Center for Neuroengineering

Summer Session at Georgetown University
June 19th to June 23rd, 2023

Technical University of Munich

TUM

GEORGETOWN UNIVERSITY

Center for Neuroengineering

Neuroengineering: Bridging Neuroscience and Engineering

Summer School – June 19th to June 23rd, 2023

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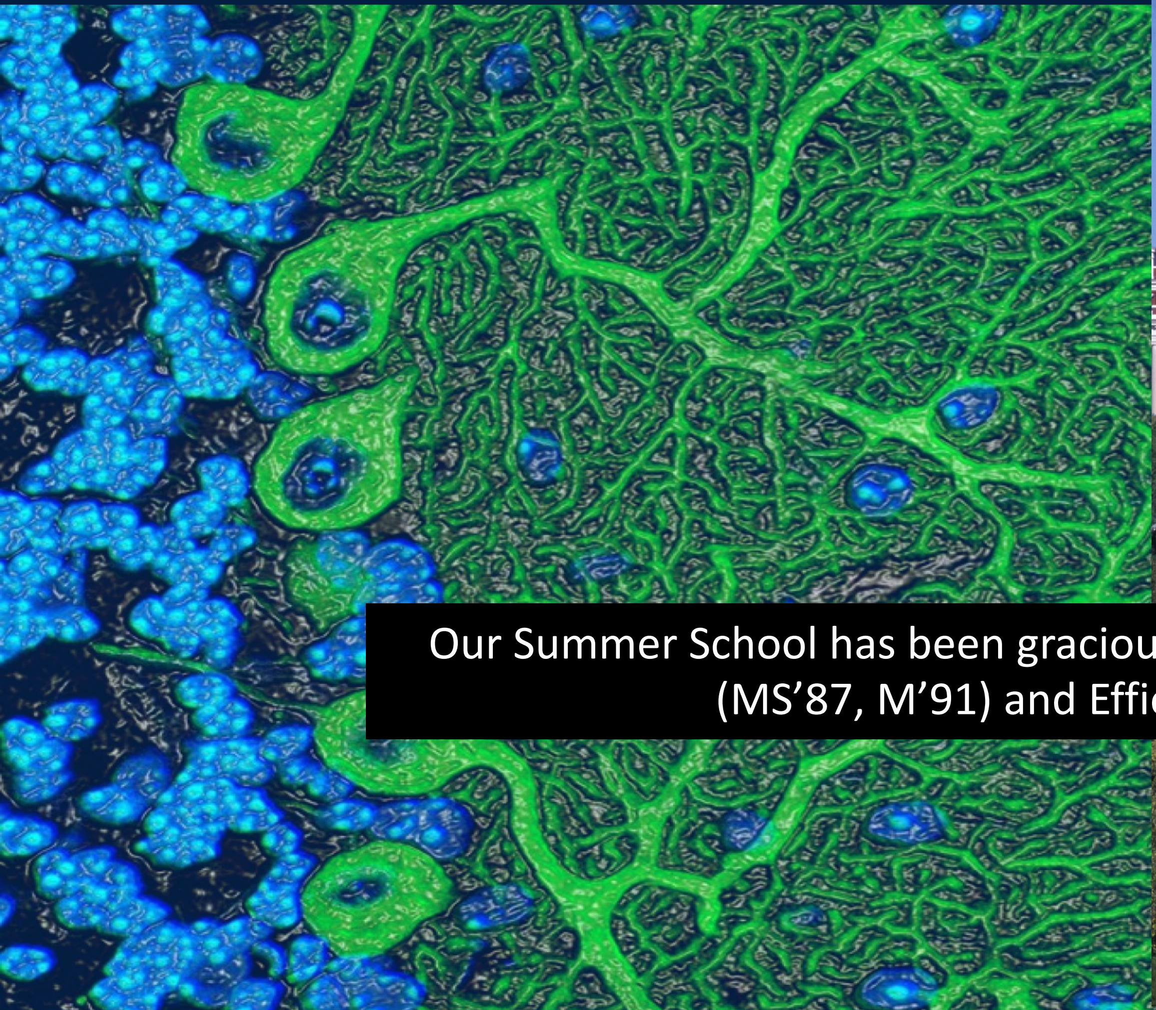

Our Summer School has been graciously sponsored by Nicholas (MS’87, M’91) and Effie Theodore

CNE Summer School 2023
Monday, June 19

6:30PM – 8:30PM	Arrival Reception 1310 Kitchen and Bar at the Georgetown Inn 1310 Wisconsin Avenue, NW Washington, DC. 20007

CNE Summer School 2023 - Tuesday, June 20 (Morning)

Location: McShain Lounge; Session Chair – Josef Rauschecker, PhD

8:45am – 9:30am	Breakfast
9:30am – 9:45am	Welcoming Remarks – Josef Rauschecker, PhD *Professor, Department of Neuroscience, Co-Director, Center for Neuroengineering, Georgetown University Medical Center*
9:45am – 10:45am	**“Neuroscience for Engineering – Engineering for Brain Science”** Gordon Cheng, PhD *Chair, Professor, and Director of the Institute for Cognitive System, Technical University of Munich*
10:45am – 11am	Coffee Break
11:00am – 11:45am	**“What makes the brain so good at learning? Insights for neuroengineering and neuromorphic AI”** Max Riesenhuber, PhD *Professor, Department of Neuroscience, Co-Director, Center for Neuroengineering, Georgetown University Medical Center*
11:45am – 12:30pm	“**Functional MRI: The non-invasive brain mapping method that continues to evolve, surprise, and inspire.**” Peter Bandettini, PhD *Chief, Section on Functional Imaging Methods, National Institutes for Mental Health*

CNE Summer School 2023 - Tuesday, June 20 (Afternoon)
Location: McShain Lounge; Session Chair – Mak Paranjape, PhD

12:30pm – 2pm	Lunch
2pm – 2:45pm	“**Augmented grasping capabilities with soft bionic hands**” Cristina Piazza, PhD *Technical University of Munich*
2:45pm – 3:30pm	“**How studying neural plasticity informs on rehabilitation from blindness and hand loss**” Ella Striem-Amit, PhD *Assistant Professor, Department of Neuroscience, Georgetown University Medical Center*
3:30pm – 3:45pm	Coffee Break
3:45pm – 4:30pm	“**Neuroprosthesis - Building Machine to Brain Interface**” Nitish V. Thakor, PhD *Professor of Biomedical Engineering, Johns Hopkins University*
Evening	Free time

CNE Summer School 2023 - Wednesday, June 21 (Morning)
Location: Healy Family Student Center; Session Chair – Max Riesenhuber, PhD

8:45am – 9:30am	Breakfast
9:30am – 10:15am	**"From Philosophy of Mind to Neuroscience and Engineering"** Josef Rauschecker, PhD *Professor, Department of Neuroscience, Co-Director, Center for Neuroengineering, Georgetown University Medical Center*
10:15am – 11:30am	Coffee break, Bookstore, Georgetown
11:30am – 1pm	Tour of GU Campus – 90 minute tour w/ John Glavin
1pm – 1:45pm	Lunch

CNE Summer School 2023 – Wed., June 21 (Afternoon)

Location: Healy Family Student Center; Session Chairs – Max Riesenhuber, PhD and Josef Rauschecker, PhD

1:45pm – 2:45pm	2 minute poster introductions
2:45pm – 6pm	Poster session (discussion of presented posters by students)
4:45pm – 6pm	Round table for key participants to plan future collaborations between Georgetown and TUM
6pm	Bus pick up at GU for German Embassy
6:30pm – 8:30pm	Reception/Dinner – Embassy of the Federal Republic of Germany

CNE Summer School 2023 - Thursday, June 22

Location: Healy Family Student Center; Session Chair – Stefano Vicini, PhD

8:45am – 9:30am	Breakfast
9:30am – 10:15am	“**Applying Neuroengineering Tools for Studying the Mechanisms of Neuropsychiatric Disorders in Rodents.”** Alexey Ostroumov, PhD *Assistant Professor, Department of Pharmacology, Georgetown University Medical Center*
10:15am – 11am	“**Computational Mechanisms of Human Sensorimotor Adaptation ”** David Franklin, PhD *Associate Professor, Technical University of Munich*
11am – 11:15am	Coffee Break
11:15am – noon	“**Magnetoelectric nanomaterials for wireless neuronal modulation”** Kristen Kozielski, PhD *Assistant Professor of Neuroengineering, Technical University of Munich*
Noon – 1:30pm	Brainstorming Session – “AI and Neuroengineering”
5pm	Open time. Please reach out if you would like advice on things to do in DC. (See contact information at end of presentation.)

CNE Summer School 2023 - Friday, June 23 (Morning)
Location: Healy Family Student Center; Session Chair – Carlo Tornatore, MD

8:30am – 9:15am	Breakfast
9:15am – 10am	**"A brain-computer-interface with cellular resolution for the investigation of human language and verbal communication"** Simon Jacob, MD *Professor, Translational Neurotechnology, Technical University of Munich*
10am – 10:45am	**"Speech Encoding in Single Neurons and Neural Populations"** Matthew Leonard, PhD *Associate Professor, Department of Neurological Surgery, Weill Institute for Neurosciences, University of California, San Francisco*
10:45am – 11am	Coffee Break

CNE Summer School 2023 - Friday, June 23 (Afternoon)
Location: Healy Family Student Center; Session Chair – Max Riesenhuber, PhD

11am – 11:45am	**"Investigating human cognitive function through intracranial recordings from the human brain"** Kareem Zaghloul, MD, PhD *Senior Investigator, Functional Neurosurgery Section, National Institute of Neurological Disorders and Stroke*
11:45pm – 12:30pm	**"The Universal Grammar of Action: A key to Neuroengineering"** Yiannis Aloimonos, PhD *Professor of Computational Vision and Intelligence, Department of Computer Science, Director of the Computer Vision Laboratory at the Institute for Advance Computer Studies (UMIACS), University of Maryland*
12:30pm – 1:15pm	Lunch
1:15pm – 2:00pm	**"Neuroengineering on the Global Stage: The Need for a Cosmopolitan Neuroethics"** James Giordano, PhD, MPhil *Pellegrino Center Professor, Departments of Neurology and Biochemistry, Chief of the Neuroethics Study Program, Co-director of the Project in Brain Science and Global Health Law and Policy, Georgetown University Medical Center*
2pm – 2:30pm	General Discussion, Closing Remarks

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Abstracts

Abstract 1

“Neuroscience for Engineering – Engineering for Brain Science”

Gordon Cheng, PhD
Chair, Professor, and Director of the Institute for Cognitive System, Technical University of Munich (TUM)

Engineers, like Robotists, are looking more and more to neuroscience in creating more and more sophisticated engineering solutions never possible before (e.g. advanced robots/devices alike). Neuroscientists are too turning to use engineering methods, not just for tools, but are now exploring brain mechanisms together with neural engineers to advance their understanding of the brain. This fusion of engineering and neuroscience represents a neuroengineering approach—a nascent research domain that is bringing together neuroscience, robotics, artificial intelligence, and even medicine. This talk highlights past and current perspectives and future key challenges in bridging this junction to make neuroengineering for the good of us all.

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Abstracts

Abstract 2

“What makes the brain so good at learning? Insights for neuroengineering and neuromorphic AI”

Max Riesenhuber, PhD
Professor, Department of Neuroscience, Co-Director, Center for Neuroengineering, Georgetown University

While machine learning algorithms have been developed that can reach or exceed human object classification capabilities using large training sets, the human brain’s abilities to learn new categorization tasks from few examples and to leverage prior learning to facilitate the learning of novel tasks still represent the gold standard that has not been met by current AI systems. Powerful algorithms for learning in deep hierarchies have been developed in Artificial Intelligence based on the backpropagation algorithm (“backprop”), yet it has been known for more than 30 years that backprop is not biologically plausible and cannot account for deep learning in the brain since it requires the computation of complex quantities such as non-local error derivatives for which there is little neuroscientific evidence. This discrepancy between artificial and natural vision systems has brought into sharp focus the question of how the brain learns to assign meaning to sensory stimuli. Several lines of evidence suggest that concepts are represented in the human anterior temporal lobe (ATL), the hub of a semantic memory system, yet it is unclear how these representations arise. I will review evidence from neurophysiology, brain imaging, and computational modeling that suggest a biologically plausible and computationally powerful model that can learn from few examples by building on prior learning and effectively combining supervised and unsupervised learning, leading to novel hypotheses for how concept representations are learned in the human brain.

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Abstracts

Abstract 3

Functional MRI: The non-invasive brain mapping method that continues to evolve, surprise, and inspire.

Peter Bandettini, PhD
Chief, Section on Functional Imaging Methods, National Institutes for Mental Health

Since its inception in 1991, functional MRI, a non-invasive method for rapidly mapping human brain activation at high resolution, has seen rapid growth and adoption by the neuroscience community. It has also engaged and benefitted from disciplines including physics, engineering, computer science, mathematics, and AI. Over the years, it has evolved in spatial and temporal resolution, depth and precision of the information it provides, and likewise, insight into the human brain function and organization. In this presentation, I will outline this evolution and highlight recent exciting advances in spatial resolution, utility in neuro-feedback, ability to assess individual differences, and the ability to characterize moment-to-moment changes in brain state over time. I will also provide speculation as to the promise it holds in the future for providing further insight into the brain, as well as potential clinical utility.

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Abstract 4

Augmented grasping capabilities with soft bionic hands

Cristina Piazza, PhD
Assistant Professor, Technical University of Munich

Since the 16th century, science and engineering have endeavored to match the richness and complexity of the human hand sensory-motor system. In the last decade novel theories and technologies, e.g. soft robotics and the simplification of the mechanical design, suggest a new promising direction towards the next generation of high technologic bionic aids. This talk aims to exploit the potential of these emerging trends and proposes new strategies to optimise the performance of an artificial hand, achieving a useful trade-off between grasping performance and mechanical design/control complexity.

Abstract 5

How studying neural plasticity informs on rehabilitation from blindness and hand loss

Ella Striem-Amit, PhD
Assistant Professor, Department of Neuroscience, Georgetown University Medical Center

What determines the function of cortical areas? What functions do brain regions take on when deprived from birth from their typical defining input or output channels? And how can these guide rehabilitation efforts?

Studying people born blind, we find that the association visual cortices maintain some of their original roles, processing information for categories parallel to those they process through vision (e.g. script and body shapes). Similarly, in studying individuals born without hands, who use their feet to perform everyday actions, we find that association motor areas maintain similar preferences for actions, regardless if they are performed with the hand or foot. Together, this suggests that computations in association cortices are independent from the specific visuomotor features (visual features, muscle group) and are able to compensate for lack of experience. Further, such research can open new avenues to use high-level action representations for motor rehabilitation and prosthesis design. In contrast, plasticity in primary cortices in these individuals shows different patterns of plasticity, suggesting that plasticity patterns can be informative of sensorimotor processing hierarchies and for interfacing with them with neuroengineering. Last, plasticity may manifest variably across individuals, opening a pathway for its use to harnessing individual differences for fitting rehabilitation approaches.

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Abstract 6

Neuroprosthesis - Building Machine to Brain Interface

Nitish V. Thakor, PhD
Professor of Biomedical Engineering, Johns Hopkins University

Brain Machine Interface (BMI) involves decoding brain (or nervous system) activity to control machines, such as prosthetic limbs. Various neural signals are decoded for this application and dexterous prosthesis control is achieved. However, these modern machine to brain interfaces (MBI) do not fully integrate sensory information such as sense of touch, force, vibration and temperature. Therefore, advances are needed to develop sensors for the machines such as prosthetic hands and then encode their signals in a biomimetic manner. The sensory information is than relayed to the amputee wearing the prosthesis for suitable sensory feedback. This talk will summarize the development of biomimetic tactile sensors, their neurall inspired (neuromorphic) encoding, and their classification. Further, the presentation will include sensory feedback techniques, and how the subject senses and utilizes the sensory information in aa machine to brain interface. Ongoing work and future developments will make it possible to build 'closed loop' BMI and MBI solutions.

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Abstract 7

From Philosophy of Mind to Neuroscience and Engineering

Josef Rauschecker, PhD
Professor, Department of Neuroscience, Co-Director, Center for Neuroengineering, Georgetown University Medical Center

If you've been sitting under a stone for the last 2-3 years and haven't heard that Georgetown University is in the process of establishing a Center for Neuroengineering, then you may be in for a surprise. Georgetown isn't exactly known for its achievements in engineering, although if you know the place a little better, you would have heard that we invented the first whole-body CT scanner, and its inventor, Bob Ledley, was inducted into the Inventors Hall of Fame and received the National Medal of Technology and Innovation. There have been other discoveries in the field of Cancer Research and Neuroscience, but Georgetown has definitely not been known for its accomplishments in engineering. This changed when it made the bold move of starting an Institute for Cognitive and Computational Sciences in 1995, supported by the Chairs of Physics, Biology, and Computer Science, but also by the Chair of our Philosophy Department, and they recruited me to become its Associate Director.

I am also proud to say that my first degree is in Electrical Engineering, and I earned my degree from the Technical University Munich/Germany. Then, after a stint in Cambridge/England, where I received my initiation into neuroscience and published my first paper at the tender age of 22, I got my first faculty position at the Max Planck Institute for Biological Cybernetics in Tübingen. I built a mammalian neurophysiology lab there, surrounded by colleagues working on fruit-flies. You could say that *Biological Cybernetics* was a precursor of what we nowadays call Neuroengineering: the application of mathematics and engineering to understanding the principles of brain function. Protagonists were Norbert Wiener ('Information processing in man and machine'), as well as McCulloch & Pitts ('What the frog's eye tells the frog's brain') from MIT. At the same time, I sought the necessary training in Medical School, and received my highest academic degree (my 'habilitation') from the Faculty of Medicine at Tübingen. Ultimately, I couldn't resist the temptation of moving my lab to the United States and followed an offer from one of the temples of medicine: the National Institutes of Health. I became a bona-fide neuroscientist, but, in my heart, I always stayed true to my education as an engineer.

So, it is in this spirit that I welcome my friends and colleagues from that world-famous institution, one of the very best in Europe, but also those of you who are merely neuroscientists. In my talk, I want to give some examples of neuroengineering, including some from our own work, that represent the kind of work we're trying to do here.

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Abstracts

Abstract 8

Applying Neuroengineering Tools for Studying the Mechanisms of Neuropsychiatric Disorders in Rodents.

Alexey Ostroumov, PhD
Assistant Professor, Department of Pharmacology, Georgetown University Medical Center

Neuropsychiatric disorders are the leading cause of disability around the world, but the progress in the discovery of significant, novel therapeutic mechanisms has been frustratingly slow. Among the major factors impeding the progress is exceedingly challenging neurobiology of higher brain function and the ethical and practical difficulties of examining the living human brain. Given these limitations, it is hard to imagine significant progress in pathophysiology or therapeutics without good animal models. In my laboratory, studying the mechanisms of neuropsychiatric disorders involves exposing rodents to drugs of abuse, stress, and aversive stimuli, which trigger various aberrant behaviors associated with addiction, depression, anxiety or other disorders. These aberrant behaviors arise from neural circuit remodeling, which, in part, results from experience-dependent changes in synaptic connectivity between neurons (i.e. synaptic plasticity). Importantly, restoring basal synaptic transmission repairs neural circuitry and alleviates aberrant behaviors, indicating that targeting experience-dependent synaptic plasticity may be a promising therapeutic tool for neuropsychiatric disorders. Hence, we seek to understand the causal mechanisms by which modifications in synaptic plasticity contribute to neural circuit remodeling and neuropsychiatric disorders. To this end, we use a range of engineering tools in rodents that allow experimental analysis at the levels of individual neurons, neural circuits, and behavior. To illustrate our approach, I will talk about novel form of inhibitory synaptic plasticity within the brain mesolimbic circuitry, which regulates reward processing, motivation, and executive function. Specifically, genetic labeling and manipulation of individual neurons showed that addictive drugs and stress cause decreased synaptic inhibition or even paradoxical GABAergic excitation of mesolimbic neurons. To examine the consequences of synaptic plasticity at the neural circuit level, we measure simultaneous activity at the scale of tens to hundreds of neurons in freely moving rodents. We found that compromised inhibition increases the instances of coincident firing between individual neurons in the mesolimbic system. The increased synchronization of neural activity may alter cognition-related brain rhythms, which are often impaired in neuropsychiatric disorders. To understand the behavioral implications of synaptic plasticity, my laboratory combines genetical and pharmacological tools in animals engaged in behavioral tasks. Given that rodent behavioral alterations can remain undetectable by human observation, we apply machine learning-assisted tools for behavioral data analysis. Using this combinatorial approach, we found that experience-dependent inhibitory plasticity alters the formation of associations between the environment and behavior, a form of learning that is dysregulated in the majority of neuropsychiatric disorders. Overall, cutting edge neuroengineering tools provide unprecedented opportunities for mechanistic insights into how experience-dependent adaptations in individual neurons alter large-scale network dynamics and contribute to neuropsychiatric disorders.

Abstract 9

Computational Mechanisms of Human Sensorimotor Adaptation

David Franklin, PhD
Associate Professor, Technical University of Munich

The human sensorimotor control system has exceptional abilities to perform skillful action despite ever changing conditions. I will discuss how this adaptability can result through intrinsic mechanisms in two different ways: sensory feedback driving feedforward adaptation; and feedforward adaptation in turn adapting the feedback responses and tuning them to the environment. We use a combination experimental and computational approaches using virtual reality and robotics to examine the mechanisms of adaptation and control. In the first part of my talk, I will examine how sensorimotor signals are used to develop motor memories of novel dynamics. I will present some of our recent research outlining the computational framework and representation of these motor memories. However, learning can also be used to adjust intrinsic feedback control. The second half of my talk will focus on a few recent studies examining feedback responses; demonstrating both how they are modulated for control and using them to probe the underlying mechanisms of visually guided reaching.

Abstract 10

Magnetoelectric nanomaterials for wireless neuronal modulation

Kristen Kozielski, PhD
Assistant Professor of Neuroengineering, Technical University of Munich

Prof. Kristen Kozielski works with new materials for wireless communication with the brain and nervous system. Her research focuses on understanding and optimizing materials for controlled, electronic signaling to and from the brain. The goal of this work is to contribute to neurotechnologies that are minimally invasive, and possibly implanted with no surgical intervention. Her multidisciplinary group works in materials science, biomaterials, nanotechnology, electrical engineering, and neurobiology.

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Abstract 11

A brain-computer-interface with cellular resolution for the investigation of human language and verbal communication

Simon Jacob, MD
Professor, Translational Neurotechnology, Technical University of Munich

Language constitutes one of the most formidable sensorimotor integration functions of the human brain. While the cortical regions in the human frontal, temporal and parietal lobe that comprise the language network have already been identified, there are vast gaps in our understanding of the neuronal mechanisms that govern how we engage in vocal communication and verbalize thoughts, intentions and emotions. I will present recent efforts in my laboratory devoted to establish a brain-computer-interface with cellular resolution for patients with language disorders (aphasia) after stroke. Using large-scale neurophysiological recordings from microelectrode arrays chronically implanted into right-hemispheric language homologue brain areas, we have begun to investigate how linguistic elements are encoded at the single-neuron level and how population-wide activity gives rise to temporal integration and combinatorial processes during speech production. The long-term goal of our transdisciplinary work is to explore neurotechnological approaches that leverage right-hemispheric cognitive resources for aphasia rehabilitation.

Abstract 12

Speech Encoding in Single Neurons and Neural Populations

Matthew Leonard, PhD
Associate Professor, Department of Neurological Surgery, Weill Institute for Neurosciences, University of California, San Francisco

Understanding the neural basis of speech perception requires studying the human brain both at the scale of fundamental computational units (neurons) and populations (columns and columnar ensembles). In this talk, I will cover work from our lab that has investigated the neural encoding of speech using direct neurophysiological recordings from human cortex. In the last decade, major advances have been made using electrocorticography (ECoG), which has described the organization of speech sound encoding across the surface of the superior temporal gyrus (STG), a critical area for speech perception. The STG has also been shown to be a key hub for linking bottom-up sensory and top-down linguistic representations to give rise to our perceptual experience of speech. Recently, we have begun to study the neural encoding of speech in STG at the single neuron level using Neuropixels probes. These high-density arrays allow for simultaneous recording from dozens to hundreds of neurons across the different layers of cortex, providing unique opportunities to understand circuit-level function in human cortex at unprecedented scales. As the tools available to study speech processing in the human brain continue to develop and expand, new and exciting questions are coming into view, pushing the boundaries of knowledge about how the human brain supports complex communication behaviors.

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Abstract 13

Investigating human cognitive function through intracranial recordings from the human brain

Kareem Zaghloul, MD, PhD
Senior Investigator, Functional Neurosurgery Section, National Institute of Neurological Disorders and Stroke

Clinical recordings captured from intracranial subdural and depth electrodes (electrocorticography [ECoG])) are important tools in accurately defining areas of epileptic and functional cortex. Surgically resecting epileptogenic tissue relies on accurately defining these areas and offers patients the best chance of seizure freedom. In addition, because these intracranial electrodes are typically kept in place for 1 to 2 weeks, during which time patients are awake and capable of performing complex cognitive tasks, there is a distinct opportunity to collect important neurophysiologic data and to explore how those data correlate with a variety of cognitive functions.

The focus of our work has been to investigate neural signals captured by these recordings to gain insight into the neural mechanisms that underlie memory formation and recall. We are interested in mapping the distributed patterns of activity that occur across the brain when you store an item in memory. Using computational approaches, we can begin to understand where and when such activity changes, and we can map those spatiotemporal changes in activity with high precision. We are also interested in understanding how these patterns of activity reactivate when you remember an item, and how connections between different areas of the brain coordinate these changes across several regions. Using microelectrodes to capture the activity of individual neurons, we also investigate how the activity of individual neurons relates to the changes we observe in these neuronal oscillations during memory encoding and recall.

Abstract 14

The Universal Grammar of Action: A key to Neuroengineering

Yiannis Aloimonos, PhD
Professor of Computational Vision and Intelligence, Department of Computer Science, Director of the Computer Vision Laboratory at the Institute for Advance Computer Studies (UMIACS), University of Maryland

Humans and animals have many things in common. One of them is that they all perform actions in their environment. This talk explores the notion that the system producing the actions is governed by a grammar. Context-free grammars have been in fashion in linguistics because they provide a simple and precise mechanism for describing the methods by which phrases in some natural language are built from smaller blocks. Also, the basic recursive structure of natural languages, the way in which clauses nest inside other clauses, and the way in which lists of adjectives and adverbs are followed by nouns and verbs, is described exactly. Similarly, for actions, let's say manipulation actions, every complex activity is built from smaller blocks involving hands and their movements, as well as objects, tools and the monitoring of their state. Thus, interpreting a "seen" action is like understanding language, and executing an action from knowledge in memory is like producing language.

This has implications both to the study of Intelligence and Neuroengineering applications. Because our ancestors (Homo Erectus, Neanderthal) did not have language but were "doing" many things (including tool making), the grammar of language – that came later- has to be based on the grammar of action. Since movement is a window into the brain, we can utilize the grammar of action to diagnose and monitor various conditions, such as Parkinson's disease and early autism, two cases that the speaker has studied. Finally, using the grammar of action one can design prosthetic arms (for stroke patients that lose mobility) that could perform a variety of tasks (such as feeding, cleaning, etc.). Experiments with humanoid robots that learn how to perform tasks by watching videos, will conclude the lecture.

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Abstract 15

Neuroengineering on the Global Stage: The Need for a Cosmopolitan Neuroethics

James Giordano, PhD, MPhil
Pellegrino Center Professor, Departments of Neurology and Biochemistry, Chief of the Neuroethics Study Program, Co-director of the Project in Brain Science and Global Health Law and Policy, Georgetown University Medical Center

Multinational investments and efforts in neuroscience and technology (neuroS/T) are establishing a global neurobioeconomy, and are influencing the foci, scope and tenor of both neurotechnological research and its applications in medicine, public life, and military operations. Given this international momentum, it becomes evermore important - if not essential - to acknowledge differing socio-cultural needs, values, philosophies and ethics when engaging discourse and deliberations about right and good engagment of neurotechnology in various contexts on the 21st century world stage. In this lecture, Dr James Giordano, Pellegrino Center Professor of Neurology, and Chief of the Neuroethics Studies Program at Georgetown University Medical Center describes multinational similarities and distinctions in neuroS/T enterprises, defines key ethico-legal and social issues generated by these developments, and proposes a cosmopolitan approach - and methods - for neuroethical address and potential resolution of such issues.

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Bios

Gordon Cheng, PhD
Chair, Professor, and Director of the Institute for Cognitive System, Technical University of Munich

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Max Riesenhuber, PhD
Professor, Department of Neuroscience, Co-Director, Center for Neuroengineering, Georgetown University Medical Center

Dr. Riesenhuber is Professor in the Department of Neuroscience at Georgetown University Medical Center and Co-Director of the CNE. His research uses computational modeling, brain imaging and EEG to understand how the brain makes sense of the world, and how these insights can be translated to neuromorphic AI and augmented cognition applications. Dr. Riesenhuber obtained his Master's degree in physics from the University of Frankfurt, Germany, in 1995, and his PhD in computational neuroscience from MIT in 2000 (with Tomaso Poggio). Dr. Riesenhuber has received several awards, including Technology Review's "TR100", one of the "100 innovators 35 or younger whose technologies are poised to make a dramatic impact on our world" and an NSF CAREER award. His research has been funded by NIH, NSF, DARPA, DoD, and industry.

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Peter Bandettini, PhD
Chief, Section on Functional Imaging Methods, National Institutes for Mental Health

Dr. Bandettini received his undergraduate degree in Physics from Marquette University in 1989, and his Ph.D. in Biophysics in 1994 at the Medical College of Wisconsin where he led the effort to carry out one of the first successful experiments in functional MRI. He completed his post doctoral training at the Massachusetts General Hospital NMR Center in 1996. He was recruited in 1999 to become Director of the Functional MRI Facility at and Chief of the Section on Functional Imaging Methods the National Institutes of Health. He is the founding Director of the Center for Multimodal Neuroimaging at the National Institute of Mental Health and has started a Machine Learning group and a Data Sharing group in NIMH. Dr. Bandettini's research has been focused for the past 32 years on advancing functional MRI methods, interpretability, and utility.

He served as Editor In Chief of the Journal, NeuroImage, from 2011 to 2017, and in 2006, was president of the Organization for Human Brain Mapping. He was the recipient of the Organization for Human Brain Mapping Young Investigator Award in 2002 and of the International Society for Magnetic Resonance in Medicine's Gold Medal - the society's highest honor - in 2020. Currently, he is also host of a podcast through the Organization for Human Brain Mapping, called “Neurosalience,” which is in third season.

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Cristina Piazza, PhD
Assistant Professor, Technical University of Munich

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Ella Striem-Amit, PhD
Assistant Professor, Department of Neuroscience, Georgetown University Medical Center

Ella Striem-Amit obtained her PhD in neuroscience at the Hebrew University of Jerusalem, Israel, and performed her postdoctoral training at Harvard University psychology department.
Since 2019, she is an Assistant Professor of Neuroscience at Georgetown University Medical Center.
Her research uses behavioral and neuroimaging experiments to study the capacity and principles of plasticity in the human brain. Specifically, she focuses on the effects of congenital sensory-motor deprivation, in conditions such as blindness, deafness, and dysplasia (being born without hands), to test the balance between nature and nurture in brain development.

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Nitish V. Thakor, PhD
Professor of Biomedical Engineering, Johns Hopkins University

Dr. Nitish Thakor is a professor of biomedical engineering and neurology at the Johns Hopkins University School of Medicine. He also has an appointment in the Johns Hopkins Department of Electrical and Computer Engineering. He conducts research on neurological instrumentation, biomedical signal processing, micro and nanotechnologies, neural prosthesis, clinical applications of neural and rehabilitation technologies, and brain-machine interface.
Dr. Thakor directs the Laboratory for Neuroengineering and is also the director of the NIH Training Grant on Neuroengineering.
One of Dr. Thakor's research projects, in collaboration with a multi-university consortium funded by DARPA, focuses on developing a next generation neurally controlled upper limb prosthesis. He is actively engaged in developing international scientific programs, collaborative exchanges, tutorials and conferences in the field of biomedical engineering.
He received his undergraduate degree from the Indian Institute of Technology, in Bombay, India. He earned both a M.S. in and a Ph.D. in biomedical engineering from the University of Wisconsin-Madison. Dr. Thakor joined the Johns Hopkins faculty in 1983.
Dr. Thakor is a co-author of more than 250 refereed journal papers and is currently the editor-in-chief of Medical and Biological Engineering and Computing. He was also the editor-in-chief of IEEE Transactions on Neural Systems and Rehabilitation Engineering from 2005 - 2011. In addition, Dr. Thakor is a recipient of a Research Career Development Award from the National Institutes of Health and a Presidential Young Investigator Award from the National Science Foundation, and is a Fellow of the American Institute of Medical and Biological Engineering, IEEE, Founding Fellow of the Biomedical Engineering Society, and Fellow of International Federation of Medical and Biological Engineering.

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CNE Summer School 2023
Bios

Josef Rauschecker, PhD
Professor, Department of Neuroscience, Co-Director, Center for Neuroengineering, Georgetown University Medical Center

Dr. Rauschecker's research interests are centered on the functional organization and plasticity of the cerebral cortex. Research in his lab focuses on the neural basis of auditory perception and auditory-motor integration in speech and music. These studies are using functional magnetic resonance imaging (fMRI) in humans. Parallel studies are conducted in nonhuman primates. This work is intended to lead to a deeper understanding of brain function and dysfunction in auditory processing and speech disorders, aphasia, agnosia and apraxia of speech. Research on hearing loss and tinnitus is aimed at understanding the brain mechanisms of this wide-spread disorder, and at the development of more intelligently designed hearing aids and neural prostheses. Dr. Rauschecker's laboratory is also interested in the effects of sensory deprivation during brain development, relating to the question of how the brain of individuals with early blindness or deafness is adaptively reorganized through sensory substitution. These studies of brain plasticity also have relevance for the understanding of degenerative diseases of the brain, such as Alzheimer's and Parkinson's disease.

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Bios

Alexey Ostroumov, PhD
Assistant Professor, Department of Pharmacology, Georgetown University Medical Center

Dr. Alexey Ostroumov studied biophysics at Kazan State University in Russia. He completed his PhD in Neuroscience at International School for Advanced Studies (SISSA) in Trieste, Italy. Then, Alexey moved to the US and was a postdoctoral researcher at Baylor College of Medicine in Houston Texas and at the University of Pennsylvania in Philadelphia. At the beginning of 2020, Alexey started his laboratory at Georgetown University, where he is an Assistant Professor in the Department of Pharmacology and Physiology.

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Bios

David Franklin, PhD
Associate Professor, Technical University of Munich

https://www.sg.tum.de/nd/team-members/

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Bios

Kristen Kozielski, PhD
Assistant Professor of Neuroengineering, Technical University of Munich

Kristen completed her PhD in Biomedical Engineering at Johns Hopkins University, and her postdoctoral research at the Max Planck Institute for Intelligent Systems. She moved to the Karlsruhe Institute of Technology in 2019 as a group leader. She has been at the Technical University of Munich (TUM) since 2021, where she is an Assistant Professor of Neuroengineering Materials in the School of Computation, Information, and Technology. At TUM, she is also the Program Co-Director of the Elite Master's Program in Neuroengineering.

https://www.ce.cit.tum.de/en/nen/staff/kozielski-kristen/

CNE Summer School 2023
Bios

Simon Jacob, MD
Professor, Translational Neurotechnology, Technical University of Munich

http://simonjacob.de/#team

CNE Summer School 2023
Bios

Matthew Leonard, PhD
Associate Professor, Department of Neurological Surgery, Weill Institute for Neurosciences, University of California, San Francisco

Dr. Leonard received his PhD in Cognitive Science from UCSD, studying factors that influence neural processing of language including language proficiency, bilingualism, language modality, and age. He went on to do postdoctoral work at UCSF focusing on neural encoding of speech using intracranial methods like ECoG and direct electrical stimulation. Since 2016, he has been faculty in the Department of Neurosurgery at UCSF, continuing to work on understanding the neurophysiology of speech and language at the neuronal and neural population scales. In addition, he has developed non-invasive neuromodulation approaches that are currently being used to enhance speech and language acquisition and modulate stress responses.

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CNE Summer School 2023
Bios

Kareem Zaghloul, MD, PhD
Senior Investigator, Functional Neurosurgery Section, National Institute of Neurological Disorders and Stroke

Dr. Zaghloul received his B.Sc. degree from MIT in 1995 and his M.D. and Ph.D. degrees from the University of Pennsylvania in 2003. His graduate work focused on developing silicon models of visual processing in the mammalian retina with Dr. Kwabena Boahen. Dr. Zaghloul completed a residency in Neurological Surgery in 2010 from the University of Pennsylvania. During this time, he completed postdoctoral research with Dr. Michael Kahana, investigating the neural correlates of human memory encoding, decision, and reward. Dr. Zaghloul has completed clinical fellowships in Epilepsy Surgery and in DBS Surgery. Dr. Zaghloul joined NINDS as a Staff Clinician in 2010, and as an Investigator in 2013. His laboratory is focused on investigating the neural mechanisms underlying human cognitive function.

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CNE Summer School 2023
Bios

Yiannis Aloimonos, PhD
Professor of Computational Vision and Intelligence, Department of Computer Science, Director of the Computer Vision Laboratory at the Institute for Advance Computer Studies (UMIACS), University of Maryland

Yiannis Aloimonos is Professor of Computational Vision and Intelligence at the Department of Computer Science, University of Maryland, College Park, and the Director of the Computer Vision Laboratory at the Institute for Advanced Computer Studies (UMIACS). He is also affiliated with the Institute for Systems Research and the Neural and Cognitive Science Program. He was born in Sparta, Greece and studied Mathematics in Athens and Computer Science at the University of Rochester, NY. He is interested in Active Perception and the modeling of vision as an active, dynamic process for real time robotic systems. For the past five years he has been working on bridging signals and symbols, specifically on the relationship of vision to reasoning, action and language.

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CNE Summer School 2023
Bios

James Giordano, PhD, MPhil
Pellegrino Center Professor, Departments of Neurology and Biochemistry, Chief of the Neuroethics Study Program, Co-director of the Project in Brain Science and Global Health Law and Policy, Georgetown University Medical Center

James Giordano PhD, MPhil is Pellegrino Center Professor in the Departments of Neurology and Biochemistry; Chief of the Neuroethics Studies Program, and Co-director of the Project in Brain Science and Global Health Law and Policy at Georgetown University Medical Center. As well, he is Senior Scientific Advisory Fellow to the Joint Staff of the Pentagon; Consulting Advisor to the NATO Project in Neurocognitive Science and Technology; and Chair Emeritus of the IEEE Brain Initiative Project on Neurotechnology and Ethics. He formerly served as an appointed member of the Neuroethics, Legal and Social Issues Panel of the Defense Advanced Projects Agency (DARPA), and was Senior Fellow and Task Leader of the EU Human Brain Project Neuroethics Group. The author of over 340 peer-reviewed publications, 10 books and 45 government reports in brain science, neurotechnology and ethics, he is an elected member of the European Academy of Science and Arts; an Overseas Fellow of the Royal Society of Medicine (UK); former Fulbright Visiting Professor of Neuroscience and Neuroethics at the Ludwig-Maximillians University, Munich, GER, and is the recipient of Germany's Klaus Reichert Prize in Medicine and Philosophy.

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CNE Summer School 2023
Administrative Details P.1

Lodging:

A block of rooms (10 Executive King rooms and 10 rooms with 2 Queen beds) has been reserved at the Georgetown Inn, 1310 Wisconsin Ave, NW, Washington, DC 20007 at a rate of $325 per night plus 15% tax for June 19-24. The block is being held until May 25th.

In order to reserve a room, please call 1+202-333-8900 reservations and tell them the CNE summer school at Georgetown for the Georgetown rate. Alternatively, you can book on-line at The Georgetown Inn . After you enter your preferred dates and select "reserve", another page will pop up and below the dates section you will see the following in small writing: **Have a Promo or Group Code? Enter it now.** Please select "Enter it Now" and under "Group Code" enter "CNE" to get the preferred rate. (The code should not be entered as a "Discount Code".)

Other hotels, AirBnB or VRBO options are available in the Washington, DC area or across the river in Arlington/Rosslyn, Virginia.

Transportation:

The Georgetown Inn is walking distance (10 to 15 minutes) from the Georgetown Campus.

Georgetown University operates a shuttle between campus and Arlington, VA, Rosslyn, VA and Dupont Circle, Washington, DC. Additionally, DC operates multiple bus routes. There is no Metro (i.e., subway) stop in Georgetown. Please see this link for information on GU shuttles, DC buses and directions to campus – https://transportation.georgetown.edu/. For timetables and maps of GU bus routes, please click on the "Shuttles" link.

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Administrative Details P.2

Transportation, cont:

Bus transportation will be provided to and from the event at the German Embassy on Wednesday evening

If you will be driving and need a parking pass for any of the days, please contact Johanna Lund at 202-687-3730 or lundj@Georgetown.edu

A map of the relevant portion of the Georgetown campus is included on the next page with key locations indicated. Additionally, here is a link to an interactive map of the Georgetown campus: https://maps.georgetown.edu

Wifi – Wifi is "GuestNet". No password is needed.

For any general questions or want information about sightseeing opportunities in Washington, DC, please contact:

Johanna Lund at 202-687-3730 or lundj@georgetown.edu, or

Mary Beth Fargo at 703-622-2837 or fargom@Georgetown.edu

McShain (Tues)
Georgetown Inn
Shuttle bus pickup
SWQ Garage Elevator
HFSC Wednesday - Friday
YATES walk
TONDORF walk
CARROLL walk
LIBRARY walk
3611 Canal Road NW
Entrance
To M Street, Whitehurst Freeway & Key Bridge