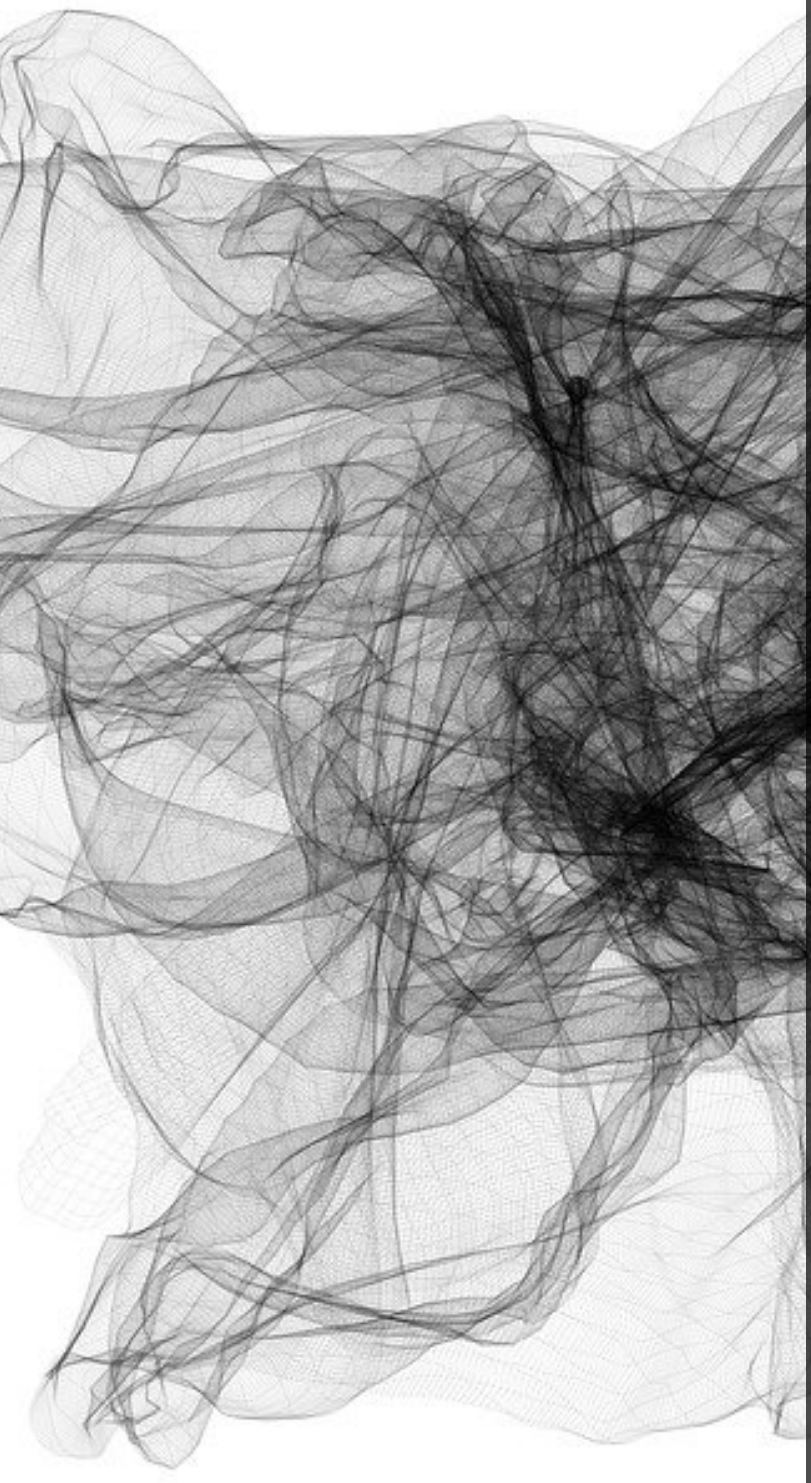
Hemispheres

A Newsletter of the Neural Engineering Center at GA Tech & Emory

Summer 2025



GA Tech & Emory's CNTP T32 Renewal

plus

2025 InterfaceNeuro Conference

Georgia Tech Neural Engineering Center EMORY UNIVERSITY

Lena Ting, PhD.
Co-Director, Georgia Tech
& Emory Neural Engineering Center

Lena Ting

Garrett Stanley, PhD.
Director, McCamish Parkinson's
Disease Innovation Program and
Co-Director, Georgia Tech
& Emory Neural Engineering Center

Garrett Stanley

from the Directors

Highlighted in this issue of the NEC newsletter is our rich history of grass-roots led training efforts that have been driven by a dedicated community of faculty and staff over more than two decades. It is this culture of learning and training that has served as the nucleus for the thriving Neural Engineering environment across GT and Emory that we all enjoy today! In this issue, we spotlight the recent renewal of the NIH funded T32 Computational Neural Engineering Training Program (CNTP), the CNTP trainee-led committees and the activities that they drive across GT and Emory, and one of our fantastic CNTP doctoral program trainees Ahmad Qader.

We also feature the highly engaging and interdisciplinary InterfaceNeuro conference held at Georgia Tech in May where speakers from around the world shared their research at the intersection of neural technology, neuroscience, and neurological disorders. Thanks to generous funding from the McCamish Parkinson's Disease Innovation Program at Georgia Tech we hosted three sessions on cutting-edge research in brain state and brain function, measuring and manipulating neural activity, and brain-computer interfaces (BCI). Over 40 trainees from the CNTP also presented their research at the conference.

Finally, our research community continues to grow and thrive: in this issue we feature NEC member Professor Zach Danziger who joined us just over a year ago, launching his laboratory at Emory in the Departments of Rehabilitation Medicine and Biomedical Engineering. His work focuses on machine learning for BCI and closed loop control of neural function in spinal cord injury.

The future looks bright for our community of scholars that brings together people from a wide range of perspectives, backgrounds, interests, and talents – collectively seeking to understand and treat neural dysfunction, and improve the lives of people with disorders of the brain and nervous system.

Lena and Garrett

National Institute of Biomedical Imaging and Bioengineering

Georgia Tech & Emory University Computational Neuralengineering Training Program (CNTP)

Training the Next Generation of Neuroscientists For Innovation, Exploration, & Cures

CNTP T32 Training Grant Renewed!

We are happy to report that following a successful initial 5 years, the Georgia Tech/Emory University Computational Neuralengineering Training Program (CNTP) was recently extended for an additional 5 years of NIH funding through 2029. Launched in 2019, the CNTP is an NIH Pre-doctoral Training Program (T32) funded through the National Institute of Biomedical Imaging and Bioengineering. The mission of the CNTP is to train the next generation of researchers at the intersection of computational neuroscience, clinical neurophysiology, and machine learning and AI. The training program addresses the opportunities provided by the explosion of tools for measurement and manipulation of nervous system function, the challenges posed by the growing threat of neurological diseases and disorders on an expanding senior population, and the emerging Neurotechnology industry. The training program provides trainees with unique opportunities to catalyze new collaborative research through research rotations, coursework in neural engineering, computational approaches, and clinical perspectives and as well as interactions with our community through seminars, journal clubs, industrial partners, and external visitors. Further, professional development and communications skills are integral to all training elements.

The initial program from 2019-2024 catalyzed a student-centric community and significantly enhanced the rapid and recent growth in research and education in Neuroscience and Neurotechnology across Georgia Tech and Emory University. This has resulted in numerous faculty hires, expansion of graduate (and undergraduate) communities, and a place in the central strategic planning at both universities. Starting modestly with 4 trainees in 2019, the program has grown and expanded to over 40 trainees, and 40+ training faculty, with a range of activities and opportunities that otherwise would not exist, including the popular clinical training course for engineers (see page 7).

In the newest phase of the CNTP, the engagement of faculty, students, and external members alike has expanded. The executive team has expanded from Profs. Garrett Stanley and Lena Ting to include Christopher Rozell and Michael Borich, and seven more faculty members have been engaged to form a leadership team and advise student-run activity committees (see page 6). The program also has an expanded External Advisory Board consisting of 7 leaders across different academic institutions and industry partners in neural engineering. Importantly, in addition to financial support from the NIH, the CNTP has benefited from critical financial support from the Georgia Tech Office of the Executive Vice President of Research, the GT/Emory BME Department, the GT School of Electrical and Computer Engineering, Emory Rehabilitation Medicine, the Emory Laney Graduate School, and the and the Emory School of Medicine, as well as trainee support from the Sartain-Lanier Foundation.

This is the latest training program over the last 20+ years funded by the federal government that has supported the thriving Georgia Tech/Emory Neural Engineering community. Funding from the National Science Foundation from 2003-2011 supported an IGERT (Integrative Graduate Education and Research Traineeship) program that was led by Profs. Steve Deweerth and Robert Butera, entitled "Hybrid Neural Microsystems: Integrating Neural Tissue and Engineered Systems". This training program focused on creating a training environment that combined cellular and systems neuroscience with microelectronics & computing technology and micro-electro-mechanical systems (MEMS). From 2011-2017 a subsequent NIH-funded training program through the National Institute on Drug Abuse (NIDA) was led by Profs. Dieter Jaeger and Garrett Stanley, entitled "From Cells to Systems and Applications: Computational Neuroscience Training at Emory and Georgia Tech" (T90/R90). This program financially supported undergraduate and graduate students across Georgia Tech BME and Emory Neuroscience and was the catalyst for the current community we have today.

In addition to cutting-edge research, the training of researchers and emerging leaders in Neuroscience and Neurotechnology is the central mission of the GT/Emory Neural Engineering Center and is something that we are very passionate about. Many of the training opportunities provided by the CNTP are advertised and open to the larger GT and Emory communities, so please be on the lookout for opportunities to grow with us!

Article Written by Garrett Stanley and Lena Ting, Neural Engineering Center, Georgia Tech and Emory University

Behind the Scenes of CNTP

CNTP Committees

Student-led activities provide PhD students with a way to build their technical, professional, and leadership skills while creating an interdisciplinary community across campuses. The following is a birds-eye-view of CNTP and some of the students who make it all happen.

COMMUNITY IMPACT

Faculty Leads: Rodgers-Dyer-Ting

Chair: Danielle Dowe co-Chair: Jeffrey Liu

Promotes faculty and trainee engagement by organizing annual retreats and collaborative social events.

Annual Fall Retreat, Oct. 2024

RECRUITMENT & OUTREACH

Faculty Leads: Frenzel-Singer-Rozell

Chair: Ethan Corey co-Chair: Kennedy Kerr

Atlanta Science Festival, Mar. 2024

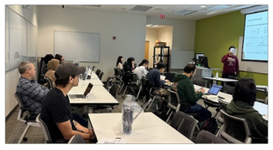
2024 Atlanta Regional Brain Bee, Mar. 2024

Helps recruit graduate students and provides educational opportunities in neural engineering to the general public.

TECHNICAL TRAINING

Faculty Leads: Danziger-Wu-Stanley

Chair: Tyler Albarran co-Chair: Sushil Bohara



Dr. Weihan Li Journal Discussion, Nov. 2024

Forms a community of scholarship by hosting paper discussions, tutorials in data science and machine learning, and rigor and reproducibility.

PROFESSIONAL DEVELOPMENT

Faculty Leads: Haider-Kesar-Borich

Chair: Vivek Anand co-Chair: Lama Moukheiber

Dr. Naila Kuhlmann Talk, Mar. 2024

Provides career and professional development through communication workshops, industry panels, and maintains CNTP website.

Innovative coursework for engineers to delve into clinical problems

How can engineering approaches address clinical challenges in neural engineering and related fields? We offer innovative coursework that allows PhD students in the Computational Neuralengineering Training Program (CNTP) to have trans-disciplinary experiences motivating the use of technology in healthcare, as well as the need for basic science and engineering research that will ultimately have clinical applications.

Here are some student voices of their experiences. For more information about the courses and to read the reflections written by these students, scan this QR code.

My favorite aspect of the class was how emotionally impactful and enjoyable it was. From observing complex surgeries, to dancing, to interacting with patients from diverse backgrounds, every experience was both eye-opening and humbling. One moment that still stays with me was when a patient at the ALS clinic asked, "Can you fix me?" A question that left me speechless and made me rethink how my research could truly make an impact beyond academic achievements. The class balanced hands-on learning with deep, meaningful connections both with the patients and clinicians that reminded me of the human side of my work.

- Collette Thomas, Clinical Experience for Engineers, Summer 2024

There are two major areas. First it bridges the gap between technology and practicality. I feel that sometimes in engineering, due to the disconnect with the clinic, the focus is mainly in developing the most sophisticated technology. By being in the room and understanding the clinical workflow, I think it helps to put the work as a neural engineer in perspective, and the need that is being addressed in the center, i.e., sometimes you just need something fast and easy. And secondly, interacting with patients and seeing how technology genuinely helps them have a better life gave me real meaning to what I do.

-Eva Martinez Luque, Clinical Experience for Engineers, Summer 2024

- Cameron Mains, Integrating Engineering, Technology, and Rehabilitation Spring 2025

In this class, I learned to approach rehabilitation technology development by first understanding the person's story and lived experience, rather than just focusing on technical requirements. I now recognize that the most impactful medical devices emerge when we connect technical specifications to meaningful life activities, which is why I'll incorporate patient vignettes in my design process to create solutions that honor the full humanity of the people who will use these technologies.

Written by Sherry Sam, Neural Engineering Center, Georgia Tech and Emory University

MEET PROF. ZACH DANZIGER

Zach Danziger and his team are on a mission to understand how the nervous system controls the body at the level of systems physiology. We sat down with the Emory Rehabilitation Medicine and Biomedical Engineering Associate Professor/Researcher and here's what he had to say:

GT/Emory NEC: Please elaborate on your research to investigate how the nervous system controls the body?
Danziger: It isn’t clear at all how we coordinate all the body’s muscles to make the movements we do. If you take a look at robots, they can’t do anything like the fluid and improvised movements we can – they are ridged and stilted. I’m interested in what the principles of control are in the nervous system and how we can apply them to better control robots and to fix things that go wrong during disease. Right now we’re looking at understanding and modeling how the lower urinary tract (the bladder, urethra, and friends) coordinates via combinations of voluntary movement and a web of involuntary reflexes. Something as simple as peeing effectively can be quite complicated, and it’s something many of us learn firsthand as we get older. We are also working to improve algorithms that can analyze the neurons in movement brain regions. We would like to give people living with paralysis control over their personal computers to give them digital independence, and if we can make better algorithms that let their neurons directly control something like a computer mouse we would be much closer to that goal. It’s a challenge because the user and algorithm have to work together. I expect that a better understanding the principles of neural control of movement will help us with this immensely.

GT/Emory NEC: How do you envision your work will impact neuroscience and the scientific community more broadly?
Danziger: As Jack Handey once said, “Perhaps, if I am very lucky, the feeble efforts of my lifetime will someday be noticed, and maybe, in some small way, they will be acknowledged as the greatest works of genius ever created by Man.”

GT/Emory NEC: What was your journey into this research area? Please elaborate on your academic journey that led to this area. The more details the better! (I personally, would like to know how you chose your major, why you decided to do your PhD and why academia.)
Danziger: After my first exposure to Plato in high school, I pretty well knew that I wanted to think for a living. It took a long time after that to figure out what I should be thinking about, though. I entered undergrad as pre-med and meandered through no small number of major changes in my four years there. Philosophy was where my heart was pulling me, but I didn’t have enough of a gift for it to make a meaningful impact to a field that the world’s greatest minds have been attacking the world’s hardest questions for thousands of years. Biomedical engineering, the major I ended up on, was a good compromise between my talents, an ability to make a contribution, and an area with an endless supply of interesting available questions. A few different areas of science made sense for me, and I worked in 4 or 5 different labs as summer jobs looking to see which I enjoyed best. I was in a lab on an undergrad scholarship doing neuroscience theory at Northwestern University, and the project combined theory, computer programming, experiments, and neural control of movement, and I got hooked on that. I studied every day on my hour-long train commute to and from the city. When the summer was up, the PI offered me a spot in his lab in the PhD program, which I happily accepted.

GT/Emory NEC: With hindsight being 20/20, in retrospect, what is the best decision you made and what was the worst decision you made in your academic journey?
Danziger: The problem with being a scientist is that I can’t really answer this question. Although we can see how things turned out given the choices we made, we can’t run the counterfactual to see how things would have turned out had we made a different choice that we now believe would have been better. This is the reason why we need to run controlled, prospective studies. To be less pedantic, I think my best and worse decisions were actually the same one: I decided to keep my focus on intellectual curiosity. It served me well because it’s easy to get caught up in the business of science (it is a job, after all) rather than letting yourself follow your interests, but being intentional about it kept my career enjoyable and fulfilling through plenty of unexpected stressors and difficulties. It gave me the energy to persevere and dedicate long hours to the research and derive a deep sense of satisfaction from the effort. The trade-off for this was that I spread myself pretty thin. I have ongoing projects in human behavioral experiments, algorithm design, animal models, machine learning, and electrophysiology, and while this is exhilarating, the lack of laser focus makes reaching the top and fully exploiting one’s knowledge in one of these areas impossible.

GT/Emory NEC: In your field, what is one idea/tool/concept that really excites you going forward? How do you see it impacting your field in the next 5-10 years?
Danziger: Coadaptation. Maybe not new, per se, but people are now taking it much more seriously. We must recognize that any time we present the nervous system with a new technology it will adapt itself to meet the demands of a new context or to avail itself of the new opportunity. But we are now in a position to allow the technology to reciprocally adapt to the user’s nervous system as well. By allowing the technology to change or update in response to how the user is engaging with the system we can improve overall performance. It’s a delicate balance to make sure an adaptive artificial system stays in a constructive relationship to the changing biology, but the potential upsides are big.

GT/Emory NEC: What is a fun fact about you that one would be surprised to know?
Danziger: I never fully gave up philosophy. I still read and think about moral philosophy and the philosophy of science all the time. This got me involved in some interesting stuff, like participating in an NSF Ethics Community of Practice for biomedical engineers, co-chairing the 9th International Conference on Ethics in Biology, Engineering, and Medicine, and being the lead author on the BMES (the national society for biomedical engineering) Code of Ethics.

GT/Emory NEC: What is one piece of advice you would have for someone working in neural engineering/neurotechnology?
Danziger: Understanding improves design. Neuroscience is a big place with lots of ideas and very few governing theories. Read the literature widely and understand the physiology. The more your engineering concepts (be they algorithmic or physical) respect the realities of how the neuroscience works the better your solutions will be. It happens all the time that to create neurotechnology we abstract away the details of neurons or how the nervous system interfaces with the body’s muscles to make the problem tractable, but the best solutions tend to embrace the complexity of neuroscience.

Inverview conducted by Vivek Anand, ECE, CNTP Fellow, Georgia Tech / Emory University

Introducing...

Ahmad Qader

A passion for advancing technology and translational research is what drew Ahmad Abdal Qader to neuroscience while pursuing biomedical engineering as an undergrad. Recognizing that accomplishing these goals required a "vast and interdisciplinary skillset", Ahmad turned to the CNTP community when he joined the BME PhD program in 2022. Now a 3rd year CNTP scholar, Ahmad is working to answer research questions that can have real impacts on people's lives.

His work focuses on understanding neural mechanisms of motor disorders like dystonia and Parkinson's disease. Co-advised by Drs. Chethan Pandarinath and Ellen Hess, Ahmad uses state of the art machine learning tools to uncover patterns of neural activity in freely behaving animal models of disease. The complex structure of free behavior imposes unique challenges compared to traditional, task-based experimental paradigms; however, it serves a crucial role in understanding the neural underpinnings of spontaneous behavior under diseased conditions. He now is working on building machine learning models with the capacity to learn the unique firing statistics in the striatum and reveal the dynamical rules that govern how neuronal populations coordinate activity to produce spontaneous behavior.

In addition to the unparalleled research resources Ahmad has found at Emory, he values and contributes to the CNTP community as a member of the Community Impact Committee. He has been committed to maintaining the welcoming nature of the program among both trainees and faculty, even as the program grows. The same emphasis on collaboration, interdisciplinary thought, and synthesis of ideas that is vital to his research is applied when planning events like the annual CNTP retreat, fellows and scholars similarly bridging fields like machine learning and neuroscience are brought together.

A midtown resident, when Ahmad isn't in the lab you can find him at Piedmont Park, playing soccer, running, or watching UFC with friends. While a fan of his walkable neighborhood, three years in Atlanta has inevitably led him to be in the possession of a car. Drawn to the food scene and outdoor activities outside the perimeter, Ahmad suggests Yuzu Sushi in Chamblee and a weekend trip to the Smokies in Gatlinburg TN!

Article written by Kennedy Kerr, BME, CNTP Fellow, Georgia Tech / Emory University

INTERFACE NEURO

InterfaceNeuro Highlights Atlanta's Growing Role in the Neurotech Revolution

Integrating the human nervous system with machines once only existed in science fiction. Today, brain-computer interfaces (BCIs) are being explored to treat conditions like Parkinson's disease, spinal cord injury, epilepsy, and depression.

Georgia Tech recently convened over 200 stakeholders from every corner of the neurotechnology landscape to explore the future of this rapidly evolving field at InterfaceNeuro. Held May 7-8, the conference brought together a dynamic community of neuroscientists, neuroengineers, clinicians, industry leaders, and individuals with lived experiences to align cutting-edge research with clinical needs and societal impact.

"One of our primary goals was to create a space where people from different backgrounds could come together, share their perspectives, and learn from one another," said Chris Rozell, professor in Georgia Tech's School of Electrical and Computer Engineering and one of the conference's organizers. "That kind of exchange is essential for advancing the field."

Originally founded by Rice University's Neuroengineering Initiative in 2023, InterfaceNeuro made its Atlanta debut with the theme "Integrating Brain, Body, and Machine for Next-Gen Intelligent Interfaces." The conference featured a curated program of keynote talks, panel discussions, research posters, and informal networking sessions designed to foster knowledge exchange and catalyze new partnerships.

Speakers and attendees alike represented the full spectrum of neuroscience and neurotechnology experts, from bench scientists and device engineers to caregivers and patients. According to conference attendee Simone Russo, it was that breadth and diversity of the conference that made the conference worthwhile.

"It was like talking to everybody at different levels, bridging the clinical side to the caregiving side, to the very basic research," said Russo, a postdoctoral researcher in the Walter H. Coulter Department of Biomedical Engineering (BME). "That's something that doesn't uually happen."

Themed sessions were sponsored by several centers across Georgia Tech and Emory University, including the McCamish Parkinson's Disease Innovation Program, the Neural Engineering Center, the Building Reliable Advances and Innovations in Neurotechnology (BRAIN) Center, and the Center for Advanced Motor Bioengineering and Research. Organized by Georgia Tech's Neuro Next Initiative, the meeting was a testament to Atlanta's expanding leadership in neuroscience and neurotechnology.

"This conference reflected the kind of community we're building at Georgia Tech — one that's deeply interdisciplinary, inclusive, and focused on real-world impact," said Garrett Stanley, BME professor, director of the McCamish Parkinson's Disease Innovation Program, and one of the conference's co-organizers. "With the launch of the Institute for Neuroscience, Neurotechnology, and Society this July, we're creating a lasting home for this momentum to grow."

This article was reprinted from the Neuro Next Initiative website. Article by Audra Davidson, Research Communications Program Manager and Neuro Next Initiative

Georgia Tech **Neural Engineering Center** EMORY UNIVERSITY

The Next Generation of Neuroscience
For Innovation, Exploration & Cures

Do you want to donate to our efforts? Please contact Luke O'Connell (luke.oconnell@bme.gatech.edu) in the College of Engineering, Ashley Coogan (ashley.coogan@cos.gatech.edu) in the College of Sciences or Paul Schultz (paul.schultz@cc.gatech.edu) in the College of Computing.

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This newsletter was produced by the staff of the Neural Engineering Center at GA Tech and Emory University.