aware of their health. It would be great if we could turn DETECT into a point-of-care device that is convenient for athletes, as well as inexpensive.”

LaPlaca finds the brain intriguing and challenging, and every day she leverages her bioengineering background to problem solve for the most efficient, yet complex, machine on earth: the human brain.

**Johnna Temenoff // Co-Director, Regenerative Engineering and Medicine Center and Biomedical Engineering Professor**

Johnna Temenoff is passionate about making people’s lives better. And she does that with her research into regenerative therapies, which involves injecting cells or proteins into tissue to aid healing and stimulate repair. As athletes age and put more stress on their bones, joints and ligaments, degeneration occurs, which leads to tears to the
tendons and ligaments. Temenoff is hoping to identify degeneration and stop it in its tracks, before a tear occurs.

“We are trying to better understand what causes the pathology that leads to tears, so we can develop a biomarker or imaging technique to monitor and intervene before the damage occurs,” said Temenoff. “We have a National Institutes of Health (NIH) grant to fund the degeneration research, which is really well suited to athletes who are monitored closely anyways.”

Starting this fall, a new NIH grant will enable Temenoff to focus on the idea of intrinsic healing. She’s proposing an injectable material that would recruit the body’s own stem cells to injured muscle to stimulate regeneration. The cells would then prevent further degeneration and potentially promote future regeneration. Temenoff suspects this research will be very useful for sports injuries like rotator cuff tears, a common condition among athletes derived from overuse.

Temenoff’s rotator cuff research has also detected early changes to the cartilage, so she’s looking to target cartilage, as well as tendons for those who may be susceptible to injury. Baseball and football players, swimmers and throwing sport competitors in track and field can benefit from cartilage monitoring. The regenerative therapies being developed would treat the cartilage with an injection, preventing negative changes to the joint.

If a tendon tear does occur, the next question is how best to treat it. Standard procedure is to suture the tendon back to the bone. The biggest issue for athletes in this situation is the inability to return to full function because the muscle is too weak. It is also very easy for re-injury to occur because of the tightness of the tendon. Temenoff has a solution in mind: to completely regenerate the tendon and avoid surgery all together.

“Ideally, we will develop regenerative therapies that mitigate the need for suturing,” said Temenoff. “And our injectable muscle therapy could reduce degeneration in the first place to improve the potential for earlier rehabilitation and return to function.”

Temenoff’s hope is that eventually the regenerative therapies will completely prevent the need for tendon reconstructive surgeries or at least provide alternatives to allow the body to regenerate if a tear does occur.

Temenoff is collaborating with Emory Orthopedics and their physician team to validate her studies. The doctors at Emory lend a unique perspective to the research by providing patient tissue samples. Emory also gains an engineering team who is focused on regeneration that they can eventually use to treat their patients. Temenoff expects this synergy to grow as her research continues. •
A Propelling Argument

A recently concluded study by AE professors Joseph H. Saleh and Mitchell L. R. Walker is tweaking old assumptions about electric propulsion (EP) vs. chemical propulsion (CP) for future spacecraft. Their findings, summarized in “Electric Propulsion Reliability: Statistical Analysis of On-Orbit Anomalies and Comparative Analysis of Electrical versus Chemical Propulsion Failure Rates,” analyze 18 years of satellite data to determine which technology has a greater incidence of on-orbit anomalies and failures. Their results revealed that after 2005, EP technologies were consistently more reliable than traditional CP methods. EP is shown to offer a clear advantage when it comes to space travel and transport, where reliability is paramount. The duo thinks these findings could eventually prompt satellite manufacturers, insurers and operators to consider switching to EP, a method that has historically been restricted to tasks that require little acceleration, such as small in-orbit maneuvers, station-keeping and some orbit raising.

– Kathleen Moore

Probing Atomic-scale Material Behavior in Real Time and in Real Environment

Materials scientists and engineers dream of directly observing atomic motion in real time and real environments using a transmission electron microscope (TEM). Josh Kacher, assistant professor in MSE, and Matthew McDowell, assistant professor in ME with a joint appointment in MSE, have been developing new capabilities at Georgia Tech to conduct miniaturized experiments inside the TEM. Direct real-time observations inside the TEM allow them to investigate how materials behave at the atomic scale at high temperatures, or under mechanical deformation, or in different environments. New capabilities implemented by Kacher and McDowell have attracted the attention of funding agencies, which has led to their receiving multiple early career awards, as well as industrial sponsorship of their research.

Kacher’s research focuses on identifying pathways to develop safer, more reliable metallic alloys by understanding how their structure influences the nucleation of deformation-induced damage at the nanoscale. A current research area is optimizing the distribution of alloying elements in aluminum alloys, a lightweight alternative to steel in automotive manufacturing, for increased formability, toughness and crash resistance.

McDowell’s research focuses on understanding how materials change and transform inside electrochemical energy devices, such as batteries, during operation using in-operando the TEM. The information guides the engineering of longer-lasting materials with better performance to enable new applications (renewable energy storage and low-cost electric vehicles).

“Historically, the design and development of materials has been hindered by our inability to observe the dynamic atomic-scale processes that occur during their operation in real time,” said Dave McDowell, regents professor and executive director of the Institute of Materials. “Professors Kacher and McDowell are at the forefront of in-situ operando transmission electron microscopy. Their fundamental research is accelerating the development of new materials that will impact everything from the safety and weight savings of automobiles to the capacity and efficiency of new batteries used to power them.”

– Alyssa Barnes
IsyE’s Arkadi Nemirovski Elected to the National Academy of Engineering

Professor Arkadi Nemirovski, who holds the John Hunter Chair in Georgia Tech’s Stewart School of Industrial & Systems Engineering (IsyE), has been elected to the National Academy of Engineering (NAE). In announcing Nemirovski’s election to the prestigious organization, the NAE commended him for his work in “developing efficient algorithms for large-scale convex optimization problems.”

Nemirovski was the only professor from Georgia Tech to be chosen for the honor this year.

“Arkadi is a world-renowned leader in his field and has profoundly influenced generations in the areas of discrete and continuous optimization. This highest of distinctions reflects his unparalleled contributions to convex optimization, which have shaped the field,” said Edwin Romeijn, IsyE’s H. Milton and Carolyn J. Stewart School Chair. “Arkadi represents the best of the Stewart School’s deep, longstanding emphasis on theoretical research. We couldn’t be more proud of him.”

Election to the NAE is among the highest professional distinctions bestowed on an engineer. According to the NAE, membership honors those who have made outstanding contributions to “engineering research, practice, or education, including, where appropriate, significant contributions to the engineering literature,” and to “the pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education.”

Nemirovski earned his Ph.D. in Mathematics from Moscow State University; his Doctor of Sciences in Mathematics from the Supreme Attestation Board at the USSR Council of Ministers; and his Doctor of Mathematics from the University of Waterloo, Canada. He joined IsyE in 2005.

Nemirovski joins other IsyE faculty who are already members of the NAE, including A. Russell Chandler III Chair and Institute Professor George Nemhauser, Coca-Cola Chair in Engineering Statistics Jeff Wu, Regent’s Professor Emeritus H. Donald Ratliff, Professor Emeritus William Rouse, and Professor Emeritus Ellis Johnson.

BioID Provides Intensive Experience that Helps Launch Careers

Josh Leibowitz came to Tech to acquire a fundamental knowledge of the medical device industry from concept to commercialization. He’s currently pursuing a Master of Biomedical Innovation and Development program, or BioID, offered through the Coulter Department of Biomedical Engineering at Georgia Tech and Emory.

The program is designed to address a gap in current professional biomedical education – the bench-to-bedside progression that transforms research into practical, usable techniques and products for improving patient care.

BioID is an intensive one-year ride, exposing students to clinical practice, engineering design and development, best-practices manufacturing, financial planning, and commercialization – bringing together the strengths of a top-ranked engineering university (Tech) and leading medical school (Emory) with the expertise of guest lecturers from throughout the diverse healthcare industry.

Following graduation, Leibowitz begins his career as part of the Johnson & Johnson R&D Leadership Development Program. For the next two years, he’ll work in the company’s medical device division, one of only six master level engineers in the country accepted into the competitive program.

– Jerry Grillo
Manu Platt Receives 2017 Biomedical Engineering Society (BMES) Diversity Award

Manu Platt, associate professor in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory, was selected to receive the 2017 Biomedical Engineering Society (BMES) Diversity Award.

As the annual honoree, Platt was selected for his outstanding contributions to improving gender and racial diversity in his field.

Platt will have the opportunity to give a lecture offering his vision of the challenges and opportunities of greater diversity in biomedical engineering at the BMES Annual Meeting in Phoenix. His lecture will also be published in The Annals of Biomedical Engineering.

Platt is the Diversity Director for the NSF Center on Emergent Behaviors of Integrated Cellular Systems, and he is a co-founder and co-director of Project ENGAGES, a biotechnology and engineering research program for African-American high school students in Georgia Tech laboratories. He was also featured in the Diverse: Issues in Higher Education magazine in 2015 as an Emerging Scholar.

Platt’s research focuses on understanding how cells sense, respond, and remodel their immediate environments for repair and regeneration in health and disease, and translating this knowledge into addressing global health disparities.

— Polly Ouellette

Chi becomes First Tech Student to Win Melosh Medal in Computational Mechanics

Civil engineering Ph.D. student Heng Chi has accomplished something no other Georgia Tech student has: winning the prestigious Robert J. Melosh Medal Competition.

Chi was one of two winners this year at the competition that recognizes the best student paper on finite element method, a mathematical approach to solving engineering problems by breaking them into simpler parts. He said the recognition means a lot — and will open doors for his future.

“The [Melosh Medal] is quite competitive, with participants from all over the world,” Chi said. “The judges are all distinguished scholars and experts in the field of numerical methods. Winning this competition means that my work is recognized by the experts in the fields.

“Second, it opens up new possibilities to my career. Being recognized by the award can significantly increase my competitiveness in seeking jobs and bring me great opportunities in the next stage of my career.”

The paper Chi presented proposes a new technique that “allows us to relax the geometries of the discretization that we use to model materials under large deformation — for instance, the stretching of rubber,” he said.

The idea is to expand the geometric shapes that can be used to model structures or other engineering problems in finite element analysis — typically triangles and four-sided shapes like squares and rectangles. Chi builds on an approach called “virtual element method,” or VEM, that uses a broader array of geometry, but has limitations.

— Joshua Stewart
Microneedle Patches: Successful First Human Trial

Despite the potentially severe consequences of illness and even death, only about 40 percent of adults in the United States receive flu shots each year; however, researchers believe a new self-administered, painless vaccine skin patch containing microscopic needles could significantly increase the number of people who get vaccinated.

A phase I clinical trial conducted by Emory University in collaboration with researchers from the Georgia Institute of Technology (including senior co-author Mark Prausnitz) has found that influenza vaccination using Band-Aid-like patches with dissolvable microneedles was safe and well-tolerated by study participants, was just as effective in generating immunity against influenza, and was strongly preferred by study participants over vaccination with a hypodermic needle and syringe.

Results of the study were published June 27, 2017 in the medical journal *The Lancet*. The research was supported by the National Institute of Biomedical Imaging and Bioengineering of the National Institutes of Health.

— Bradley Dixon

2017 Nevada Medal Goes to Newly-Minted PhD Sujith Mangalathu

Ph.D. student — and now graduate — Sujith Mangalathu has won the 2017 Nevada Medal for his work on bridge engineering.

Mangalathu learned of the honor in early May, just days after he officially graduated from Georgia Tech with his Ph.D. in civil engineering.

“This award motivates me further to continue my research in the field of bridge engineering and to address the challenges in assessing the risk associated with natural disasters and aging infrastructure,” Mangalathu said.

“I am humbled, honored and grateful to have been selected as a recipient of the prestigious Nevada Medal for Distinguished Graduate Student Paper in Bridge Engineering for 2017.”

Mangalathu’s winning paper explored using machine learning techniques to identify the relative importance of uncertain input parameters and to generate bridge-specific fragility curves for bridges in California.

“[My] proposed approach helps bridge owners with rapid seismic assessment and spending their resources judiciously — for example, data collection, field investigations, censoring — in the generation of a more reliable database for regional risk assessment,” said Mangalathu, who has been working as a post-doctoral scholar in the School of Civil and Environmental Engineering since he completed his dissertation earlier in the spring.

The Nevada Medal recognizes outstanding grad student contributions to state-of-the-art bridge engineering, according to the University of Nevada, Reno Center for Civil Engineering Earthquake Research. Judges consider the work’s originality and its potential impact on bridge engineering, design and construction.

— Joshua Stewart
ISyE Professor Jeff Wu Receives the 2017 ENBIS Box Medal Award for Achievements in Statistics

The H. Milton Stewart School of Industrial & System Engineering’s Coca-Cola Chair in Engineering Statistics and Professor Jeff Wu has received the 2017 Box Medal Award from ENBIS, the European Network for Business and Industrial Statistics. The Box Medal is named after George Box, the late British-American statistician who is considered one of the greatest statistical minds of our time.

According to ENBIS, the Box Medal is awarded each year to “an extraordinary statistician who has remarkably contributed with his work to the development and the application of statistical methods in European business and industry.” Wu was chosen for his many contributions to the study of statistics, as well as “his ability to clearly explain complex concepts … and for systematically passing on his knowledge.” Wu has supervised 45 Ph.D. students in the course of his career, many of whom are active researchers in the statistical sciences.

Wu is known for his work on the convergence of the EM algorithm; resampling methods; nonlinear least squares; sensitivity testing and industrial statistics, including design of experiments, robust parameter design and computer experiments; and has been credited for coining the term “data science” as early as 1997.

An elected member of Academia Sinica and the National Academy of Engineering, Wu has received several awards, including the COPSS Presidents’ Award, the Shewhart Medal, the R. A. Fisher Lectureship, and the Deming Lecturer Award. Wu has published more than 170 peer-reviewed articles and two books and was the second editor of *Statistica Sinica*.

— Shelley Wunder-Smith

ECE Student Awarded Institute’s Top Accolade

Electrical engineering student George Tzintzarov was awarded this year’s Love Family Foundation Scholarship for his outstanding scholastic record at the Georgia Tech Student Honors Celebration on April 20, 2017. The scholarship represents the highest achievement for a graduating senior at Georgia Tech. Students of all six colleges are considered equally. The award, together with a check for $10,000, is given by the Gay and Erskine Love Foundation.

Tzintzarov has maintained a 4.0 GPA while engaging in multiple academic enrichment activities outside of normal coursework. He held summer internships at Cisco and Boeing, and he has worked as a co-op student in the Georgia Tech Research Institute’s Electronic Systems Lab.

Tzintzarov was able to get a taste of research in two different labs during his undergraduate career. He worked in Professor Ayanna Howard’s Human-Automation Systems (HumAnS) Lab through the Opportunity Research Scholars (ORS) program and was later an undergraduate research assistant in Professor John Cressler’s Silicon-Germanium Devices and Circuits Lab.

Propelled by his exposure to undergraduate research, Tzintzarov is now pursuing a Ph.D. degree with a focus on microelectronics/microsystems with Professor Cressler as his advisor.

— Jackie Nemeth
AE Alumnus is New Vice Chief of Staff

In June, Daniel Guggenheim School of Aerospace Engineering alumnus James McConville was officially promoted to the post of U.S. Army vice chief of staff, where he will be responsible for the day-to-day operations of the Army and serve as a senior aviator. Previously a lieutenant general, McConville now holds the rank of four-star general. While earning his master’s degree in aerospace engineering at Georgia Tech, McConville was part of a team of students that won the 1989 American Helicopter Society/McDonnell Douglas Helicopter Student Design Competition by designing a low-cost light utility helicopter, according to Flying Magazine. The Quincy, Mass., native is the brother-in-law of AE professor Dimitri Mavris.

— Kathleen Moore

Algenol and Tech’s Biocrude Project Progresses

Georgia Tech is part of a team that won a $6.25 million grant from the Department of Energy to advance the state-of-the-art in algal production and biofuel processing, with the end goal of a sustainable, economically viable biofuel intermediate.

The project recently passed the first, and most important gate review, the Validation gate. This frees up the bulk of the funds for the main project.

Tech’s partners on the project include team leader Algenol Biotech LLC, as well as the National Renewable Energy Laboratory and Reliance Industries Limited.

Project partners propose producing algal biofuel intermediates (BFI) from cyanobacteria at an annualized rate of more than 4,000 gallon/acre per year, reducing the carbon footprint by at least 60 percent compared to gasoline, while reducing the energy expenditure of biomass harvesting, dewatering and hydrothermal liquefaction integration up to 10 percent.

Tech will work with Algenol to examine the current state of commercial readiness of Algenol’s system for BFI production and provide guidance for system innovations required to enable commercial deployment.

The principals from Georgia Tech are Matthew Realff (ChBE) and Valerie Thomas (ISyE), whose work concentrates on life-cycle analysis, techno-economic analysis and process engineering. Drs. Ron Chance and Paul Roessler are the principal investigators for the project.

— Bradley Dixon

Tien Invited to Join Nation’s Brightest Young Engineers at 2017 Frontiers of Engineering Symposium

The School of Civil and Environmental Engineering’s Iris Tien will travel to Connecticut this fall for two days of meetings and idea-sharing with some of the nation’s most promising young engineers.

Organized by the National Academy of Engineering, the Frontiers of Engineering symposium gathers what the academy calls “exceptional” engineers from 30 to 45 years old to facilitate “cross-disciplinary exchange and promote the transfer of new techniques and approaches across fields in order to sustain and build U.S. innovative capacity.”

It’s a highly competitive and prestigious invitation extended to only 82 people this year.

“I am excited to have been selected as a part of this group to discuss society’s outstanding grand challenges and how scientific discoveries combined with technological advancements can contribute to solutions to these challenges,” said Tien, an assistant professor in the School.

For 2017, the symposium will focus on the latest advances in four areas: mega-tall buildings and other future places of work, unraveling the complexity of the brain, energy strategies to power our future, and machines that teach themselves.

“My research in risk and reliability of critical infrastructure systems intersects each of the four main session topics for this year’s symposium,” Tien said, noting she’s looking forward to bringing new ideas into her research as a result of the gathering.

Invited participants for 2017 include three Georgia Tech assistant professors, as well as rising stars from companies like Proctor & Gamble, Google and Medtronic.

— Joshua Stewart
Ayanna Howard Chosen for Atlanta Magazine Honor

Ayanna Howard was selected as one of Atlanta magazine’s 2017 Women Making a Mark, a distinction reserved for a select group of women working to grow and strengthen the metro Atlanta community. Howard was profiled in the June issue of Atlanta magazine and was recognized at a luncheon with her fellow honorees.

Howard was chosen for this award for her outstanding work in robotics research and education at Georgia Tech, where she is the Linda J. and Mark C. Smith Chair Professor in the Georgia Tech School of Electrical and Computer Engineering (ECE). The award also recognized her establishment of Zyrobotics, a startup company spun out of research originating from her lab. Howard, who serves as Zyrobotics’ CTO, and her team develop STEM apps and technologies that combine education and therapy to help achieve developmental milestones for children of all abilities.

Howard was also honored for her outreach activities focused on engaging girls and students with disabilities in STEM fields. Dating back to her work at NASA Jet Propulsion Laboratory in the late 1990s, Howard ran a mentoring program for undergraduate women, and continuing today, she works on increasing minority participation at the graduate, undergraduate, and high school levels. She has provided research opportunities to dozens of undergraduates, of whom 75 percent are underrepresented minorities and/or women.

An ECE faculty member since 2005, Howard serves as the School’s associate chair for Faculty Development and leads the Human-Automation Systems Laboratory, home to research in human-robot interaction and assistive robotics.

— Jackie Nemeth

The School of Civil and Environmental Engineering is pleased to announce the creation of two new professorships and the appointments of

Patricia Mokhtarian, Ph.D.
Susan G. and Christopher D. Pappas Professor

Patricia Mokhtarian has specialized in the study of travel behavior for more than 30 years. She’s especially interested in the impact of telecommunications technology on that behavior and is widely recognized as an expert in the field.

She has been a professor in the School since 2013.

Professor J. David Frost, Ph.D., P.E.
Elizabeth and Bill Higginbotham Professor

David Frost’s work focuses on the study and analysis of natural and man-made disasters, including creating new kinds of tools to study sub-surface soils and problems related to earthquakes and other disasters.

He has been a member of the School’s faculty for two decades.

Learn more
ce.gatech.edu/give
Legs churning furiously, head tucked, heavy breath that forms clouds in the morning air. For Craig Forest, biking 100 miles at 5 a.m. is akin to meditation. Forest, an associate professor in the George W. Woodruff School of Mechanical Engineering, approaches training for triathlons like an engineer. He experiments constantly in order to determine exactly how hard he can push himself without injury, and he calculates the nutrients he needs in order to maximize his energy. Forest is extremely familiar with the human body—especially since his research interests center around bioengineering. Forest is the director of the Precision Biosystems Lab and focuses on the production of tools that aim to analyze brain activity. The tools will potentially help researchers to determine the method of communication between the 86 billion neurons in the brain and to hopefully understand what causes diseases such as Alzheimer’s, Parkinson’s and epilepsy.

Forest even thinks that the discipline required to do hundreds of iterations of research experiments and the discipline required to train hundreds of hours for a race are very similar.

"Being a professor and an endurance athlete is about pushing yourself to your mental and physical limits," said Forest. "We have to push, push, push, and there's lots of failure. It's very competitive." Forest ramped up his athletic lifestyle at the same time he began teaching at Georgia Tech in 2008. For him, it was the ideal way to decompress after long and stressful days of research and teaching as a young professor who was eager to prove himself.

His love for cycling and running grew, and he began to get stronger and faster. Soon Forest decided to begin competing. He has steadily worked towards more challenging events and even completed a triathlon that was the accumulation of a year of intense training.

"The high of finishing that race is unlike anything I have ever experienced," said Forest. "If you're trying to push yourself to your limit for five to 10 hours, you're going to have highs and lows. I love that roller coaster. It helps me understand myself better." Forest's journey as a professor and athlete has only just begun. His drive and commitment to everything he puts his mind to ensures that he will have many more years of pushing the limits of speed and science.

Beyond his own athletic experiences, Forest loves to bring the joy of being active to other people as well. Each year, he registers everyone who works in his lab for the Pi Mile race, during which hundreds run on a 3.14-mile-long course that winds through campus. The jury is still out on whether his colleagues love or hate him for this.