Leveraging the whole-brain network

Research centers empower interdisciplinary collaboration to confront global challenges

Climate change. Cancer. Public health. Working across more than two dozen research centers, Northwestern Engineering faculty stand at the forefront of finding solutions to society's toughest challenges. While these centers vary in size, scope, and focus, they all cultivate talent, collaboration, and innovation at the intersection of disciplines.

"Learning from each other and seeing ourselves as both contributors and beneficiaries of a dynamic and ever-evolving whole-brain network is at the center of McCormick's culture," says McCormick School of Engineering Dean Julio M. Ottino. "Increasingly, our centers serve as a catalyst for inter-disciplinary research at McCormick, complementing the strong foundation provided by our departments and linking us to other schools."

Five centers led by Northwestern Engineering faculty have achieved recent notable success. Their stories offer insight into the world-changing potential of Northwestern research across the broad spectrum of engineering disciplines.

ALEX GERAGE

Center for Physical Genomics and Engineering

Leading a new frontier in engineering living systems

Since its founding in 2019, the Center for Physical Genomics and Engineering (CPGE) has pioneered research in physical genomics—a burgeoning field of study bridging molecular biology, bioengineering, and physics—that seeks to reprogram the genome by controlling the structure of chromatin, a complex of protein and DNA that regulates gene expression. The approach opens the door to fundamentally new methods to treat diseases such as cancer and Alzheimer's and to engineer living systems to overcome environmental challenges such as climate change.

Emphasizing integration across disciplines

CPGE's 14 core faculty members, many of whom maintain multiple appointments or lead their own research centers, come from 11 departments across Northwestern Engineering and Northwestern's Weinberg College of Arts and Sciences and Feinberg School of Medicine. The center roster also includes 11 external members from other universities, a group that continues to grow thanks to CPGE's annual Symposium on Physical Genomics.

$7.75 MILLION

Grant supporting CPGE's new NCI Cellular Cancer Biology Imaging Research Center

Recent accomplishments

CPGE leads a National Cancer Institute (NCI) Cellular Cancer Biology Imaging Research Center to develop and test nano-imaging technologies, used in conjunction with molecular and computational methods, to study the origin of cancer stem cells and their ability to adapt to chemotherapies. The project brings together researchers in optics, imaging analysis, electron microscopy, computational genomics, and cancer biology to close existing knowledge and technology gaps in this area of cancer research, potentially leading to strategies for preventing tumor resistance to therapeutics.

The center's Physical Genomics Training Program, supported by a National Institutes of Health T32 training grant, welcomed its first cohort of six graduate students last fall. Students participated in transdisciplinary coursework, lab-based training, career development, and research seminars while also receiving mentorship from faculty across 17 departments at the University.

Leadership

Vadim Backman

Director and Sachs Family Professor of Biomedical Engineering and Medicine

"It's easy to become compartmentalized in your own field, but we're trying to bring in fantastic people with unique areas of expertise—engineers, biologists, molecular modelers, mathematicians, physicists, AI experts—and show them how to find a common language. If you bring together people who really want to make change, good things are going to happen."

VADIM BACKMAN

Center for Advanced Regenerative Engineering

Unlocking the human body's healing potential

Tissue loss and dysfunction from injury or disease can lead to significant morbidity and billions of dollars in economic losses from decreased productivity. Launched in 2018, the Center for Advanced Regenerative Engineering (CARE) supports research, technology development, and clinical expertise at the convergence of engineering, medicine, and biological sciences to improve the repair and regeneration of blood vessels, skin, nerves, bones, and other tissues and organs.

Building an ecosystem

Central to CARE's mission is forging an ecosystem of research, education, and clinical translation to help bring reliable and scalable technologies from the research bench to operating rooms. To accomplish this, CARE has partnered with two dozen academic and industry partners—from Northwestern's Feinberg School of Medicine to the US Army Institute of Surgical Research to Medline Industries—to jumpstart research and testing collaborations while addressing regulatory approval processes and user adoption challenges.

Recent accomplishments

In 2021, spinout startup Acuitive Technologies brought CITREGEN, a biomaterial created in the center, to market for use in musculoskeletal surgeries. Stryker Corporation employs this biomaterial in Citrelock, an implantable device used to attach soft tissue grafts to bone in reconstruction surgeries. Comparable in strength to cortical bone, Citrelock maintains structural integrity during healing while allowing host tissue to remodel the implant over time.

Also in 2021, CARE was awarded a National Institutes of Health T32 graduate student training grant, one of the first two T32 grants awarded in the field of regenerative engineering. Called RE-Training, the program will educate regenerative engineers through faculty mentorship, hands-on industry internships, and clinical experiences through CARE's partners.

Leadership

Guillermo Ameer

Director and Daniel Hale Williams Professor of Biomedical Engineering

"Clinical translation—bringing our innovations from the research lab to patients to improve their care—is very important to our goals."

GUILLERMO AMEER

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Number of CARE-affiliated faculty, which include members from Shirley Ryan AbilityLab, University of Chicago, and Lurie Children's Hospital

Northwestern University Transportation Center

Transportation solutions for industry, government, and the public

From climate change to supply chains, transportation plays an integral role in some of the biggest challenges facing society. The Northwestern University Transportation Center (NUTC) brings together experts from academia, government, and private and nonprofit corporations to develop new policy, operations, and technology to improve the movement of goods, people, energy, and information.

Enduring collaborations with industry leaders

NUTC is widely recognized for its close collaborations with companies representing all facets of transportation: shipping and carrier firms, freight forwarders and third-party logistics providers, financial institutions, consulting firms, and trade associations. The center's Business Advisory Council is composed of senior leaders from more than 60 companies, including FedEx, UPS, IBM, Boeing, and United Airlines, who provide guidance to faculty, support research initiatives, and help foster NUTC-hosted outreach programs and special events.

Recent accomplishments

Beginning in April 2020, NUTC hosted nine weekly virtual roundtable seminars that covered the COVID-19 pandemic's impact on the global supply chain. Once lockdown restrictions were lifted, the focus pivoted to the changing transportation landscape in cities.

These roundtables helped NUTC secure a $1 million grant from the US Department of Transportation to further explore the effects of communications technology and e-commerce on travel demand in wake of the pandemic.

The center is also expanding its research in autonomous, electric, connected, and shared mobility systems. NUTC researchers are collaborating with researchers at the University of Illinois Urbana-Champaign to build a test-track facility to study autonomous freight trucks.

Leadership

Hani Mahmassani

Director, William A. Patterson Distinguished Chair in Transportation, and professor of civil and environmental engineering

"Many centers work with their state and federal transportation departments, but very few have established an enduring relationship with the transportation industry." HANI MAHMASSANI

1954

NUTC's founding, making it the country's oldest university center for multidisciplinary transportation research

Center for Human-Computer Interaction + Design

Developing the future of human and computer interaction at home, work, and play

Society's relationship with technology has evolved beyond simply sitting in front of a computer. Modern human-computer interaction reflects a dramatically different landscape—pervasive, multi-modal, and inclusive.

Launched in 2020 as a joint venture between Northwestern Engineering and Northwestern's School of Communication, the Center for Human-Computer Interaction + Design (HCI+D) studies the future of human-computer interaction and creates next-generation technologies to support a more collaborative, sustainable, and equitable society.

Bringing together diverse disciplines

HCI+D faculty includes experts in communication, computer science, design, learning sciences, mechanical engineering, medicine, organizational behavior, journalism, economics, and psychology who study how computing can enhance people's lives through seven core research areas:

- Better Health
- Collaborative Computing
- Data Visualization
- Human-Centered Artificial Intelligence (AI)
- Inclusive Computing
- Interactive Computing
- Revitalizing Communities

27

HCI+D faculty affiliates represent seven of Northwestern's nine schools

Recent accomplishments

By studying algorithms supporting online marketplaces and crowdfunding platforms, HCI+D researchers pinpointed changes to improve equity and access to fundraising. Another project developed AI-driven, inclusive audio-editing interfaces for sound engineers, musicians, and podcasters with blindness or visual impairment.

The center also launched the Human-Computer Interaction Certificate. Open to all Northwestern undergraduate students, the program builds knowledge in designing, evaluating, and implementing interactive computing systems for human use.

Leadership

Elizabeth Gerber
Codirector and professor of mechanical engineering and of communication studies

Bryan Pardo
Codirector and professor of computer science and of radio, television, and film

Darren Gergle
Codirector and professor of communication studies

"We are experiencing an unprecedented time in computing technology that isn't just influencing how we work, but what we do at home and in the classroom. HCI+D provides an important interdisciplinary perspective of the evolving relationship between these pervasive technologies and our society."

ELIZABETH GERBER

Center for Innovation in Global Health Technologies

Creating context-appropriate healthcare for the developing world

Through education and training, research, and product development, the Center for Innovation in Global Health Technologies (CIGHT) develops and brings to market on-demand healthcare technologies that integrate seamlessly with the lives of patients and medical practitioners in the developing world.

From classroom ideas to global implementation

Since its founding in 2005, many of CIGHT's ideas for diagnostic devices were developed through student projects in senior biomedical design courses. CIGHT faculty and student researchers travel annually to Cape Town, South Africa, to collaborate with faculty from the University of Cape Town to test and implement the devices in the region's resource-poor townships. Past innovations include a phototherapy blanket to treat jaundice in neonates, a digital x-ray system, and a specimen cup to test for tuberculosis.

Recent accomplishments

CIGHT leveraged its expertise in point-of-care diagnostics to develop a highly sensitive, easy-to-use test device for COVID-19. Called DASH (Diagnostic Analyzer for Specific Hybridization), the device uses a polymerase chain reaction—PCR—technique to detect the virus. Users place a nasal swab into a chamber within a small cartridge, and then insert the cartridge into the testing unit. Results appear on the unit's touchscreen within 15 minutes.

In March 2022, DASH received emergency use authorization from the US Food and Drug Administration. The device is produced through Minute Molecular Diagnostics, a startup company spun out of CIGHT and cofounded by David Kelso, clinical professor of biomedical engineering and CIGHT founder, and Sally McFall, research professor of biomedical engineering.

Leadership

Matthew Glucksberg
Codirector and professor of biomedical engineering

Sally McFall
Codirector and research professor of biomedical engineering

"Unlike many university centers, we do product development. And we do it directly in our labs."

MATTHEW GLUCKSBERG

1 MILLION
COVID-19 test cartridges per month produced by CIGHT spinoff company Minute Molecular Diagnostics