CLEVELAND CLINIC
DEPARTMENT OF BIOMEDICAL ENGINEERING
FACULTY POSITION IN SIGNAL PROCESSING RESEARCH

Cleveland Clinic's Department of Biomedical Engineering (BME) seeks to hire a Professional Staff (faculty) member to lead a research program in the area of *neural signal processing*. The position will formally be housed in BME within the Lerner Research Institute, however it is expected that the individual will build an interdisciplinary and collaborative research program that involves scientists and physician-scientists across multiple institutes.

The neuroscience research community at Cleveland Clinic spans the research and clinical institutes and includes neuroscientists, biomedical engineers, physicists, mathematicians, geneticists, molecular biologists, and physician-scientists. Investigators within the neuroscience community are supported by one of the top and largest clinical neurological institutes in the country, comprised of more than 200 medical and surgical specialists dedicated to the treatment of neurological and psychiatric disorders. Neuroscience research is supported by state-of-the-art molecular biology labs, small and large animal neurophysiology labs, small animal MRI, the largest single center repository of human intracranial electrophysiology data bank from patients with epilepsy (subdural grids and SEEG depth electrodes) and one of the most active and integrated neuromodulation (e.g., deep brain stimulation) centers in the country. Exceptional collaboration possibilities between laboratory and clinical scientists, and access to large populations of patients provide a unique opportunity for translational investigations.

We desire an energetic individual with demonstrated skills in leadership, organization, grant writing, innovation, and interpersonal communication. The most attractive candidate will hold a doctorate in electrical engineering, biomedical engineering, or other engineering-related field such as physics, mathematics, or related disciplines. The candidate will be experienced in developing novel neural signal processing methodologies, translational research, and have a both a solid publication record in high-quality peer-reviewed journals and a funding track record that are commensurate with their current career path. The individual would be expected to maintain an independent research program while leading and supervising an expanding group of signal processing researchers including mentorship for junior investigators and students. Applications will be considered at the rank of Associate, and Full Staff.

A generous multi-year start-up package is available to support this recruitment, including financial resources for salary, operations, and equipment reflecting the rank of the individual.

Interested applicants should submit:

- A letter of application
- Complete curriculum vitae
- Detailed research plan and statement of current and future research goals
- Contact details of three references

Send (preferably by email) the above materials to:

Paul Marasco, PhD
Chair, Search Committee
Department of Biomedical Engineering / ND20
Cleveland Clinic
9500 Euclid Avenue
Cleveland, OH 44195
E-mail: marascp2@ccf.org

More information about the Cleveland Clinic and its relevant institutes, departments and resources is provided on the subsequent pages. Cleveland Clinic is pleased to be an equal employment/affirmative action employer: Women/Minorities/Veterans/Individuals with Disabilities. Smoke/drug free environment.

ENVIRONMENT AND RESOURCES

The Cleveland Clinic is one of the world's most distinguished academic medical centers and ranked by U.S. News & World Report as the No. 2 Hospital in America in 2017. Our mission is to provide better care of the sick, investigation into their problems and education of those who serve. The Cleveland Clinic Health System sees over 7M patients and performs over 200,000 surgical cases annually, on people from all 50 states and 185 countries around the world. Clinic, Hospital, Research and Education form the four pillars of the Cleveland Clinic. https://my.clevelandclinic.org/about

LERNER RESEARCH INSTITUTE

The **Lerner Research Institute (LRI),** led by Serpil Erzurum, MD, is home to all of the laboratory-based and translational research at the Cleveland Clinic. Its mission is to promote human health by investigating in the laboratory and the clinic the causes of disease and discovering novel approaches to prevention and treatments; to train the next generation of biomedical researchers; and to foster productive collaborations with those providing clinical care. Lerner researchers publish ~1,500 articles in peer-reviewed biomedical journals each year. Lerner's total annual research expenditure was $260 million in 2016 (with $140 million in competitive federal funding, placing Lerner in the top five research institutes in the nation in federal grant funding). Approximately 1,500 people (including approximately 200 principal investigators, 240 research fellows, and about 150 graduate students) in 12 departments work in research programs focusing on heart and vascular, cancer, brain, eye, metabolic, musculoskeletal, inflammatory and fibrotic diseases. The Lerner has more than 700,000 square feet of lab, office and scientific core services space. Lerner faculty oversee the curriculum and teach students enrolled in the Cleveland Clinic Lerner College of Medicine (CCLCM) of Case Western Reserve University – training the next generation of physician-scientists. Institute faculty also participate in multiple doctoral programs, including the Molecular Medicine PhD Program, which integrates traditional graduate training with an emphasis on human diseases. The Lerner is a significant source of commercial property, generating 64 invention disclosures, 15 licenses, 121 patents, and one new spinoff company in 2016. http://www.lerner.ccf.org

The Department of Biomedical Engineering (BME), led by D. Geoffrey Vince, PhD, is one of 12 departments within the LRI. BME is home to 19 principal investigators (148 total people, including Staff, employees, post docs and graduate students) whose research interests include musculoskeletal, neuroscience, cardiovascular, nanomedicine and cancer. BME has a strong educational mission, training ~60 undergraduates and 25 graduate students in 2016. We have formal educational partnerships with neighboring universities Case Western Reserve University, University of Akron and Cleveland State University. BME faculty are also very active in the commercialization of intellectual property, producing new companies, patents, and licensing agreements each year. In 2016, BME accounted for 29 invention disclosures, 43 patent applications, 75 issued patents and 6 new licenses. http://www.lerner.ccf.org/bme/

The Department of Neurosciences, led by Bruce Trapp, PhD, is comprised of a group of internationally-recognized scientists who are committed to understanding the mechanisms of brain development and function, as well as better understanding the causes of neurodegenerative diseases and developing and improving therapeutic strategies. Areas of focus include multiple sclerosis, ALS, Parkinson's, Alzheimer's, stroke, spinal cord injury, neuroinflammation, and chronic pain. https://www.lerner.ccf.org/neurosci/

The Department of Quantitative Health Sciences (QHS), led by Michael Kattan, PhD, is another of the 12 departments within the LRI. QHS personnel number about 95 including 20 PhD biostatisticians or epidemiologists, 5 other doctoral staff, 34 Master level biostatisticians, 17 statistical programmers, and 10 systems analysts, in addition to administrative support staff. QHS members' expertise spans numerous biostatistical areas including (1) Risk Calculator and Shared Decision Making (2) Database Design (REDCap), (3) Imaging, (4) Biostatistical Analysis, (5) Bioinformatics and Genomics, (6) Health Services Research and Cost Effectiveness Analysis, (7) Patient Reported Outcome Measurements (PROMs), (8) Study Design, and (9) Population Studies. In particular, QHS has developed and maintains a comprehensive catalog of over 100 online clinical risk calculators http://rcalc.ccf.org.

Development of risk calculators for musculoskeletal disease, utilizing the rich data from CC's extensive electronic health record and "OrthoMiDaS Episode of Care" (OME) database is a current area of research priority. Further QHS has extensive computational resources for software support as well as "big data" storage (2 petobyte capacity) and analysis. https://www.lerner.ccf.org/qhs/

LERNER RESEARCH INSTITUTE, CONT.

The LRI is equipped with over two dozen Cores which provide a wide range of services to investigators (http://www.lerner.ccf.org/services/). A few of the existing resources and Core that may be of particular interest to prospective candidates are highlighted here:

- **Gait Biomechanics Laboratory (1400 ft^2)**, fully equipped with motion analysis cameras, force plates, EMG, Biodex, pressure platform, insole system, etc.
- **Biorobotics Laboratory (500 ft^2),** equipped with two 6-DOF robots and software modules (simVitro) for in vitro simulation of major joints including the spine, knee, foot/ankle, hip, shoulder, elbow, wrist http://mds.clevelandclinic.org/Services/BioRobotics/simVITRO.aspx.
- **Tissue Mechanics Laboratory (1300 ft^2),** equipped with five materials testing machines allowing for the full range of testing in uniaxial, biaxial and torsion modes at high-precision low-speed as well as high-speed rates. The Tissue Mechanics lab is also equipped with a full suite of load cells and transducers, several tendon actuators, and a video acquisition system.
- **CAREN system,** a 6 DOF treadmill that immerses the subject in a virtual reality experience for the study of clinical function, rehabilitation and balance (https://youtu.be/hocvsEMnWrA). Details are included in the attached PDF.
- **Mechanical Prototype and Electronics Cores** are staffed with highly skilled and experienced individuals using state of the art software and manufacturing equipment to support the design and fabrication of custom devices ranging from nano-chips to instrumented treadmills.
- **Cleveland Clinic Pre-Clinical Magnetic Resonance Imaging Center (CCPMC)** facility includes a BioSpec 7T/20 ultrahigh field system MRI that provides high-spatial-resolution images for preclinical research applications. Imaging capabilities include: structural MRI, diffusion tensor imaging (DTI), angiography, arterial spin labeling (ASL), functional MRI (fMRI), dynamic contrast enhanced (DCE) imaging, short echo time imaging, relaxation imaging and MR spectroscopy (MRS).
- **Computational Biomodeling (CoBi) Core** led by Ahmet Erdemir, PhD provides cost-effective solutions for advanced computer simulation needs. CoBi Core services include model development and simulation, consulting, and training in order to investigate mechanical and biological phenomena. The CoBi Core team has a firm knowledge of and experience in rigid body dynamics, solid mechanics, optimization and optimal control, finite element method, inverse finite element analysis, musculoskeletal movement simulations, soft and hard tissue mechanics. Open source software packages, such as OpenSim for musculoskeletal modeling and FEBio and Code-Aster for finite element analysis are available.
- **High performance computing cluster** is provided to investigators at no cost: 20 dual CPU nodes, 400 cores total, +1024 GB RAM, +360 TB Intel Lustre filesystem.

NEUROLOGICAL INSTITUTE

The multidisciplinary Cleveland Clinic Neurological Institute includes more than 300 medical, surgical and research specialists dedicated to the treatment of adult and pediatric patients with neurological and psychiatric disorders. The institute offers a disease-specific, patient-focused approach to care. Our unique, fully integrated model strengthens our current standard of care, allows us to measure quality and outcomes on a continual basis, and enhances our ability to conduct research. U.S. News & World Report's "America's Best Hospitals" survey consistently has ranked our neurology and neurosurgery programs among the top 10 in the nation. Our neurology, neurosurgery, and pediatric neurology and neurosurgery programs are also ranked best in Ohio.

The institute model allows our patients to better access the care they need through specialized, multidisciplinary, disease-specific centers that integrate the expertise of neurologists, neurosurgeons, psychiatrists, psychologists, neuroradiologists, and others, into the comprehensive care of a single disease.

We provide care across the spectrum of neurological disorders, including primary and metastatic tumors of the brain, spine, and nerves; pediatric and adult epilepsy; headache, facial pain syndromes and associated disorders; movement disorders such as Parkinson's disease, essential tremor and dystonia; cerebral palsy and spasticity; hydrocephalus; metabolic and mitochondrial disease; fetal and neonatal neurological problems; multiple sclerosis; stroke; cerebral aneurysms; brain and spinal vascular malformations; carotid stenosis; intracranial atherosclerosis; nerve and muscle diseases, including amyotrophic lateral sclerosis, peripheral neuropathy, myasthenia gravis and myopathies; sleep disorders; and mental/behavioral health disorders and chemical dependencies.

NEUROLOGICAL INSTITUTE DEPARTMENTS & CENTERS

The Cleveland Clinic Neurological Institute houses 15 centers and departments that include:

The Epilepsy Center:
Cleveland Clinic has one of the largest, most comprehensive programs in the world for the evaluation and medical and surgical treatment of epilepsy in children and adults. It cares for more than 10,000 patients per year and its neurosurgeons perform more than 400 epilepsy surgery procedures per year. The epilepsy center has been at the forefront of clinical innovation in epilepsy surgery evaluation and procedures since the 1980's. It was the first to introduce extraoperative subdural grid electrocorticographic mapping in patients suffering from medically intractable epilepsy. In addition, it was one of the first to take epilepsy surgery in children to the next level and t6o introduce SEEG depth electrode evaluation methods to the United States in 2009. In 2017, more than 75 SEEG implantations were done at the Epilepsy Center with a large amount of neurophysiological signal brain recordings stored. The Epilepsy Center houses a large group of physicians, physician-scientists, biomedical engineers, physicists, and mathematicians. Researchers associated with the epilepsy center have access to state of the art imaging facilities including a 7T MRI, MEG scan, PET and SPECT scanners.

Center for Neurological Restoration
The Center for Neurological Restoration is dedicated to the medical and surgical management of movement disorders, including Parkinson and Huntington diseases; headache and facial pain, including trigeminal neuralgia and dizziness; and chronic pain and interdisciplinary neurorehabilitation, including chronic back pain and degenerative disc/joint diseases. The Center for Neurological Restoration has been at the forefront of neuromodulation for various neurological disorders since the late 1990's. It is one of the busiest centers for deep brain stimulation (DBS) in the US. Its researchers and clinicians are currently working on novel neuromodulation techniques that include DBS for stroke rehabilitation.

Center for Behavioral Health
The center for brain health delivers care to patients with various types mental health disorders. Its reasearchers are investigating the mechanisms of bipolar disorders

Lou Ruvo Center for Brain Health
Cleveland Clinic Lou Ruvo Center for Brain Health is a unique and exciting concept in medicine: a medical center dedicated solely to the pursuit of more effective treatments for brain diseases and to the provision of state-of-the-art care for patients affected by these diseases and their families.

Rose Ella Burkhardt Brain Tumor and Neuro-Oncology Center
The Rose Ella Burkhardt Brain Tumor and Neuro-Oncology Center is a nationally recognized leader in the diagnosis and treatment of primary and metastatic spine, nerve, and brain tumors, and their effects on the nervous system.

Annually, the Burkhardt Brain Tumor Center physicians record approximately 8,000 patient visits and perform more than 900 surgeries.

Cerebrovascular Center
A multidisciplinary team of neurologists, neurosurgeons, neuroradiologists, neurointensivists and rehabilitation specialists who provide expert diagnosis and medical, endovascular and surgical management of all cerebrovascular conditions.

Mellen Center for Multiple Sclerosis
Mellen Center for Multiple Sclerosis Treatment and Research was established in 1984, and is now one of the largest and most comprehensive programs for multiple sclerosis (MS) care and research worldwide.

Neuromuscular Center
Cleveland Clinic's Neuromuscular Center specializes in the diagnosis, treatment, and research of these and other neuromuscular disorders. Specialists at the Neuromuscular Center offer comprehensive workups to achieve accurate diagnosis of nerve disease and rely upon state-of-the-art treatment modalities to optimize quality of life. Both inpatients and outpatients benefit from well-orchestrated teamwork by Cleveland Clinic specialists and allied health professionals.

Pediatric Neurology
At Cleveland Clinic, our pediatric neurology specialists oversee more than 10,000 patient visits each year. Our neurology staff, a team of nationally and internationally respected members all board-certified in both pediatrics and neurology, offers state-of-the-art care for an array of neurological disorders. Our neurosurgery staff is devoted to the comprehensive and most advanced surgical treatment of children with neurological disorders and adults with congenital disorders.

Pediatric Neuroscience
Cleveland Clinic’s Pediatric Neuroscience Program includes a wide range of doctors in many specialties who collaborate to provide multidisciplinary care to children with neurological disorders.

Physical Medicine and Rehabilitation
The Department of Physical Medicine and Rehabilitation features an integrated academic practice model, linking the main campus with nine acute care hospitals, three inpatient rehabilitation hospitals, more than 50 outpatient therapy venues, skilled nursing facilities, long-term acute care hospitals and Cleveland Clinic's Center for Connected Care. This enterprise employs a fully operational disease-based rehabilitation care delivery system. All of the department's clinicians work side by side with the surgeons and medical specialists who share their subspecialty interests and expertise. Patients benefit from innovative rehabilitation strategies provided by a unified academic faculty, with access to the full range of specialty consultants, sophisticated laboratory and imaging resources and Cleveland Clinic treatment protocols and carepaths.

Sleep Disorders Center
Cleveland Clinic's Sleep Disorders Center is a multispecialty, comprehensive program dedicated to the diagnosis and treatment of sleep disorders in children and adults. Accredited by the American Academy of Sleep Medicine, the center is comprised of specialists in neurology, pediatrics, pulmonary medicine, psychiatry, psychology, otolaryngology, and family medicine.

Center for Spine Health
Cleveland Clinic’s Center for Spine Health helps thousands of patients with conditions of the back and neck, ranging from the most common to the most complex. Whether your goal is to get back to sports, work, hobbies or just enjoying life, the specialists at the Center for Spine Health can help. Our specialists are nationally recognized in orthopaedic surgery, neurosurgery and medical spine and provide patients with the latest, most innovative, most effective medical and surgical treatments available for back and neck problems.

Neuroradiology
Cleveland Clinic's Section of Neuroradiology specializes in imaging and diagnosing neurological disorders such as epilepsy, brain tumors, multiple sclerosis and problems of the ear-nose-throat system. Patients are referred from around the United States and the world for these services. The division includes 18 full time board certified staff, in addition to fellows and residents, who can participate in studies needing radiological guidance.

Concussion Center
Cleveland Clinic's Concussion Center is committed to evaluating and managing concussed patients using a comprehensive, multidisciplinary approach. The Concussion Center offers concussion evaluations and management through a collaborative team effort made up of Primary Care Sports Medicine physicians, neurologists, neurosurgeons, neuropsychologists, certified athletic trainers, vestibular therapists, radiologists, neuro-ophthalmologists, and researchers, all dedicated to patient recovery.

IMAGING INSTITUTE

The Imaging Institute, led by Gregory Borkowski, MD, is a unique radiologic center within the Cleveland Clinic. The Imaging Institute combines physician leadership of a sub-specialty academic practice with absolute state of the art image acquisition equipment to be a world leader in radiological services. The Imaging Institute employees over 200 staff radiologists and conducts in excess of 2.4 million exams annually.
(https://my.clevelandclinic.org/departments/imaging)

The **Division of Neuroradiology is led by Paul Ruggieri, MD.** There are 10 clinical MR scanners (including a 7T scanner) and 9 clinical CT scanners located on the Main Campus and 32 MR scanners and 66 CT scanners across the Cleveland Clinic Health System. Two MRIs (a 3T Prisma and 7T) are dedicated for research. Associated with this group are nuclear medicine capabilities, including 3 PET/CTs, a PET/MR, a cyclotron, and nuclear chemistry lab. One research member of the neuroradiology group is also board certified in nuclear medicine.

The Imaging Sciences group is led by a neuroradiologist Stephen Jones MD PhD and a physicist, Mark Lowe PhD. The group includes 6 PhD scientists, with 3 imaging scientists, computer analysts and support, and dedicated MRI technologists. While the group performs much of their own funded research, they also extensively collaborate with members of the NI on numerous grants. There are two dedicate research MRIs: a cutting edge 3T Prisma, and a 7T Siemens. An advanced array of sequences are included, such multiband, HARDI, etc. The research group is expert with all forms of advanced imaging, particularly resting state connectivity, DTI, and volumetrics. There is a mock scanner on site. The group has extensive experience scanning brains with intracranial electrodes, which includes phantom safety studies and computer modeling. A supercomputing facility is maintained will all advanced neuroimaging software in a Linux environment, with massive parallel processing capability. This system connects to a dedicated research image archive. Ancillary equipment include a 96 channel EEG-fMRI system, EMG-fMRI system, full physiology monitoring capability, and hypercapnia studies.

INNOVATION AND TRANSLATION

Cleveland Clinic Innovations (CCI), led by Peter O'Neill, is the commercialization arm of Cleveland Clinic and turns medical breakthrough inventions into patient-benefiting medical products and companies. A robust team of market analysts, subject matter experts and former medical industry leaders is deployed via our INVENT® process to ensure the most promising inventions are positioned to succeed in the ever-changing healthcare marketplace. Expertise from across Cleveland Clinic and our external network is solicited to offer strategic advice for select inventions. If a technology is deemed to merit a new venture, a dedicated team of investment and operational professionals will facilitate spin-off company formation, fundraising and governance. Since its inception in 2000, CCI has facilitated $168M in State of Ohio innovation grants, 1200+ issued patents, 500+ licenses, 78 spin-off companies, and over $1B in follow-on equity investment. http://innovations.clevelandclinic.org/