EECS & ACES+

jointly presents

4:00 – 5:00 p.m.
Thursday
September 29, 2016
Wolstein Research Bldg
Room 1413

Brain-machine Interfaces: From Basic Science to Neurological Rehabilitation

Abstract: In this talk, I will describe how state-of-the-art research on brain-machine interfaces makes it possible for the brains of primates to interact directly and in a bi-directional way with mechanical, computational and virtual devices without any interference of the body muscles or sensory organs.

I will review a series of recent experiments using real-time computational models to investigate how ensembles of neurons encode motor information. These experiments have revealed that brain-machine interfaces can be used not only to study fundamental aspects of neural ensemble physiology, but they can also serve as an experimental paradigm aimed at testing the design of novel neuroprosthetic devices. I will also describe evidence indicating that continuous operation of a closed-loop brain machine interface, which utilizes a robotic arm as its main actuator, can induce significant changes in the physiological properties of neural circuits in multiple motor and sensory cortical areas. This research raises the hypothesis that the properties of a robot arm, or other neurally controlled tools, can be assimilated by brain representations as if they were extensions of the subject's own body.

Bio: **Miguel Nicolelis, M.D., Ph.D.**, is the Duke School of Medicine Distinguished Professor of Neuroscience at Duke University, Professor of Neurobiology, Biomedical Engineering and Psychology and Neuroscience, and founder of Duke's Center for Neuroengineering. He is Founder and Scientific Director of the Edmond and Lily Safra International Institute for Neuroscience of Natal. Dr. Nicolelis is also founder of the Walk Again Project, an international consortium of scientists and engineers, dedicated to the development of an exoskeleton device to assist severely paralyzed patients in regaining full body mobility.

Dr. Nicolelis has dedicated his career to investigating how the brains of freely behaving animals encode sensory and motor information. As a result of his studies, Dr. Nicolelis was first to propose and demonstrate that animals and human subjects can utilize their electrical brain activity to directly control neuroprosthetic devices via brain-machine interfaces (BMI).

Over the past 25 years, Dr. Nicolelis pioneered and perfected the development of a new neurophysiological method, known today as chronic, multi-site, multi-electrode recordings. Using this approach in a variety of animal species, as well as in intra-operative procedures in human patients, Dr. Nicolelis launched a new field of investigation, which aims at measuring the concurrent activity and interactions of large populations of single neurons throughout the brain. Through his work, Dr. Nicolelis has discovered a series of key physiological principles that govern the operation of mammalian brain circuits.

Dr. Nicolelis pioneering BMI studies have become extremely influential since they offer potential new therapies for patients suffering from severe levels of paralysis, Parkinson's disease, and epilepsy. Today, numerous neuroscience laboratories in the US, Europe, Asia, and Latin America have incorporated Dr. Nicolelis' experimental paradigm to study a variety of mammalian neuronal systems. His research has influenced basic and applied research in computer science, robotics, and biomedical engineering.

Dr. Nicolelis is a member of the French and Brazilian Academies of Science and has authored over 200 manuscripts, edited numerous books and special journal publications, and holds three US patents. He is the author of Beyond Boundaries: The New Neuroscience of Connecting Brains with Machines and How It Will Change Our Lives; and most recently co-authored The Relativistic Brain: How it Works and Why it Cannot be Simulated by a Turing Machine.

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