
UMBC

# 2020 ANNUAL REPORT
# COLLEGE OF ENGINEERING & INFORMATION TECHNOLOGY


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UMBC
College of Engineering &
Information Technology

Cover photos, clockwise from TOP LEFT: Helena Mentis, Associate Professor, Information Systems. Photo courtesy of Mentis; Lee Blaney, Associate Professor, Chemical, Biochemical, and Environmental Engineering. Photo courtesy of Blaney; Vandana Janeja, Professor and Chair, Information Systems. Photo courtesy of Janeja; Ellie Khan, Sr. Specialist, at the Retriever 5k. Photo courtesy of Khan; Dean Keith Bowman. Photo courtesy of Bowman; Murat Guner, Lecturer, Computer Science and Electrical Engineering. Photo courtesy of Guner; Kathy Suess, Assistant Director in Shared Services. Photo courtesy of Suess; Carlos Romero-Talamas, Associate Professor, Mechanical Engineering. Photo courtesy of Romero-Talamas; Donique Lewis, Dean's Office. Photo courtesy of Lewis. Previous page, clockwise from LEFT: Krista Wallace, Transfer Success Advisor. Photo courtesy of Wallace; Dean Keith Bowman teleworking from home and remaining socially distant. Photo courtesy of Dean Keith Bowman; Diane Zeenny Ghorayeb. Photo courtesy of Ghorayeb.

# *College Welcome*

NEVER BEFORE,

in the 54-year history of our university, has the challenge of wrapping up one spring semester been so intensely followed by the dynamic and evolving challenges we experienced in preparing for the fall semester ahead. We appreciate all who have stepped up to help keep us on track and prepare for the semester ahead. Everything we have been doing to engage and support our students has immense value. We know that many elements of our COVID-19 experiences have placed incredible burdens on families, raised workloads, and compromised scholarly work advancement. Still, we are confident we will find a way to get through all of this, together. ▸▸

Even during a year of uncertainty, we continue to see our faculty, staff, and students' strength and perseverance, each continuing to contribute in a positive way towards the college, university, and community's success. Despite all the extra burdens and responsibilities our faculty have taken on, they continue to expand the boundaries of their work, providing breakthrough research in the area of COVID-19; from enhancing testing options to analyzing the societal and stigmatic impacts of the virus and its origin on cultural perceptions. And our reputation remains strong: among doctoral public universities, our college's undergraduate engineering programs are tied for 64th in the 2021 US News & World Report rankings with George Mason University and San Diego State, and our computer science program is tied for 52nd with Michigan Tech.

Within the college, our growing population of students remain active in their scholarly

*"We are confident we will find a way to get through all of this, together."*

**– DEAN KEITH J BOWMAN**

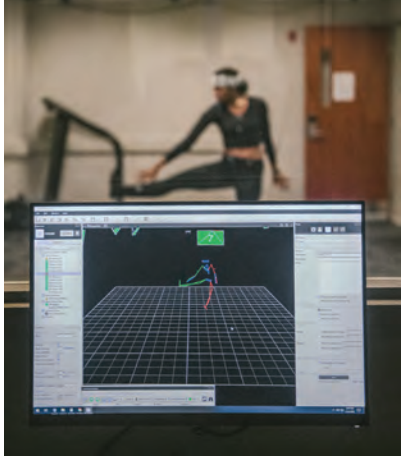
## AS OUR COUNTRY RECONCILES ITS HISTORY OF SYSTEMIC DISCRIMINATION, WE ARE COMMITTED TO MAKING SURE OUR COLLEGE IS A LEADER IN FOSTERING CHANGE.

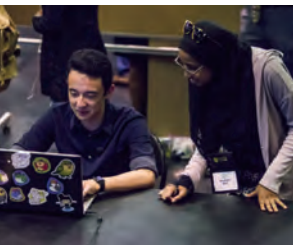
activities, continue to participate in their organizations, and play an active key role in the college's research enterprise. The College of Engineering & Information Technology (COEIT) currently has the largest enrollment of undergraduate students among UMBC's three colleges. Our graduate student population has grown to account for over half of the university's graduate student headcount. Across the past decade, the fastest-growing demographic among our undergraduate students are students who identify as Black or African American. As our country reconciles its history of systemic discrimination, we are committed to making sure our college is a leader in fostering change.

We continue to strive to close the inequality gap with our Center for Women in Technology (CWIT) providing leadership. Not only serving women in the field, they provide many programs that offer support and community activities for students from all backgrounds. Their success can be seen in the percent of graduates from the college, which has increased by 90% over the past ten years.

Many COEIT faculty spent part of their summer taking PIVOT+ (Planning Instructional Variety for Online Teaching), a training program developed in collaboration with UMBC's Division of Information Technology. This program was designed to provide our faculty (and staff) with best practices for delivering instruction and support in the online environment. This includes best practices for moving lab courses online, discussions about achieving accessibility and inclusivity needs, preserving academic integrity, and ensuring quality communication while remote. PIVOT+ will provide resources to faculty for a smooth transition from on-campus to remote instruction. Dr. Jamie Gurganus (aka Prof. G) led COEIT's PIVOT+ team with the support of several college full-time faculty members.

As we move forward, we continue to be guided by our vision of a strong college and an exceptional student experience.



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Previous page, clockwise from TOP LEFT: COEIT Staff celebrate at the holiday luncheon. Photo by Marlayna Demond '11 for UMBC; CyberDawgs hold a team meeting. Photo by Marlayna Demond '11 for UMBC; Briana Norwood '20, dance, at the opening of the ISRC. Photo by Marlayna Demond '11 for UMBC; Visitors explore the ILSB after the ribbon-cutting ceremony. Photo by Marlayna Demond '11 for UMBC; Students present at the COMP 101 Demonstration event. Photo courtesy of Helena Mentis; New Assistant Professor Maryam Rahnemoonfar at the College's Welcome Back. Photo by Marlayna Demond '11 for UMBC; Dean Bill LaCourse cuts the ribbon, surrounded by distinguished guests, at the ILSB opening celebration on the building's terrace. Photo by Marlayna Demond '11 for UMBC; Students participate in a panel discussion. Photo by Marlayna Demond '11 for UMBC; Mustafa Al-Adhami, Ph.D. '20, mechanical engineering, speaks at GRIT-X 2019. Photo courtesy of Arionna Gonsalves. Students collaborate on a laptop. Photo by Marlayna Demond '11 for UMBC. All photos taken prior to the COVID-19 pandemic.

# CONTENTS

Taking a dance break at the Winter Retreat, February 2020. Photo courtesy of Cindy Greenwood.

# CWIT: BROADER FOCUS, BROADER IMPACT

BY CAROLYN SEAMAN

***The UMBC Center for Women in Technology (CWIT)*** enables success for all women and other underrepresented groups in technology fields. In the College of Engineering & Information Technology, CWIT supports students with a nurturing and challenging community, transformative leadership experiences, and professional development opportunities. Our vision is to prepare and empower our students to be change agents in creating technology workplaces that are diverse, equitable, and inclusive.

We serve all women, including all persons who identify as female, regardless of race, nationality, sexual orientation, or gender expression, and their allies. CWIT pursues its vision and mission by setting and accomplishing goals in six areas: Program Delivery; Community Building; Gender Climate Research; Pipeline Development; Advocacy; and National Impact.

The CWIT team is driven by a belief that there is a social justice imperative to ensure equity in STEM fields as our society advances technologically. This requires critical attention to the policies and structures of our educational institutions, as well as to the details of our everyday interactions among members of the CWIT community. CWIT is committed to academic, professional, personal, and inclusive excellence.

In 2019, CWIT embarked on a nearly year-long visioning and strategic planning activity, where staff and CWIT stakeholders reflected on and articulated the mission, vision, values, and goals presented above. While our reason for being has not fundamentally changed, we have updated how we talk about our mission, and also chosen some new emphases for the next three years, including expanding the Affiliates program; a more intentional focus on intersectionality; increased K-12 outreach; and more efforts to partner with, and spread our message to more people and units across campus. These new emphases mark an expansion of CWIT in several directions, in terms of scope, our student body, our reach, our staff, and our impact.

CWIT has always implicitly served women of all backgrounds, including those from underrepresented minorities. However, we have come to realize that we need to explicitly address all the barriers that women face in technology workplaces and society, not just those that arise because of their gender. Our 2019 strategic plan includes strategies specifically addressing the recruitment, retention, and support of Black and Latinx students, professional development for our staff on providing more targeted support of these populations, and a systematic process for auditing our communications and event planning for obstacles to full participation from any group.

The summer of 2020 and the deepening national discussion of race, racial justice, and systemic racism has given CWIT an opportunity to step into the intersectional reality of many of our community members. CWIT released a statement on racial justice in June, and in August facilitated the first of a series of student discussions on race, in partnership with UMBC's Mosaic Center.

This important pivot to meaningfully broaden CWIT's impact in terms of demographics did not start in 2019, but built on several years of work in diversifying the demographics of our scholar population.

In the past three years of application cycles for our Scholars Programs, CWIT has noticed a timely shift in the demographics of our incoming cohorts towards increased racial diversity. While the proportion of women among our Scholars has been stable at 72-73% over this time period, the overall proportion of underrepresented minority Scholars (URM) served by CWIT ▸▸

increased from 17% in 2016 to 24% in 2020. This did not happen by accident, but happened through intentional changes in our recruitment and selection strategies.

Our recruitment for the CWIT and Cyber Scholars programs typically includes high school visits, email campaigns, and admissions events both on and off campus. However, over time we have been more strategic about high school visits, trying to focus these effort-intensive activities on high schools that help us reach our target audiences. The reduction in high school visits and increased reliance on email and other virtual engagement has allowed our team to cast a wider net to attract prospective students.

One key strategy for Scholar recruitment has been to design our own signature CWIT recruitment events and invite students based on lists of prospective students from UMBC admissions, as well as other COEIT partners such as Project Lead the Way and the Maryland Center for Computing Education. We've also leveraged the networks of our current Scholars and our Parents for Women in Technology group and asked them to share the events and applications with prospective students.

We've become much more intentional about how we review applications for our two overnight recruitment programs, Cyber 101 and Bits & Bytes, with respect to the distribution of high schools across the region. We've also become more mindful of our reach through our day recruitment program, BEST of CWIT, which had a 4% increase in URM high school attendees from 2018 to 2019. Overall, we have broadened the regions and school districts that we target for K-12 engagement activities and recruitment, with an increased focus on Baltimore City. We are also collecting more demographic data (i.e. race/ethnicity, gender expression, etc.) about

CWIT Associate Director Dr. Ireland talks with CWIT students at Sophomore Leadership Practicum in early Spring 2019. Photo by Marlayna Demond '11 for UMBC.

Sharing out small group results at the Winter Retreat in February 2020. Photo courtesy of Cindy Greenwood.

prospective CWIT community members via the application and registration forms for our K-12 programs and recruitment events so that we can be more knowledgeable about the populations we're reaching (or not reaching) and supporting their needs within COEIT and at UMBC more broadly.

Another major shift in our practice is the overhaul of our application and selection processes. We spent a significant amount of time refining the language on our application essays to increase clarity and specificity, and also create more opportunities for students to showcase their varied strengths and potential contributions to us. Most importantly, we revamped our reviewer process by adopting a standard rubric, aligning the interview questions across the three Scholars programs, conducting training sessions for application reviewers and interviewers. These changes have helped reduce subjectivity and bias, increase reviewer and interviewer competence, and helped us to articulate our standards with fairness and clarity.

Another dimension of recent CWIT growth and expansion is to engage more students within COEIT, through the CWIT Affiliates program. CWIT Affiliates are COEIT students (particularly women, but also their allies) who have not received a scholarship from CWIT, but are still interested in CWIT's mission to promote gender equity, and who are invited to participate in CWIT professional development, networking, and community building events. The Affiliates program has existed for many years and provided an informal way for more COEIT students to participate in the life of CWIT. However, new resources have been purposed towards the expansion of both the size and impact of Affiliates within CWIT. In the summer of 2019, Kate O'Keefe was hired as a new CWIT Assistant Director specifically for the Affiliates program, with support from our many industry ▸▸

Cyber 101 in fall 2019. Photo courtesy of Cindy Greenwood.

supporters, the COEIT Dean's Office, and the Center for Cybersecurity. We have also set aside reserve funds to support expanded Affiliates programming and evaluation.

The goal of expanding the Affiliates program is to reach COEIT students who would benefit not only from the academic support and professional development programs, but also from the sense of belonging and community that CWIT offers through social events, peer mentoring, and leadership opportunities. All of these factors are key to increased retention and graduation, especially among women and students from other underrepresented groups, and so we hope to contribute to COEIT's success in this area through an expanded Affiliates program.

Research on computing and engineering education is also part of CWIT's mission, especially as it relates to diversity, equity, and inclusion. Our portfolio of grant-funded research projects is expanding, as is our reach and impact on the literature and the national discussion of these issues. Current research projects include scholarship support for transfer students, innovative interventions to support transfer students before, during, and after their transfer to a 4-year institution, gender climate within COEIT, and a deep analysis of the factors and patterns that lead to female students leaving engineering. Proposals and plans for upcoming projects include further support of transfer students and an examination of the long-term effects of COVID-19 on computing and engineering students and interventions to counter those effects.

If students are at the heart of CWIT, the hands, feet, and head are all constituted by the exceptional members of the CWIT staff, which has nearly doubled in the past 18 months. The CWIT Director is Dr. Carolyn Seaman, who served as interim director for two years before becoming director in August 2020. She has been involved with CWIT in various capacities since its founding in 1998, which was also her first year as a UMBC faculty member in the

Department of Information Systems. Dr. Danyelle Tauryce Ireland is CWIT's associate director, and takes the lead on CWIT's research and assessment activities, as well as our relationships with industry partners. Assistant Director Cindy Greenwood manages our Cyber Scholars program and also leads our K-12 outreach activities. Erica D'Eramo, also an assistant director, leads the CWIT Scholars program and oversees our recruitment and application processes. Our newest assistant director, Kate O'Keefe, leads the expansion of our Affiliates program and also coordinates our Living Learning Community.

Thea Robertson, as CWIT's administrative assistant, manages CWIT's financial and operational processes, as well as our social media presence, and keeps us organized. Thomas Waters is CWIT's coordinator for allies and strategic projects. He prepares and teaches our Allies in CWIT curriculum, and has taken the lead on several initiatives called out in our new strategic plan.

All the ways that CWIT is expanding are leading to the ultimate goal of expanding our impact within and beyond COEIT. Our impact on the college's student retention numbers will take some time to see, but along the way we are constantly seeking opportunities to make a difference in all the different spheres in which we operate. A prime example is the way we have shifted our operations online in response to the COVID-19 crisis this year. Starting in March, we put all our programming online (we even found a way to give out pizza remotely). Throughout the spring and summer, we have experimented with new platforms and formats for online engagement, gaining experience and building our portfolio of programming ▸▸

THE SUMMER OF 2020 AND THE DEEPENING NATIONAL DISCUSSION OF RACE, RACIAL JUSTICE, AND SYSTEMIC RACISM HAS GIVEN CWIT AN OPPORTUNITY TO STEP INTO THE INTERSECTIONAL REALITY OF MANY OF OUR COMMUNITY MEMBERS.

CWIT staff and students discuss leadership at the Sophomore Leadership Practicum in early spring 2019. Photo by Marlayna Demond '11 for UMBC.

options. We ramped up our programming over the summer in an effort to keep students engaged, keep the CWIT community strong and close, and to provide students with a way to keep connected to campus outside their classes. We want to avoid an interruption in the ongoing work we do to develop students as future professionals and change makers, so we are finding ways to offer all the different kinds of support we always have. We are looking ahead to serving the longer-term needs of students who are experiencing this interruption in their education.

The CWIT team is honored to have had the opportunity to serve COEIT students over the last 20 years, and into the future. We are proud of the work we have done and the impact we've had on our students and our institution. We are energized by the expansion we've seen in recent years, and the challenges and opportunities that lie ahead.

# OUR STUDENTS

# CWIT SCHOLAR SAMMIE MAYGERS '20 FINDS, AND BUILDS, A COMMUNITY OF SUPPORT AT UMBC

BY MEGAN HANKS


Sammie Maygers, fifth from right, with fellow CWIT Scholars, and Erica D'Eramo, left, at the Society of Women Engineers Conference in 2019. Photo courtesy of CWIT.

> "I HAD PEOPLE WHO I COULD REALLY TRUST."
>
> – SAMMIE MAYGERS '20
> CHEMICAL ENGINEERING

When her courses moved online in mid-March due to the coronavirus pandemic, Sammie Maygers '20, chemical engineering, knew staying connected with her UMBC community would need to be a top priority. In some ways, her experience changed substantially. But it was also a continuation of the same UMBC journey, powered by community support.

When Maygers was looking at colleges, she knew that UMBC was the place for her as soon as she heard about the Center for Women in Technology (CWIT) from a high school classmate. When she visited campus, she says that it instantly felt like a family. "UMBC feels like home," she says. "It's inclusive."

CWIT appealed to Maygers because it meant having a network of peers to work with and rely on. Her connections with new friends and mentors started the summer before her freshman year and continue as she heads toward graduation.

"One thing that CWIT does that is really fantastic is they send you on a retreat before the school year starts, with all of the new scholars," she explains. "So when you move in, you've pretty much met all of the people who live on your floor. Even once people got busy, we were always doing work together and I had people who I could really trust."

## GROWING AS A LEADER

Working to build and strengthen this community are dedicated CWIT staff. Maygers shares that Erica D'Eramo, assistant director for the CWIT Scholars Program, has been especially impactful on her UMBC experience, including helping her grow and develop as a leader.

"Sammie has an enthusiasm and passion that is contagious," says D'Eramo. "She has been a mentor to many students—as a 'Big Wit' peer mentor in CWIT, and in her Frisbee family, too. So many times I have heard students tell me how amazing it has been to have Sammie as a guide and, more importantly, as a close friend they can rely on."

Each incoming CWIT scholar is paired with an older student who is also a part of the program. As students move through the program, they become mentors to incoming scholars. Now a graduating senior, Maygers now has a "family" of younger scholars as well as alumni, and they connect regularly.

To sustain and grow these relationships during the pandemic, Maygers says that it is more important than ever to connect with her CWIT community outside of online classes. She intentionally sets aside time to virtually hang out with her mentees, friends, Chem-E-Car teammates, and classmates, including game nights.

## COMMUNITY THROUGH STUDENT ORGS

The format of her classes this semester is helping Maygers stay connected during this difficult time. Most of her current courses are presentation-based. She and her classmates had previously been meeting virtually to develop their presentations, so that work has held steady.

Other changes have been harder to adjust to. Maygers is a member of UMBC's Chem-E-Car team, which builds and races vehicles powered by precise chemical reactions. The team was heading to a regional competition at Virginia Tech this month, but that's no longer happening. ▸▸


ABOVE: Sammie Maygers, center, with members of the Chem-E-Car team. Maygers holds the team's first prototype at the 2019 COEIT Celebration. Photo courtesy of Maygers.
TOP RIGHT: Sammie Maygers. Photo courtesy of Maygers.

"I've put a year and a half of work into the Chem-E-Car team, and I'll never see it through," Maygers says. She finds herself "mourning the things I was expecting to come."

Another activity that has proven challenging for Maygers to carry on with is ultimate frisbee, but her close connections to teammates remain strong. In high school, she was a three-sport athlete, and it was important to her to find a way to stay active in college. Soon after arriving at UMBC, she learned about the ultimate frisbee club team from an older student in CWIT. Although practices are cancelled, UMBC's ultimate frisbee team has held informal virtual meetups every week.

## VIRTUAL CONNECTIONS

Intentionally maintaining all these connections has helped Maygers stay centered and motivated. One day that could be an online coffee with a friend. Another day it could be an online board meeting of the American Institute of Chemical Engineers, UMBC chapter.

Maygers is also continuing her work as a teaching fellow in Mark Marten's chemical engineering kinetics course. "Being a teaching fellow has given me the opportunity to support students academically and personally. The course load of a student taking this level of chemical engineering courses can really be overwhelming, and I love helping students realize that making mistakes and failing helps them grow as an engineer."

Maygers has conducted research alongside Marten, professor and chair of chemical, biochemical, and environmental engineering, since fall 2016. One of the most powerful lessons she's learned from working with him is to be unafraid of learning new skills and making mistakes. This is one of the core messages she works to pass along to both students in the course and younger CWIT scholars.


Sammie Maygers, fourth from left in front row, with her fellow CWIT scholars. Photo courtesy of CWIT.

## THOUGHTFUL ENGINEERING SOLUTIONS

Maygers now has her eye on her steps after graduation, and who will be walking those steps with her. She will have a unique opportunity to continue working closely with friends from UMBC after she graduates this spring.

As she has moved through the chemical engineering program, Maygers has become passionate about developing thoughtful engineering solutions. For her, this means solutions that are environmentally conscious and energy efficient. She looks forward to pursuing this passion as an engineer at the Naval Surface Warfare Center (NSWC) near Bethesda, Maryland.

She and classmates Laina Colony '20, chemical engineering, and Zach Voelkel '20, mechanical engineering, learned about opportunities at the NSWC through a trip organized by UMBC's Career Center. Not only were they all offered positions at the NSWC, but Colony and Maygers will have a chance to work together on the same team and be roommates, along with Voelkel.

A community of support welcomed Maygers to UMBC before she started classes freshman year. She thoughtfully grew that community during her time as a Retriever. Now, she'll carry it with her to the next stage of her life and career.

*"I love helping students realize that making mistakes and failing helps them grow as an engineer."*

**– SAMMIE MAYGERS '20, CHEMICAL ENGINEERING**

# TWO UMBC STUDENT TEAMS WIN USM COVID-19 APP CHALLENGE

BY MEGAN HANKS

Earlier this summer, the University System of Maryland (USM) COVID-19 Task Force invited members of the USM community to develop mobile apps that would help Maryland residents respond to the COVID-19 pandemic. Among the six winning teams just announced are two groups from UMBC. One team developed an app to support the healthcare of people with COVID-19. The other focused on connecting residents with dining options and restaurant policies as they change during the pandemic.

## COMMUNITY PARTICIPATION

Each of the six winning teams received a $3,000 award, provided by UMBC's Alex. Brown Center for Entrepreneurship. The apps submitted were reviewed by a panel of judges from large corporations, start-up companies, and academia.

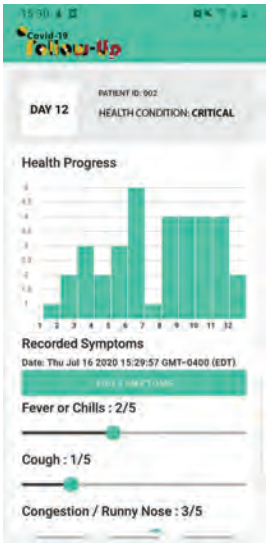
Undergraduate and graduate students were invited to participate, as well as university staff, faculty, postdoctoral researchers, members of USM-affiliated startup companies and small businesses. Winners hailed from UMBC, University of Baltimore, Towson University, and University of Maryland, College Park.

## TRACKING HEALTH CONDITIONS OF COVID-19 PATIENTS

In the community category, Kirubel Tolosa M.S. '23, information systems; Pradeep Margasahayam Prakash M.S. '21, information systems; and Raghav Deivachilai M.S. '23, computer science, created an app called Follow-up. The app enables healthcare providers to track the condition of people with COVID-19 who are isolating at home. By receiving regular symptom updates, physicians and nurses are able to more easily follow-up with their patients as needed.

The Follow-up team entered the app challenge with the goal of developing an app that would help address the spread of the virus and its impact on affected individuals. At the same time, they knew they had to design and prototype their app in a short time frame, so their scope and requirements had to be manageable.

"This challenge has taught us the value of teamwork and collaboration," said Tolosa, on behalf of the group. "We are looking forward to working on this app further to put it to use in a real-world setting."




From TOP: The Follow-up app interface. Image courtesy of the Follow-up team; Kirubel Tolosa. Photo courtesy of Tolosa; Pradeep Prakash. Photo courtesy of Prakash; Raghav Deivachilai. Photo courtesy of Deivachilai.

## SUPPORTING RESTAURANTS DURING COVID-19


From TOP: The Snuggrub app interface. Image courtesy of the Snuggrub team; Emily Sullivan. Photo courtesy of Sullivan; Dominic Crofoot. Photo courtesy of Crofoot.

The app Snuggrub, developed by Emily Sullivan '21, computer science, and Dominic Crofoot '19, computer science, was a winner in the student category. Sullivan and Crofoot focused on the way that many formerly full-service restaurants shifted to pick-up only service or outdoor dining during the pandemic. At the same time, dining regulations, guidance, and options began changing frequently. They developed a way for users to stay up-to-date on information about nearby restaurants without needing to contact individual businesses to ask the same questions repeatedly.

The app allows users to stay informed and receive real-time updates, while making decisions based on current information. It also supports restaurants in connecting with customers and providing them with the information they need to dine safely.

Sullivan shares that the idea for Snuggrub came from wanting to support small businesses that were facing challenges due to isolation during COVID-19. "During the time when restaurants were just opening back up for indoor or outdoor dining, it was messy trying to figure out if the hours and information posted online were accurate and updated. The only way to figure it out was to call them directly, which is time-consuming for both us and the restaurant," she says. "So Snuggrub became a way to have all that information in one place and have it easy to understand."

The opportunity to develop an app to help address a challenge facing people across the state was appealing to Sullivan and Crofoot because it allowed them to put their skills to the test. They met when they were both interns at the Anne Arundel County Office of Information Technology. While Sullivan is still a UMBC student (and interning with the federal government), Crofoot is currently a full stack developer for Anne Arundel County.

"Dominic and I both have experience creating applications from our jobs, but this process was totally different since we were creating something from the ground up and we were doing it with such a small team and short deadline as well," says Sullivan. "This definitely was a learning experience in personal discipline and timeline management."

Priyanka Ranade '18, M.S. '19, information systems at Northrop Grumman. Photo courtesy of Ranade.

# MEET THREE COEIT RETRIEVERS WHO WENT FROM INTERNSHIP TO CAREER SUCCESS WITH UMBC CAREER CENTER SUPPORT

BY KAIT MCCAFFREY

Decades after the start of the internship boom, internships continue to be invaluable for both undergraduate and graduate students. As UMBC students demonstrate, gaining real-world experience and networking within an area of interest can have a lasting impact when it comes time to search for a full-time position.

"Most employers use internships as a recruiting tool to find their future full-time employees," says Christine Routzahn, director of the Career Center. "Nearly 60 percent of our recent graduates who were employed at graduation indicated that they accepted full-time offers with an organization that they interned or worked for while at UMBC."

These students were able to use the skills and tools they acquired as interns to transition to full-time positions after their UMBC graduation. Many took advantage of the opportunities afforded by UMBC's Career Center to secure their positions. According to Susan Plitt, associate director of the UMBC Career Center, "Nearly 800 employers visited the UMBC campus last year to connect with our students. Each semester, we coordinate career and internship fairs to aid in making these connections."

The Fall 2019 Career and Internship Fair, held on September 25, hosted 160 organizations, many of whom were seeking summer 2020 interns from first-year undergraduates to advanced graduate students.

Here, three recent UMBC alumni share how they used campus resources and connections to secure full-time positions and move forward in their career, with advice for today's UMBC students.

## DISTINGUISH YOURSELF BY GETTING INVOLVED

Mamadou Diallo '19, mechanical engineering, took advantage of numerous professional organizations while at UMBC to help prepare himself for his future career. He was an active member of the National Society of Black Engineers, the American Society of Mechanical Engineers, and was a Mechanical Engineering S-STEM Scholar. When he began connecting with employers, this high level of involvement helped distinguish him among other candidates.

"My advice to other students is to be involved in extracurricular activities. After being hired [for my internship], I spoke with one of the recruiters as to why I was selected out of the many applicants. She replied that my involvement outside of the classroom were what stood out the most," says Diallo.

Mamadou Diallo '19, mechanical engineering, poses for a headshot. Photo courtesy of Diallo.

To find this dream internship, Diallo didn't have to go any farther than the Retriever Activity Center (RAC). At the annual Career Fair, he met with representatives from Regal Beloit and followed up through UMBCworks to secure his internship, which later led to a full-time engineering position.

As an engineering design and applications intern for a manufacturer of electric ▸▸

motors, Diallo worked to best meet the needs of customers. This included making recommendations to ensure pricing was fair and accurate, and tools continued to meet industry standards.

Diallo was able to boost workflow efficiencies at the company. Thanks to his strong track record as an intern, he was hired as a full-time application engineer prior to graduating from UMBC this past spring.

"UMBC was invaluable in helping me to secure my internship and career," says Diallo. "The Career Center helped me work on my resume and practice my interviewing skills, and reverse interviews allowed me to interview alumni and learn so many valuable lessons from them."

Chris Mills '19 working on his research for Google. Photo courtesy of Mills.

## CONTINUE YOUR WORK OUTSIDE THE CLASSROOM

As a computer science major, Chris Mills '19 figured out how to stand out from the crowd when vying for a position with one of the biggest names in technology: Google.

"I think what set me apart from other students (especially ones applying from big name schools such as MIT) was the amount of programming outside of class I did," he explains. "HackUMBC played a large part in my practical proficiency, allowing me to create a product from scratch, to utilize other people's libraries, and to work with other teammates on a singular project."

Mills attended on-campus career fairs and spoke with recruiters on-site to find an internship that best suited his interests. His goal was to work in a well-established business in the technology industry with a strong work/life balance and positive workplace culture. He was offered a position as a software engineer intern at Google for summer 2017 and returned the following summer to continue his work.

The coursework Mills completed while at UMBC benefited him greatly in his position at Google, he says. "In many of my required courses, the class lectures gave a good foundation of the theoretical knowledge, while the projects/homework showed practical applications that can and will be used in a software engineer's career," he explains.

Since Mills completed two Google internships, he was able to bypass the traditional interview process and start

*"[T]his was the community I wanted to learn in."*

**– PRIYANKA RANADE '18, M.S. '19, INFORMATION SYSTEMS**

full-time at Google this past summer, immediately after graduation. Mills now works with the Google shopping team as a software engineer building solutions to reduce both latency and space of shopping data that is served to users.

## BUILD RELATIONSHIPS WITH THOSE AROUND YOU

It was love at first sight when Priyanka Ranade '18, M.S. '19, information systems, joined the UMBC community.

"As soon as I stepped foot onto UMBC's campus, I could see that it replicated the world I wished to see around me," says Ranade. "The level of diversity, sense of community, as well as UMBC's clear repertoire of grit and support showed me right away that this was the community I wanted to learn in."

Ranade found an incredibly strong support system in her campus mentors: Anupam Joshi, chair and professor of computer science and electrical engineering; Karuna Joshi, information systems; and Cindy Greenwood, assistant director of the Cyber Scholars program. Ranade actually discovered her internship through an on-campus event through the Center for Women in Technology, a partnership with the Cyber Scholars Program.

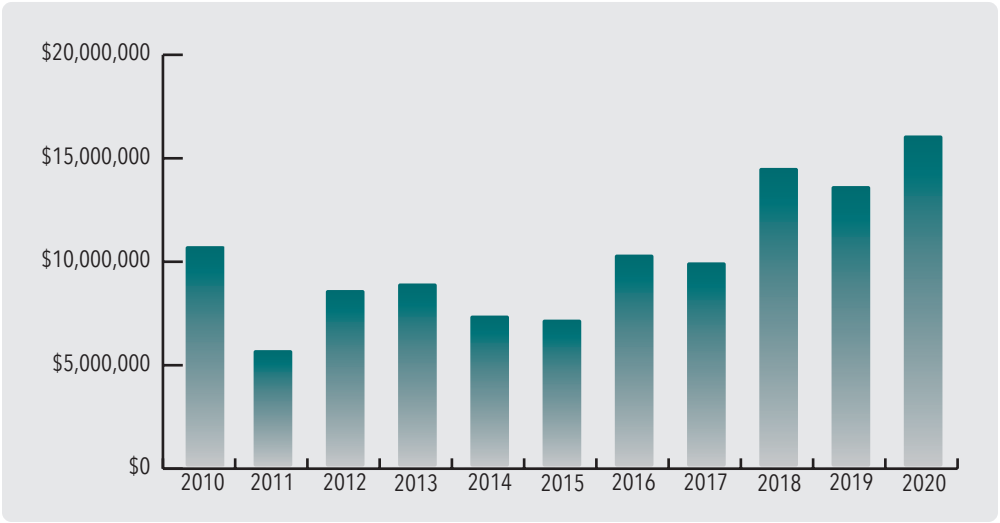
"I knew I wanted to learn about cybersecurity issues beyond the undergraduate classroom level," she says. She actively sought out opportunities through networking, which led to an internship at Northrop Grumman. "Northrop Grumman gave me a big picture idea of cyber and allowed me to spend time in different parts of the company, as well as hear the experiences and journeys of other employees," Ranade explains.

To prepare for her interview, Ranade had her resume reviewed by UMBC's Career Center and took advantage of mock interview opportunities to be fully prepared. After a successful summer as a cyber strategy intern, Ranade's manager recommended her to the Pathways Program, one of three rotational programs at Northrop Grumman.

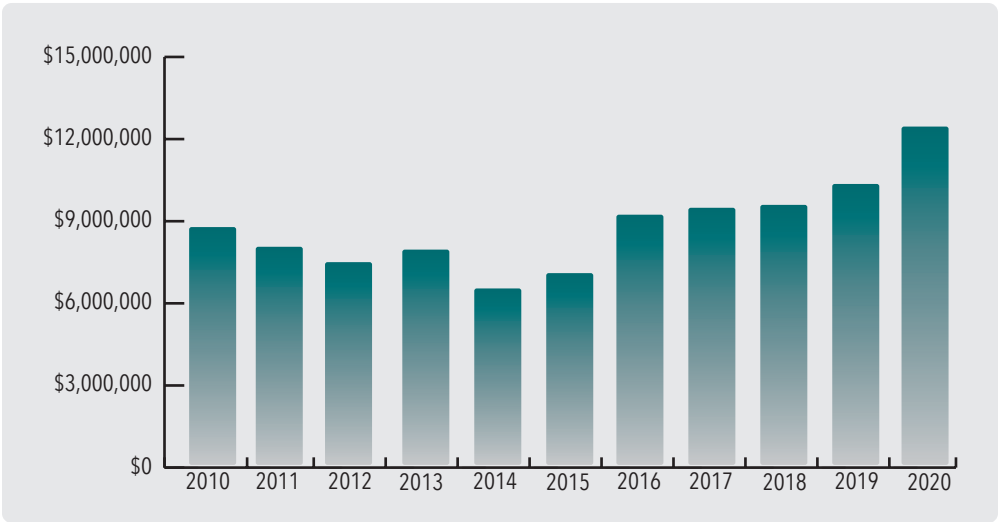
Ranade currently works in research and development doing machine learning work for military systems at Northrop Grumman. She credits the relationship-building skills she developed at UMBC for her success.

"Out of the many lessons UMBC has taught me, the most prominent one is the strong combination of sincerity in your work as well as fruitful relationships. Relationships are key in building your career," says Ranade. "Sharpening your skills is one thing, but having mentors who see your potential and guide you to greater heights than you could imagine is key."

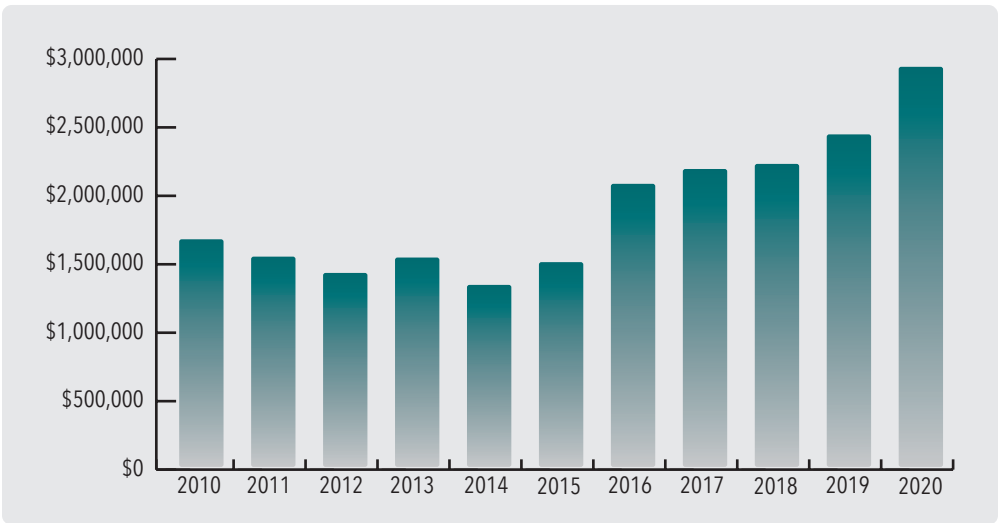
## RESEARCH AWARDS BY FISCAL YEAR




## RESEARCH EXPENDITURES BY FISCAL YEAR




## F&A RECOVERIES BY FISCAL YEAR



# 124%

INCREASE IN RESEARCH AWARDS FY 2015 – FY 2020

# 100%

INCREASE IN F&A RECOVERIES FY 2015 – FY 2020

# 73%

INCREASE IN RESEARCH EXPENDITURES FY 2015 – FY 2020

# 59%

INCREASE IN FTES 2011 – 2020

# 49%

INCREASE IN HEAD COUNT 2011 – 2020

# 68%

INCREASE IN DEGREES AWARDED 2011 – 2020

# 60%

INCREASE IN CREDIT HOURS 2011 – 2020

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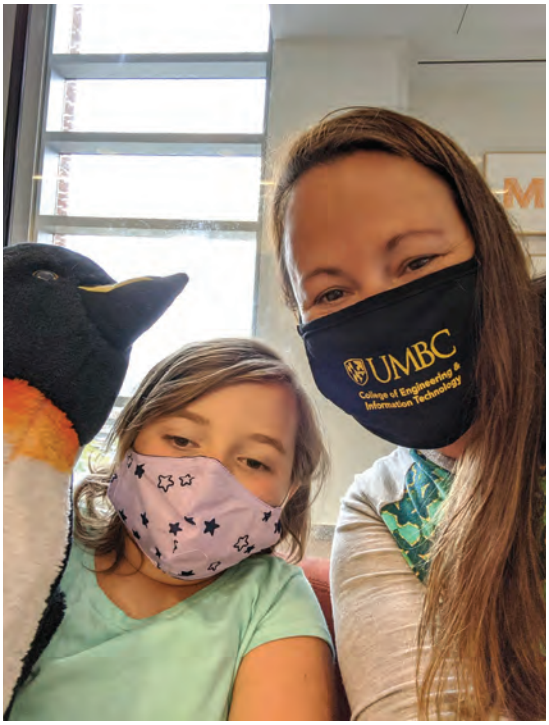
INCREASE IN AFRICAN AMERICAN HEAD COUNT 2011 – 2020

# 90%

INCREASE IN DEGREES AWARDED AFRICAN AMERICANS 2011 – 2020

# COEIT BY THE NUMBERS

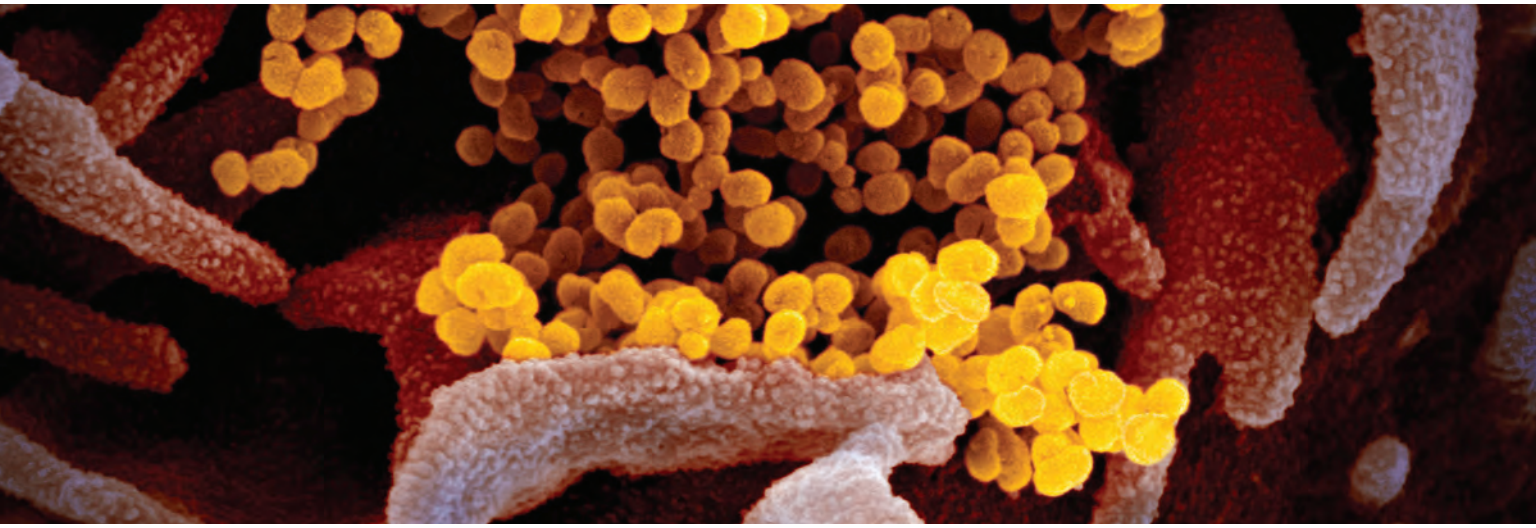






Clockwise, from TOP LEFT: Brandi Loftus and daughter. Photo courtesy of Loftus; Michael Palmer, Assistant Dean of Finance and Administration, Photo courtesy of Palmer. Maria Sanchez, Director of Education and Outreach. Photo courtesy of Sanchez; Karl Steiner, Vice President for Research, UMBC. Photo courtesy of Steiner.

# COVID-19



Novel Coronavirus SARS-CoV-2. Photo by NIAID, used under CC 2.0.

# UMBC RESEARCHERS RECEIVE NSF RAPID GRANT TO SPEED COVID-19 DETECTION THROUGH A DEEP NEURAL NETWORK

BY MEGAN HANKS

A research team from UMBC and the University of Maryland School of Medicine (UMSOM) has received a Rapid Response Research (RAPID) grant from the National Science Foundation to detect COVID-19 infections earlier through computing. Aryya Gangopadhyay, professor of information systems at UMBC, is PI on the grant. He explains that this work will use machine learning to improve the speed and accuracy of COVID-19 diagnosis, helping to limit spread of the disease.

## DEVELOPING HIGHLY ACCURATE SCREENING TOOL AND SYNTHETIC DATASETS

Through the year-long grant totaling approximately $150,000, researchers will design, build, and train deep neural networks to detect cases of COVID-19. Gangopadhyay says this approach has a proven track record. Deep neural networks have already been used effectively in diagnosing pneumonia.

This research will combine the power of AI and medical imaging to solve a critical problem in infectious diseases with pandemic potential, including COVID-19 and others, explains Gangopadhyay. “Our focus for this research

Aryya Gangopadhyay. Photo by Marlayna Demond ’11 for UMBC.

> "THE RESEARCH IS AN EXAMPLE OF MULTIDISCIPLINARY DATA SCIENCE THAT COMBINES EXPERTISE IN DIFFERENT FIELDS, SUCH AS MEDICINE AND COMPUTATIONAL RESEARCH."
>
> – ARYYA GANGOPADHYAY

is COVID-19. The research is an example of multidisciplinary data science that combines expertise in different fields, such as medicine and computational research," he says.

## RESEARCH TEAM

Gangopadhyay notes that the research will benefit from the infrastructure, research strength, and industrial partnerships of UMBC's Center for Accelerated Real Time Analytics (CARTA).

UMBC's team includes Yelena Yesha, distinguished professor of computer science and electrical engineering (CSEE) and director of CARTA; Yaacov Yesha, professor of CSEE; Phuong Nguyen, research assistant professor of CSEE; David Chapman, assistant professor of CSEE; and computer science Ph.D. students Sumeet Menon and Jayalakshmi Mangalagiri. Eliot Siegel, professor and vice chair of radiology at UMSOM and chief of imaging service at the VA Maryland Healthcare System, will contribute to the research.

The team plans to work quickly and hopes to have some results available by August. Then, the researchers will work with clinicians to validate their models and data to ensure that the tools are highly accurate in predicting COVID-19.

"We are very committed to this work," Gangopadhyay says, recognizing the incredible potential of the research.

## COLLABORATION DURING PUBLIC HEALTH CRISIS

This is UMBC's second NSF RAPID Grant responding to COVID-19. In early March, UMBC's Charissa Cheah, professor of psychology, and Shimei Pan, associate professor of information systems, and Cixin Wang, assistant professor of school psychology at University of Maryland, College Park, received a grant to examine the intensified discrimination experienced by Chinese-Americans in the time of COVID-19.

Cheah shared, "Knowledge from this RAPID grant will help educators, health care providers, and policymakers to proactively support targeted marginalized groups and the larger public during future emergency events."

Both UMBC awards demonstrate the necessity to move quickly and to collaborate strategically on research related to this public health crisis.

# UMBC'S DIPANJAN PAN DEVELOPS RAPID DIAGNOSTIC TEST FOR VIRUS CAUSING COVID-19

## BY MEGAN HANKS

Novel Coronavirus SARS-CoV-2. Photo by NIAID, used under CC 2.0.

Dipanjan Pan. Photo courtesy of the University of Illinois at Urbana-Champaign.

A team led by UMBC's Dipanjan Pan has developed an experimental diagnostic test to rapidly detect the novel coronavirus causing COVID-19, potentially as early as the first day of infection. Researchers designed the test to show results visually, through a color change visible with the naked eye when the virus is present. Unlike other tests, it does not require advanced laboratory techniques or tools. The American Chemical Society recently published their paper on the technique in the journal ACS Nano.

Pan is both a professor of chemical, biochemical, and environmental engineering at UMBC and professor of diagnostic radiology and nuclear medicine and pediatrics at the University of Maryland School of Medicine (UMSOM). His co-authors included UMSOM Pan Lab researchers Parikshit Moitra and Maha Alafeef, and UMBC faculty research assistant Ketan Dighe. The work also included Matthew B. Frieman, a UMSOM faculty member from the Virology Institute.

## FROM SAMPLE TO RESULTS IN TEN MINUTES

Like some other diagnostic tests, this one starts with a nasal swab or saliva sample. After the sample is retrieved, a technician extracts RNA from it through a 10-minute process. This process then uses a biosensor molecule attached to gold nanoparticles to detect a particular protein unique to the virus. When the molecule attaches to the protein, the gold nanoparticles respond by causing a chemical used in the test to turn blue.

As recent media reports have revealed, current tests that are used to diagnose COVID-19 are not always reliable, with high rates of false negatives and false positives. Pan hopes the design of this new diagnostic test will avoid some of these pitfalls.

"Many of the diagnostic tests currently on the market cannot detect the virus until several days after infection. For this reason, they have a significant rate of false negative results," he explains. A test that can detect the presence of the virus sooner after infection would avoid this issue.

## HOLISTIC APPROACH

"We are taking a holistic approach for sensing COVID-19 virus," says Pan. "My lab is developing highly specific technologies for rapid sensing of the virus. A different variant of such can be deployed in the hospital settings, community-based centers, and even at home."

Pan notes, "Our immediate goal is to continue to analyze clinical samples to confirm the laboratory-based sensitivity results with the clinical cases. If successful, this rapid detection technology will be a significant advancement in early detection of the virus."

Pan is now pursuing emergency use authorization for the test through the U.S. Food and Drug Administration, as he develops it for commercial application.

Pan is the chief technology officer and co-founder of KaloCyte, Inc., a biotechnology company that is developing a synthetic substitute for red blood cells. KaloCyte, Inc. recently received a $300,000 investment from the University System of Maryland Momentum Fund. Pan is also a co-founder of Innsight Tech, Inc. an Illinois spin-off for developing technologies for ocular disease. His third start-up company, VitruVian Bio, has recently been formed to translate COVID-19-based biosensing technologies.

"IF SUCCESSFUL, THIS RAPID DETECTION TECHNOLOGY WILL BE A SIGNIFICANT ADVANCEMENT IN EARLY DETECTION OF THE VIRUS."

– DIPANJAN PAN

# UMBC'S FOAD HAMIDI RECEIVES NSF RAPID GRANT TO EXPAND FREE, SECURE INTERNET ACCESS IN BALTIMORE DURING COVID-19 AND BEYOND

BY MEGAN HANKS

DURING THE **COVID-19 pandemic, internet access has become more critical, with people relying on it to work, learn, and connect with family and friends. However, the internet is not equally accessible to all people. UMBC's Foad Hamidi recently received a collaborative Rapid Response Research (RAPID) grant from the National Science Foundation (NSF) to increase high-speed wireless internet access to communities in Baltimore.**

**Not having access to the internet has heightened existing inequities during the pandemic, says Hamidi, assistant professor of information systems. "It impacts families in different ways, whether it's related to education, employment, or social connections," he explains.**

**Hamidi will collaborate with the Digital Harbor Foundation, Project Waves, and other community groups to increase the accessibility of wireless internet that is both free and secure.**

## BUILDING AND SUSTAINING NETWORKS

**The Digital Harbor Foundation (DHF) is a Baltimore-based tech center that enables youth to learn about technology through hands-on learning, including through a**

well-equipped makerspace. Project Waves is a non-profit organization that provides pay-what-you-can broadband internet to communities in need. Their work with Hamidi will focus on supporting residents who want to get internet access set up in their homes and to study the impact of having this access.

Hamidi and his collaborators will work with other groups to amplify free and secure wireless internet in accessible spaces, such as libraries and community centers. For some groups, this work will be new. For others, the grant will allow them to speed up work they've already been doing.

Importantly, Hamidi notes, the community organizations will help sustain these networks over time. "The pandemic has amplified the need for internet access, but it will continue after the crisis," he says.

"The COVID-19 crisis is a complex and multifaceted phenomenon that amplifies the inequities already present in our societies," explains Hamidi. "In this project, we are taking into account both the social and technical aspects of providing free and secure internet access to low-income communities. More broadly, we look forward to better understanding how participatory approaches to internet access can address issues of inequity arising from the digital divide in our cities." ▸▸


Foad Hamidi. Photo by Britney Clause, '11.

> "THE COVID-19 CRISIS IS A COMPLEX AND MULTIFACETED PHENOMENON THAT AMPLIFIES THE INEQUITIES ALREADY PRESENT IN OUR SOCIETIES."
>
> – FOAD HAMIDI

## INCREASING ACCESS TO COMPUTING SKILLS

Hamidi's project is also part of a larger effort, based at UMBC, to expand access to basic computing skills among students in Baltimore City as well as nearby Montgomery County. This is the goal of Megean Garvin, director of research and assessment for the Maryland Center for Computing Education (MCCE).

The COVID-19 pandemic has pushed the issue of computing education to the fore, as more and more students and educators recognize the value of computing skills in this time of physical distancing. However, Garvin says, the teaching workforce needs professional development to not only use technology, but be able to create their own computer science curricula and classroom resources.

The MCCE, initially funded by Maryland in 2018, has worked to provide professional development in computing for teachers across the state and has begun to transform teacher preparation as well. By the 2021 – 2022 school year, all public high schools in Maryland will be required to offer a high quality computer science course, and elementary and middle schools will be expected to integrate computer science into their curricula. The MCCE is working to help teachers and schools reach that target and have confidence in the quality of their computer science offerings.

To ensure teachers can be successful in providing students with computing education, Garvin notes, it is essential to take into account the "digital divide," particularly in Baltimore City. Even with the most advanced training and support, computing teachers can't be effective if their students can't access computing devices and, as Hamidi's work highlights, the internet.

## COMPUTING EDUCATION ECOSYSTEM

In response to this challenge, the MCCE and partners created the Baltimore City Computing Education Ecosystem Workgroup. This partnership includes the University System of Maryland, UMBC, University of Baltimore, Baltimore City Community College, Morgan State University, and Towson University, plus Baltimore City-based organizations such as the Digital Harbor Foundation and Code in the Schools. Their goal is to develop and deliver on strategies for a robust computing education for students from pre-kindergarten to high school, in the context of COVID-19 and remote learning.

In addition to the grant Hamidi has received to work in this area, Garvin has been awarded a two-year grant from the Spencer Foundation to study the Baltimore Urban Computing Education Ecosystem's response to COVID-19.

The Engineering and Computing Education Program in UMBC's College of Engineering and Information Technology has also developed a similar computing education partnership in Montgomery County. There, UMBC at the Universities at Shady Grove is working closely with Montgomery College and Montgomery County Public Schools to support a culture shift in computing education. As in Baltimore, they hope to provide technology access and learning opportunities in computing for all students.

"Access to reliable and affordable internet connectivity has become a new necessity in our dynamic and information-rich century," says Hamidi. "We need to investigate conditions necessary for communities to have an active role in shaping, creating and taking ownership of the technologies they need."

Foad Hamidi and UMBC colleagues. Photo by Britney Clause, '11, taken prior to COVID-19 pandemic.

# UMBC LEADS RESEARCH TEAM TO STUDY COVID-19-RELATED DISCRIMINATION AGAINST CHINESE AMERICANS

BY MEGAN HANKS

Charissa Cheah.

Shimei Pan.

Cixin Wang. Photo courtesy of UMD.

As the COVID-19 outbreak originating in China has spread to populations across all continents except Antarctica, racism and discrimination against Chinese-American people have also increased. A team of researchers from UMBC and the University of Maryland, College Park (UMD) just received a Rapid Response Research (RAPID) grant from the National Science Foundation to examine this intensified discrimination. They are also researching Chinese-American families' coping strategies.

This research is led by PI Charissa Cheah, professor of psychology at UMBC. Her co-investigators are Shimei Pan, assistant professor of information systems at UMBC, and Cixin Wang, assistant professor of school psychology at UMD. Their study, "RAPID: Influences of the Coronavirus (COVID-19) Outbreak on Racial Discrimination, Identity Development and Socialization," is the one of first NSF research awards granted to examine the COVID-19 outbreak.

Cheah, Pan, and Wang will collect data on public opinion, the social climate, and the experiences of Chinese-American families. They seek to capture the current moment and make it possible for future researchers to study this phenomenon in the longer term.

"The negative impact of infectious diseases on psychological health is understudied but highly significant, especially for minority groups

linked to the disease through social group categorization," says Cheah. She explains, "The results from this study will significantly contribute to our understanding of risk and resilience processes among parents and children under conditions of an acute but prolonged health and social threat."

## UNDERSTANDING THE IMPACT

As social scientists, Cheah and Wang will conduct focus groups and surveys to understand how various forms of racial discrimination connected to the COVID-19 outbreak are impacting families, particularly the identity development and adjustment of Chinese-American children. After the initial research phase, they will complete follow-up research six to nine months later to learn how parents have helped socialize their children and offered coping strategies around issues of race, identity, and psychosocial adjustment, in response to discrimination.

Pan, a computer scientist, will lead the analysis of outbreak-related Twitter posts to understand how public opinion, including anxiety and discriminatory attitudes, change as the outbreak intensifies or slows. Pan will apply large-scale social media analytics to study Twitter data from late 2019 onward, to ensure she captures posts from the moment the COVID-19 outbreak began.

The research is significant to Pan on a personal level, as a Chinese American and a parent. "I am aware of the related events and sentiments expressed in the news. As a parent to a Chinese American teenage son, I wonder how this experience will influence his identity formation now and as an adult," she shares.

This project will also provide graduate and undergraduate students with an opportunity to conduct culturally-sensitive research with racial and ethnic minority families using multi-method and interdisciplinary approaches.

"As a researcher focusing on bullying and mental health, I have seen and heard about discrimination towards Chinese-American and other Asian-American students, and increased anxiety related to COVID-19," says Wang. "We aim to study the unfolding outbreak and related discrimination against Chinese Americans and other Asian populations to identify specific ways to promote resilience and support children and families during this challenging time."

> *"As a parent to a Chinese American teenage son, I wonder how this experience will influence his identity formation now and as an adult."*
>
> – SHIMEI PAN

Cheah values the opportunity to do research that will immediately impact an urgent real-world issue, and also have a lasting impact on communities. She notes, "Knowledge from this RAPID grant will help educators, health care providers, and policymakers to proactively support targeted marginalized groups and the larger public during future emergency events."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Previous page, clockwise from TOP LEFT: Dr. Ruey-Hung Chen, Chair, Mechanical Engineering. Photo courtesy of Helena Mentis; Flynn Wolf, HCC PhD Student. Photo by Marlayna Demond '11 for UMBC; Andrea Kleinsmith, Assistant Professor, Information Systems. Photo by Marlayna Demond '11 for UMBC; Virtual reality equipment. Photo by Marlayna Demond '11 for UMBC; Helena Mentis, Associate Dean for Academic Programs and Learning. Photo by Marlayna Demond '11 for UMBC; Drs. Mark Marten and Dipanjan Pan, COEIT Welcome Back Celebration. Photo courtesy of Helena Mentis. All photos taken prior to COVID-19.

# FACULTY ACCOMPLISHMENTS AND RESEARCH

# UMBC'S NAGHMEH KARIMI RECEIVES NSF CAREER AWARD TO DEVELOP LONG-LASTING SECURITY FOR CRYPTOGRAPHIC CHIPS

BY MEGAN HANKS

Naghmeh Karimi is the most recent UMBC faculty member to receive a prestigious CAREER Award from the National Science Foundation (NSF). The grant, totaling approximately $500,000 over five years, will support her work to investigate how device-aging related risks compromise the security of cryptographic devices.

Karimi explains that cryptographic chips offer continued advances in authenticating messages and devices as well as preserving the integrity and confidentiality of sensitive information. They do so by implementing cryptographic algorithms in hardware. These chips combine the benefits of cryptographic applications with the speed and power advantage of hardware implementations.

Despite their significant benefits, cryptographic chips can be compromised by adversaries who have gained physical access to the chips. Current protections against such attacks do not consider the aging of devices, which can shift device parameters over time.

## ADDRESSING SECURITY VULNERABILITIES

Aging makes cryptographic chips operate slower and, ultimately, results in their malfunction, says Karimi. She explains that the typical lifetime of integrated circuits is 7 to 8 years. As the devices age, their performance decreases. Karimi is exploring the specific security vulnerabilities of aged devices and how they can be protected.

"We want to preserve the security of devices over their lifetime," Karimi says.

Karimi and her research team will study whether the success of the side-channel analysis and fault-injection attacks increase in older devices. Karimi will create and test several countermeasures to protect devices against such attacks.

## CONNECTING STUDENTS WITH OPPORTUNITIES IN TECH SECURITY

The CAREER Award funding will support several UMBC undergraduate and graduate student researchers working with Karimi to develop long-lasting security solutions for hardware platforms.

At the same time, Karimi will also develop and launch a new course in UMBC's computer science and electrical engineering department on cryptography, hardware security, and testing. She will also work with the UMBC Cyber Scholars Program to connect students with internship opportunities focused on hardware security, to give them additional hands-on experience in the field.

"The success of this project will enable us to develop long-lasting security for trusted hardware platforms," Karimi says. "This will result in aging-resistant security solutions that benefit society through devices that remain secure over their lifetime."

# UMBC'S JIANWU WANG RECEIVES NSF CAREER AWARD TO HELP CLIMATE SCIENTISTS MAKE DISCOVERIES FROM MASSIVE, COMPLEX DATA SETS

BY MEGAN HANKS

Milford Lake, Kansas, USA. Photo by USGS, United States Geological Survey, on Unsplash.

JIANWU WANG, assistant professor of information systems, is the most recent UMBC faculty member to receive a prestigious CAREER Award from the National Science Foundation (NSF). Wang's NSF grant totals more than $500,000 over five years. It will support his work to develop more efficient and reproducible causality analytics for use in climate science.

Understanding cause and effect is fundamental to research in many disciplines. There are some unique challenges in using climate data to discover cause-effect relationships. Wang explains that Earth changes so rapidly that climate scientists studying it must continuously capture a huge volume of data. Each point in time yields distinct information about the planet's environment, and there is no way to retest the climate to confirm causal relationships.

Jianwu Wang. Photo courtesy of Wang.

Rapidly available climate data can be challenging for researchers to keep up with, explains Wang. "Computation and data ▸▸

> "THESE FINDINGS COULD HELP US BETTER UNDERSTAND HOW EARTH'S CLIMATE SYSTEM WORKS."
>
> – JIANWU WANG

techniques have become the third and fourth paradigm for science in many disciplines," he says. "The novel computational and data science techniques we will study through this award could help climate or Earth scientists to quickly find interesting patterns from data and use data to conduct hypothesis testing."

## USING BIG DATA TO STUDY EARTH

Wang is exploring new ways of applying artificial intelligence and data science to studying Earth and its climate system. He has collaborated with faculty across UMBC, including in the physics department and the Joint Center for Earth Systems Technology, where he is an affiliated faculty member. These connections have helped him better understand the needs of climate scientists.

Recent advances in artificial intelligence and data science give hope to studying Earth from a data-driven perspective. Yet climate scientists are challenged by the need to process terabytes of data collected about Earth, Wang has learned. The data's volume and complexity can make it very difficult to examine, which could mean missed opportunities for insights.

Wang hopes that his work will help climate scientists better understand the data they have already collected, and find better ways to test their causality-related hypotheses. The end goal of the research is to develop a climate causality analytics platform that is scalable and reproducible.

## RESEARCH OPPORTUNITIES FOR STUDENTS

As he plans next steps, Wang is particularly looking forward to providing students with research opportunities. He will connect with graduate and undergraduate students through UMBC's Center for Women in Technology, McNair Scholars program, and Louis Stokes Alliances for Minority Participation (LSAMP) program. He will also connect with local high school students through UMBC's Shriver Center.

The range of perspectives these students bring will help Wang address the challenges posed by climate data, ultimately making it more useful and accessible. "We expect our research will help climate scientists efficiently discover causal relationships from complex climate datasets and easily share their findings with others," he explains.

"These findings could help us better understand how Earth's climate system works," Wang says. "Eventually, they could help us better predict and adapt to many specific climate-related events, such as extreme heatwaves, droughts, and floods."

# UMBC RESEARCHERS WORK TO SUPPORT FIRST RESPONDERS THROUGH NSF-FUNDED STRESS-RESPONSE TECHNOLOGY

BY MEGAN HANKS AND CATALINA DANSBERGER DUQUE

Researchers from UMBC's departments of information systems (IS) and emergency health services (EHS) are joining forces to help improve the lives of first responders. Through a $370,000 grant from the National Science Foundation, they are using a wristband to collect stress level information from first responders during simulations that mimic on-call situations. The researchers are developing a visual display system for the data to aid first responders in understanding and reflecting on how they react to stressful situations.

This information will ultimately enable those who train and support firefighters, police officers, and paramedics to help these first

Students in UMBC's emergency health services program have the wearable sensors set up before a simulation. Photo by Raquel Hamner '21, visual arts, for UMBC. Photo taken prior to COVID-19.

responders manage highly stressful situations. Their goal is to reduce the stress-induced health challenges that professionals in these fields can experience.

## BUILDING A RESEARCH TEAM

Andrea Kleinsmith, principal investigator, and J. Lee Jenkins, co-principal investigator, are leading a team of researchers for this project. The core group also includes co-investigators Helena Mentis, and Gary Williams '04 and M.S. '19, emergency health services. Kleinsmith and Mentis are IS faculty and Jenkins and Williams are EHS faculty. Mentis is also an associate dean in UMBC's College of Engineering and Information Technology, and Jenkins is the chair of the EHS department.

The initial phase of the project focuses on EHS juniors and seniors taking a course that includes emergency response simulations. The students on the project team collect physiological data that indicates the stress levels of simulation participants. The information they gather is informing the development of the system.

"One of the devices that we're using to collect the data is an E4 wristband by Emaptica," explains Kleinsmith. "It has sensors that collect data every quarter of a second, recording different physiological responses like heart rate, electrodermal activity, and skin temperature."

Kleinsmith notes, "We collect this information along with the video of the simulation." She hopes this will enable the team to develop a visual display for first-responder trainees to review their own stress-response information, to see how they work together as a team, and to see the connections between those two things. This will be an important first step in helping them limit and better manage on-the-job stress.

Clothilde Natividad '19, emergency health services, participated in the research program last year. She returns periodically to assist current students who are now enrolled in the class. "One of my best experiences as a student was being part of that research study," shares Natividad. As a participant, she was impressed by seeing that researchers in the field are aware of the stress first responders experience and are working to do something about it.

## HELPING FIRST-RESPONDERS RESPOND TO THEIR OWN STRESS LEVELS

The project places UMBC researchers at the cutting edge of IS and EHS fields with a collaboration designed to improve health outcomes for first responders. "The innovation component is not that we don't know how to track stress or give data back to people," says Mentis. "The part that no one has brought together until now is about collaborative teamwork in a stressful environment, and the first responders being capable of recognizing their own stress reactions and understanding how to respond when in the field and afterward."

The researchers aren't just observing the paramedic trainees and their instructors. They are in continuous dialogue with them as they work to determine what the stress information display will look like and what features they would find most helpful.

The information gathered so far on the stress responses of simulation participants is still very raw, but it's already proving useful. Program graduates have shared that "EHS simulation preparation is very close to the real world," says Williams. Having experience completing these

team-based simulations, and now receiving data about their bodies' stress responses to the simulations, helps them to recognize stress, to "remain calm when they are on call," and to work effectively on teams.

Williams notes, "Once trainees have graduated and are in the field with a real patient," the goal is that "they know what to do and their stress levels are not as high."

UMBC researchers and instructors observing students in the emergency health services program as they complete a simulation. Photo by Raquel Hamner '21, visual arts, for UMBC. Photo taken prior to COVID-19.

## INNOVATING TO SAVE LIVES

The long-term impact of this project goes beyond the classroom and into the field, where high rates of stress can impact the health of first responders and their families.

"You can imagine the daily stress that EMTs, firefighters, and police officers have is tremendous. The effect that it has on their life, wellbeing, and health is enormous, with heart attacks, strokes, and suicide," says Kleinsmith. "If we could find ways of improving their resilience by decreasing their stress response through education, that would enormously improve the health and lives of first responders."

As the project continues through the rest of this academic year, the researchers will get ever closer to seeing that desired impact. Over the next several months, they will continue to run team-based simulations, gather data, and continue processing the data to inform the physical design of the system and to see how having stress response information can change the experience of EHS trainees, as individuals and teams.

Word of the project is already beginning to reach the EMS community. Kleinsmith and Williams recently spoke at the International EMS Research Symposium in Louisiana, where they received the Best Oral Presentation award for their talk on how paramedic team emotional intelligence impacts performance.

Photo by Missael López on Unsplash

# SENSING AN OPPORTUNITY TO IMPROVE WIND ENERGY: MARYLAND INNOVATION INITIATIVE AND BWTECH HELP UMBC FACULTY COMMERCIALIZE THEIR RESEARCH

BY MEGAN HANKS

WIND TURBINES are massive, with a single turbine blade measuring up to 350 feet (about 110 meters), longer than the wingspan of some commercial airplanes. At its highest point, a blade can be 850 feet (260 meters) off the ground, almost reaching the height of Eiffel Tower. When UMBC engineer Soobum Lee looks up at these turbines, generating energy in fields and even offshore, he thinks about their size as an enormous opportunity, and also a challenge.

Lee, associate professor of mechanical engineering, studies energy harvesting, but not in a way that most casual observers would connect with wind turbines. He researches how vibrations can power portable devices on a very small scale, and he develops devices that convert those subtle vibrations into energy.

A few years ago, Lee began exploring how to harvest energy from the rotation of vehicle tires. This led him to begin looking at the spinning motion of wind turbines, and the additional small vibrations that turbines make as they spin continuously. He came up with a novel idea: using these small vibrations—not previously

Soobum Lee, right, with his business partners Ahmed Abdelaziz, center, and Pranay Kohli. Photo by Marlayna Demond '11 for UMBC. Photo taken prior to COVID-19.

harnessed for energy—to power transmitters that could send sensor data to a wind turbine's operation and maintenance systems.

Lee explains that wind turbines have sensors on their blades to alert their operators if the blade gets damaged, such as by birds or lightning, or if there is a malfunction or maintenance issue. For example, icicles can form on turbine blades, changing their aerodynamics. Or, the blade could be vibrating abnormally, indicating a more serious mechanical or structural issue in the blade.

Until now, these sensors have been powered by batteries that need to be changed every two years or so. Changing the batteries is time-consuming and can be dangerous for people maintaining the turbines, as they need to climb up the turbines, hundreds of feet in the air, to access multiple sensors on one blade.

"The sensors are to help with maintenance," says Lee. "If they also create a maintenance need, it's a problem." He wondered, what if you could design a sensor that wouldn't require new batteries?

## BRINGING RESEARCH TO CONSUMERS

Over the past 7 years, UMBC faculty from engineering and the sciences to the arts have worked to commercialize their research, to bring innovative technologies to companies and consumers. Knowing that this can be a challenging transition, UMBC and the State of Maryland have created a range of initiatives to help faculty pursue entrepreneurship opportunities. One core opportunity is the Maryland Innovation Initiative (MII), established by the state and five research institutions, including UMBC, to promote research commercialization.

A unique feature of the MII program is the introduction of university "site miners" to facilitate the application process for faculty inventors. These commercialization experts support faculty with preparing proposals and advocate for projects in the review process. UMBC site miner David Fink, entrepreneur in residence, says, "The MII program is the most significant factor in the increased commercialization of UMBC-owned intellectual property." Sixteen companies have been formed by UMBC faculty since the start of MII.

Since 2013, Lee has applied for three MII grants. His first two attempts were not successful but helped him grow his proposal. On his third try, he received a phase one grant to develop his vibration-powered sensor technology.

Through bwtech@UMBC, UMBC's research and technology park, Lee connected with Pranay Kohli, an energy sector executive with experience working with companies and clients around the world. In 2018, Lee and Kohli founded ACTIVEcharge, LLC, a startup that develops solutions to autonomously monitor wind turbines.

"Soobum and I have benefited tremendously from the MII program. Although we had the technology and the business skills, what MII and bwtech provided us was the ecosystem of ▸▸

professionals who have guided us along the way," says Kohli, CEO of ACTIVEcharge. "That has opened up so many doors for us as we move forward to commercializing the solution."

## TECHNOLOGY WITH AN IMPACT

Lee's work has continued to move forward since he received the MII grant. In the lab, he and his students have developed a power management circuit and have integrated it with a power source, sensor, and data transmitter that is about six inches tall and weighs about two pounds.

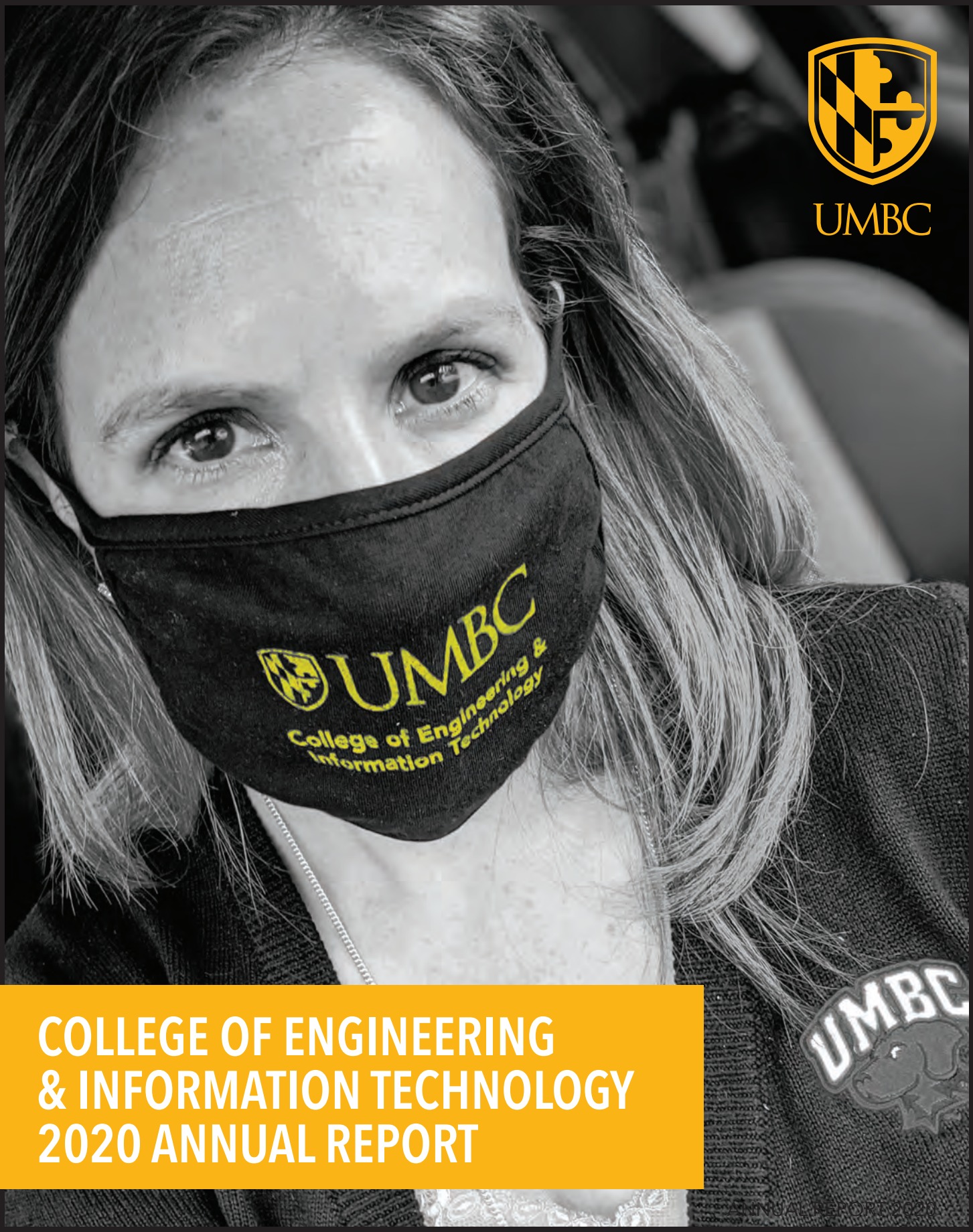
The sensor provides the signal to the transmitter, and the transmitter sends the data to a receiver. This process uses the energy produced by the attached mechanical generator, powered by vibrations from turbine blades. No external source of energy is needed. It is also designed to sit inside the blades, so it is completely protected from the elements and does not interfere with the blade aerodynamics.

Lee and Kohli hope that, in the next two to four years, their integrated solution will be installed on turbine blades across the country and internationally. Their goal is to provide turbine maintenance crews with near-real-time data that can support their work in a way that doesn't create additional labor or physical risk and prevents potential catastrophic events.

Sustainable energy projects are growing in the U.S., and now is an important moment to make technology improvements that will boost that growth further, Lee notes. He shares, "I want to make things even better than they are now."

The device that contains the sensor. Photo by Marlayna Demond '11 for UMBC.


Clockwise from TOP LEFT: Hank Mink, Mechanical Engineering. Photo courtesy of Mink; Lindita Dietzen, COEIT Shared Services. Photo courtesy of Dietzen; Mark Berczynski, Lecturer, Engineering and Computing Education. Photo courtesy of Berczynski; Cindy Greenwood and Thea Robertson, Center for Women in Technology. Photo courtesy of Greenwood.
Back cover photo: Jamie Gurganus (aka. Prof G), Associate Director. Photo courtesy of Gurganus.

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