ENGINEERING
FOR HEALTH CARE

VCU School of Engineering

p.18

p.28

p.26

p.25

p.12

TABLE OF CONTENTS

GRAPHIC DESIGNER:
Amanda Porcella

WRITERS:
Emi Endo
Rebecca Jones
Leila Ugincius

PHOTOGRAPHERS:
Karl Bethea II
Hillary Kuhn
Tony Sylvestro
Kate Vinnedge

ILLUSTRATOR:
Hillary Kuhn

MISC. CONTRIBUTORS:
Cheryle Caplinger
Desiree Choe
Holly Hansen
Margaret Karles
Kenneth Kim
Dustin Kratochwill
Alexandria Tayborn
Daniel Wagner

FROM THE DEAN

The many avenues of engineering progress are unified by a single goal: "to build a better life for all." I see this challenge being met daily in remarkable ways at the Virginia Commonwealth University School of Engineering. Across our growing campus, faculty and students employ rigorous analysis to unlock the secrets of what is possible. Then they turn possibilities into tools that help us make it real!

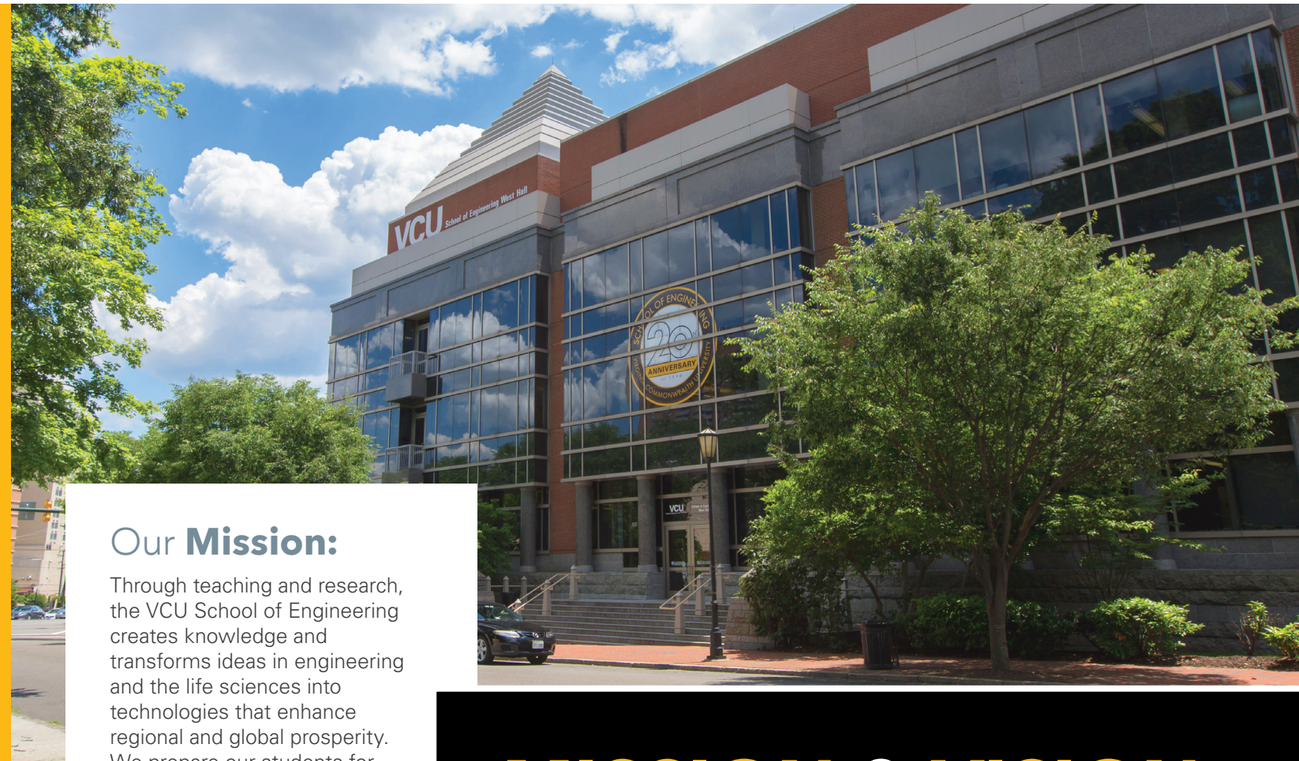
This is an extraordinary time for VCU Engineering. Last year's 20th anniversary prompted us to reflect on our accomplishments since 1996, and the list surprised even us. We now embark on our third decade knowing that the best is yet to come. Our extramural research funding continues to increase, as does faculty hiring. Brilliant students from a world of backgrounds are coming to VCU Engineering in ever-greater numbers. Why? Because our philosophy of public-private partnership inspires both established and emerging engineers to take hold of real problems and build solutions that are creative and based on solid science and engineering principles.

As you will see in these pages, much of that energy at VCU Engineering has converged on advancing human health. Each of our departments is reimagining health care through exciting work in nanoelectronics, data science, biosensors and more. Our bold new pharmaceutical engineering initiative is also well underway, with advanced labs translating new discoveries into better diagnostics and therapies for clinicians and, most importantly, better outcomes for patients.

In fact, our progress has extended beyond the capacity of the buildings that incubated our first two decades. This past year marked our expansion in the Virginia Biotechnology Research Park, a campus of companies, research institutes and government labs that is perfectly suited to our culture of collaboration. The ground alongside East Hall is where our program will continue to grow, in the form of a state-of-the-art engineering research building for which blueprints and renderings are taking shape.

If you are a longtime friend of the school, thank you for helping bring us to this exhilarating moment. If you're new to VCU Engineering, welcome. You picked a great time to join us. Now, let's make it real together. **Go Rams!**

Barbara D. Boyan, Ph.D.
Dean, VCU School of Engineering
Alice T. and William H. Goodwin, Jr. Chair
in Biomedical Engineering



Our **Mission:**

Through teaching and research, the VCU School of Engineering creates knowledge and transforms ideas in engineering and the life sciences into technologies that enhance regional and global prosperity. We prepare our students for leadership and entrepreneurship through collaborative and interdisciplinary partnerships.

Our **Vision:**

To establish the VCU School of Engineering as a preeminent school in education, research and technological development at the intersection of engineering, business, medicine and the life sciences.

MISSION & VISION

ASSOCIATE **DEANS**

L. Franklin Bost, M.B.A., IDSA

Executive Associate Dean
Strategy & Innovation

Bost is a seasoned executive with experience in marketing and sales, international business development, strategic and business planning, P&L management and developing and designing medical products. Since February of 2013, Bost has quickly established operational processes and financial reporting measures to efficiently align and advance all initiatives and expenditures with the school's strategic plan. In the last three years, he's raised approximately $233 million in funding for the school.

"I joined VCU to lead innovation and outreach programs. You need an engineer whenever you make something. With the right processes in place, we can showcase the change engineers foster."

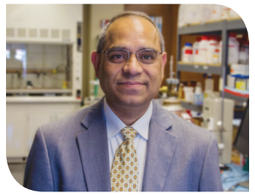
Afroditi V. Filippas, Ph.D.

Associate Dean
Undergraduate Studies

Filippas is responsible for all aspects of the undergraduate program. She has been in her current role since fall 2010, significantly growing enrollment and retention with her energy and enthusiasm for molding holistic engineers who are independent, lifelong learners. Previously, she served as the associate chair of the electrical and computer engineering department. She works with student services and the school's undergraduate program directors to develop effective advising programs and educational experiences. In this, and in her own teaching, she strives to help all students achieve their goals.

"In challenging times, universities must be bastions of inclusion and free expression. Through training in entrepreneurship and interdisciplinary collaboration, our graduates find creative solutions to this century's challenges."

Ram Gupta, Ph.D.



Associate Dean
Research

Gupta guides our student and faculty researchers to be concise, compelling and driven. Prior to joining VCU in August of 2014, he served as director of the Energy for Sustainability program at the National Science Foundation and was an editorial adviser for various journals including *ACS Sustainable Chemistry & Engineering* and the *Journal of Biomedical Nanotechnology*. Gupta's leadership and strategic communication skills have driven a 56 percent increase in written proposals between fiscal year 2014 and 2016, as well as a 82 percent increase in grant expenditures.

"I want to help faculty and students refine research questions, get funding to test their ideas and then see the successful use of their research results to improve human lives."

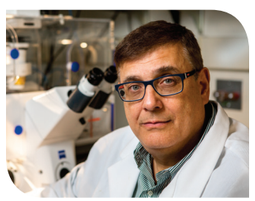
John Leonard, Ph.D.

Executive Associate Dean
Finance & Administration

Leonard oversees business and administrative operations, applying his administrative and data analytics expertise to finance, strategic planning and performance measurement. He came to VCU in 2016 from the Georgia Institute of Technology, where he was associate dean for finance and administration in the College of Engineering. He is widely published and is a recognized expert in the analysis and design of Intelligent Transportation Systems and coordinated traffic signal systems, as well as innovative, data-driven approaches to higher education administration.

"VCU is poised to make significant leaps forward in both national and international recognition. If the next three years are anything like the last three, it's going to be dramatic. I want to contribute to this success."

Zvi Schwartz, D.M.D., Ph.D.

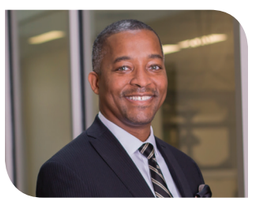


Associate Dean
Strategic Initiatives

Schwartz joined VCU Engineering in April of 2013, bringing 35-plus years of biomedical engineering, dental medicine and research expertise. His duties include evaluating building space for future expansion to support a growing student body and new research initiatives, while also maintaining and upgrading all existing office space, classrooms and laboratories. With more than 450 journal publications and numerous awards under his belt, including the American Academy of Periodontology's R. Earl Regeneration Award, Schwartz makes sure our engineering facilities fit the school's strategic and research goals.

"I'm excited to craft an environment where people feel secure and welcome. From labs to equipment and other technologies, I make sure people have what they need to succeed."

Gregory E. Triplett, Ph.D.



Associate Dean
Graduate Studies

Triplett is a first generation graduate who found his voice and ability to make a difference through academic teaching and research. Prior to joining VCU in January of 2016, he spent 11 years at the University of Missouri (Mizzou). There, he received the William T. Kemper Fellowship for Teaching Excellence Award, the Booker T. Washington Advisor of the Year Award and the Air Force Office of Scientific Research's Young Investigator Award. Triplett secured nearly $9 million in total grant funding at Mizzou and more than doubled student participation in honors research.

"I want to make the value of a VCU graduate degree loud and clear. Recruiting, retaining and graduating talented students from every part of the country and world shows VCU's momentum."

DEPARTMENT **CHAIRS**

Krzysztof Cios, Ph.D., D.Sc., M.B.A.

Computer Science (CS)

Computers can write articles from data, crunch big data to create personalized consumer experiences and even conduct health care procedures. Since coming to VCU in 2007, Cios has built up a robust department that is equipped with the research skills to continue to propel technological progress. He has established certificate programs in data science and cybersecurity, and a dual-Ph.D. program with the University of Córdoba in Spain. Cios also serves VCU in its multidisciplinary C. Kenneth and Dianne Wright Center for Clinical and Translational Research as director of enterprise informatics and director of biomedical informatics core.

"We are at the forefront of a technological revolution, and we get to address industries' most pressing problems with our expertise, particularly in the areas of data science and cybersecurity."

Henry J. Donahue, Ph.D.

Biomedical Engineering (BME)

Donahue joined VCU in January of 2016 after a 21-year career at Penn State, where he directed the Division of Musculoskeletal Sciences. Research within that division enabled the Department of Orthopaedics at Penn State to be ranked in the top 5 nationally in NIH funding. Since Donahue's arrival at VCU, the number of BME faculty has increased over 33 percent. Donahue plans to grow the VCU BME undergraduate and graduate programs while developing convergent initiatives with the Schools of Medicine, Dentistry and Pharmacy. He is excited to be part of our open, collaborative research culture.

"I want our program to be the program of choice for students considering undergraduate and graduate biomedical engineering in the commonwealth and beyond. We also want to be the employer of choice for new faculty."

B. Frank Gupton, Ph.D.

Chemical & Life Science Engineering (CLSE)

As a student, Gupton's perspective changed forever when he was asked to participate in research with a professor. Suddenly, he saw how what he learned in class related to real-world needs. Now he strives to give VCU faculty and students the tools to be successful and productive. He joined VCU as a research professor in 2007 and was promoted to department chair in 2008. Gupton shares his experience from 30-plus years in the chemical and pharmaceutical industry to motivate students and to increase departmental efficiencies.

"Nearly 80 percent of our undergraduates are participating in research initiatives. We have some very special, extremely motivated individuals who teach me new things each day."

Gary Tepper, Ph.D.

Mechanical & Nuclear Engineering (MNE)

Tepper earned his Ph.D. from the University of California at San Diego. There, he watched his adviser build a new engineering school that is now ranked in the top 25. Tepper joined VCU in 1997 as an assistant professor and then accepted the department's chair position in 2009. Along the way, Tepper helped create the nation's first hybrid Ph.D. program in mechanical and nuclear engineering. He's excited to push our strong group of faculty members to achieve their full potential and become stars within their respective research fields.

"Our department has nearly doubled in size in the last seven years. It's one of the largest and most popular majors at VCU."

Erdem Topsakal, Ph.D.

Electrical & Computer Engineering (ECE)

Topsakal joined VCU in June of 2015 and quickly assembled an undergraduate student advisory board tasked with shaping the direction of department initiatives. The board helps rally the student body to apply what they're learning in classrooms out in the community. These students take part in open houses, high school visits and other exciting projects. Topsakal also formed a general advisory board of industry leaders, high school principals and faculty from other institutions to evaluate department programs, its research portfolio and curriculum.

"Every day, I wake up excited to come to work and witness how talented and hardworking our students, faculty and staff are. I ask everyone to buckle up because ECE is moving faster than ever. There's so much potential here."

"The VCU School of Engineering has become a wonderful platform of learning and opportunity guided by the leaders on this page. Buildings, labs and equipment are important tools, but our people are the key to transforming lives and impacting society for the benefit of all of us."

– Paul Rocheleau
Executive Director of Strategic Programs

DATA-DRIVEN **FORWARD MOTION**

> John Leonard is famous for his ability to take data from many different kinds of sources and use it to make decisions that are founded in fact, and not in dreams, so that you can realize dreams.
>
> –Dean Barbara D. Boyan, Ph.D.

John Leonard, Ph.D., joined the School of Engineering as executive associate dean for finance and administration August 1 in 2016. He comes to VCU from the Georgia Institute of Technology, where he was associate dean for finance and administration in the College of Engineering.

"John Leonard is famous for his ability to take data from many different kinds of sources and use it to make decisions that are founded in fact, and not in dreams, so that you can realize dreams," said Barbara D. Boyan, Ph.D., dean of the VCU School of Engineering.

He holds a doctorate in engineering from the University of California, Irvine and is widely published in the field of traffic operations analysis and design. This specialty also informs how Leonard wants to help drive VCU Engineering to the next level.

"Just as with transportation, I look at a university as a complex system with many moving parts," Leonard said. "You need data to help understand the big picture. Data underpins decisions that can help the system perform better — more efficiently and effectively — for the users. In the case of VCU, this means for students and faculty."

He believes his data-driven approach is well aligned with the university's commitment to the Responsibility Centered Management (RCM) budget-planning model, which encourages entrepreneurial activities like new programs, services and revenues in areas experiencing growth. RCM ultimately improves operations, he says, because of its emphasis on transparency and communication between administration and faculty.

He is working with stakeholders on key performance indicators based on the school's strategic plan. "Like instruments on the dashboard of a car, these measures and indicators will help everyone understand where we are and how far we have to go," Leonard said. Thus far, those signals tell him that the school is headed in the right direction.

NEW ASSOCIATE DEAN FOR GRADUATE STUDIES

GREGORY E. TRIPLETT, PH.D.

Gregory E. Triplett, Ph.D., joined VCU Engineering as associate dean for graduate studies in January 2016. "I visited, and it was crystal clear that there is so much interest in moving VCU forward. I thought, 'There's something going on here that I want to be a part of,'" he said.

Triplett has quickly become a key part of that forward motion. He comes to VCU from the University of Missouri, where he won awards for teaching, advising and research, secured almost $9 million in grants and doubled student participation in honors research.

Triplett is now focused on helping VCU Engineering recruit top graduate students with new programs like VCU Connect, which increases contact with and research support to graduate students, and VCU Synergy, which targets specific talent pools. He's eager to promote the school's advancements in cybersecurity, bone research, medical diagnostics using embedded sensors, pharmaceutical engineering and nuclear engineering. He also sees the school's relationship to VCU's programs in medicine and the arts — and Richmond itself — as major benefits to engineering students. "There's a huge industrial base here," said Triplett. "Richmond has a lot of history, but there is also a sense here that you can take part in a new history."

NEW CHAIR OF BIOMEDICAL ENGINEERING

HENRY J. DONAHUE, PH.D.

After a distinguished 20-year career at Pennsylvania State University, Henry J. Donahue, Ph.D., came to VCU as chair of biomedical engineering in January 2016. "The whole school is expanding, and biomedical engineering is expanding at perhaps an even higher rate. I thought it was a great chance to help move science, engineering research and education forward," said Donahue. "VCU presented a unique opportunity to make a big impact."

He plans to grow student enrollment and wants to increase faculty by 50 percent, particularly in rehabilitation, regenerative medicine and mechanobiology. He is also building extramural funding for research.

Donahue was recently inducted into the American Institute for Medical and Biological Engineering (AIMBE) College of Fellows. His research program includes a NASA-funded project on effects of space travel on the musculoskeletal system. He advocates a model of convergence in research, which he describes as the "next step of interdisciplinary work." The convergence paradigm teaches specialists to think in other disciplines and prompts deeper collaborations. Donahue thinks VCU is well positioned for convergence in science, engineering, design, marketing and entrepreneurship. He sees engineering as the natural leader. "Engineers already do this to some extent, because engineers work in teams," he said. "They know you can't build a bridge by yourself."

Facts & Figures

82
m.s. students

165
ph.d. students

247
graduate students

1746
undergraduate students

294 biomedical engineering

202 chemical & life science engineering

340 computer science

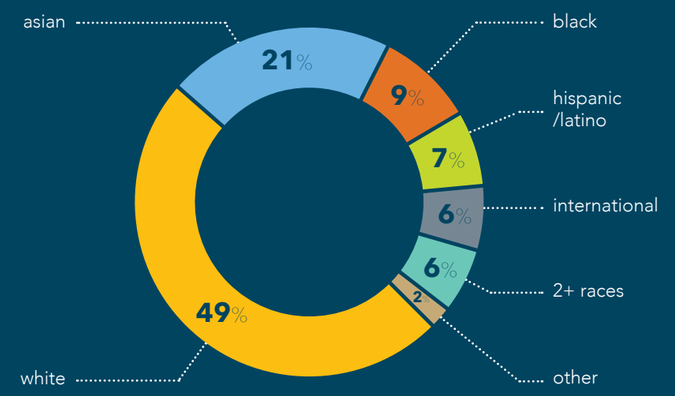
294 electrical & computer engineering

539 mechanical & nuclear engineering

1250 average admit SAT

3.97 average admit GPA

Diversity



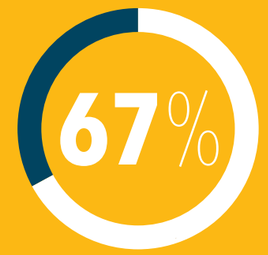
75% male

25% female

43% increase in under-represented students since 2010

50% increase in female students since 2010

Faculty



increase in faculty since 2010

19:1 student to faculty ratio

Student Engagement

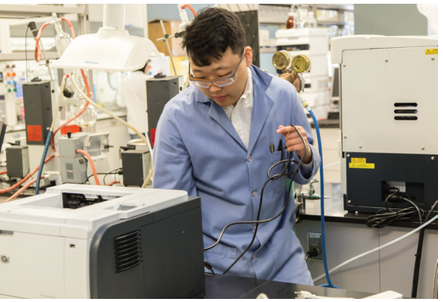
23
engineering student organizations

of spring 2016 undergraduate students with a GPA over 3.0

208
internships and co-ops completed by undergraduate students in 2015–16

BIOTECH **EIGHT**

In 2016, the VCU School of Engineering expanded in the Virginia Biotechnology Research Park, a 34-acre life sciences community that houses private sector companies, research institutes, non-profits and state and federal laboratories adjacent to the VCU Medical Center.



The research park's Biotech Eight (BT8) is now home to many of VCU Engineering's most advanced facilities. The school's "wet labs" in BT8 are equipped with specialized instrumentation including nuclear magnetic resonance, gas chromatography-mass spectrometry and liquid chromatography-mass spectrometry. VCU's artificial heart lab, which features a mock circulatory loop and flow visualization, is housed in this facility. BT8 also supports the school's collaborative research programs with "dry lab" facilities including a Precision Imaging Research Laboratory (PIRL).

VCU's Medicines for All and Pharmacy on Demand *(see pages 14-17)* laboratories are headquartered here. The VCU Center for Human Factors and Rehabilitation Engineering and VCU's Center for Rational Catalyst Synthesis (CeRCaS) — the world's first and only research center that focuses on understanding the chemical fundamentals of catalyst synthesis — are also in BT8.

In addition to labs, VCU's BT8 facilities provide work areas that support the school's culture of research, education and collaboration. It is the location of VCU Institute for Engineering & Medicine offices and conference rooms. It is also where the school's new Ph.D. program in pharmaceutical engineering will be headquartered.

MECHANICAL & NUCLEAR ENGINEERING

INNOVATION LAB

VCU's engineering students are designing the future — and printing it in 3D in the new Mechanical and Nuclear Engineering (MNE) Innovation Laboratory.

The Department of Mechanical and Nuclear Engineering worked with the 3D printing industry leader to establish the Commonwealth of Virginia's first Innovation Laboratory featuring a MakerBot Innovation Center. The MNE Innovation Laboratory has 30 MakerBot Fifth Generation Replicator Desktop 3D Printers for rapid prototyping and three MakerBot Replicator Z18s that print extra-large objects. It also has 3D scanners and digitizers for reverse engineering projects.

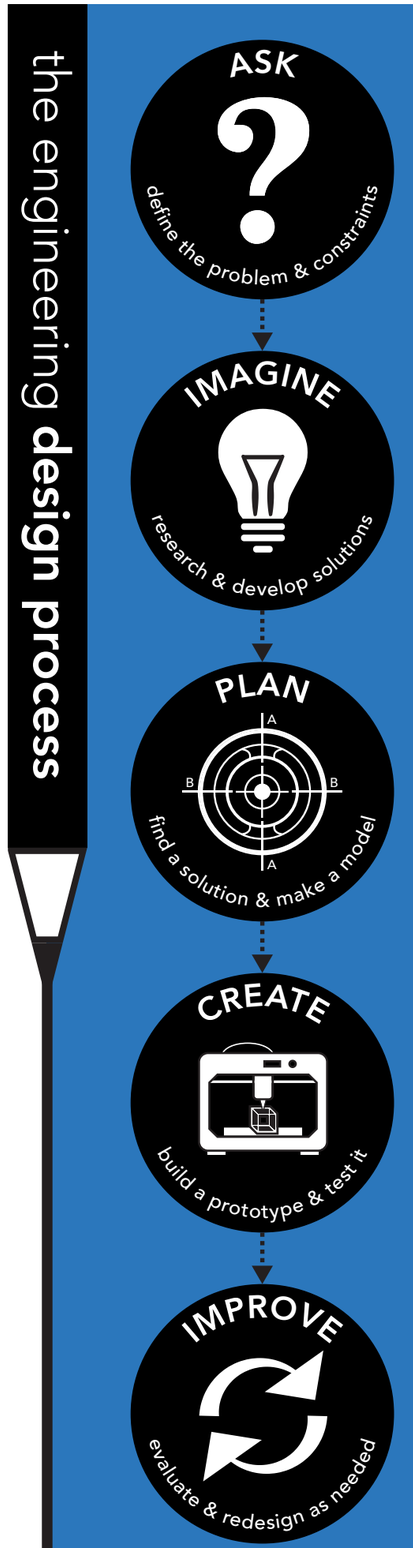
"The new MNE Innovation Laboratory gives VCU students the latest tools to rapidly turn their creative ideas into working prototypes," said Gary Tepper, Ph.D., chair of the department. "Students learn academic concepts in the classroom, but they get tremendous satisfaction and a much deeper understanding when they apply their engineering skills to build and innovate."

The facility dramatically increases all engineering students' access to additive manufacturing, an essential component of 21st century education in design engineering and product development.

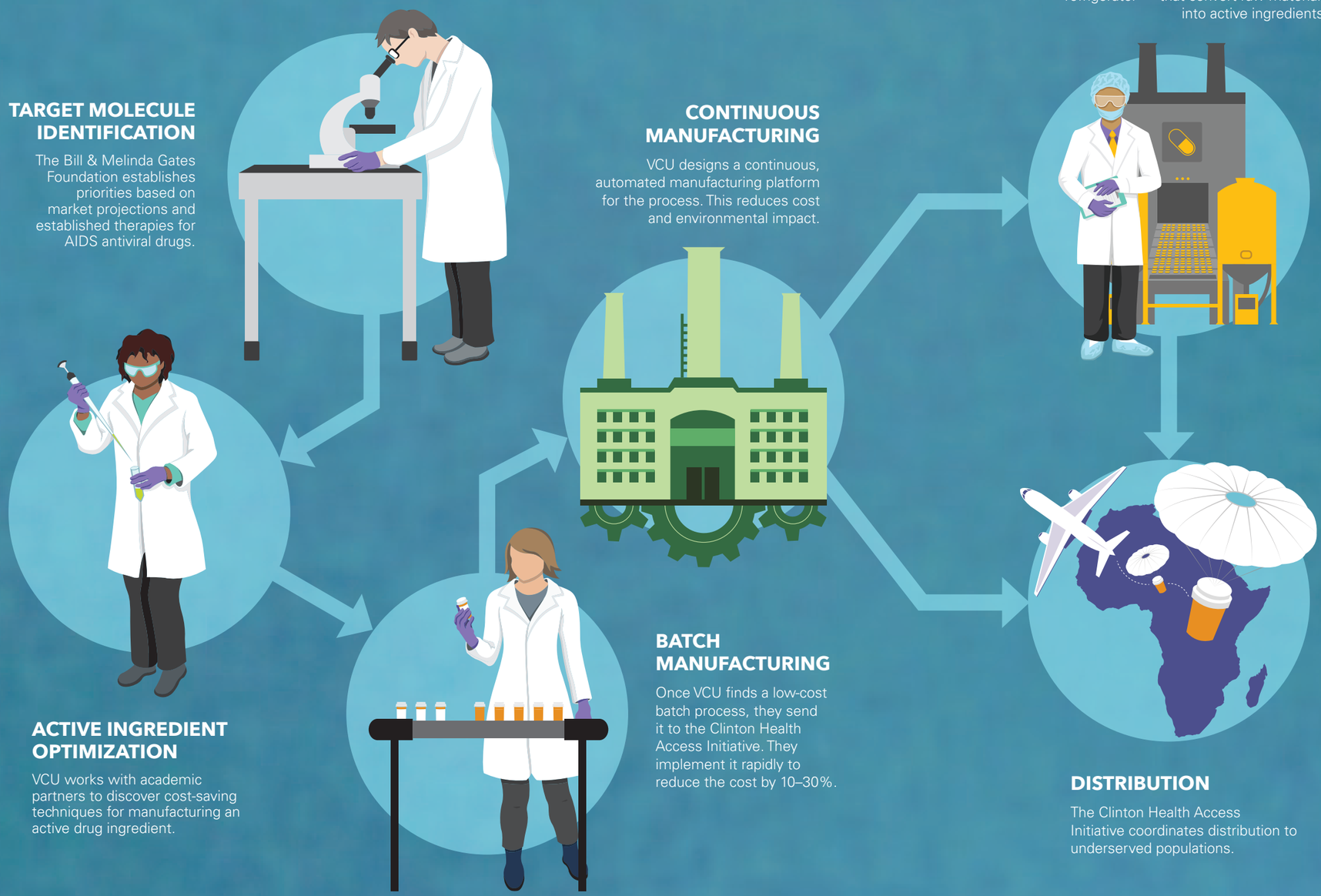
"It fosters a hands-on learning environment for the entire School of Engineering. When we started thinking about this last year, rapid prototyping for product development was becoming a hot item for undergraduate studies and Capstone Design projects. This technology gives students practical experience that reinforces design and innovation concepts related to all engineering disciplines," said Charles Cartin, Ph.D., director of the MNE Innovation Laboratory.

Designing, fabricating and testing sophisticated prototypes quickly in-house lets students improve functionality early in the design process.

"Students often create designs on a computer and think it's right. Often it's not," said L. Franklin Bost, executive associate dean of innovation and outreach. "When prototypes are made via 3D printing, required design modifications can be quickly identified. That's the learning moment and speeds the development process."



ACCESS TO MEDICATIONS REIMAGINED



VCU's Medicines for All and Pharmacy on Demand initiatives design new approaches that reduce cost, decrease manufacturing footprint and increase global access to a new generation of medicines.

When we think of prescription medicines, most of us envision expensive, one-size-fits-all white pills made in a huge factory far away. But that picture is shifting as VCU School of Engineering researchers redesign medicines.

Two projects in the VCU School of Engineering are working hand-in-glove to make medicines cheaper to create and easier to distribute. The Medicines for All Initiative decreases the cost of chemical formulations for drugs. Pharmacy on Demand, a project the school is also advancing, then dramatically streamlines the platforms that produce them.

These efforts are bringing changes to medicines. Many will be available to populations that have traditionally gone without. Some next-gen pharmaceuticals will be manufactured in a portable factory no bigger than a refrigerator. Some may even be produced by the body itself.

"It is important that the way that pharmaceuticals are manufactured be re-imagined," said Barbara D. Boyan, Ph.D., dean of the VCU School of Engineering.

The Medicines for All Initiative is doing just that by reducing the cost of active pharmaceutical ingredients (APIs) — a major cost driver in treating infectious diseases in the developing world.

There is a critical need for novel, cost-saving approaches to API production, but neither innovator drug companies nor generic manufacturers have economic incentives to develop them. Medicines for All addresses this problem by identifying manufacturing routes that utilize the lowest-cost raw materials and most efficient tools available.

B. Frank Gupton, Ph.D., professor and chair in the Department of Chemical and Life Science Engineering, leads Medicines for All, which received approximately $5 million from the Bill & Melinda Gates Foundation in 2016 to develop a more cost-effective way to manufacture a new HIV/AIDS therapy.

"Dolutegravir is a relatively new drug. Our expectation is that it will be a first-line treatment. It's a new member of an old class of AIDS drugs, and it seems to be much more effective," Gupton said.

Continued on page 16

This grant represents the Gates Foundation's third major investment in Medicines for All, having also funded the initiative's work to bring down API cost of the first-line AIDS treatments Nevirapine and Tenofovir.

> "By taking processes from the macro scale to the micro scale, we are able to bring science and engineering closer to the patient."
>
> –Thomas D. Roper, Ph.D.

Medicines for All also works closely with the Clinton Health Access Initiative (CHAI) to transfer the new production processes to manufacturers so the medications can reach communities in need.

"We develop the new process, then we transfer the know-how and the technology over to CHAI and they get it to the manufacturers," Gupton said. Once CHAI receives the process, turnaround is fast.

"For Nevirapine, six months after the transfer to CHAI it was in commercial production," Gupton said. "In academia, things rarely happen that quickly — and even in industry, it usually doesn't happen that fast. Based on that past success, the goal this time is for an even faster transfer to CHAI for the drug Tenofovir."

Gupton has extensive experience in chemical and pharmaceutical companies including Boehringer Ingelheim. He explains that one of the active ingredient cost drivers is speed-to-market. This is because when a molecule is identified as a drug candidate, the company typically has only 1 ½ years to file its regulatory submission.

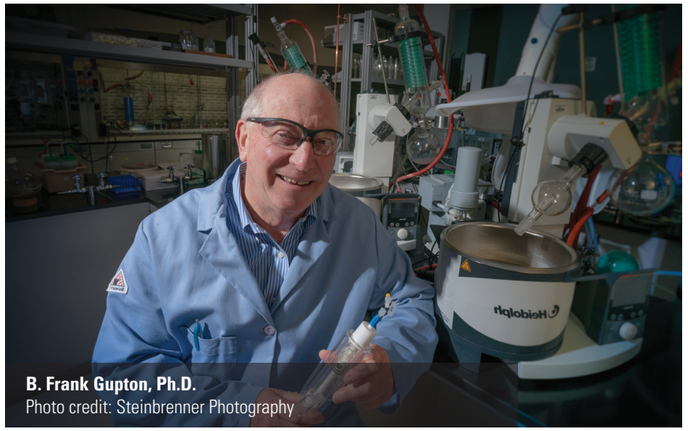
"They have 18 months to lock down the process, so they go with what they have. They don't usually change the process after that," Gupton said. Active ingredients represent only about 10 percent of the cost of a patented medication. But once the patent expires, the economics flip. Generic manufacturers are not tasked with research and development, so active ingredients make up a bigger share of overall costs, usually 60 to 70 percent.

The new API manufacturing processes that Medicines for All creates for specific drug targets can also be applied to other medicines. So while it meets an urgent health care need today, Medicines for All also signals dramatic change in future drug production technologies.

At the other end of the drug manufacturing cycle, Pharmacy on Demand designs drug manufacturing processes that shrink the environmental and industrial footprint as they expand global access to drugs. Thomas D. Roper, Ph.D., the school's new director of pharmaceutical engineering, is working on Pharmacy on Demand with colleagues from the Massachusetts Institute of Technology.

"I would say that the theme of my lab is miniaturization for the purpose of personalized medicine," Roper said. "By taking processes from the macro scale to the micro scale, we are able to bring science and engineering closer to the patient."

Pharmacy on Demand is an object lesson in these themes — in this case, the object is a pharmaceutical factory merely the size of a refrigerator. Pharmacy on Demand is creating small, configurable pharmaceutical manufacturing platforms that can ultimately be shipped to different locations to supply patients with locally produced, high-quality medicines.



B. Frank Gupton, Ph.D.
Photo credit: Steinbrenner Photography

In addition to providing pharmaceutical manufacturing where it has traditionally been absent, the units reduce environmental impact and make the manufacturing process safer. The units convert raw materials into active ingredients and formulated products in a continuous flow, avoiding the stops and starts of batch processing. This results in lower costs, less waste and better pharmaceuticals.

"In my opinion, the biggest advantage of these manufacturing facilities is footprint," Roper said. "Take hydrogen, for example, which is highly flammable and explosive. If you have a big reactor with hydrogen under high pressure, imagine the safety parameters. But a facility this size isn't going to catch fire because there's not enough hydrogen."

Roper's recruitment to VCU from GlaxoSmithKline was funded in large part by a substantial eminent scholar award from the Commonwealth Research Commercialization Fund (CRCF), the university's first CRCF award in the eminent scholar category.

As he helps shape development of these initiatives, Roper anticipates other projects in biological catalysis that will streamline the pharmaceutical manufacturing process further.

"Another way to manufacture things is biologically," Roper said. "An area I am interested in is biological catalysis of reactions, so eventually you are creating medicines on the patient's cell or an enzyme."

In this paradigm, the medicine is not a tablet from an amber-colored bottle, but a chemical process that transfers the manufacturing to the patient's body.

"In other words, if you string together chemical transformations that can be done by enzymes on a cell, you can effectively reduce the size of your manufacturing footprint," Roper said.

He sees other trends away from the production of substances that patients take regularly and toward the creation of processes that play out in a patient's body over time.

Roper also points to development of long-acting medicines that patients take only once every 60 to 90 days. Such medications may have more adverse effects; when perfected, however, they offer major advantages, including freedom from the stigma of disease and greater assurance that patients will actually take their prescriptions.

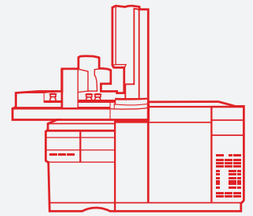
"Compliance in pharmaceuticals is terrible. Even in cancer treatment, patients will not always take their medicine when they are supposed to," Roper said.

He noted an additional advantage to many next-generation drugs — one harder to quantify.

"There is a general improvement in patient quality of life," Roper said. "These treatments come closer to being cures, so people have to spend less time feeling like a patient."

Lab Instrumentation

Research that makes medicine available to all requires infrastructure, and the school is meeting that challenge with investments in state-of-the-art laboratory equipment. Meet a few of the sophisticated instruments helping our researchers create the next generation of drug development and delivery technologies.

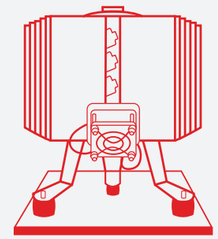


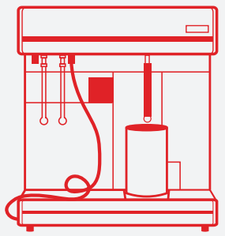
Gas Chromatograph–Mass Spectrometer (GC/MS)

Separates and identifies substances in a test sample. Its gas chromatography tests purity of vaporized compounds. Its mass spectrometer ionizes chemicals, then sorts the ions based on mass.

Flow Reactor

Processes chemical reactions in a continuous flow, as opposed to processing reactions batch-by-batch, in order to develop the highest quality drug manufacturing protocols. VCU's labs have 10 flow reactors, including a photochemical flow reactor that uses light to catalyze the desired reaction.



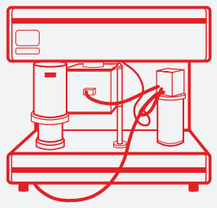


Micromiretics Physisorption ASAP 2020 Plus

Measures the surface area of low-surface materials such as micropore structures and nanotubes in order to characterize catalysts, the substances that bring about or increase chemical reactions.

Chemical Esorption Autochem II 2920II

Conducts precise studies of how atoms, ions or molecules from a gas, liquid or dissolved solid adhere to a surface to give valuable information about properties of catalysts.



HEALTH HACKS

VCU's first-ever medical hackathon brought 170 students together for one weekend. The result was 33 new solutions for unmet medical needs.

Students from VCU and other universities gathered Oct. 1–2 to develop solutions for unmet medical needs at VCU's first medical hackathon, HealthHacks. The 24-hour, intense marathon focused on creating novel solutions to real problems in the areas of product design and improvements, hospital throughput and patient experience. Attendees formed 33 teams with more than 20 engineering and medical mentors available for consultations.

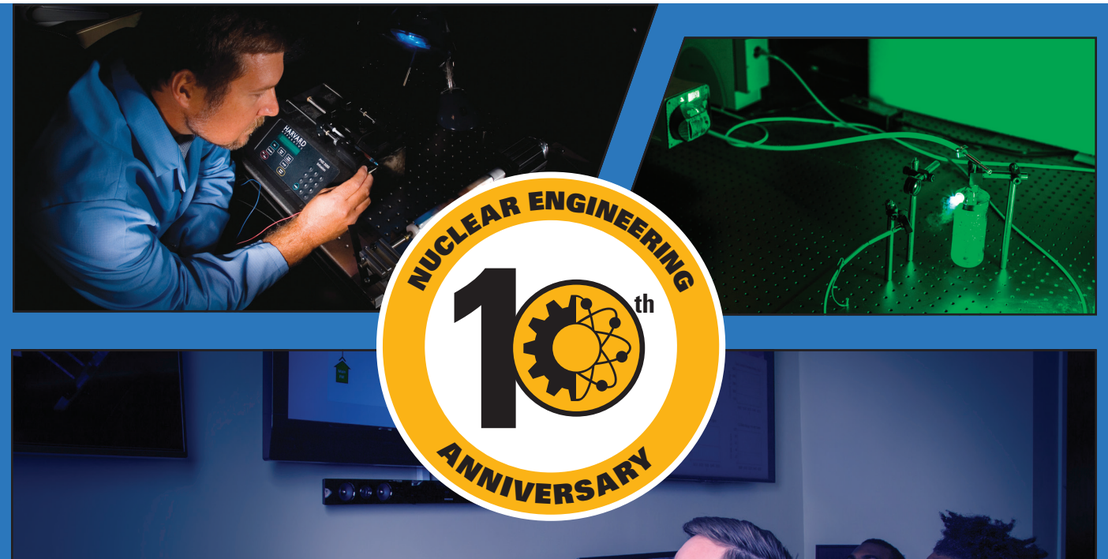
"The event demonstrated that many viable solutions could be conceived and prototyped in a very short time by a focused team of dedicated individuals," said L. Franklin Bost, director of the VCU Institute for Engineering and Medicine and executive associate dean of the VCU School of Engineering, which co-hosted the event with the VCU School of Medicine.

Student organizers Simone Gregor, a senior biomedical engineering student and Honors College member, and Sina Mostaghimi, a fourth-year VCU School of Medicine student, brought the HealthHacks concept to VCU.

Team Heart-in-Hand received first place for a system to translate 2-D computerized topography scan images into 3-D visuals that can be viewed on a phone or a virtual reality headset to help physicians and patients understand disease progression and potential surgical procedures.

Team AmpEase took second place for a complete overhaul of how a critical two-stage medication is rapidly administered through a syringe. The third-place team, TremorSense, targeted monitoring of patients with tremors with a new wearable watch that tracks tremors over time to see if patients' medication is effective.

"We often think of solving the 'big' problems in health care. However, there are numerous everyday patient care needs that should be addressed by focused teams of motivated individuals," Bost said.



Ten years ago, the Department of Mechanical Engineering added nuclear engineering to its program offerings, bringing comprehensive nuclear engineering education back to Virginia.

Today, VCU is the only university in the commonwealth with an accredited undergraduate nuclear engineering major concentration, as well as M.S. and Ph.D. programs in mechanical and nuclear engineering. Those programs exemplify the school's commitment to public-private partnership as they make robust intellectual contributions to the nuclear engineering discipline while also meeting significant industry needs.

The idea to create VCU's nuclear engineering program was born when industry and academia came together in 2007 to address the fact that engineers had to leave the state in order to earn advanced degrees in nuclear engineering.

"Historically, Virginia had been a pioneer in nuclear, but nuclear engineering graduates were no longer being produced in-state. Although we were able to recruit fantastic new hires from out of state nuclear engineering programs, we often lost them after a year or two when they decided to go back 'home.' It was clear that both VCU and industry would benefit. There was a huge opportunity here," said Sama Bilbao y León, Ph.D., who in 2007 was a nuclear safety analysis engineer with Dominion. Bilbao y León, who went on to teach VCU's first nuclear engineering course, is currently the school's director of nuclear engineering programs and an associate professor.

The program's growth has been steady and strategic. Two years after VCU's first M.S. nuclear engineering course in 2007, the department added an undergraduate nuclear engineering concentration option to the mechanical engineering bachelor's degree. In 2010, the department's name was officially changed to include nuclear engineering, and in 2012 the nuclear concentration received accreditation from the Accreditation Board for Engineering and Technology. In 2013, VCU enrolled the first students into the Ph.D. program in mechanical and nuclear engineering, which remains the school's newest doctorate and the country's only hybrid mechanical/nuclear Ph.D. To date, 83 students have earned bachelor's degrees in mechanical engineering with a nuclear engineering major concentration from VCU. The program has also conferred 88 Master of Science degrees and six doctorates in mechanical and nuclear engineering.

"At every level, our program is distinguished by hybridization and integration," Tepper said. "It's a very good partnership for our graduates as well. They can earn an undergraduate degree in mechanical engineering, for example, but with an ABET-accredited nuclear concentration. This gives them flexibility in how they market themselves. Feedback from companies indicates that they like that, too."

FOCUS ON RESEARCH

STUDYING THE EFFECTS OF E-CIGARETTES

While the effects of conventional tobacco products on human health and pregnancy have been established, little is known about new e-cigarette products.

René Olivares-Navarrete, Ph.D., assistant professor of biomedical engineering, received a two-year grant from the National Institute of Dental and Craniofacial Research at the National Institutes of Health to study "Perturbation of Craniofacial Morphogenesis, Healing, and Regeneration by E-cigarette Aerosol Mixtures."

"In our project, we are using a multisystem approach to examine the effects of e-cigarette aerosol mixtures on skull and face development," he said. "We will use frogs and mice to determine whether indirect exposure to e-cigarette aerosols during development affects how the structures in the face form. The conclusions drawn from these studies are broadly relevant as more nicotine users turn to e-cigarettes as an alternative to traditional tobacco smoking. Today, the federal government has limited access to these products to children under 18, acknowledging their still-unknown effects."

Olivares-Navarrete is a dentist who spent several years in private practice before pursuing his Ph.D. His research focuses on how clinical materials that are implanted in the body can be modified to control cells in the body — such as stem cells or immune cells. The materials are called "cell-instructive" and, as the name indicates, the idea is to control what the cells produce to reduce inflammation or produce specific tissues, for example.

The overall goal of Olivares-Navarrete's research is to harness the intrinsic healing and reparative capacity of our bodies to induce faster healing and regeneration. To that end, his group is developing models of challenging clinical populations (e.g. smokers, diabetics, chronic prescription users) to understand why these populations have more difficulty healing and to find ways to reestablish the normal balance in these populations with regenerative medicine strategies.

Olivares-Navarrete is collaborating on the project with Amanda Dickinson, Ph.D., assistant professor in the Department of Biology, College of Humanities and Sciences, and biomedical engineering students Kelly Hotchkiss, Alexander Whitehead, Pranav Baderdinni and Cristian Coriano.

René Olivares-Navarrete, Ph.D.

NANOMEDICINE DATABASE TOOL

A team of VCU School of Engineering computer science and nanomedicine researchers is harnessing the power of machine learning to make it easier to advance research in the rapidly growing field of nanotechnology.

As more newly engineered nanomaterials — at the scale of 100,000 times smaller than the thickness of a sheet of paper — are being created and tested, the volume of research literature has skyrocketed.

"It's hard to keep 200 papers in your head," said Bridget McInnes, Ph.D., assistant professor in the Department of Computer Science. Researchers are finding it increasingly difficult to keep up with new findings, she said. That's where natural language processing comes in, helping to automate the extraction and cataloguing of information from massive amounts of text.

McInnes and Nastassja Lewinski, Ph.D., assistant professor in the Department of Chemical and Life Science Engineering (CLSE), formed the data science and nanoinformatics lab to develop tools and algorithms to support research discovery for nanotechnology. Some of the students involved are part of the Vertically Integrated Projects program, through which undergraduate students team up with graduate students, postdoctoral fellows and faculty over several semesters.

Lewinski said the lab can help researchers discover new connections within the literature. This could help speed up the painstaking process of reviewing research, leading to achieving advancements more quickly. "The drug development process takes already, 10, 15 to 20 years," Lewinski said. "Where can you save time?"

With both departments working together, the computer can generate information that CLSE researchers use in their lab. "Developing these tools is integral in allowing biomedical researchers to quickly extract, catalog and analyze new information for the advancement of science," McInnes said.

For instance, Lewinski said nanoparticles called gold nanoshells—microscopic balls made of gold-encased glass—can be manipulated so that laser treatment is applied only on the diseased tissue and not the normal tissue. The computer can rapidly identify within the literature how these nanoparticles have been synthesized and their biological effects to inform further research in this area.

LONG-TERM **GLUCOSE MONITORING**

A research team based in the Department of Electrical and Computer Engineering has received a two-year grant from the Commonwealth Health Research Board (CHRB) to develop an implantable biosensor for long-term continuous glucose monitoring. The device will improve comfort, safety and quality of life for the nearly one out of seven adults in Virginia who have diabetes.

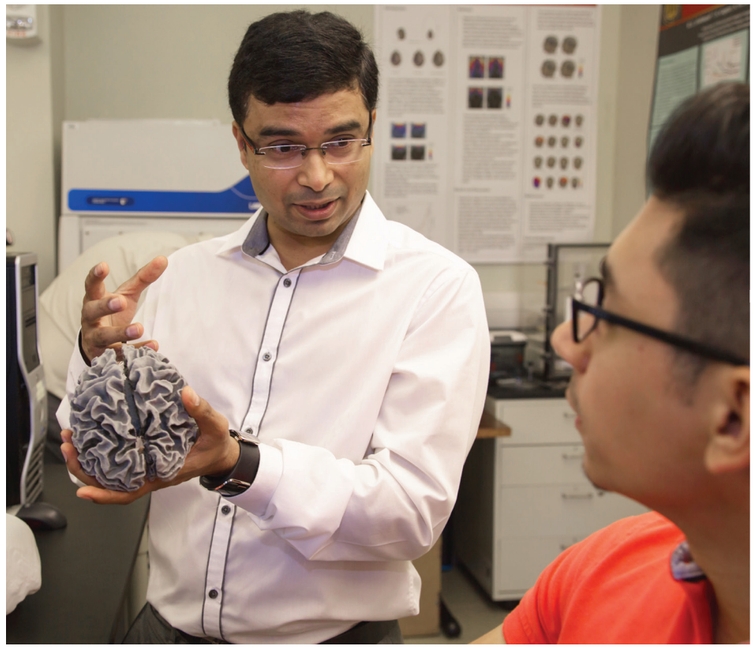
The team is prototyping a subcutaneous, ultra-sensitive biosensor that will remain fully functional in the body for up to a year — a significant improvement over currently available biosensors, which typically last less than two weeks and are bulky and uncomfortable.

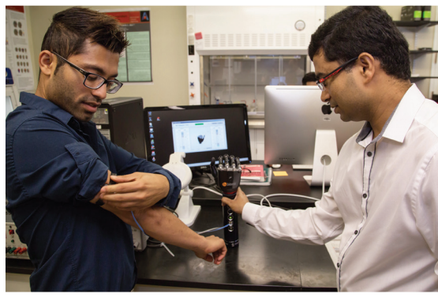
"What we are trying to develop is essentially a lab on an implantable chip," said Erdem Topsakal, Ph.D., chair of the Department of Electrical and Computer Engineering and principal investigator. "We hope that this technology will be used to detect not only glucose but many other blood constituents and disease markers in the future."

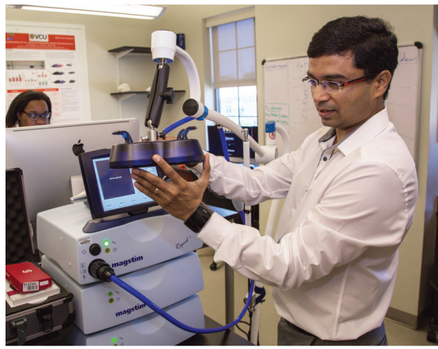
The VCU team obtained the award from the CHRB following a highly competitive application process. Of the 67 proposals submitted by colleges and universities statewide, only six new projects were selected for funding. Five other projects received a second year of funding from the CHRB.

The technology is based on patterned surfaces and nanostructures that enhance biosensor sensitivity. Their design also allows for miniaturization, thus eliminating the discomfort associated with available sensor technologies. The device is constructed using nanoscale materials, which are a fraction of the width of a human hair. For this reason, it is versatile enough to take on various nanostructural forms including nanobelts, nanotubes and nanowires.

The team includes Department of Electrical and Computer Engineering faculty members Hadis Morkoc, Ph.D., Ümit Özgür, Ph.D., and Vitaly Avrutin, Ph.D.; Barbara D. Boyan, Ph.D., dean of the VCU School of Engineering; and Gary Francis, M.D, Ph.D., of the VCU Department of Pediatrics.







BRAIN MAGNETICS

One in five Americans over the age of 18 suffers from diagnosable neurological disorders including Parkinson's disease, post-traumatic stress disorder (PTSD) and traumatic brain injury (TBI). Deep-brain stimulation by magnetic fields has offered promising treatments, but progress is hampered by poor understanding of the interaction of magnetic fields with neurons.

Ravi Hadimani, Ph.D., assistant professor in the Department of Mechanical and Nuclear Engineering, is helping forge the path toward safe, non-invasive treatment methods with a study that will better clarify how brains respond to magnetic fields. Hadimani is co-principal investigator along with colleagues at Iowa State University on this project, funded by a three-year National Science Foundation grant. The project is also developing the next generation of researchers at VCU and abroad and has helped Hadimani establish the new Biomagnetics Laboratory at VCU.

"These NSF funds together with the start-up funds provided by the School of Engineering will allow VCU's Biomagnetics Laboratory to exploit magnetism to the fullest for improving human health," Hadimani said.

> "These NSF funds together with the start-up funds provided by the School of Engineering will allow VCU's Biomagnetics Laboratory to exploit magnetism to the fullest for improving human health."

This study builds on Hadimani's research that showed magnetic stimulation could change the growth patterns of neurons in vitro. It will generate data to refine the technique which, when perfected, may help treat hard-to-access regions of the brain including those associated with PTSD and Parkinson's disease. Using specially fabricated microchips that can isolate single rat neurons, Hadimani and his colleagues align the chips and apply magnetic fields from commercial Transcranial Magnetic Stimulation (TMS) coils and see how neurons respond.

"My expertise comes in finding how much stimulation to use and where to apply it. There is a complex relationship between the geometry of the TMS coil and the stimulation location and intensity in the brain. Based on the results, we will redesign the coils and make other modifications to the system."

VCU undergraduates, graduate students and post-docs are assisting in experiments in the Biomagnetics Laboratory. VCU undergraduates Gabrielle Jones and Ciro Alcoba Serrate conducted experiments at Cardiff University in the United Kingdom, thanks to a related NSF grant under the International Research Experience for Students program.

FOCUS ON RESEARCH

Overactive Bladder

A $1.7 million grant awarded to John Speich, Ph.D., associate professor and associate chair in the Department of Mechanical and Nuclear Engineering, and Adam Klausner, Ph.D., associate professor and the Warren Koontz Professor of Urologic Research in the Division of Urology/Department of Surgery of VCU's School of Medicine, may lead to improved diagnosis and treatment of overactive bladder. The condition affects nearly 20 percent of adults.

The five-year study, "The Detrusor Tension Sensor: A Model for Novel Cystometrics in Overactive Bladder," was funded by the National Institutes of Health's National Institute of Diabetes and Digestive and Kidney Diseases.

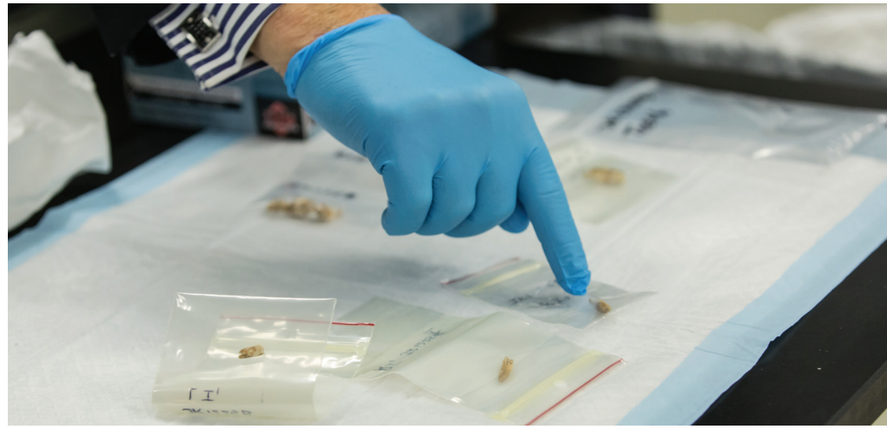
For the past 50 years, overactive bladder has typically been diagnosed via an invasive test called urodynamics, in which a catheter is inserted to measure the pressure in the bladder. Speich and Klausner are working to improve the standard urodynamics testing by adding 2-D and 3-D ultrasound, as well as 4-D ultrasounds that show 3-D images in motion over time.

Speich helped develop an improved "urgency meter," which allows patients to describe how full their bladder is with more accuracy, providing the physician with more specific information that can be used to diagnose the problem. "Right now, when a patient is undergoing a urodynamics test, the physician asks how their bladder feels as it is filling. They ask for three data points – their first sensation, their first desire to empty and when they have a strong desire to empty," he said. "We've developed a meter that continuously records their reported sensation. It basically looks like a fuel gauge, going from empty to full, and gives the physician a more complete picture of their sensation throughout filling."

Speich's goal is to give doctors in the clinic better tools for analyzing data so they can make better, more informed decisions about diagnosis and treatment.

"As engineers, we make things to help people. I am working with my team to design tools that can improve the way we diagnose clinical conditions like overactive bladder. In the end, this will hopefully lead to improved quality of life for patients with bladder problems," he said.

JAMESTOWN
TOOTH EXTRACTION



The term "oral history" conjures images of man's first attempts to learn from the past. Now researchers working in the Department of Biomedical Engineering are giving those words new meaning.

VCU post-doctoral fellow D. Joshua Cohen, M.D., and a team of medical, dental and archaeological researchers are studying the skull and teeth of a 15-year-old boy who died in Jamestown in 1607. What they find may yield clues about diet and other aspects of daily life in 17th-century America.

The project began when Washington, D.C. area-based dental specialists viewed the Smithsonian's forensic archaeology exhibit "Written in Bone," a popular show that investigated what human skeletons reveal about the past. It included a skull of a young boy with fractured teeth and an associated abscess.

They met with researchers from Jamestown Rediscovery at Historic Jamestowne. All agreed that the Nanomaterials Characterization Core (NCC), a research core facility of the VCU Office of Research and located in VCU's Institute for Engineering and Medicine, was essential to uncovering what the boy's remains reveal about early Jamestown.

"It was a bit of kismet that all of the parties came together here, because Dean Boyan's group has been researching in the field of bone for years," said Cohen. "Our scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX) analyses provide a chemical readout of the recovered materials. We hope to see what part of the contents of the root canal came from the boy himself and what came from ingested material."

David Givens, senior staff archaeologist with Preservation Virginia, said that the boy's root canal was "a reservoir for everything that went into his mouth."

The team is working with a sample roughly the size of a period on a sheet of paper. Using NCC instrumentation, the tiny dot enlarges to become a vast network of branches that can be seen in detail. The concentration of carbon indicates that part of the root canal material is plant-based. Additional tests will reveal more about the early history of one of the most important settlements in North America.

"Something like this colorizes the past in a way you don't see in documents," Givens said.

STUDENT FEATURES

STUDENT SUCCESS

Hunter Andrews

Innovations in Fuel Cycle Research
Hunter Andrews, a Ph.D. student in mechanical and nuclear engineering, received an Innovations in Fuel Cycle Research Award sponsored by the U.S. Department of Energy. His research paper, "Measurement and Analysis of Exchange Current Density of Lanthanides in LiCl-KCl Eutectic Salt," was presented at the American Nuclear Society Student Conference in April 2016.

DOE IUP Student Fellowship
Andrews is also the recipient of a U.S. Department of Energy Integrated University Program Fellowship, which will support his doctoral research with $50,000 annually for three years. He is developing a method that combines electrochemistry and laser-induced breakdown spectroscopy to mitigate the risk of unauthorized extraction of materials from used nuclear fuel.

Nicolas Andrade

NSF Student Fellowship
Nicolas Andrade (Electrical and Computer Engineering '16) has received a National Science Foundation Graduate Research Fellowship. The fellowship provides annual stipends, international research and professional development opportunities. Andrade is now in a joint master's-Ph.D. program at the University of California, Berkeley, where he is studying high-efficiency transistors and light-switching technologies.

Ellen Korcovelos

Fulbright Fellowship
Ellen Korcovelos, a 2016 bioinformatics graduate with a computer science minor, received a Fulbright grant to study linguistic variations between individuals with dementia and those without cognitive decay at the University of Toronto. After her Fulbright year, she will return to Commonwealth Computer Research Inc., where she works as a data scientist.

Aaron Lam

DOE Scholarship
Aaron Lam, a junior in VCU's mechanical and nuclear engineering program, has received a U.S. Department of Energy scholarship. In addition to helping with expenses this academic year, the award allowed Lam to conduct nuclear-related research in nanomaterials with Jessika Rojas, Ph.D., assistant professor of mechanical and nuclear engineering.

Patrick Link

NSF Student Fellowship
Patrick Link (Biomedical Engineering '16) has received a National Science Foundation Graduate Research Fellowship. The fellowship provides three-year, $34,000 annual stipends, as well as education allowances, international research and professional development opportunities. As a Ph.D. student in VCU's biomedical engineering program, Link is studying nanoparticles for delivery of therapeutics to the lungs.

Lynn Secondo

Fulbright Fellowship
Lynn Secondo, a Ph.D. candidate in chemical and life science engineering, received a Fulbright grant that will fund her research on metal oxide fuel additives in diesel exhaust and the nanoparticle effects on the human lungs at the Chemical Process and Energy Resources Institute in Thermi, Greece. After her Fulbright year, she will finish her doctorate at VCU.

Daniell Tincher

DOE IUP Student Fellowship
Mechanical and nuclear engineering Ph.D. student Daniell Tincher is the recipient of a U.S. Department of Energy Integrated University Program Fellowship, which will support his doctoral research with $50,000 annually for three years. Tincher is designing a nuclear reactor simulator that runs industry standard codes, but makes them more accessible and also enables real-time, event-driven simulations.

Lauren Griggs

Susan E. Kennedy award
Biomedical engineering doctoral candidate Lauren Griggs received the Susan E. Kennedy award, which is given to one graduate student at the university who is making strides to advance the presence of women in higher education. This award recognizes Griggs' mentorship of young women in STEM fields through a number of VCU Engineering outreach programs.

NSRA award
Griggs also received a National Institutes of Health National Research Service Award (NIH NRSA F31). This highly competitive grant is awarded to her as principal investigator. She will use the award to further her study of the mechanistic role of the extracellular matrix in growth factor induced epithelial to mesenchymal transition.

ANESTHESIOLOGY SIMULATION APP

An interdisciplinary, cross-campus team is collaborating to create a virtual training tool for future nurse anesthetists.

"We don't currently have a way to troubleshoot and role-play or experiment with different scenarios," said Coffee Bourne, a doctoral student in the Department of Nurse Anesthesia. In a real-world setting, students can't exactly "give a patient a drug and see what happens."

But by playing a simulation game, students can get a feel for what it would be like to handle emergency situations and solve problems while racing the clock, said Bourne, who helped lead the project to develop the game, a new smartphone app. "You can't help but learn something," she said.

The training app project has pulled together students from across the campus. In addition to the Department of Nurse Anesthesia in the School of Allied Health Professions, the team includes undergraduate and graduate students in the VCU School of Engineering, School of the Arts and School of Business.

Carol Fung, Ph.D., assistant professor of computer science, said computer science students are exposed to anesthesiology as they study app development. Nurse anesthesia students, meanwhile, have been watching digital arts students redesign the interface to give it a professional polish. And business students are delving into the potential market for the app.

> "By playing a simulation game, students can get a feel for what it would be like to handle emergency situations and solve problems while racing the clock."

The training app team.

Bourne said it sometimes seems like people from different disciplines come in speaking "five different languages. We somehow bring that all together."

The development of the app is one of several ongoing projects within a multidisciplinary Vertically Integrated Project (VIP) team formed in the fall of 2015 to improve critical patient care provided by anesthesiologists and nurse anesthetists through various engineered solutions, said Bennett Ward, Ph.D., director of project outreach in the School of Engineering. The VIP team is seeking to improve the working environment for anesthesia providers, which Ward described as "little changed for many years."

Tiny

That cell phone in your purse or pocket could ring at the worst possible moment. But studies suggest it presents a more significant danger to expectant mothers and fetuses: electromagnetic (EM) radiation. Tiny Tech, a startup from VCU School of Engineering and VCU Brandcenter collaborators, is addressing that concern with maternity clothing that comfortably and effectively shields mothers-to-be from EM radiation.

Umar Hasni, a Ph.D. student in electrical engineering and Margaret Karles, a student in the VCU Brandcenter's Experience Design program, have joined Erdem Topsakal, Ph.D., professor and chair of the Department of Electrical and Computer Engineering, to develop the product and form the company.

Continued on page 36

Umar Hasni and Margaret Karles. Photo credit: VCU University Relations

"In the age of connectivity, everything is at the touch of our fingertips. In order to make that happen, radio frequencies and microwave frequencies are connecting everybody's devices," says Hasni. "You can't stop technology from progressing — you want it to do better. So we're focusing on how we can still progress in technology but keep ourselves safe as well."

Connections between electronics and health are a longstanding interest for Topsakal, whose electrical engineering research includes healthcare applications of microwaves. After his father's death from lung cancer, his interests turned to the possible relationship between radio waves and cancers.

"The European Commission declared EM radiation potentially carcinogenic, and I needed to know more," said Topsakal.

He also examined an important 2012 Yale study in which pregnant laboratory mice exposed to ordinary cell phone radiation produced offspring that were more hyperactive and had poorer memories compared to a control group — essentially the characteristics of ADHD. Fetuses and infants have thinner skulls, so it made sense to Topsakal that they might be most susceptible to the effects of radio waves.

"That was when the light bulb came on. You could develop fabrics for garments that selectively screen out EM radiation," he said.

But why screen out EM radiation selectively? Topsakal explains that a 100 percent reflective surface is essentially a metal sheet — the kind of thing being manufactured overseas today. Those garments are expensive and notoriously uncomfortable. Worse, their stiff fabrics create openings, usually around the arms and neck, which allow radio waves in and can even keep them from escaping.

Using their patent-pending technology, Tiny Tech is able to produce fabric flexible enough to fit the body's contours comfortably while also screening out 99.9 percent of EM radiation waves.

They think that one of Tiny Tech's greatest strengths is the fact that it is streamlined enough to make EM radiation protection affordable.

"The reason we are able to make it so cost effective is because it is so brutally simple," Hasni said. "I could tell you how to make it and you could go home and make it. It would be very crude, but —"

"Beautifully simple — not 'brutally' simple," interjected Karles, who leads the branding side of the startup and designed the first proof-of-concept prototype.

They are rolling the product out to expectant mothers first. Karles explains that consumer data indicate expectant mothers, who number approximately 4 million annually in the U.S., are particularly concerned about EM radiation. Many pregnant women are removing wireless technologies from their homes and going back to hard wiring. People are already interested. Tiny Tech was featured in a story on National Public Radio affiliate WVTF and RADIO IQ in October 2016.

> "You can't stop technology from progressing – you want it to do better. So we're focusing on how we can still progress in technology but keep ourselves safe as well."

Tiny Tech has attracted multiple investors. They received funding from the VCU Pre-Accelerator program, which also designated Tiny Tech as "Most Scale-able Company." They also won a grant from the VCU Venture Creation Competition. Most recently, they were awarded an investment from the VCU Quest for Innovation Commercialization Fund. They are applying for the Richmond-based Lighthouse Labs Accelerator Fund, along with a few other accelerator programs. In the meantime, they will use their seed capital to produce and test prototypes.

"We will wash the garments a hundred times to make sure they are still effective," Topsakal said. "We will also have people trying them on to make sure the clothes are comfortable."

The team believes that VCU has also enriched Tiny Tech's development in ways that go beyond financial support.

"There are incredible engineering resources that were always available to us," Hasni said. "And when you work with people from different backgrounds, you learn so much. That is one of the key things that VCU facilitated."

After intensive prototyping, the team would like to see a soft launch, with online sales starting this summer. They plan to license the Tiny Tech process to clothing manufacturers and would like to see the Tiny Tech brand become as ubiquitous — and as trusted — as the "Cotton, Inc." logo.

"People will see our logo and know, 'Oh, Tiny Tech is protecting these clothes,'" Karles said. "We think it will make a piece of clothing something you want to wear."

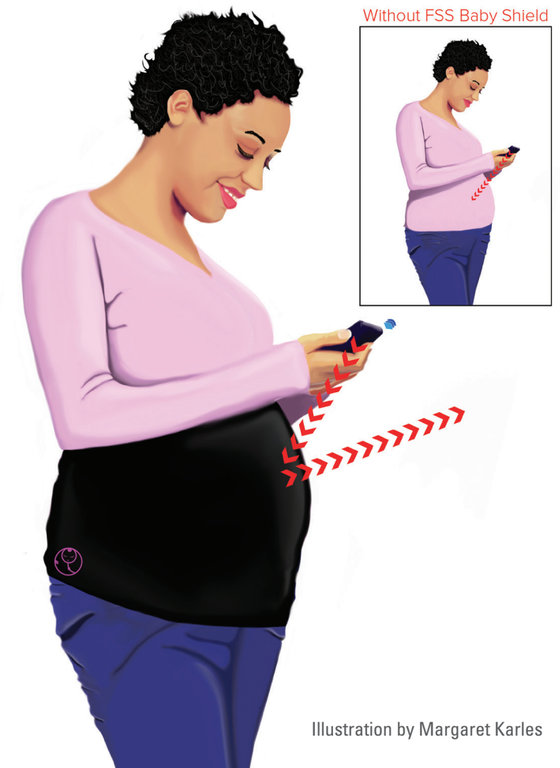
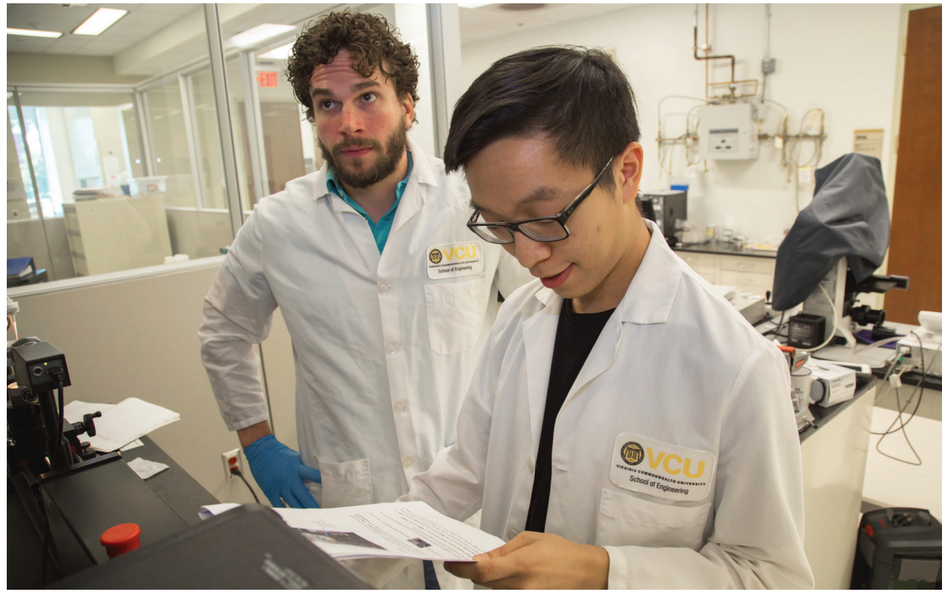
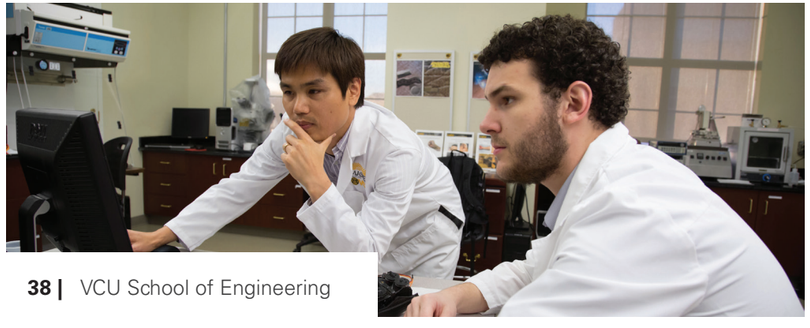


Illustration by Margaret Karles



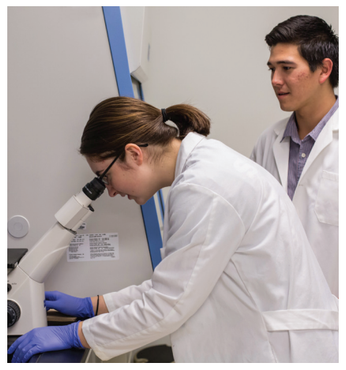
DURI

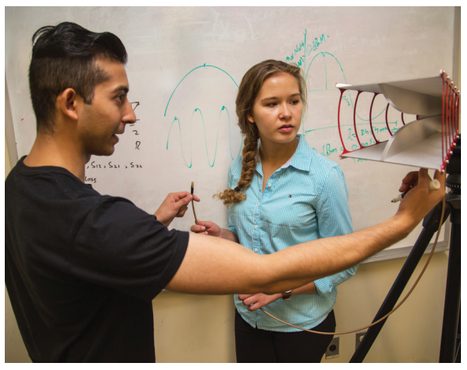
THE DEAN'S UNDERGRADUATE RESEARCH INITIATIVE broadens the undergraduate student research experience and helps graduate students develop mentorship skills. DURI fellows work with mentors on a yearlong research project and get course credit, stipends and support to present at a conference. Recent projects include a 3-D printed, electronic prosthetic hand, and a study on hybrid storage caching techniques for large datasets.



DERI

THE DEAN'S EARLY RESEARCH INITIATIVE brings high school students to our labs and lets them dig into real-world engineering research through one-year research fellowships. With guidance from graduate student mentors, DERI fellows work on a research project for a total of 60 hours during the summer then continue their fellowship into the school year. Recent projects include studies on nano-rod magnet growth and characterization, and human-machine interfaces using skin-like electronics.





MAGIC GLOVES

Every time Jessica L. Bishop suffered an attack of Raynaud's disease during her senior year, it motivated her to work even harder on her Capstone Design project, a pair of "magic gloves."

Illustration by Desiree Choe

"It's something I'm very passionate about. It's something that definitely affects me," Bishop said. "There's a slew of medications that they can put you on, [but] there's nothing specific to the Raynaud's."

Raynaud's disease sufferers in the throes of an attack are unable to tell when their hands get cold, which leaves them susceptible to frostbite and other tissue damage.

So Bishop and team members T. Ryan Beaver, Nathaniel Kirby and Alisa Sverdlov set out to create a responsive glove that would help regulate the fingers' temperature and mitigate against the danger of Raynaud's disease.

The magic glove features a special fiber that is sewn into the fabric and heats up when electricity is applied. A controller with a thermometer sits in the glove's fingertips. When temperatures reach a dangerous level, the controller turns on one of two heaters. A low-powered heater keeps the wearer at a safe temperature. If the temperature falls below that, the high-powered heater kicks in. But, if the temperature rises too much, the heater turns off so the wearer doesn't sweat.

With so much equipment, you would expect the gloves to be incredibly heavy, compromising flexibility for heat. Not so, said Sverdlov. The inside layer of the gloves can be removed from the outside layer, so people can wear them indoors while working at a computer and still have dexterity, she said.

Mohamed Gad-el-Hak, Ph.D., said he was thrilled to serve as faculty adviser for the project.

"What attracted me to the project is Jessica's positive attitude about channeling a personal adversity into doing something to help all of humanity," said Gad-el-hak, the retired Inez Caudill Eminent Professor in the Department of Mechanical and Nuclear Engineering. "Students like that are what makes it all worthwhile, not to mention life worth living."

ALUMNI SUCCESS STORIES

Melissa Peskin

Melissa Peskin's innovations help utility companies keep prices — and environmental impact — low.

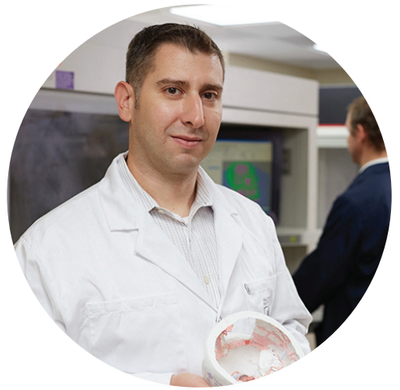
Peskin (Mechanical and Nuclear Engineering '07) is a consulting engineer with Dominion Voltage Inc., a subsidiary of Dominion Resources. She has two patented technologies that help utilities conserve energy safely and maintain power quality.

In May 2016, Peskin and Philip Powell, director of grid innovations at Dominion, patented an analysis method to predict where a utility may need to improve facilities to ensure sufficient voltage when a circuit's source voltage is reduced. It is used with their 2010 patent for a method of conserving energy by slightly reducing voltage.

Electric distribution planning uses computer models and field data to analyze power flow. An unknown in those models led to this new patent. "The facilities between service transformers and customer meters are often not in the model, so using smart meter data gives insight into the least-documented part of the electric distribution system. In playing detective with unusual voltage patterns, I developed methods to identify likely causes of anomalies, which helps planning engineers and field personnel address them," she said. The result is a better system and lower bills for consumers.

Peskin credits the VCU Engineering culture and curriculum with preparing her for success at Dominion.

"VCU Engineering got me ready to enter the engineering workforce. The team-based projects prepared me for my small but fast-paced team at Dominion," she said.



Peter Liacouras, Ph.D.

Using sophisticated 3D printers, Peter Liacouras, Ph.D., is helping to shape the next generation of medical devices.

As director of services at the new Walter Reed National Military Medical Center's 3D Medical Applications Center, a position he has held since 2011, Liacouras (Biomedical Engineering '06) is on the forefront of life-enhancing innovations for service members returning with serious injuries. One example is "shorty feet," a supplementary prosthetic that helps bilateral amputees mobilize without having to use their full prosthetic legs.

"We created the first pair in response to a request from the lead prosthetist, who wanted a one-off for a patient to take on his honeymoon," Liacouras said. "We designed the device in CAD, printed a plastic prototype, and then printed the permanent version in titanium alloy. Since July 2012, the 3D MAC has produced more than 70 pairs. They are now used in training, at a pool or beach, to easily play with a young child, or for something as simple as getting up in the middle of the night."

To help amputees return to pre-injury activities, Liacouras and his team make custom prosthetic attachments for holding fishing rods, rock climbing or playing musical instruments. They also designed a specialty ice hockey skate that attaches directly to the socket as the terminal device. Only two pairs of these skates are known to exist.

Liacouras earned his Ph.D. in biomedical engineering at VCU in 2006. The simulation work he undertook for his dissertation research under the direction of Jennifer Wayne, Ph.D., was a perfect transition for his work at Walter Reed.

FACULTY

WELCOMING NEW LEADERS

1 PAUL ROCHELEAU
Executive Director of Strategic Programs

Paul Rocheleau is executive director of strategic programs for the VCU School of Engineering, bringing him full-time into the program he helped establish as a founding trustee in 1997.

"I became involved with VCU Engineering while managing a multinational chemical company named Albright & Wilson. We had significant research and technical operations in the Richmond area, and there was a critical need for an engineering program in Central Virginia," he said.

Connecting industry and academics is at the heart of Rocheleau's new role. "VCU Engineering was founded as a public-private partnership, and the concept is even more important now, given the rapid pace of technological change and global competition. VCU Engineering has become a robust platform to drive economic growth by serving as a vital link between academia, industry and government," he said. He's focused on helping the school define its competencies and finding external partners that value the expertise VCU has built up over a short 20-year history.

"Our pharmaceutical engineering initiative is a great example. It has opened new doors for students and faculty and is expected to create significant economic impact," he said. He believes "for-cause involvement and philanthropy" will drive that impact and hopes to have several new private sector partnerships well underway in his first year.

For Rocheleau, building new technology initiatives touches on the school's core values. "VCU Engineering has always asked, 'How do you take energized students, great faculty talent and new ideas to provide a framework that creates value for the individual and society at large?' Our engineering program is providing the skills and creative thinking to capture new opportunities and solve critical problems — as engineers have been doing for decades."

2 MICHAEL DOWDY
Chief Development Officer

Chief development officer Michael Dowdy is a new face in the School of Engineering Foundation, but he's a fundraising leader with deep VCU roots.

Most recently, Dowdy held senior development positions with the University of Maryland Baltimore and East Carolina University. From 1993 to 2006, he led the MCV Foundation, helping drive the $330 million Campaign for VCU and establishing a planned giving program that attracted more than $100 million in future support. "I was fortunate to be at VCU during the founding of the School of Engineering," said Dowdy. "I witnessed the passion for establishing the school and am pleased to be part of continuing its evolution."

Dowdy is building a robust pipeline of future major donors and wants to see the school optimize naming opportunities to acknowledge major benefactors. He is also capitalizing on synergies between his new role at VCU Engineering and his years at MCV. "The School of Engineering has strong alliances with the medical school, and I think my comfort level in the health sciences can help with our strategic goals, especially as we build new programs with the School of Pharmacy," he said.

As he returns to what he calls "frontline fundraising," Dowdy is eager to talk with donors about the importance of their support. "Philanthropy isn't necessarily the biggest piece of the budget, but it's often the piece that makes the difference between 'good' and 'excellent,'" said Dowdy. "For every dollar given, we can show a strong impact."

3 ANDREW HOBSON
Alumni Board President

As a mechanical engineer, Andrew Hobson (MNE '12) knows a thing or two about building pipelines.

Adding to the talent pipeline that moves VCU School of Engineering alumni into great career opportunities is something Hobson is looking forward to as he begins his two-year term as president of the Alumni Board. "I got a lot of help from alumni and industry people when I was in school here. During Capstone Expo, people came out of the woodwork to help and a lot of them were VCU Engineering alumni," he said. "I wanted to give back."

Hobson sees connection as one of the themes of his goals for the Alumni Board. He is pushing for more participation in Rams Connected, the internal database that current students can use to contact engineering alumni willing to share their insights about the field. He would also like to see Third Thursday happy hours continue to grow.

"They are a nice meet-and-greet and a great way to meet alumni. Faculty members are invited, and employers also attend. Last year, one alum got a job from a recruiter at one of these," he said.

He's also interested in expanding the Alumni Board and would like to see the 12-member board double in size in the next two years. Given the level of alumni commitment to VCU Engineering, he's optimistic about meeting that goal.

"I'm always surprised at how many people want to help," he said. "I wish more people knew about the level of engagement at VCU Engineering."

4 MARK CRUISE
Foundation Board President

Mark Cruise begins his role as president of the VCU School of Engineering Foundation Board this year. As vice president of e-vapor product development for Altria Client Services, Cruise is most impressed with the school's product: the students. "Having access to VCU Engineering students' technical capabilities, critical thinking skills and leadership means that our investment provides us with top talent," he said. "We have VCU interns yearly, and we hire some of them every year."

In a sense, Cruise now makes a similar transition. "I served as vice president of the board for two years and learned a great deal from watching [outgoing president] Mary Doswell," he said. "And Dean Boyan has tremendous energy and vision. She pulls you in like a magnet and makes you want to be involved."

Cruise's top priorities have a parts-to-whole relationship. First, he wants to maintain the robust support of scholarships, chairs and professorships that brings top engineering talent to VCU. Cruise is also eager to begin the new Engineering Research Building, something he feels is essential to recruiting blue-chip faculty and students.

He sees these goals in the context of VCU's Make it Real Campaign, which unifies all of the university's schools with collective target of $750 million by 2020. "It's a goal that is lofty, but achievable — especially if we show people how much excitement there is in this school," he said, adding that it's the students who make that case most powerfully.

"It doesn't take a lot of time with students to see their pride, excitement, commitment and confidence," Cruise said. "I've worked with engineers for a long time, and I know that this is what makes everything possible."

FACULTY AWARD Highlights

Supriyo Bandyopadhyay, Ph.D.
Bandyopadhyay, Commonwealth professor in the Department of Electrical and Computer Engineering, has been awarded the Distinguished Alumnus Award by the Indian Institute of Technology in Kharagpur, India. The award, which honors achievements in industry, academia or entrepreneurship, was conferred at the Institute's 62nd Annual Convocation on July 31, 2016.

Daren Chen, Ph.D.
Chen, professor and Floyd D. Gottwald, Sr. Chair in the Department of Mechanical and Nuclear Engineering, has received a VCU Quest Innovation Fund grant for a novel wireless sensor network for air quality monitoring. The goal of this project is to develop a miniature and cost-effective sizer for monitoring of fine particles.

Sama Bilbao y León, Ph.D.
Bilbao y León, associate professor and director of nuclear engineering programs in the Department of Mechanical and Nuclear Engineering, has been named president and chairman of the board of the Virginia Nuclear Energy Consortium (VNEC). VNEC's mission is to sustain and enhance the Commonwealth of Virginia as a national and global leader in nuclear energy.

Daniel Conway, Ph.D.
Conway, assistant professor in the Department of Biomedical Engineering, has received a five-year National Institutes of Health grant for a study of the role of force across proteins in epithelial cells. His study will advance understanding of epithelial homeostasis, which includes wound repair, and epithelial diseases such as cancer and fibrosis.

P. Worth Longest, Ph.D.
Longest, professor in the Department of Mechanical and Nuclear Engineering, was inducted into the American Institute for Medical and Biological Engineering (AIMBE) College of Fellows. He was elected by AIMBE peers and members for his outstanding contributions to the field of pharmaceutical aerosols that enable improved targeting of small airways.

Wei-Ning Wang, Ph.D.
Wang, assistant professor in the Department of Mechanical and Nuclear Engineering, has received a grant from the American Chemical Society for his two-year project to develop metal organic framework-based photocatalysts for CO2 conversion into hydrocarbon fuels. This research will open up new avenues to design functional materials for energy and environmental applications.

Xuejun Wen, M.D., Ph.D.
Wen, William H. Goodwin professor in the Department of Chemical and Life Science Engineering, has received National Institutes of Health grants for a wireless system for self-powered implantable pediatric cardiac sensors, a hydrogel-based technology to regenerate injured brain tissues and a coating technology that prevents and treats medical device associated infections.

Kenneth Wynne, Ph.D.
Wynne, Commonwealth professor in the Department of Chemical and Life Science Engineering and research professor in the Department of Chemistry, was presented with one of four 2016 International Awards by the Society of Polymer Science, Japan. The award recognizes Wynne's work in nanostructural design, synthesis and characterization of functional polymer surfaces.

Henry Donahue, Ph.D.
Donahue, professor and chair in the Department of Biomedical Engineering, was inducted into the American Institute for Medical and Biological Engineering (AIMBE) College of Fellows for discoveries in bone biology, service to professional societies and mentoring leaders in musculoskeletal biology and bioengineering. He also received the Orthopaedic Research Society's Outstanding Achievement in Mentoring Award.

Ravi Hadimani, Ph.D.
Hadimani, assistant professor in the Department of Mechanical and Nuclear Engineering, has received a National Science Foundation grant to build a brain phantom for neuromodulation and neuroimaging purposes. The proposed device will more closely resemble the human head and brain's structural, electrical and magnetic properties than models currently available.

Lukasz Kurgan, Ph.D.
Kurgan, Qimonda professor and vice chair of the Department of Computer Science, has been awarded a National Science Foundation grant to develop a family of novel and high-throughput computational methods that accurately predict all major functions of intrinsic disorder (ID) in proteins. ID is important for numerous cellular processes and is prevalent in many human diseases.

Barbara D. Boyan, Ph.D. & Zvi Schwartz, D.M.D., Ph.D.
Boyan, dean of the VCU School of Engineering and Schwartz, associate dean for strategic operations, are collaborating with investigators at Institut Straumann AG (Basel, Switzerland) to study new approaches for use of bone graft materials and nanostructure modified surfaces for dental implants. Ethan Lotz, a Ph.D. student in biomedical engineering, spent six months as an intern at Straumann prior to starting his research project here. This long-term relationship with the Swiss company specializing in devices for oral health care and tissue regeneration products has resulted in more than 100 peer-reviewed publications.

Woon-Hong Yeo, Ph.D.
Yeo, assistant professor in the Department of Mechanical and Nuclear Engineering, has received a Commonwealth Research Commercialization Fund grant to develop a prototype, skin-wearable electrocardiogram (ECG) monitor. The device uses nanomaterials to produce mechanically flexible and stretchable skin-like electronics that measure real-time ECG and physical activity on a smartphone app.

Wei Zhang, Ph.D.
Zhang, professor in the Department of Electrical and Computer Engineering, has received a grant from the National Science Foundation for a project that integrates embedded systems security into computer engineering and science curricula. The curriculum focuses on security in the junction between software and hardware. Zhang is principal investigator in this four-university collaboration.

Hong Zhao, Ph.D.
Zhao, assistant professor in the Department of Mechanical and Nuclear Engineering, has received a grant from the National Science Foundation for fundamental research on a novel dual-droplet electrohydrodynamic printing process. Results may support a unique additive manufacturing platform for patterning nanosheets, as well as other anisotropic colloidal particles such as nanowires and quantum dots.

OFFICE OF THE DEAN

Barbara D. Boyan, Ph.D.
Dean; Professor; Alice T. & William H. Goodwin, Jr. Chair in Biomedical Engineering
bboyan@vcu.edu | (804) 828-0190
Research Topics:
- Tissue engineering
- Response of cells to biomaterials
- Mechanisms of action of hormones & growth factors in chondrocytes & osteoblasts

Lewis Franklin Bost, M.B.A., IDSA
Executive Associate Dean; Professor and Director, Institute for Engineering & Medicine
lfbost@vcu.edu | (804) 828-5871
Research Topics:
- Design thinking, product design & development processes
- Entrepreneurial business strategy & commercialization
- US FDA quality system regulations & ISO medical device standards

Afroditi V. Filippas, Ph.D.
Professor; Associate Dean for Undergraduate Studies
avfilippas@vcu.edu | (804) 828-4097
Research Topics:
- Microwave & RF modeling & simulation
- Signal processing
- Medical devices

Ram B. Gupta, Ph.D.
Professor; Associate Dean for Research
rbgupta@vcu.edu | (804) 828-1211
Research Topics:
- Solar fuel & hydrogen
- Batteries & supercapacitors
- Nanoparticles & smart medicine

Robert H. Klenke, Ph.D.
Professor; Director of the Vertically Integrated Projects Program
rhklenke@vcu.edu | (804) 827-7007
Research Topics:
- Collaborative unmanned aerial vehicles
- Cyber-physical systems security
- Hardware/software codesign

John Leonard, Ph.D.
Executive Associate Dean of Finance & Administration; Professor
jdleonard@vcu.edu | (804) 828-9228
Research Topics:
- Modeling & simulation of traffic & transportation systems
- Traffic & transportation engineering
- Institutional research, strategy & policy

Lorraine M. Parker, Ph.D.
Director of Diversity & Student Programs
lparker@vcu.edu | (804) 827-7000 ext. 406
Research Topics:
- Improving retention of women & minorities in STEM
- Database design
- Handling missing information in databases

Zvi Schwartz, Ph.D., D.M.D.
Associate Dean for Strategic Initiatives; Professor
zschwartz@vcu.edu | (804) 828-5824
Research Topics:
- Regulation of bone & cartilage
- Implant & bone substitute mechanism of action & clinical use
- Steroid hormone mechanism of action in health & cancer

John E. Speich, Ph.D.
Associate Professor; Associate Chair & Director of Cooperative Education Program
jespeich@vcu.edu | (804) 827-7036
Research Topics:
- Smooth muscle biomechanics
- Robotic devices for medical applications
- Bladder biomechanics & urodynamics

Gregory E. Triplett, Ph.D.
Professor; Associate Dean for Graduate Studies
getriplett@vcu.edu | (804) 828-5387
Research Topics:
- Optoelectronics/photonics
- Electronic materials
- Computational intelligence

Ben Ward, Ph.D.
Associate Professor; Director of Project Outreach
bcward@vcu.edu | (804) 828-6371
Research Topics:
- Capstone Senior Design program
- Medical device development
- High performance polymers & fibers

BIOMEDICAL Engineering

Henry J. Donahue, Ph.D.
Professor; Chair
hjdonahue@vcu.edu | (804) 828-7958
Research Topics:
- Musculoskeletal tissue engineering & regenerative medicine
- Musculoskeletal adaptation to spaceflight
- Mechanobiology

Barbara D. Boyan, Ph.D.
(See Office of the Dean)

Daniel E. Conway, Ph.D.
Assistant Professor
dconway@vcu.edu | (804) 828-2592
Research Topics:
- Mechanotransduction
- Live-cell imaging
- Cellular biomechanics

Ding-Yu Fei, Ph.D.
Associate Professor
fei@vcu.edu | (804) 828-2664
Research Topics:
- Sensor network-based lower-limb prosthesis optimization & control
- Bioinstrumentation & telemedicine devices
- Technologies for radiation oncology

Rebecca L. Heise, Ph.D.
Assistant Professor
rlheise@vcu.edu | (804) 828-3496
Research Topics:
- Lung injury
- Pulmonary regenerative medicine
- Mechanobiology

Sharon L. Hyzy
Senior Research Associate, M.S.
slhyzy@vcu.edu | (804) 828-8723
Research Topics:
- Bone morphogenic proteins
- Animal defect models
- Biomaterial-cell interactions

Russell D. Jamison, Ph.D.
Alice T. & William H. Goodwin, Jr. Chair, Engineering Education; Professor, Biomedical Engineering & Chemical and Life Science Engineering; Dean Emeritus
rjamison@vcu.edu | (804) 828-0460
Research Topics:
- Innovation & entrepreneurship
- Leadership of teams in ambiguity
- Design for highly-constrained environments

Christopher A. Lemmon, Ph.D.
Assistant Professor
clemmon@vcu.edu | (804) 827-0446
Research Topics:
- Mechanobiology in the extracellular matrix
- Biomechanics of fibrosis
- Cellular contractile force measurements

Gerald E. Miller, Ph.D.
Professor; Director of the Center for Human Factors & Rehabilitation Engineering
gemiller@vcu.edu | (804) 828-7263
Research Topics:
- Artificial hearts design & evaluation
- Speech recognition for distorted speech & noisy environments
- Design of assistive technology

René Olivares-Navarrete, D.D.S., Ph.D.
Assistant Professor
ronavarrete@vcu.edu | (804) 828-8718
Research Topics:
- Cell instructive materials for stem & immune cells
- Immunomodulation in regeneration
- Craniofacial & orthopedic tissue engineering & regenerative medicine

Dianne T.V. Pawluk, Ph.D.
Associate Professor
dtpawluk@vcu.edu | (804) 828-9491
Research Topics:
- Assistive technology for individuals who are blind or visually impaired
- Hand prostheses
- Human haptic perception

Anathea Pepperl, Ph.D.
Assistant Professor
aapepperl@vcu.edu | (804) 827-3996
Research Topics:
- Assistive technology for elderly patients & caregivers
- Image segmentation in medical applications
- Ultrasound techniques for studies of pressure ulcer progression

Carrie L. Peterson, Ph.D.
Assistant Professor
clpeterson@vcu.edu | (804) 827-5270
Research Topics:
- Neuroplasticity & neurorehabilitation
- Muscle function & dynamics in individuals with neurologic deficits
- Musculoskeletal modeling & simulation of human movement

Zvi Schwartz, Ph.D., D.M.D.
(See Office of the Dean)

Jennifer S. Wayne, Ph.D.
Professor; Associate Chair; Graduate Program Director
jswayne@vcu.edu | (804) 828-2595
Research Topics:
- Experimental & computational simulation of diarthrodial joint function
- Biomechanical evaluation of biological structures
- Articular cartilage: normal function, reparative strategies

Seth Weinberg, Ph.D.
Assistant Professor
shweinberg@vcu.edu | (804) 827-5223
Research Topics:
- Computational modeling of physiology & disease
- Cardiac electrophysiology & mechanisms of arrhythmias
- Mechanobiology & extracellular matrix assembly

Paul A. Wetzel, Ph.D.
Associate Professor
pawetzel@vcu.edu | (804) 827-0487
Research Topics:
- Eye tracking systems & eye movement analysis
- Effects of neurological diseases on eye movement control
- Visual task analysis

Ning Zhang, Ph.D.
Associate Professor; Director, Laboratory for Stem Cell Biology & Engineering
nzhang2@vcu.edu | (804) 828-5352
Research Topics:
- Stem cell biology & clinical translation
- Central nervous system trauma & diseases
- Biomaterials for oral biofilm prevention

Yue Zhang, Ph.D.
Associate Professor
yzhang29@vcu.edu | (804) 828-0870
Research Topics:
- Bone biology & regeneration
- Cartilage biology
- Animal models of musculoskeletal conditions

CHEMICAL & LIFE SCIENCE Engineering

B. Frank Gupton, Ph.D.
Professor; Chair
bfgupton@vcu.edu | (804) 828-4799
Research Topics:
- Cross-coupling catalysis
- Flow chemistry/continuous chemical processing
- Organic synthesis in pharmaceutical applications

Saeed Ahmad, Ph.D.
Research Assistant Professor
sahmad@vcu.edu | (804) 828-5645
Research Topics:
- Process development
- Pharmaceutical APIs
- Continuous synthesis

Sandro R. P. da Rocha, Ph.D.
Associate Professor
srdarocha@vcu.edu | (804) 828-0985
Research Topics:
- Nanomedicine: nanomaterials; dendrimers; in vivo models; organelle targeting
- Pulmonary drug delivery: epithelial transport modulation; lung cancer
- Medicinal aerosols: formulation development; portable inhalers; nanotechnology lungs

Stephen S. Fong, Ph.D.
Associate Professor; Vice Chair
ssfong@vcu.edu | (804) 827-7038
Research Topics:
- Metabolic engineering
- Computational metabolic modeling
- Biorefineries

Ram B. Gupta, Ph.D.
(See Office of the Dean)

Rudy Krack
Instructor; Laboratory Engineer
rkrack@vcu.edu | (804) 828-6641
Research Topics:
- Undergraduate instructional laboratories
- Laboratory safety
- Capstone Senior Design projects

Nastassja A. Lewinski, Ph.D.
Assistant Professor
nalewinski@vcu.edu | (804) 828-0452
Research Topics:
- Biological effects of nanoparticles
- Advanced in vitro exposure systems
- Nanomedicine

Rajendar R. Mallepally, Ph.D.
Research Assistant Professor
rrmallepally@vcu.edu | (804) 827-7000 ext. 460
- Supercritical fluid assisted materials processing
- Polymer solution phase behavior at high pressures
- High pressure thermophysical properties of hydrocarbons, fuels & lubricants

Michael H. Peters, Ph.D.
Professor
mpeters@vcu.edu | (804) 828-7790
Research Topics:
- Protein engineering: protein interactions & misfolded protein states in disease
- Nanolipid drug carriers
- Nonequilibrium statistical mechanics

Daniel Rivalti, Ph.D.
Research Assistant Professor
drivalti@vcu.edu | (804) 828-3846
Research Topics:
- Homogeneous catalysis & metal catalyzed reactions
- Continuous Flow Reactions
- API Synthesis

Thomas D. Roper, Ph.D.
Director of Pharmaceutical Engineering
tdroper@vcu.edu | (919) 260-5509
Research Topics:
- Continuous flow chemistry & reaction engineering
- Biocatalysis & metabolic engineering of reaction pathways
- Particle sciences & formulation engineering

Christina Tang, Ph.D.
Assistant Professor
ctang2@vcu.edu | (804) 827-1917
Research Topics:
- Smart, multifunctional textiles/polymer composites
- Self-assembly of metal-polymer hybrid nanoparticles
- Rheology of polymers/gels/biopolymers

Xuejun Wen, M.D., Ph.D.
William H. Goodwin Professor
xwen@vcu.edu | (804) 828-5353
Research Topics:
- Biomaterials: natural, pure synthetic & hybrid
- Stem cell biology & engineering, tissue engineering & regenerative medicine
- 3D printing & Biofabrication

Kenneth J. Wynne, Ph.D.
Commonwealth Professor
kjwynne@vcu.edu | (804) 828-9303
Research Topics:
- Surface polymer science
- Kinetics nanoscale & mesoscale diffusion
- Antimicrobial & cytocompatible coatings

Vamsi K. Yadavalli, Ph.D.
Associate Professor
vyadavalli@vcu.edu | (804) 828-0587
Research Topics:
- Micro & nanofabrication using functional biomaterials
- Nanoscale surface characterization
- Biosensors for therapeutic monitoring

Hu Yang, Ph.D.
Qimonda Associate Professor
hyang2@vcu.edu | (804) 828-5459
Research Topics:
- Clickable polymers for drug delivery
- Drug delivery for glaucoma
- Brain cancer therapy

COMPUTER SCIENCE

Krzysztof J. Cios, Ph.D., D.Sc., M.B.A.
Professor; Chair
kcios@vcu.edu | (804) 828-9671
Research Topics:
- Machine learning
- Data mining
- Biomedical informatics

Tomasz Arodz, Ph.D.
Associate Professor
tarodz@vcu.edu | (804) 827-3989
Research Topics:
- Machine learning & data science
- Systems biology
- Computational biology

Eyuphan Bulut, Ph.D.
Assistant Professor
ebulut@vcu.edu | (804) 828-6382
Research Topics:
- Mobile computing, mobile sensing & wireless networks
- Cybersecurity, network security & privacy & trust
- Mobile (3G/4G) systems & Internet of Things (IoT)

Alberto Cano, Ph.D.
Assistant Professor
acano@vcu.edu | (804) 827-4002
Research Topics:
- Scalable algorithms for big data mining
- Parallel, distributed & GPU computing
- Evolutionary algorithms & genetic programming

Wei Cheng, Ph.D.
Assistant Professor
wcheng3@vcu.edu | (804) 827-4003
Research Topics:
- Security & privacy
- Vehicle networks
- Underwater networks

Kostadin Damevski, Ph.D.
Assistant Professor
kdamevski@vcu.edu | (804) 827-3607
Research Topics:
- Software maintenance
- Software engineering
- Applications of information retrieval in software engineering

Thang Dinh, Ph.D.
Assistant Professor
tndinh@vcu.edu | (804) 827-4007
Research Topics:
- Network vulnerability assessment
- Security & privacy in social networks & wireless networks
- Approximation algorithm, combinatorial optimization

Debra Duke, M.S.
Instructor
s2dmduke@vcu.edu | (804) 828-7135
Research Topics:
- Computer science education

Carol Fung, Ph.D.
Assistant Professor
cfung@vcu.edu | (804) 828-9731
Research Topics:
- Android security framework for permission control & privacy breach detection
- DDoS detection & mitigation using next generation network technologies
- Security issues in software defined networks & VFV-based networks

Sevag Gharibian, Ph.D.
Assistant Professor
sgharibian@vcu.edu | (804) 828-0407
Research Topics:
- Algorithms
- Complexity theory
- Quantum computation

Preetam Ghosh, Ph.D.
Associate Professor
pghosh@vcu.edu | (804) 827-3995
Research Topics:
- Modeling & simulation
- Systems biology
- Wireless networks

Vojislav Kecman, Ph.D.
Professor
vkecman@vcu.edu | (804) 827-3608
Research Topics:
- Machine learning & data mining
- Fuzzy logic modeling
- SVM algorithms for large datasets

Bartosz Krawczyk, Ph.D.
Assistant Professor
bkrawczyk@vcu.edu | (804) 828-7365
Research Topics:
- Machine learning, ensembles, imbalanced data, kernel methods
- Data stream mining, concept drift, active learning
- Medical informatics, clinical decision support, activity recognition

Lukasz Kurgan, Ph.D.
Professor; Qimonda Chair
lkurgan@vcu.edu | (804) 827-3986
Research Topics:
- Structural bioinformatics of proteins & protein-ligands interactions
- Intrinsic disorder in proteins
- Structural genomics

John Leonard, Ph.D.
(See Office of the Dean)

Milos Manic, Ph.D.
Professor
misko@vcu.edu | (804) 827-3999
Research Topics:
- Fuzzy neural data mining techniques
- Energy security
- Human-machine interfaces

Bridget McInnes, Ph.D.
Assistant Professor
btmcinnes@vcu.edu | (804) 828-0403
Research Topics:
- Natural language processing
- Biomedical informatics
- Nanoinformatics

Hong-Sheng Zhou, Ph.D.
Assistant Professor
hszhou@vcu.edu | (804) 827-4006
Research Topics:
- Theoretical & applied cryptography
- Cryptocurrencies & blockchain technologies
- Quantum (resilient) cryptography

ELECTRICAL & COMPUTER Engineering

Erdem Topsakal, Ph.D.
Professor; Chair
etopsakal@vcu.edu | (804) 828-1313
Research Topics:
- Microwave hyperthermia & ablation/early Cancer detection & monitoring
- Wireless medical telemetry (implantable & body-centric) & e-health
- Novel microwave antennas, arrays & sensors for military applications

Gary M. Atkinson, Ph.D.
Associate Professor; Director of Virginia Microelectronics Center
gmatkins@vcu.edu | (804) 827-0185
Research Topics:
- Micro & nanofabrication
- Sensors & actuators
- Energy conversion devices

Vitaliy Avrutin, Ph.D.
Research Assistant Professor
vavrutin@vcu.edu | (804) 827-7000 ext. 357
Research Topics:
- III-nitride epitaxial structures for light emitters & high-power devices
- Semipolar & nonpolar III-nitride epitaxial structures on silicon & sapphire substrates for light emitters
- ZnO-based heterostructures & transparent conductive oxides (TCOs) for electronic & optoelectronic devices & plasmonics

Tim Bakker, Ph.D.
Research Assistant Professor
bakkert@vcu.edu | (804) 827-7005 ext. 210
Research Topics:
- Digital system design for fault-tolerant & safety-critical systems
- Unmanned Aircraft System (UAS) flight control system design & testing
- UAS payload design, integration & testing

Supriyo Bandyopadhyay, Ph.D.
Commonwealth Professor
sbandy@vcu.edu | (804) 827-6275
Research Topics:
- Straintronics
- Coherent spin transport in nanowires for sensing & information processing
- Nanowire-based room temperature infrared detectors

Michael J. Cabral, Ph.D.
Associate Professor
mcabral@vcu.edu | (804) 828-9068
Research Topics:
- Engineering education
- Nanofabrication techniques
- Molecular electronics

Alen Docef, Ph.D.
Associate Professor; Associate Chair
adocef@vcu.edu | (804) 827-7032
Research Topics:
- Medical image processing
- Digital signal processing algorithms
- Engineering education

Carl Elks, Ph.D.
Assistant Professor
crelks@vcu.edu | (804) 828-8222
Research Topics:
- Embedded systems cybersecurity
- Dependability analysis of safety critical systems
- Cyber physical systems

Afroditi V. Filippas, Ph.D.
(See Office of the Dean)

Xubin He, Ph.D.
Professor
xhe2@vcu.edu | (804) 827-7627
Research Topics:
- Data storage & I/O systems
- Computer architecture
- Erasure coding techniques for reliable big data management

Rosalyn Hobson Hargraves, Ph.D.
Associate Professor
rhobson@vcu.edu | (804) 828-8308
- STEM education with a focus on underrepresented populations
- Engineering education
- Machine learning for medical applications

Ashok Iyer, Ph.D., P.E.
Professor
aiyer@vcu.edu | (804) 827-7035
Research Topics:
- GPS applications
- Neural networks
- Linear & nonlinear control theory

Nathaniel Kinsey, Ph.D.
Assistant Professor
nkinsey@vcu.edu | (804) 827-7627
Research Topics:
- Nanophotonics
- Nonlinear optics
- Optical materials

Robert H. Klenke, Ph.D.
(See Office of the Dean)

Hadis Morkoc, Ph.D.
Founders Professor
hmorkoc@vcu.edu | (804) 827-3765
Research Topics:
- Group III-IV semiconductors
- Light emitting diodes
- Nitride semiconductor heterostructures

Yuichi Motai, Ph.D.
Associate Professor
ymotai@vcu.edu | (804) 828-1281
Research Topics:
- Sensory intelligence
- Medical imaging
- Computer vision

Ruixin Niu, Ph.D.
Assistant Professor
rniu@vcu.edu | (804) 828-0030
Research Topics:
- Statistical, secure & sparse signal processing
- Information fusion & adaptive sensing in sensor networks
- Wireless communications & MIMO radar

Ümit Özgür, Ph.D.
Qimonda Associate Professor
uozgur@vcu.edu | (804) 828-2581
Research Topics:
- Group III-nitride & zinc oxide optoelectronics
- Ultrafast optical spectroscopy
- Physics of semiconductor heterostructures

R. Daniel Resler, Ph.D.
Associate Professor
dresler@vcu.edu | (804) 827-3987
Research Topics:
- Programming languages
- Compiler design
- Automatic generation of software

Gregory E. Triplett, Ph.D.
(See Office of the Dean)

Zhifang Wang, Ph.D.
Assistant Professor
zfwang@vcu.edu | (804) 828-5330
Research Topics:
- Electric power system modeling & optimization
- Renewable integration & demand side management
- Power grid vulnerability analysis

Weijun Xiao, Ph.D.
Assistant Professor
wxiao@vcu.edu | (804) 828-5339
Research Topics:
- GPU & heterogeneous computing
- Emerging memory & storage technologies
- Embedded systems

Wei Zhang, Ph.D.
Professor; Director of Computer Engineering
wzhang4@vcu.edu | (804) 827-2631
Research Topics:
- Real-time & embedded systems
- Computer architecture
- Parallel computing

MECHANICAL & NUCLEAR Engineering

Gary C. Tepper, Ph.D.
Professor; Chair
gctepper@vcu.edu | (804) 827-4079
Research Topics:
- Aerosols
- Nanomaterials
- Radiation detectors

Jayasimha Atulasimha, Ph.D.
Qimonda Associate Professor
jatulasimha@vcu.edu | (804) 827-7037
Research Topics:
- Energy efficient nanomagnetic computing
- Novel magnetic & multiferroic materials & devices
- Nanofabrication

Sama Bilbao y León, Ph.D.
Associate Professor; Director of Nuclear Engineering Programs
sbilbao@vcu.edu | (804) 828-2570
Research Topics:
- Nuclear thermal hydraulics
- Nuclear reactor design & safety
- Energy & environmental policy

L. Franklin Bost, MBA, IDSA
(See Office of the Dean)

Charles Cartin, Ph.D.
Assistant Professor
cartincp@vcu.edu | (804) 827-3569
Research Topics:
- Design engineering & design optimization
- Product innovation, design, fabrication & development methods
- Computer-aided design (CAD), computer-aided engineering (CAE) & engineering education

Daren Chen, Ph.D.
Professor; Floyd D. Gottwald, Sr. Chair in Mechanical & Nuclear Engineering
dchen3@vcu.edu | (804) 828-2828
Research Topics:
- Particle-based manufacturing
- Aerosol & particle technology
- Particle instrumentation & characteristics

Laleh Golshahi, Ph.D.
Assistant Professor
lgolshahi@vcu.edu | (804) 827-3742
Research Topics:
- Respiratory aerosol & fluid dynamics
- Pediatric lungs targeted drug delivery
- Aerosol filtration & bio-aerosols

Frank A. Gulla M.S., P.E.
Assistant Professor
fagulla@vcu.edu | (804) 827-4012
Research Topics:
- Engineering education
- Process control engineering
- Manufacturing engineering

Ibrahim Guven, Ph.D.
Assistant Professor
iguven@vcu.edu | (804) 827-3652
Research Topics:
- Failure & fracture in materials
- Peridynamic modeling & simulation
- Multiscale computational solid mechanics

Ravi Hadimani, Ph.D.
Assistant Professor
rhadimani@vcu.edu | (804) 828-3679
Incoming
Research Topics:
- Biomagnetics & non-invasive neuromodulation
- Magnetic materials
- Energy harvesting

P. Worth Longest, Ph.D.
Professor; Co-Director of Particle Science & Engineering Center
pwlongest@vcu.edu | (804) 827-7023
Research Topics:
- Respiratory therapeutics
- Targeted drug delivery
- Pharmaceutical aerosols

James G. Miller, M.S., P.E.
Assistant Professor
jgmiller@vcu.edu | (804) 827-4000
Research Topics:
- Engineering education
- Reactor simulation
- Reactor theory

Reza Mohammadi, Ph.D.
Assistant Professor
rmohammadi@vcu.edu | (804) 827-3997
Research Topics:
- Ultra-incompressible superhard materials
- Thin film deposition & characterization
- Superhydrophobic materials

Karla M. Mossi, Ph.D.
Associate Professor; Graduate Program Director
kmmossi@vcu.edu | (804) 827-5275
Research Topics:
- Energy harvesting
- Smart materials
- Sensors

Naveen Palapati, Ph.D.
Assistant Professor
palapatinkr@vcu.edu | (804) 827-5276
Research Topics:
- Nanoscale lithium-ion batteries
- Nanomanipulation
- Material Characterization

Dmitry Pestov, Ph.D
Nanocharacterization Center Scientist
dpestov@vcu.edu | (804) 828-2143
Research Topics:
- Electron beam-assisted chemical transformations
- Electron microscopy for archaeological applications
- Chemical & biological miniature sensors

Supathorn Phongikaroon, Ph.D., P.E.
Associate Professor
sphongikaroon@vcu.edu | (804) 827-2278
Research Topics:
- Nuclear & chemical separation technology in fuel cycle research & development
- Electrochemical processes
- Special material detection & analysis via laser & mass spectroscopy techniques

Jessika Rojas, Ph.D.
Assistant Professor
jvrojas@vcu.edu | (804) 828-4267
Research Topics:
- Radiation-induced synthesis of nanomaterials
- Radiation effects on nanomaterials & nuclear materials
- Nanostructures for nuclear science & technology

Robert M. Sexton, Ph.D.
Associate Professor
rmsexton@vcu.edu | (804) 827-7044
Research Topics:
- Response dynamics & vibrations of offshore drilling & production systems
- Deepwater marine riser systems & the various nonlinear effects
- Simulation & control of sophisticated, high-capacity tensioning systems

John E. Speich, Ph.D.
(See Office of the Dean)

Hooman V. Tafreshi, Ph.D.
Professor
htafreshi@vcu.edu | (804) 828-9936
Research Topics:
- Interfacial phenomena & superhydrophobicity
- Fluid, heat & particle transport through porous materials
- Separation science

Wei-Ning Wang, Ph.D.
Assistant Professor
wnwang@vcu.edu | (804) 827-4306
Research Topics:
- Aerosol processing of functional nanomaterials
- Heterogeneous catalysis for energy & the environment
- Smart luminescent materials for sensing & medical applications

Woon-Hong Yeo, Ph.D.
Assistant Professor
whyeo@vcu.edu | (804) 827-3517
Research Topics:
- Nanomembrane electronics for human health monitoring
- Human-machine interfaces via skin-like electronics
- Nano-biosensors for disease diagnostics

Hong Zhao, Ph.D.
Assistant Professor
hzhao2@vcu.edu | (804) 827-7025
Research Topics:
- Surface science & surface engineering
- Transport & self-assembly of colloidal nanoparticles
- Printed functional devices & micro/nano additive manufacturing

FOUNDATION **BOARD OF TRUSTEES**

CHAIRMAN EMERITUS
William H. Goodwin, Jr.
Chairman & President
CCA Industries, Inc.

PRESIDENT
Mark Cruise
Vice President, Applied Technology
Altria Client Services

PAST PRESIDENT
Mary Doswell
Consultant

LONG-RANGE PLANNING COMMITTEE CHAIR
Paul F. Rocheleau
Virginia Life Sciences Investment, LLC

ADVANCEMENT COMMITTEE CHAIR
William K. Lamp
Principal
Engineers Plus

FINANCE COMMITTEE CHAIR
Steve Henderson
Director of Investments
Spider Management Co.

AUDIT COMMITTEE CHAIR
Jennifer Boykin
Vice President, Engineering & Design
Newport News Shipbuilding

NOMINATING COMMITTEE CHAIR
Larry Cummings
Marketing Leader, Strategic Partnerships
Trane

Temple Ballard
Vice President, Technical Direction
Suez

David Barlow
Vice President, PE
CHA Consulting Inc.

Thomas E. Gottwald
President & CEO
NewMarket Corporation

Andy Hobson
Sales
TLA, Inc.

Hans de Koning
President
Flexicell

Steven R. Lindgren
Vice President, Sales
KSB, Inc.

John A. Luke, Jr.
Chairman, President & CEO
MeadWestvaco

Nimisha Mukherjee
Associate Director, Regulatory Affairs
Merck Sharp & Dohme Corp.

Martin Prakken
CEO
BluePrint Automation

Brian Riopelle
Chair, IP Litigations/Patents Department
McGuire Woods

Greg Sitkiewicz
Cuff Business Manager,
Patient Care Solutions
GE Healthcare

Jeffrey T. Stanfield
Human Resources Director,
DuPont Teijin Films
Americas Region

Barbara D. Boyan, Ph.D.
Dean, School of Engineering
Virginia Commonwealth University

Marti K.S. Heil
Vice President for Development
& Alumni Relations
Virginia Commonwealth University

FOUNDING & EMERITI TRUSTEES
The Honorable George F. Allen
President
George Allen Strategies

William W. Berry*
Former Chairman & CEO
Dominion Resources

James C. Cherry
CEO
Park Sterling Bank.

William S. Cooper, Jr.
Former Pres., CEO, Founder & Director
Choice Communications

Bradford A. Crosby
Contracts Department Manager
Norfolk Naval Shipyard

Clifford A. Cutchins, IV
Past President
Partner
McGuire Woods LLP

Marguerite Davis
Owner
The Davis Collection

Thomas D. Eilerson
Chairman
EDC

Joseph C. Farrell*
Retired Chairman, CEO & President
Pittston Company

Thomas F. Farrell, II
Chairman, President & CEO
Dominion Resources, Inc.

J. Carter Fox
Former Chairman, President & CEO
Chesapeake Corporation

Robert M. Freeman*
Former Chairman & CEO
Signet Banking Corporation

Bruce C. Gottwald
Chairman
NewMarket Corporation

Bruce A. Henderson*
Former Chairman & CEO
Imation Corporation

C.T. Hill
Former Chairman, President & CEO
SunTrust Bank, Mid-Atlantic

Richard G. Holder*
Former Chairman & CEO
Reynolds Metals Corporation

Sean Hunkler
Vice President, Manufacturing
MEMC

Arthur D. Hurtado
Former Chairman & CEO
Altamira Technologies Corporation

Hugh Joyce
President
James River Air Conditioning Co, Inc.

E. Morgan Massey
CEO, Owner & Chairman
Evan Energy Compnay

Malcolm S. McDonald
CEO, Owner & Chairman
Evan Energy Company

John L. McElroy, Jr.
Chairman Emeritus
Wells Fargo Securities

David L. Milby*
Former Sr. VP
Philip Morris USA

Wayne K. Nesbit
Vice President
CREE

S. F. Pauley
Chairman & CEO
Carpenter Company

Richard E. Posey
Retired President & CEO
MOEN

E. Bryson Powell
President
Midlothian Enterprises, Inc.

Anne G. Rhodes
Community Leader

Robert E. Rigsby
Retired President & COO
Dominion Virginia Power

Walter S. Robertson, III
Chief Executive Officer
Sterne Agee

E. Claiborne Robins*
Former Chairman & Director
Wyeth Consumer Healthcare

Dwight Schar
President
NVR

Wolfgang Schubl
Director
Weidmuller Ltd.

Thomas J. Seifert
COO and CFO
Qimonda

Richard L. Sharp*
Managing Director
V10 Capital Partners

Jeremiah J. Sheehan
Retired CEO & Chairman
Reynolds Metals, Co.

John D. Sherman, Jr.
Retired President & CEO
Scott & Stringfellow, Inc.

Hugh R. Stallard
Retired President
Verizon Virginia

Mark A. Sternheimer, Sr.
President
Sternheimer Brothers, Inc.

Richard G. Tilghman
Retired Vice Chairman
SunTrust Banks, Inc., Mid-Atlantic

James E. Ukrop
Chairman
Ukrop's Super Markets/First Market Bank

Hays T. Watkins
Retired CEO
CSX Railroad

Robert C. Williams
Chairman Emeritus
James River Corporation

Robert W. Woltz, Jr.
Retired President
Verizon Virginia

C. Kenneth Wright
Chairman
Wright Properties

**Deceased*

ALUMNI BOARD

PRESIDENT
Andy Hobson, MNE '12
Sales Engineer
TLA, Inc.

VICE PRESIDENT & NOMINATIONS CHAIR
Tyler Berry, MNE '12
Mechanical Engineer
Engineers Plus

EX-OFFICIO & SOCIAL LIAISON
Tin Myint '06
Product Development and Customer Solutions Engineering
Dominion Voltage, Inc.

CAREER SERVICES LIAISON
Aaron Moody, ECE '04
Quality Control Supervisor
Federal Reserve Bank of Richmond

CAREER SERVICES LIAISON
Phillip Vaughan, BME '10
Administrative Assistant
VCU School of Engineering, Career Services

UNDERGRADUATE STUDENT SERVICES LIAISON
Melissa Peskin, MNE '07
Consulting Engineer
Dominion Voltage, Inc.

GRADUATE STUDENT SERVICES LIAISON
Benjamin Spence, MNE '13
Test and Balance Engineer
Comfort Systems USA

STUDENT RECRUITMENT LIAISON
Justin Koca, MNE '06
Project Manager
GE Power

MEMBERS
Morgan Barlow, BME '12
Patent Examiner
United States Patent and Trademark Office (USPTO)

Claiborne Collier, BME '06, Grad CLSE '08
Senior Analyst of Data Quality
American Red Cross

Christopher Heinz, ECE '10
Consultant
CapTech Ventures, Inc.

Oscar L. Martin, Ph.D. CLSE '09
Group Vice President of Innovation
Klockner Pentaplast

Lyndon McClure, MNE '11
Engineer of Maintenance and Reliability
Evonik

Brian Noel, ECE '06
Lead Electrical Engineer
Monolith Materials

Luke Rhodes, CS '08
Realtor
Engel & Völkers Richmond

Joshua A. Stolberg, MNE '07
Engineer
Alstom Power

Brad Trevillian, MNE '06
General Manager
TRANE

VCU School of Engineering

601 West Main St.
P.O. Box 843068
Richmond, VA 23284-3068

Non-profit org.
U.S. Postage Paid
Richmond, Virginia
Permit No. 869

/ VCUEngineering

@ VCUEngr

@ VCU_Eng

egr.vcu.edu/linkedin

VCUSchoolOfEngr

egr.vcu.edu

An equal opportunity, affirmative action university

BIOMEDICAL Engineering

CHEMICAL & LIFE SCIENCE Engineering

COMPUTER SCIENCE

ELECTRICAL & COMPUTER Engineering

MECHANICAL & NUCLEAR Engineering