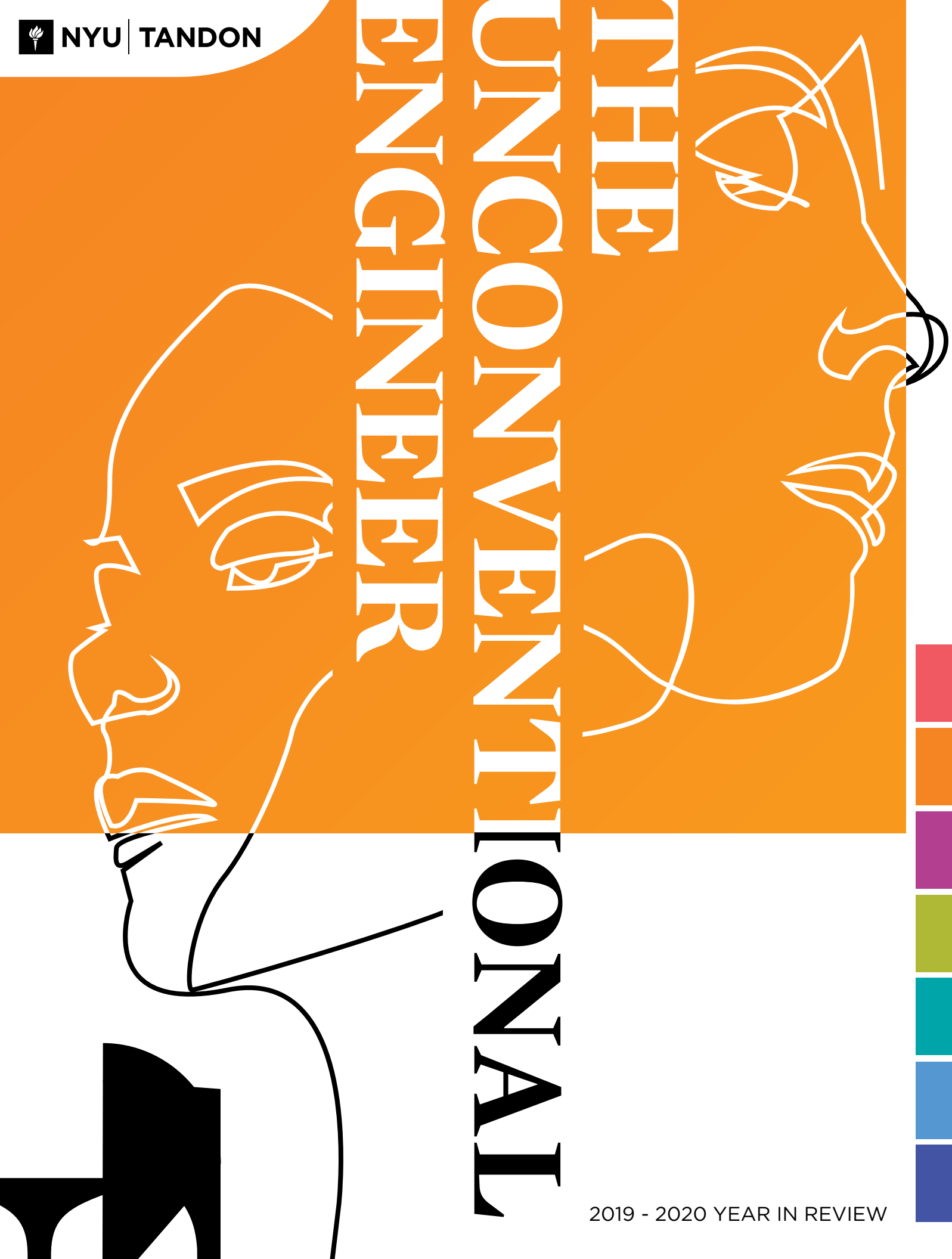
NYU | TANDON

THE UNCONVENTIONAL ENGINEER



2019 - 2020 YEAR IN REVIEW


NYU
TANDON SCHOOL
OF ENGINEERING
Polytechnic Institute
6
METROTECH
CENTER

LETTER FROM THE DEAN

WHEN THE UNPREDICTABLE HAPPENS, OUR THINKING HAS TO BE UNCONVENTIONAL

I don't need to tell you that 2020 has been a year of great upheaval. In the face of a global pandemic, elections, and unrest, it has been made abundantly clear that the world is crying out for innovative, critical solutions to the greatest issues affecting our lives. When the unpredictable happens, our thinking has to be unconventional. And NYU Tandon is where unconventional engineers learn, teach, research, and invent.

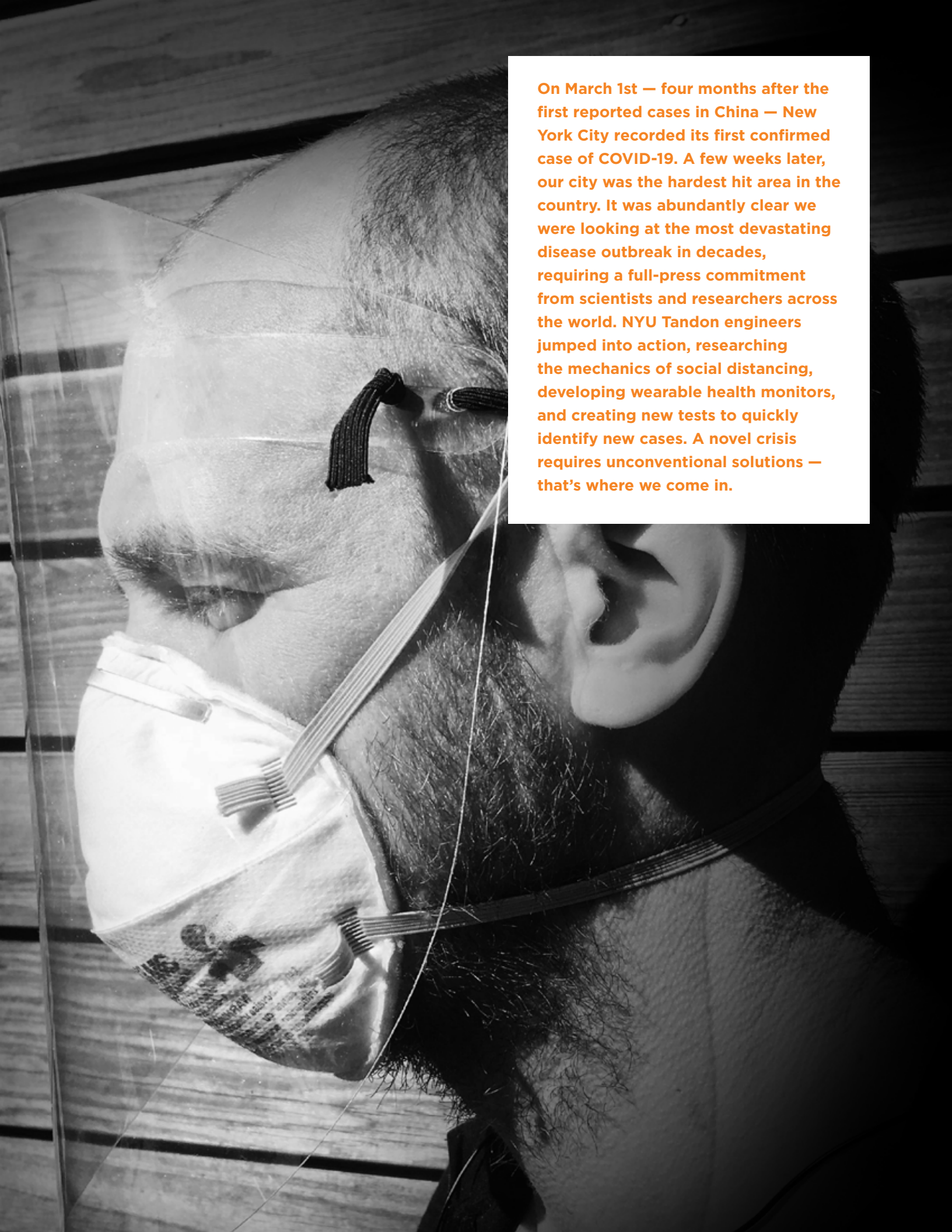
We are educating and empowering new generations of engineers who are capable of taking on unprecedented challenges. When the pandemic hit, we hit back. Our researchers attacked the problem head on, creating new technologies to study the way the disease spread and developing technologies to monitor symptoms and enhance testing. We were prepared because NYU Tandon has been working at the intersection of engineering, healthcare, and life sciences since long before 2020. We're creating next-generation solutions at every scale — from designing "labs-on-a-chip" to engineering biomaterials for targeted drug therapy to improving the nation's telehealth systems. We don't wait for a crisis — we look to the future to make good health and safety a priority.

We're also tackling threats to our lives in other ways. In the realm of politics, we are building technology to keep the democratic process fair and accountable, whether it s tracking political ad spending or tackling the rise of deepfake technology. In an increasingly online world, our cybersecurity experts are ensuring public safety in digital spaces, and we're helping build ethical AI, creating the next generation of robotics, redesigning cities so they work for everyone, and plenty more.

Our unconventional approaches are getting the recognition they deserve. We have rocketed more than 40 spots in the U.S. News Rankings in the last decade. Around half of our faculty members hold National Science Foundation CAREER or other young investigator awards. And we're accomplishing all this by creating a school that is actually reflective of the country we live in. We're narrowing the STEM gender gap, building an inclusive and welcoming place for all, and improving as an institution in the process. We've implemented a series of diversity and inclusion initiatives, released strategic plans to ensure greater participation from all populations in STEM, and remained dedicated to creating a campus that does New York City and Brooklyn proud.

Still, there is much work to be accomplished. The world has presented multiple problems that need to be addressed immediately. We're excited to take it all on. When our engineers come together and bring their know-how, creativity, and energy to bear, you can be sure that the solutions come from here in Brooklyn. It s what we call NYU Tandon Made — ideas born from equal parts determination, street smarts, innovation, entrepreneurship, and a healthy measure of heart.

So come take a look at what we're building at NYU Tandon. We promise, it s like nothing else you've seen before.



On March 1st — four months after the first reported cases in China — New York City recorded its first confirmed case of COVID-19. A few weeks later, our city was the hardest hit area in the country. It was abundantly clear we were looking at the most devastating disease outbreak in decades, requiring a full-press commitment from scientists and researchers across the world. NYU Tandon engineers jumped into action, researching the mechanics of social distancing, developing wearable health monitors, and creating new tests to quickly identify new cases. A novel crisis requires unconventional solutions — that's where we come in.

UNCONVENTIONAL YEAR

A GLOBAL PANDEMIC HITS. WE HIT BACK.

NATIONAL SCIENCE FOUNDATION RAPID GRANT RESEARCH

1 HUMAN INTERACTION IN A TIME OF PANDEMIC

PAUL TORRENS
Department of Computer Science and Engineering; Center for Urban Science and Progress

Understanding how people move around and interact with each other in the public sphere became more vital than ever when the COVID-19 pandemic hit. **Torrens**, whose research employs motion capture technology, is now exploring how new forms of spatial behavior emerge and testing how existing theories of spatial behavior hold under extraordinary circumstances.

Torrens is fine-tuning emergent relationships among citizen behaviours and regulations—work that could inform policy in this and future public-health crises. As we navigate a new normal, human interaction will continue to help define us as a society, and Torrens is adding clarity to that definition.

2 INTELLIGENT, WEARABLE TELEHEALTH DEVICES

S. FAROKH ATASHZAR
Department of Electrical and Computer Engineering; Department of Mechanical and Aerospace Engineering; NYU WIRELESS

YAO WANG
Department of Electrical and Computer Engineering; Department of Biomedical Engineering; NYU WIRELESS

In response to the pressing need for smart and scalable wearable technologies that could be produced rapidly to assist in monitoring COVID-19 patients, **Atashzar** and **Wang** developed a wireless smart IoMT (Internet of Medical Things) necklace containing sensors that can accurately, objectively, and continuously track multiple vital symptoms of respiratory malfunction and infection, thus covering a large spectrum of COVID-19 symptoms, and predicting the probability of health anomalies through machine intelligence and data modeling.

The device can be used in both home and hospital settings, and by means of novel machine learning models, the data it produces can aid practitioners in detecting early health anomalies and in predicting potential adverse events.

3 RESILIENT INFRASTRUCTURE SYSTEMS

YURY DVORKIN
Department of Electrical and Computer Engineering; Center for Urban Science and Progress

When many cities began enforcing shelter-in-place policies in order to slow the pandemic, **Dvorkin**, who heads the Smart Energy Research (SEARCH) Group, part of the Department of Electrical and Computer Engineering's Power Lab, knew it was likely to have an effect on vital physical infrastructure systems such as gas, electricity, water, and transportation. Given the looming danger that unusual demand could lead to outages and inability (or limited ability) to serve sheltered population groups, he designed a model that can represent infrastructure operations under various disease-outbreak scenarios and inform the development of efficient strategies to mitigate these vulnerabilities. His project, which bridges the gap between computational epidemiology and infrastructure modeling, also has applications in the fields of climate resiliency and environmental sciences and public health and response preparedness.

4 LEVERAGING MOBILITY DATA

CONSTANTINE KONTOKOSTA
Department of Civil and Urban Engineering; Center for Urban Science and Progress

How effective is social distancing? Will some groups be more affected by the impacts of shelter-in-place mandates and the disease itself than others? Those questions swirled as the extent of the pandemic was becoming evident, and **Kontakosta** quickly marshalled anonymized smartphone location data from millions of users in New York City to study "exposure density"—a dynamic measure of neighborhood activity levels—thus allowing public health officials to estimate the likelihood of successful containment efforts for specific localities and predict where future localized outbreaks and chains of transmission could emerge.

5 3D-MAPPING HOT SPOTS

DEBRA LAEFER
Department of Civil and Urban Engineering; Center for Urban Science and Progress

When the pandemic hit, **Laefer** immediately sent researchers into the field to observe potential hot spots outside hospitals and mass transit hubs to record what people were touching — and thus the most likely surfaces to carry the coronavirus. (Virus mapping dates to 1854, when John Snow traced the source of a cholera epidemic in London to infected wells.) NYU teams, however, used geospatial data to pioneer a more accurate and effective tool for this virus: 3D mapping. Their data is available through NYU's Spatial Data Repository.

Their study set the groundwork for machine learning models to speed the analysis of how a virus spreads in airports, grocery stores, and playgrounds — anywhere large groups of people come, touch things, and leave.

NEW YORK'S UNIQUE CHALLENGES

MAURIZIO PORFIRI
Department of Mechanical and Aerospace Engineering;
Department of Biomedical Engineering;
Department of Civil and Urban Engineering;
Center for Urban Science and Progress

ZHONG-PING JIANG
Department of Electrical and Computer Engineering

ALESSANDRO RIZZO
Department of Mechanical and Aerospace Engineering
(Visiting Professor)

At the start of the pandemic, researchers in New York were stymied by various factors: models from other contagions are not applicable to the novel coronavirus because they are confounded by its absence of symptoms in early stages, New York's complex mobility patterns, and limited testing resources.

Using data from New Rochelle — the New York suburb first seriously afflicted by the virus — a team from NYU Tandon built a mathematical model specifically for the city's unique social and transportation structures. Their goal: to help health and government leaders make smart, up-to-date testing and contact-tracing decisions.

In a city where few own cars for drive-through assessment, and testing is often conducted at hospitals already strained by the virus, they provided quick, real-time scientific insights. They factored in the type and timing of testing, asymptomatic occurrence, and hospitalization stages, making that information freely available to the public.

SHEDDING LIGHT ON PANIC BUYING

QUANYAN ZHU
Department of Electrical and Computer Engineering;
Center for Urban Science and Progress

Zhu understands that panic is a natural human behavior, but pair a propensity for panicked hoarding with the human predilection for sharing on social media, he knew, and a vicious cycle occurs: frantic buying drives Facebook and Twitter posts about shortages (real or perceived) beyond local markets, leading to further panic buying. That consumer behavior was likely to result in overstocking, shortage of essential products, and price hikes.

He and his team collected and analyzed data relating to consumer buying patterns from a multitude of online and offline sources and identified relationships between behaviors with the help of statistical techniques. They successfully predicted price hike points for such items as masks, sanitizers, and disinfectants during the pandemic, findings that are used to inform price policies and supply regulation of critical products to prevent hoarding-related shortages.

WHAT WE CAN LEARN FROM WASTEWATER

ANDREA SILVERMAN
Department of Civil and Urban Engineering

SARS-CoV-2, the coronavirus strain that causes COVID-19, passes through the body and ends up in sewage, so cities across the nation already have facilities that could help officials track the spread of the disease locally: sewage treatment plants. Monitoring the concentration of the virus in wastewater can be more comprehensive than individual testing and can signal when a hotspot is developing.

Silverman is part of a team that developed a startup blueprint" for municipalities that details best practices for sample collection, analysis, and interpretation, and speedy and appropriate translation and communication of results to public health decision-makers.

- **Samrat Acharya**, a Ph.D. student from Nepal—a country where citizens have been forced to rapidly enter the digital age to learn about health threats, conduct business, and communicate with family and friends—published guidelines on cybersecurity and safe internet usage in his native language.
- Responding to an early nation-wide shortage of protective personal equipment that was particularly acute in New York, Tandon researchers designed a face shield for healthcare workers on the front lines of the pandemic that could be produced and assembled in under one minute, a fraction of the time it took using 3D printing.
- The Tandon MakerSpace designed and produced desperately needed parts for powered air purifying respirators and ventilator moisture traps—elements that break easily and must thus be replaced frequently and quickly.
- Tandon researchers created the NYU Tandon **AirVENT**, a personal negative pressure hood to protect medical personnel from airborne particles, using a modified and easily portable salon hair dryer.
- Since CPAP/BiPAP machines (non-invasive breathing support devices) entail a non-closed-loop fluid circuit that can emit aerosolized virus and contaminate the environment, Tandon researchers created the NYU Tandon **AirMOD**, using off-the-shelf components in novel arrangements to render a closed-loop circuit that prevents contamination and infection of others.

OTHER COVID RESEARCH

CHARTING DISPARITIES IN CARE

RUMI CHUNARA
Department of Computer Science and Engineering at NYU Tandon; Department of Biostatistics at NYU School of Global Public Health

At the start of the pandemic, researchers documented serious racial and ethnic disparities in risk of infection and hospital outcomes. Would similar disparities be evident, **Chunara** wondered, in those who accessed COVID-19 care via telemedicine.

Using electronic health record data from NYU Langone, she and her fellow researchers discovered that Black patients were not accessing care through telemedicine at the same rate as white patients, and that mean income and household size were also significantly related to telemedicine use. The findings are important, not only because they highlight the fact that the most vulnerable among us may not have access to the same digital tools as others, but because population-level inferences (and by extension public policies) are often drawn from the biased data generated by those tools.

The roots of healthcare disparities are complex, but **Chunara's** work could help inform the design of remote medical technology and promote digital health equity for all.

ENGINEERING A DUAL-PURPOSE TEST

JIN MONTCLARE
Department of Chemical and Biomolecular Engineering

According to the World Health Organization, "Diagnostic testing for COVID-19 is critical to tracking the virus, understanding epidemiology, informing case management, and to suppressing transmission." So, what if there were a quick at-home test for the virus that was as easy and affordable as an at-home pregnancy test? **Montclare** is close to making that scenario a reality.

Widely recognized for her work in protein engineering, **Montclare** explains that while detecting infection is crucial, identifying immunity is equally important to keeping outbreaks in check, especially as businesses reopen. To that end, she is helping create a test strip requiring just a drop of blood from a simple finger prick; the strip — coated with proteins specially engineered to grab onto significant targets will recognize either the virus or particular antibodies that are mounted by an individual's immune response, making this a uniquely dual-purpose test.

THE CENTER FOR CYBERSECURITY

Since 2018 Tandon's Center for Cybersecurity has hosted and updated the Index of Cyber Security, polling practitioners and experts around the world on cybersecurity threat-related issues. In March, the index revealed an 11% rise in phishing concerns, correlating, closely with the dramatic rise in the number of people working from home because of COVID-19. Other risk indicators also rose during the month. Phishing — in which attackers typically target users via fake emails to obtain access to computers and networks — was followed by increases in criminal attacks (up 8%) and attacks against endpoint devices like computers or mobile phones (up 7%).

C2SMART
CONNECTED CITIES WITH SMART TRANSPORTATION

The COVID-19 outbreak dramatically changed the process of getting around in New York and beyond, and C2SMART researchers have built an interactive dashboard that allows policymakers and researchers to examine the impact of the outbreak on mass transit, commercial supply chains, personal travel, and more — as it unfolds.

Drawing upon toll data, transit ridership, travel time, weigh-in-motion trucking data, crash rate, and parking citations, among other sources, the dashboard is regularly updated with new data, metrics, and visualizations as they become available.

Among the phenomenon documented up until now:

- An increase in non-shared modes of travel such as bike/scooter and a decrease in shared modes such as public transportation and ride-sharing
- A net decrease in home-to-work trips due to increased adoption of working from home
- A reduction in tourism
- A reduction in travel due to systemic unemployment and economic slowdown

C2SMART is studying how these shifts could affect our transportation systems in terms of useability, operating and capital budgets, and emergency preparedness, right now and as we move into the future.

At NYU Tandon, engineering isn't about huddling over a desk — it's about engaging with the world around us and the communities where we live. We're building the technologies necessary to strengthen our democracy, ensuring AI and other technologies are ethical, studying gun violence and its effects, and plenty more. Because good engineers build things — like a better world.

MEETING THE CHALLENGE

Before embarking on a demanding engineering program in the fall, most students would be tempted to spend the summer simply relaxing. Yet when incoming students were invited to participate in NYU Tandon's 2020 Tandon Made Challenge, which called upon them to team with their future classmates to solve a pressing healthcare challenge in a post COVID-19 world, more than 150 eagerly rolled up their sleeves.

There were more than bragging rights at stake: after a pitch session, conducted via Zoom, two teams (one undergraduate and one graduate) were tapped to receive $5,000 each to develop and build their prototype in the fall, with the ultimate goal being to create a viable, market-ready product with the potential to join our start-up initiative, the NYU Tandon Future Labs.

- The first of the three challenges charged students with finding ways to retrofit existing hardware so that it could be used without human contact — thereby limiting the spread of COVID-19 and other viruses. **Extend-O-Guard, an elastic, polymer-coated, flexible spring band** that consumers can use to cover the handle of shopping carts, rented bikes, and other such items, was deemed the graduate team winner, and the winning undergraduate project was **a Dual Tone Multi-Frequency (DTMF)-Controlled Zero Contact Buttons Kit for use in elevators.**
- Challenge two called on competitors to use 5G and other wireless technologies to provide remote diagnostics, patient support, treatment, and beyond. The undergraduate winner was **5Glass, a device that enables medical responders to stream live footage of a patient during an ambulance ride,** while the winning graduate team came up with **PhysioAI, an online platform** using advanced machine-learning techniques to provide physical rehabilitation and therapy.
- Challenge three asked "How can we use robots and robotics to be assistive to doctors, nurses, and healthcare workers in hospitals during pandemics such as COVID-19?" The winning graduate students answered with the **Disposo-Bot, an autonomous waste-collecting robot,** and the undergraduates created **InnoVate, a robotic IV pole** equipped with an autonomous movement system to minimize physical contact.

UNCONVENTIONAL ENGINEER

BREAKING DOWN SILOS

It s rare to come across a tech project that doesn't require some combination of engineering disciplines: electrical, computer, mechanical, civil — they often all play a part, and that s not to mention the non-technical team members who might be required. The Vertically Integrated Projects (VIP) program allows NYU Tandon students to choose from dozens of real-world hands-on projects and knock down silos by collaborating with peers from other majors.

Building ground and aerial robots, using data science to track global dietary trends, or exploring the world of autonomous vehicles — there's a project for almost any interest.

Our VIP students are actively:

- Deploying computer-aided design, 3D printing, circuit fabrication, and biomedical research to create a better way to preserve and transport donor lungs for transplant recipients
- Prototyping customizable, low-cost orthotics for patients with limited mobility
- Designing and building off-road vehicles from the ground up — and then racing them (pictured left)
- Creating robots capable of navigating the surface of Mars and a lot more

DISMANTLING DEPARTMENT WALLS

No one denies that engineering disciplines have their own individual language and conventions. A barrier can exist, for example, between chemical or environmental engineers, who describe transformation of matter in the form of chemical reactions, and electrical engineers, who use complex mathematical formulations to describe the interaction of the electricity network with its physical components.

Still, three of Tandon's assistant professors are finding common ground and establishing themselves as early career pioneers of interdisciplinary research, according to the journal ***iScience***. Environmental engineer **Andrea Silverman**, electrical engineer **Yury Dvorkin**, and chemical engineer **Miguel Modestino** are combining their knowledge to tackle complex societal problems at the intersection of their fields. Case in point: their provisional patent application for grid-integrated electrosynthetic hydrogen generators, which serve as building blocks of a larger vision to synergistically integrate water-electricity-chemical networks.

SOMETHING FOR EVERYONE

If you ever wanted to view New York City from a rat s perspective, explore the secret life of yeast, or learn how to foil intrusive facial recognition software, the 2020 Integrated Digital Media (IDM) Showcase was a must-see.

This year, for the first time ever, the event was held virtually; while that change of plans was necessitated by the COVID-19 crisis, few people are more prepared to make a leap of that type than IDM students, who, after all, possess talents ideally suited to an electronic arena.

All of the projects can be viewed on the idm.show page, but if you're interested in ...

- **Social Justice,** check out Life Like Mine, a narrative game by Brittney Mc
- **Urban History,** download Metro ARchive, an app created by Sammy Levin and McCoy Zhu
- **Children's Literacy,** try ABCs of the Galaxy, an AR experience by Lauren Owen

WHAT DOES AN UNCONVENTIONAL ENGINEER LOOK LIKE?

As Tandon faculty members prove, not all civil engineers design bridges, and not all computer engineers are tackling the problems of operating systems. Tandon engineers are involved in every sector, and in sometimes surprising ways.

CARLA GANNIS
INDUSTRY PROFESSOR OF INTEGRATED DIGITAL MEDIA

Gannis's work sits squarely on the crossroads of art and technology, whether it takes the form of animated GIFs, large-scale illustrations, 3D-printed sculptures, or augmented reality experiences. Taking her inspiration from networked communication, art and literary history, emerging technologies, and speculative fiction, she explains that her pieces draw upon the incredible amount of media we now take in, while also critiquing that phenomenon.

Her latest work, Wwwunderkammer, plays on the concept of "cabinets of curiosities," antique collections of natural specimens, diagrams, and other interesting or exotic objects that often had elements of both science and speculation or superstition.

An interactive environment that viewers can access in Social VR, Wwwunderkammer invites viewers to choose an avatar and explore a vast and richly detailed virtual dreamscape. Those familiar with **Gannis's** body of work will find familiar objects and themes throughout: pieces reminiscent of the fantastical paintings of Arcimboldo; her own avatar, C.A.R.L.A. G.A.N. (Crossplatform Avatar for Recursive Life Action Generative Adversarial Network); and plenty of emojis, among them. While she examines how digital media influences the way we experience the real world, **Gannis** ultimately wants her audience to realize that, technology aside, we interact with the virtual every day, in the form of culture, dreams, fantasy, and ideologies.

BETH SIMONE NOVECK
DIRECTOR OF TANDON'S GOVERNANCE LAB (GOVLAB)

Noveck is committed to studying the impact of technology on governing, and under her leadership, The GovLab helps public institutions design, implement, and assess innovative ways of using tech to help institutions and people work more transparently and collaboratively.

Among the Lab's most recent work: exploring how policymakers can responsibly reuse the public s personal data for crisis management in an age of COVID-19 and for more effective, inclusive policy making after the pandemic, substitute Among the Lab's most recent work: partnering with the Inter-American Development Bank to advise governments worldwide on ways to most efficiently and effectively address the challenges of COVID-19.

DARRYL REEVES,
INDUSTRY ASSISTANT PROFESSOR OF COMPUTER SCIENCE AND ENGINEERING

With billions of nucleotides in the human genome, there are way too many to look at individually, so an automated approach is required. That s where computational biologists like **Reeves** come in. Because he has domain expertise in biology along with mathematical and computer science skills, he can develop efficient computer-enabled methods for comparing and analyzing genomes of any size — a process that s made the modern study of genomics possible.

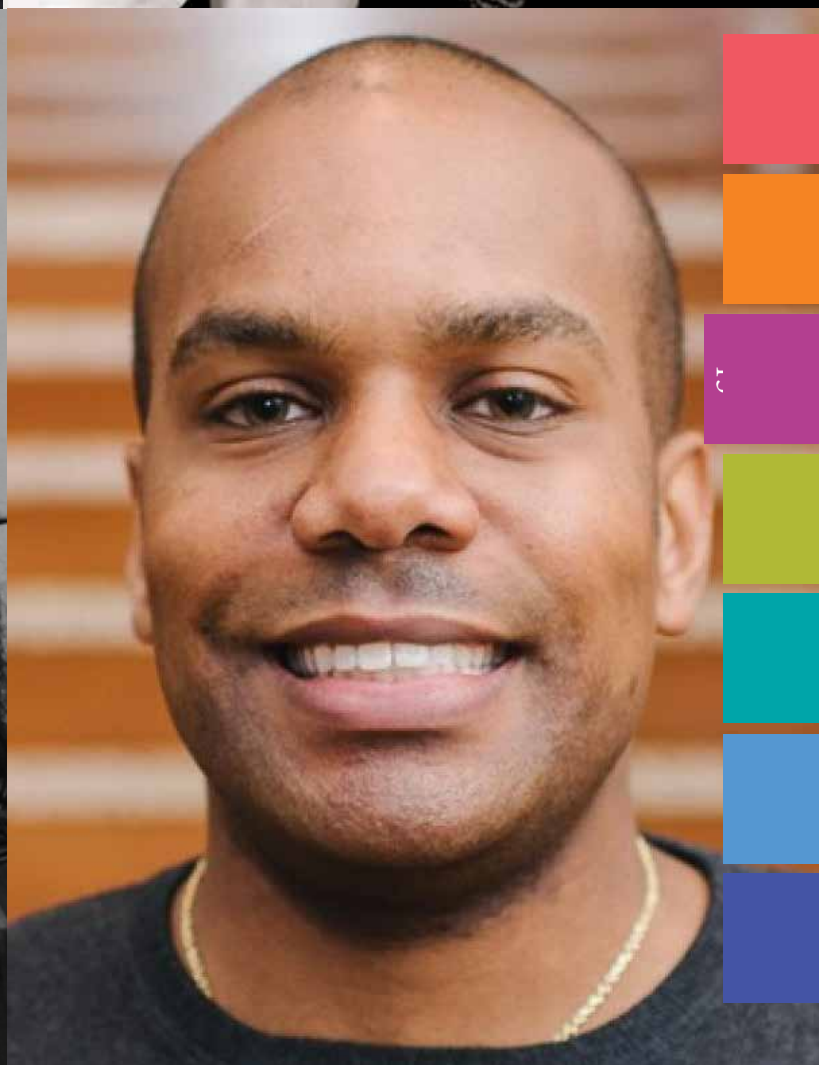
Reeves has also explored communities of organisms such as the human microbiome, which plays host to trillions of bacterial cells in addition to our own human cells. Some are beneficial, and some can be harmful, but, again, it would be impossible to process, manage, and analyze the entirety of the DNA present in these communities without the help of computers and sophisticated algorithms. In the past, he says, you might not have been taught to think of biology as a hardcore quantifiable science, but technology has changed that forever.

JULIA STOYANOVICH
ASSISTANT PROFESSOR OF COMPUTER SCIENCE AND ENGINEERING AND THE NYU CENTER FOR DATA SCIENCE

At a time when artificially intelligent automated decision systems (ADS) are being used by banks to determine who gets loans, by landlords to determine who gets to rent an apartment, by employers to decide whom to invite for job interviews, and by court systems to decide who gets offered bail or parole, it s disturbing to realize that those systems can be inherently biased. **Stoyanovich** cautions that while it is customary to think that the complexity and opacity of the algorithms involved are to blame for some of these "bias bugs," the data being used to train the systems is the main culprit. Accountability for the decisions being made by an ADS, however, always rests with a human being.

She feels a deep responsibility to teach students about the social implications of the technology they build. A typical student, she says, has an engineer s desire to build useful artifacts, such as a classification algorithm with low error rates, but may not have the awareness of historical discrimination, or the motivation to ask hard questions about the choice of a model or of a metric. But that student, as she explains, will soon become a practising data scientist, influencing how technology companies impact society.

Among the unconventional teaching tools now at her disposal is the "Data, Responsibly" comic series, which she created in collaboration with graduate student **Falaah Arif Khan.**



ENGINEERING FOR EQUALITY

AT NYU TANDON, WE ARE COMMITTED TO SUPPORTING A DIVERSE, VIBRANT, CREATIVE COMMUNITY OF PROBLEM-SOLVERS, INNOVATORS, INVENTORS, DESIGNERS, AND ARTISTS. OUR INITIATIVES INCLUDE:

Inclusion at Tandon (I@T): aimed at creating an environment in which everyone can feel welcomed, respected, and supported. We want to be effective allies of Black and Latino students, the LGBT community, aspiring women STEM professionals, and all other groups historically underrepresented in STEM. We acknowledge that true allyship takes uncomfortable reckonings, constant vigilance, and above all, accountability.

Black and Latino Men @ Tandon: to further our mission of being one of the leading educators of Black and Latino STEM scholars and industry professionals in the nation and supporting them during every step of their journeys.

Woman@Tandon: living for the day people don't talk about "women in STEM" — just accomplished scientists, technologists, creators, and engineers who also happen to be women. Until then, we aim to be a leader in building a supportive environment where we all work together to increase women's representation, retention, and success through a wide range of programs, services and activities, such as our WoMentorship Program and our annual Women's Summit.

Good engineering requires the unique perspectives of many different people coming together. Here at NYU Tandon, that goes beyond our interdisciplinary collaborations. Working with colleagues and students from a diverse range of backgrounds and identities creates opportunities for critical engagement with pressing issues we're facing today. And more perspectives only improves our unconventional outlook.

WE'RE HONORED

In early 2020, Tandon's Department of Computer Science and Engineering received a National Center for Women and Information Technology Extension Services Transformation (NEXT) Award for excellence in recruiting and retaining women in computing education.

The NEXT Awards honor undergraduate academic departments that have increased women's participation in computing education — an especially vital goal considering that a recent study revealed that while women earned 57% of all undergraduate degrees, they earned less than 20% of all computer and information sciences undergraduate degrees.

WIDENING THE PIPELINE TO STEM CAREERS

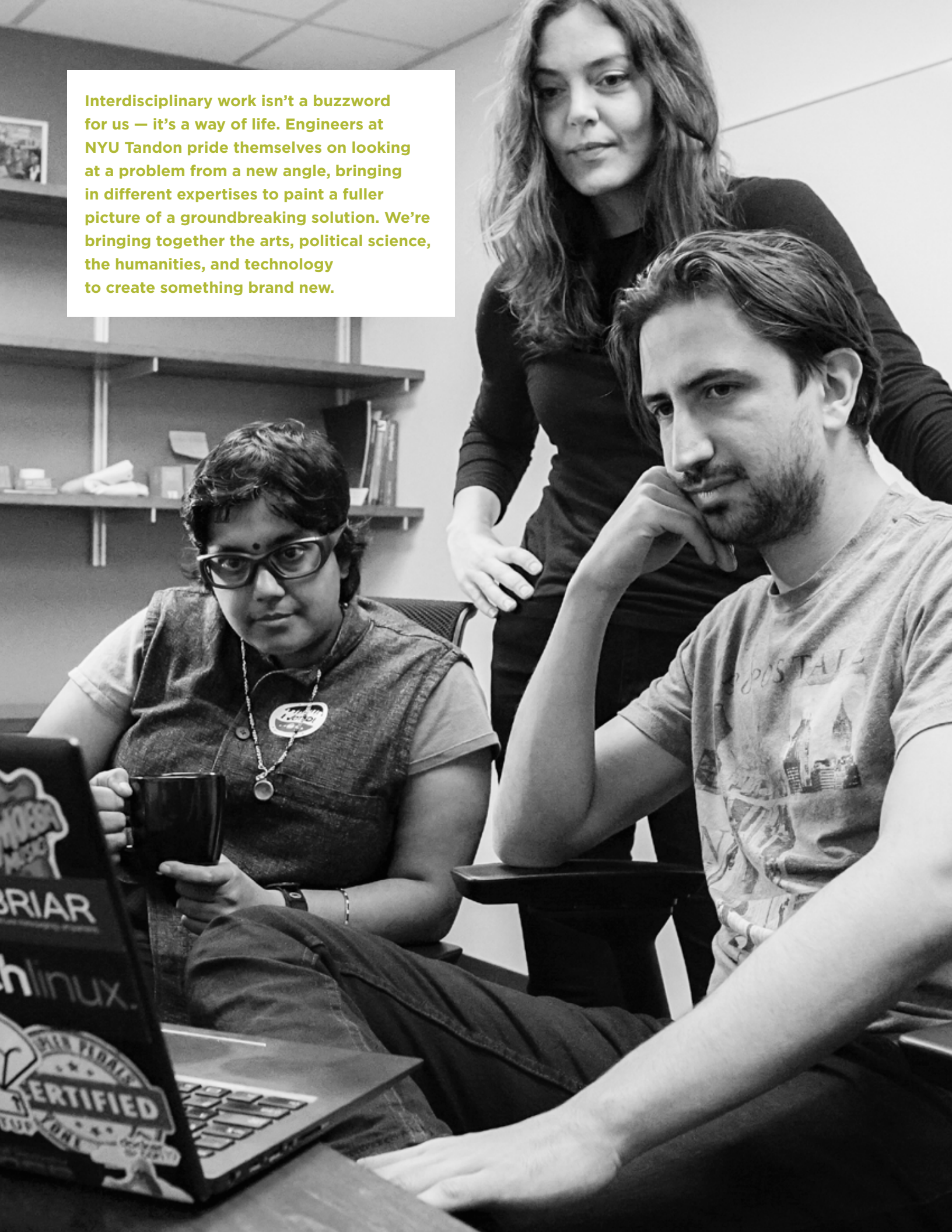
Cybersecurity may be the hot spot, but nearly every area of computer science offers attractive salaries and more empty seats than people with the skills to fill them. People with expertise in game design, artificial neural networks and machine vision, robotics, and predictive modeling are in high demand. Until recently, however, people without the right undergraduate degrees were locked out. A ***Bridge to Tandon*** opens the door: In as little as one semester, this intensive online program gives highly motivated students with a bachelor's degree in non-computer science fields the skills and tools to enter a rigorous master's program.

Since its inception the ***Bridge*** program has become known for taking its graduates far in their careers. **Meredith Mante** is a great example, though not in the geographical sense. **Mante**, an elite college pole-vaulter who earned her undergraduate degree in psychology at Princeton, remained right here in Brooklyn, to accept a teaching post in Tandon's Department of Computer Science and Engineering.

THE CITY'S YOUNGEST ASPIRING SCIENTISTS, TECHNOLOGISTS, AND ENGINEERS

Even in the midst of a global pandemic, Tandon's ***Center for K-12 STEM Education*** found ways to engage virtually: for example, this summer's ***CrEST (Creativity in Engineering, Science, and Technology)*** program enlisted several Tandon undergraduate and graduate students to mentor young innovators and entrepreneurs from local high schools; the program culminated in an online showcase where participants got to display the detailed CAD plans, YouTube-ready ads, savvy cost analyses, and marketable prototypes they had created.

Tandon has long recognized the critical need to engage K-12 students, teachers, and schools in STEM topics through hands-on, authentic learning, and to that end, the Center has created dozens of innovative programs like ***CrEST,*** always placing a strong emphasis on serving those from demographic groups that are underrepresented in STEM fields: students of color, girls and young women, and those from less financially advantaged backgrounds.



Interdisciplinary work isn't a buzzword for us — it's a way of life. Engineers at NYU Tandon pride themselves on looking at a problem from a new angle, bringing in different expertises to paint a fuller picture of a groundbreaking solution. We're bringing together the arts, political science, the humanities, and technology to create something brand new.

DATA AND DEMOCRACY

ONLINE TRANSPARENCY

NYU Tandon Professor **Damon McCoy** and doctoral student **Laura Edelson** are bringing truth to political advertising with the ***NYU Ad Observatory,*** a novel online tool that helps reporters, researchers, thought leaders, policy makers, and the general public easily analyze political ads on Facebook during campaigns and ahead of U.S. elections.

Transparency in political advertising is vital to ensuring safe and fair elections, but difficult to achieve without disclosure of funding. That information is not required for political ads on Facebook, which is used by nearly 70% of Americans, is by far the country's leading source of news, and is the top social media destination for political advertising. To reveal the data beneath the ads, the team uses Facebook's API and ad library reports, but enhances this information with additional features, including the ability to search by topic (like immigration), ad adjective (like donate), or total ad spend over time.

The team also developed a crowd-sourcing tool integrated with the Ad Observatory called ***Ad Observer,*** which Facebook users can add to their Web browser and which allows them to help researchers drill down to state-level rankings of political advertisers by spend, learn who's funding national and state-level advertising for major races, screen for problematic or misleading content, and contribute to improving ***NYU Tandon's*** ability to flag that content.

UNCONVENTIONAL APPROACHES TO PRESSING ISSUES

DEEPFAKES AND MISINFORMATION

Deepfake technology lets almost anyone create realistic-looking photos and videos of people saying and doing things that they never actually said or did. Deepfakes pose a range of political and social dangers, including eroding public trust, damaging personal reputations, and undermining the electoral process.

Among the hardest aspects of detecting deepfakes is that digital photo files aren't coded so that it s evident when tampering has taken place. Professor of Computer Science and Engineering **Nasir Memon** is taking a proactive approach, creating a forensics-friendly image right from the start using tamper-resistant digital markings, rather than the common tactic: initially focusing on good visual quality and later hoping that forensic techniques work.

He's tackling another tough problem as well. The dissemination of fake news on social media is a pernicious trend with dire implications for the world. Indeed, research shows that public engagement with spurious news is greater than with legitimate news from mainstream sources, making social media a powerful channel for propaganda.

A new study on the spread of disinformation by **Memon** and his colleagues reveals that pairing headlines with credibility alerts from fact-checkers, the public, news media and even AI, can reduce peoples' intention to share. However, the effectiveness of these alerts varies with political orientation and gender. The good news for truth seekers? Official fact-checking sources are overwhelmingly trusted.

GOING TO CONGRESS

With legislation and regulation almost always developed by officials working behind closed doors, the rates of trust in America's institutions are at historic low. At a session on Capitol Hill this year, **Beth Simone Noveck**, director of ***The Governance Lab*** (The GovLab) at NYU Tandon, called upon government leaders to adopt new technology to improve citizen engagement in lawmaking. She announced the launch of ***"CrowdLaw for Congress,*** a GovLab training initiative that provides examples from legislatures and parliaments around the world for U.S. institutions to draw upon as they seek to deepen the foundations of democracy in uncertain times.

She returned to Washington a second time (virtually) after the COVID-19 crisis hit, for a session hosted by the Select Committee on the Modernization of Congress, where she discussed best practices for remote committee and member operations, and ways other legislatures around the world are handling business during the global pandemic.

Made up of a consortium including New York University, Columbia University, The New School, CUNY, School of Visual Arts, Manhattan College, and Pratt Institute, the *NYC Media Lab* at NYU Tandon facilitates prototyping projects across a wide range of disciplines and programs. Media Lab members are envisioning new ways of experiencing music, improving accessibility options for media consumers, pushing the boundaries of augmented reality and plenty more. The future of media can be found here in Brooklyn.

RESPONSIBLE AI

Tandon researchers regularly create all types of cutting-edge technology, including novel ways of using big data and artificial intelligence. Those are complex issues with complex ramifications, so it s imperative that ethics and responsibility be an integral theme of their work.

Our new ***Center for Responsible AI*** is a hub for interdisciplinary research and the creation of best-in-class open-source tools and frameworks for equitable data-sharing, increased transparency, and more. We're developing standardized curricula so that every computer and data science student understands the importance of responsible AI, as well as educating current practitioners and the general public, and we're establishing an AI for Good startup program, leveraging opportunities to apply artificial intelligence to societal problems that are otherwise overlooked in pursuit of broad capital market opportunities.

INSIGHTS INTO GUN VIOLENCE

Surges in firearm acquisition after mass shootings are a well-documented phenomenon, but analytic research into the causes of this behavior — be it driven by a desire for self-protection, or a fear that access to firearms will be curtailed — has been sparse.

A new study led by Institute Professor **Maurizio Porfiri** applied a data science methodology to infer causal relationships and found that the decision to purchase a gun is driven by the latter concern — stricter regulations on gun purchase and ownership — more than by a desire to protect oneself. The study is part of a first-of-its-kind effort backed by a $2 million grant from the National Science Foundation (NSF) to examine causal relationships between potentially contributing factors such as firearm prevalence, state legislation, media exposure, and people's opinion of firearm-related harms, all at the individual, state, and nation levels. all at the individual, state, and nation levels.


GUN RIGHTS
VS.
GUN CONTROL
By MAURIZIO PORFIRI et al.

OUR AREAS OF RESEARCH EXCELLENCE

Our researchers are building a better world — not just by creating new technology, but by using that technology in a mission for justice, transparency, health, and safety. So, while it's been an unprecedented year requiring attention to unprecedented and pressing challenges, we never lost sight of our focus on our core aims: exploring vital research areas, the intersections between them, and the tools needed to create world-changing solutions.

CYBERSECURITY

It s become a truism that almost every business is now a tech business, given how deeply dependent every sector has become on digital systems. And with every facet of our lives now affected by those systems, it s more important than ever to make sure they don't go unguarded. This year our researchers tackled the dangers of automatic software updates, DNA fingerprinting, and much more.

- Software updates have long been prime targets for hackers, and the threat posed by such attacks has grown as Internet-connected devices have moved beyond computers and smartphones to include medical equipment, automobiles, and many other devices. Associate Professor of Computer Science and Engineering **Justin Cappos's** open-source technology, The Update Framework (TUF), is the industry standard for securing software update systems and is now used by the leading providers of cloud-based services, including Amazon, Microsoft, and Google. This year, TUF achieved an important milestone: it became the first specification project to graduate from the Linux Foundation's Cloud Native Computing Foundation. (A specification — common examples of which are HTML and HTTP — allows different implementers to create core functionality in a common, precisely defined way to solve a task.)
- Professor of Electrical and Computer Engineering **Ramesh Karri** is addressing the risks that arise at the frontier between cyberspace and DNA biology. DNA fingerprinting, a key process in a nearly $10 billion global business that includes players like 23andMe and AncestryDNA, identifies individuals from very small spans of their genetic material. This roughly 0.1% of the human genome unique to each individual can also be used to prove that a DNA sample has not been tampered with or swapped between collection and delivery to labs, a risk researchers identified a decade ago. **Karri** and his colleagues recently demonstrated a system for flagging any tampering by creating "genetic barcodes" based upon these tiny regions.
- Thieves have several ways of obtaining data from the magnetic stripes on our credit cards and can then use it to produce counterfeit cards or to monetize data through other illicit activities. **Damon McCoy**, assistant professor of computer science and engineering, and his team analyzed a large set of data extracted from an illicit online bazaar for buying stolen and leaked credit card information and discovered that chip-enabled cards are no guarantee of security. Among their other discoveries: cards issued in specific states — like South Carolina — were more likely to have their data purchased and cards issued by certain banks are considered more desirable than others to thieves

EMERGING MEDIA

Students and researchers in NYU Tandon's ***Integrated Digital Media (IDM)*** program are encouraged to experiment with Image, sound, narrative, and interactivity — and entirely new ways of creating, experiencing, and relating to media end up emerging.

We combine artistic inquiry with scientific research and technological practice — it s not STEM, it s STEAM — and explore the social, cultural and ethical potentials of transformative technologies like augmented and virtual reality, social gaming, motion capture, user experience design, and more.

Faculty members include renowned artists and composers like IDM co-director **R. Luke DuBois**, whose work has been exhibited at such venues as the Institut Valencià d'Art Modern in Spain, the Smithsonian American Art Museum, and the Aspen Institute; user experience experts like **Reginé Gilbert**, author of ***Inclusive Design for a Digital World: Designing with Accessibility in Mind;*** activist technologists like **Benedetta Piantella**, who has partnered with UNICEF and the Earth Institute, among other institutions, on projects around the world; and many others.

We don't only modify and transform industry-standard technologies, we create new ones, and we're doing it across every sector, including entertainment, health, commerce, architecture, education, urban planning, and communications.

SUSTAINABILITY

At a time when climate change poses a grave threat to the planet, and the viability of our water, energy, transportation, and agricultural systems seems in grave danger, one major question looms: how do we effectively meet the needs of the present without compromising the ability of future generations to meet their own?

Tandon researchers are developing new ways to generate clean energy, keep our water supplies safe, decrease our carbon footprint and more. Their recent research includes:

- Associate Professor of Chemical and Biomolecular Engineering **Ryan Hartman** is designing an intelligent microsystem that uses a lab reactor, liquefied catalyst, and machine learning techniques to make industrial chemical processes faster and greener
- Assistant Professor of Civil and Urban Engineering **Andrea Silverman**, along with Industry Assistant Professor **Tega Brain** and Assistant Professor **Elizabeth Hénaff** (both from the Department of Technology, Culture, and Society), is studying how the effects of flooding — a near-certain result of global warming — impact public health and infrastructure in urban areas.
- Associate Professor of Chemical and Biomolecular Engineering **André Taylor** is improving hydrogen fuel cell technologies and paving the path to a future that features vehicles whose only exhaust fumes are water vapor; greatly increasing the power conversion efficiencies of perovskite solar cells; and finding ways to harvest sunlight underwater.

The Urban Future Lab **is a major driver of the Carbon to Value Initiative (C2V Initiative), a unique partnership aimed at creating a thriving innovation ecosystem for the commercialization of carbontech — technologies that capture and convert carbon dioxide into valuable products or services. Supported by the State of New York, the C2V Initiative will help innovative young companies enable rapid commercialization of carbontech, bringing potentially planet-saving technologies to market faster. It's just one more way we are engineering a brighter future.**

ROBOTICS/DATA SCIENCE/AI

We've built a collaborative ecosystem aimed at harnessing the collective power of data, machine learning techniques, and autonomous systems, and our researchers are blazing new trails: at the ***Medical Robotics and Interactive Intelligent Technologies (MERIIT) Lab,*** for example, we're augmenting human capabilities well beyond the norm, with a particular focus on neuro-rehabilitation and surgical robotic systems. At the ***Agile Robotics and Perception Lab,*** unmanned ground and aerial vehicles roam, and increasing autonomy is a major goal. Our ***Machines in Motion Laboratory*** (pictured far right) asks: What are the algorithmic principles that would allow a robot to run through a rocky terrain, lift a couch while reaching for an object that rolled under it or manipulate a screwdriver while balancing on top of a ladder?

And they're all working in concert with our data scientists, who are discovering innovative and ethical ways to analyze, visualize, and utilize the 2.5 quintillion bytes of data the world generates each and every day.

In recent months, among numerous other major accomplishments, we've:

- Knocked over the hurdles to making 5G networks a viable bridge between robotic systems and cloud servers — a feat that presents tantalizing operational benefits, such as allowing robots to perceive the environment, perform complex operations, and make decisions autonomously, all without incurring major energy and weight costs from onboard computational and power-generation equipment
- Designed Solo 8, a relatively low-cost, easy-and-fast-to-assemble quadruped robot that can be upgraded and modified, opening the door to sophisticated research and development to teams on limited budgets, including those at startups, smaller labs, or teaching institutions
- Demonstrated the potential dangers of incorporating deep neural networks into automotive systems, and revealed backdoor vulnerabilities in the AI behind automotive computer vision systems
- Gained insights about what kinds of cues influence social behavior in the animal kingdom by deploying an innovative system, called "behavioral teleporting" — the transfer of the complete inventory of behaviors and actions (ethogram) of a live zebrafish onto a remotely located robotic replica

HEALTH

This year we welcomed a new chair of biomedical engineering, **Andreas H. Hielscher,** who arrives with decades of experience in translational, lab-bench-to-bedside and an impressive record of developing new biophotonic technologies applicable to breast cancer, rheumatoid arthritis, and peripheral artery disease, among other conditions. Tandon researchers in his department and others have made enormous strides in recent months, and among their vast body of work has been:

- Developing a machine learning model that could improve the treatment of Parkinson's disease and other neurological movement disorders
- Conducting research focused on optimizing modified T-Cell lymphocytes for the immunotherapeutic treatment of cancer
- Improving telehealth services for stroke victims by designing novel control architectures for safe, remote sensorimotor rehabilitation
- Finding Imaging biomarkers for very early changes in the optic nerve area, well before glaucoma can cause loss of vision

For biomedical engineers, what they're building is only as important as the patients it can help save. We're reimagining what a Department of Biomedical Engineering can be, building up the faculty, and bringing a strong collaborative perspective to the school. In partnership with NYU Grossman School of Medicine and NYU Langone Medical Center, the department is creating new methods of tissue engineering and repair, unique imaging systems that can help screen patients for rare diseases, and advanced prosthetics, among other projects. Together, they are bridging the gap between the lab and the clinic to improve human health.

ALL THINGS URBAN

NYU Tandon researchers are finding ways to make the cities of the future smarter, greener, better connected, and more resilient — goals with added urgency now that more than half of the world's population now lives in urban areas, and that figure is only expected to grow over the coming decades. (U.N. projections state that it will be more than 70% by mid-century.)

Few engineering schools can claim the entirety of New York City as a living lab, as we can, and

we leverage our locale as a staging ground to find solutions for the global urban communities of the future. We know the cities of tomorrow will be increasing dense and increasingly challenging, but we're working on several fronts to ensure, for example, that

- Transportation infrastructure and systems are secure, efficient and resilient — work being conducted at C2SMART, our U.S. Department of Transportation Tier 1 University Transportation Center
- Environmental pollution, public health, building safety, and the myriad other issues affecting livability are addressed using data-driven, technologically advanced, scalable methods — the focus of our Center for Urban Science and Progress (CUSP)

COMMUNICATION/IT

Our academic research center ***NYU WIRELESS*** offers its faculty, students, and its many major industrial-affiliate sponsors a world-class environment that is creating the fundamental theories and techniques for next-generation communications.

By next generation, we don't mean 5G (been there, helped pioneer that). ***NYU WIRELESS*** researchers are now beginning to imagine the possibilities of the sub-terahertz spectrum starting at 95 GHz, and the futuristic 6G applications that it can support, with some predicting mind-boggling speeds of 8,000 gigabits per second. Never mind that 5G enables a movie to download in a few seconds; with 6G speeds you could download almost 150 hours worth of screen programming, not to mention previously unimaginable medical and IoT applications.

Consider the caliber of its researchers, and you'll see that if science fiction writers can envision it, ***NYU WIRELESS*** can probably make it happen. Among them are:

Founder **Theodore "Ted" Rappaport**, a Wireless Hall of Fame inductee whose original research broke the ground for 5G

Director **Thomas Marzetta**, a member of the National Academy of Engineering often referred to as the Father of Massive MIMO (multiple-input multiple-output) technology

Associate Director **Sundeep Rangan**, a co-founder of Flarion Technologies, a spinoff of Bell Labs and developer of one of the first cellular OFDM (orthogonal frequency-division multiplexing) data systems and the precursor to LTE

Institute Professor **Elza Erkip**, who has made many seminal contributions to the theory and practical design of cooperative and MIMO communications and who is often included on lists of the most-cited researchers in her field.

From our groundbreaking research to the excellent records of our students, we're proud of all our accomplishments. Our forward-thinking, unconventional research and student output received more awards over the last year then we could reasonably list. That follows up on decades of recognition: half of our faculty members are now winners of CAREER or other young-investigator honors. Because at NYU Tandon, exceptional work is our standard.

AWARDS & ACHIEVEMENTS

Student Awards

DANIELA BLANCO
Lemelson-MIT Student Prize

No one who has followed Daniela Blanco's story at NYU Tandon — a story that includes garnering a $100,000 Technology Venture Prize at the NYU Stern $300K Entrepreneurship Challenge, the $20,000 top prize in the InnoVention Competition at Tandon, a $20,000 Stage II VentureWell grant, top prize in the hotly contested Greentech category of the University Startup World Cup, and the title of 2019 Global Student Entrepreneur of the Year, to name just a few of her honors — will be very surprised to learn that in early 2020, shortly before earning her Ph.D. in chemical engineering, she added yet another notch to her belt: an Lemelson-MIT Student Prize, which honors promising collegiate inventors around the country. She was recognized, in part, for her development of reactors for sustainable chemical processes.

JASON LIPTON
U.S. Department of Energy Office of Science Graduate Student Research Award

It s not just a figure of speech to suggest that Jason Lipton, a Ph.D. candidate in the Department of Chemical and Biomolecular Engineering, is putting the spotlight on lithium ion batteries. The U.S. Department of Energy's Office of Science Graduate Student Research (SCGSR) tapped him to do experimental research at the Argonne National Laboratory, where he can.explore how light affects energy storage in lithium ion batteries.

Argonne is home to a mile-long synchrotron, a special kind of particle accelerator ideal for identifying structural features of materials and for doing x-ray crystal studies "in operando" — essentially in real time, while a catalysis process is at work. The research could lead to solutions to one of the major problems with rechargeable batteries: long charging times.

ZIYI MA
Dwight David Eisenhower Transportation Fellowship

Ziyi Ma, a graduate student studying Transportation Planning and Engineering, was awarded the 2019 Dwight David Eisenhower Transportation Fellowship by the Federal Highway Administration. The fellowship will allow him to develop an open-source, agent-based simulation tool for public transit planning—an extension based on a virtual test bed of New York City's large-scale transportation simulation model.

MAKERBRACE AND SUNTHETICS
SXSW Finalists

One of the most hotly anticipated events at South by Southwest (SXSW) is the Innovation Awards, and this year, two Tandon teams stood out in the crowded field as leaders in the categories of student innovation and climate, culture & social impact: MakerBrace, an interdisciplinary student team designing and fabricating low cost, highly adaptable, 3D-printed braces for people with cerebral palsy, and Sunthetics, a Tandon-bred startup developing AI-optimized chemical reactors for the sustainable manufacture of nylon intermediates, using 30% less raw material and 30% less energy and reducing manufacturing costs by 20%.

[illegible]EM
Silver Medal

When many people hear the name "E. coli," they think immediately of food poisoning or terrible gastric distress, but in reality, most types of E. coli are harmless and even serve to help keep the human digestive tract healthy.

A group of students employed the oft-misunderstood bacteria in a project that garnered them a silver medal at the 2019 International Genetically Engineered Machine (iGEM) Competition, the world's premier synthetic biology contest, which draws hundreds of teams from around the globe each year to create novel biological systems.

[illegible] ROSMAN
National Science Foundation Graduate Research Fellowship

The National Science Foundation (NSF) Graduate Research Fellowship is the oldest fellowship program of its kind and one with a remarkable track record of accurately identifying recipients who go on to achieve high levels of academic and professional success. (Past fellows include numerous Nobel Prize winners, Google founder Sergey Brin, and Freakonomics co-author Steven Levitt.) While it typically goes to doctoral candidates, master s student Katie Rosman garnered the honor for her work in data science and her efforts to develop innovative machine learning methods that are directly applicable to critical real-world problems, including preventing opioid overdoses, mitigating health disparities caused by environmental factors, and ensuring that the algorithmic systems used to make bail and parole decisions are just and equitable.

FACULTY HONORS

WEIQIANG CHEN
Assistant Professor of Mechanical and Aerospace Engineering; Assistant Professor of Biomedical Engineering

Young Innovator Award from the Biomedical Engineering Society

Chen was deemed a "Young Innovator of Cellular and Molecular Bioengineering" in recognition of his body of research, which employs principles of mechanical engineering and physics to identify the state of individual cells. The scholarship could lead to new methods of examining how stressors such as injury and chronic diseases like diabetes and hypertension drive cellular allostasis, a biological process of arriving at a new level of equilibrium.

ANNA CHOROMANSKA
Assistant Professor of Electrical and Computer Engineering

Sloan Fellowship

The Alfred P. Sloan Foundation awards fellowships only to those whose "creativity, leadership, and independent research achievements make them some of the most promising researchers working today, according to the organization's website. "To receive a Sloan Research Fellowship is to be told by your fellow scientists that you stand out among your peers.

Among the early-career scientists and scholars accorded that rare honor in 2020 is Choromanska, who runs Tandon's ECE Machine Learning Lab and is also affiliated with the NYU Center for Data Science and NYU Center for Urban science and Progress (CUSP).

Her machine-learning research focuses on both the theoretical and the applicable, with current projects encompassing optimization, large data analysis, and robotics and autonomy. She is now collaborating with NVIDIA on an autonomous car driving project, and her work has also been used by such companies as Facebook and Baidu.

The founder of the ECE Seminar Series on Modern Artificial Intelligence, she brings to Tandon other world-renowned researchers, industry leaders, and Nobel laureates who are making an immense impact on the development of new machine learning techniques and technologies.

JULIANNA FREIRE
Professor of Computer Science and Engineering

ACM Contributions Award

Freire, who is a faculty member of Tandon's Visualization Imaging and Data Analysis Center (VIDA) and holds an appointment at the Courant Institute for Mathematical Science, was honored by the Association for Computing Machinery (ACM) Special Interest Group on Management of Data (SIGMOD) for her fundamental contributions to data management methods and tools for computational reproducibility and her efforts to increase the adoption of reproducibility best practices in science.

Dennis Shasta, a Courant professor who serves as the assistant director of Tandon's NYU WIRELESS research center, was also one of the six 2020 recipients of the award, in recognition of his work on meta algorithms for machine learning.

RAMESH KARRI
Professor of Electrical and Computer Engineering at NYU Tandon, Co-founder and Co-chair of the NYU Center for Cyber Security

Institute of Electrical and Electronics Engineers (IEEE) Fellowship

Karri was recognized by the IEEE for his contributions to and leadership in trustworthy electronic hardware. His seminal work is helping ensure that the global hardware supply chain is as secure as possible—an especially great concern in an age when chips are being manufactured at supplier foundries far from where they are designed, giving bad actors ample opportunity to install malicious "Trojan horse" circuits or to pirate intellectual property. Vulnerabilities in the chain threaten not only personal computers and smartphones but automotive systems, major utilities, the aerospace industry, nuclear facilities, and industrial equipment.

Karri is widely acknowledged for bringing the pressing need for strong hardware security to the attention of the industry and for placing NYU Tandon at the forefront of the vital field.

THOMAS L. MARZETTA
Distinguished Industry Professor of Electrical and Computer Engineering; Director of NYU WIRELESS

National Academy of Engineering (NAE)

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

The NAE specifically cited Marzetta's contributions to massive multiple-input multiple-output (MIMO) antenna arrays in wireless communications. Massive MIMO – considered a key enabler for the fifth generation of wireless technology, or 5G – utilizes numerous small, individually controlled, low-power antennas to direct streams of information, selectively and simultaneously, to many users. This confers spectral efficiency orders of magnitude greater than that experienced in 4G service, along with high-quality service throughout the cell, simplicity and scalability, and outstanding energy efficiency.

MIGUEL MODESTINO
Assistant Professor of Chemical and Biomolecular Engineering

MIT Technology Review "Innovators Under 35" and NSF CAREER Award

Both the NSF and ***MIT Technology Review*** recognized Modestino's work to integrate renewable-energy processes into the chemical industry and develop a path to environmentally sound chemical production.

Chemical manufacturing currently consumes roughly 10% of the world's energy demand, mostly in the form of fossil fuel-generated heat for thermochemical reactions, but Modestino's research is advancing organic electrosynthesis — which relies on electricity, not heat, to drive reactions — and which can be generated by solar, wind, or other renewable means, thereby reducing carbon emissions compared to current methods for thermochemical reactions, which rely on petroleum or coal.

He has explained that if the industry transitions from thermochemical to electrochemical processes involving clean electricity sources, the reduction in carbon dioxide emissions would be enormous. He estimates that implementing organic electrochemical processes at large scale, driven by solar or wind power, could result in the sustainable production of well over a third of all chemical products currently being manufactured.

KATEPALLI SREENIVASAN
Dean Emeritus of NYU Tandon; Eugene Kleiner Professor for Innovation in Mechanical Engineering

American Physical Society Fluid Dynamics Prize; Honorary Fellowship at India's Tata Institute of Fundamental Research; American Society of Mechanical Engineers (ASME) Charles Russ Richards Memorial Award; Society of Engineering Science (SES) G.I. Taylor Medal

Over the last several months, Sreenivasan — who is also on the faculty of the NYU College of Arts and Science and NYU Courant and is one of the rare few to hold the NYU distinction of being named a University Professor, a title conferred upon scholars whose work is interdisciplinary and reflects exceptional breadth — has added numerous laurels to what was already a lengthy list.

The American Physical Society noted his "fundamental contributions to fluid dynamics, especially turbulence from quantum to astrophysical scales," while ASME (in conjunction with the Pi Tau Sigma Honor Society) cited his "outstanding achievements in mechanical engineering for twenty years of more following graduation." The Taylor Medal was bestowed in recognition of his "outstanding research contributions in either theoretical or experimental Fluid Mechanics or both." Sreenivasan's honorary fellowship at the Tata Institute of Fundamental Research, in Mumbai, is a distinction shared by only 19 others from around the world, several of whom are Nobel laureates and Fields medalists.

THEODORE "TED" RAPPAPORT
David Lee/Ernst Weber Professor of Electrical Engineering; Founding Director of NYU WIRELESS

Wireless Hall of Fame and IEEE Eric E. Sumner Award

Rappaport, who is also a faculty member of NYU Courant and the School of Medicine, was recognized by both the IEEE and Wireless Hall of Fame as one of the preeminent thought leaders in the wireless field.

His pioneering research on radio wave propagation, wireless communication system design, and broadband wireless communications circuits and systems at millimeter wave (mmWave) frequencies (30 to 300 gigahertz) blazed a trail for the commercialization of fifth-generation (5G) wireless technology.

Before Rappaport published his seminal 2013 paper, "Millimeter Wave Mobile Communications for 5G Cellular: It Will Work," in an IEEE journal, few experts even acknowledged the possibilities of tapping that underutilized spectrum. Now, NYU WIRELESS, which Rappaport launched upon arriving at the NYU Tandon School of Engineering in 2012, is moving well beyond 5G research to explore the frontiers of 6G and beyond.

JULIAN TOGELIUS
Associate Professor of Computer Science and Engineering

Institute of Electrical and Electronics Engineers (IEEE) Outstanding Early Career Award

The IEEE Computational Intelligence Society honored Togelius, who directs Tandon's Game Innovation Lab, for his contributions to the field of computational intelligence and games.

A frequently-cited researcher, Togelius did some of the world's first work on automatic game design, including co-authoring research on modeling player behavior and experience. He is the co-author of the 2019 paper "Playing Atari with Six Neurons," which demonstrated that even simple AI systems can learn and which won the International Conference on Autonomous Agents and Multiagent Systems (AAMAS) 2019 Best Paper Award.

"Essentially my work involves asking what AI can do for games, and what games can do for AI," said Togelius. "I want to make computer games adapt to their players through finding out what players want (whether they know it or not) and creating new game levels, challenges, or rules that suit the players."

He is currently working on enabling tools to help game designers be more creative and using games to diagnose the shortcomings of reinforcement learning.

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