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Presentation Title:

Motor Cortical Encoding of Arm Movement

Abstract:

Movement direction is strongly encoded in the firing rate of neurons throughout the nervous system. This robust signaling, recorded from the motor cortex, can be used directly to control prosthetic devices for those suffering from paralysis. In addition, this signaling can be used as a foundation for analytical techniques used to describe the way information propagates through biological networks.

In our applied studies, we have shown how firing rates recorded in parallel from populations of motor cortical neurons can be decoded to control a prosthetic arm and hand with 10 degrees-of-freedom. Using this technology, paralyzed human subjects can operate the prosthetic

device to perform sophisticated, natural movements allowing them to carry out a variety of daily-living tasks.

We are studying the modulation of cortical neurons during reaching with the hypothesis that it is driven by various behavior-derived input taking place in distinct parts of the movement. Directional tuning of this input induces correlational structure capable of generating the directionality of motor cortical activity. Widespread correlation of neuronal firing is easily recognized with analyses using dimensionality reduction and can explain the temporal dynamics of motor cortical populations during reaching. Rather than considering motor function as deterministic, organized before the movement begins, these results show how ongoing input can drive neural firing throughout movement.

Correlational structure of neural activity is a prominent feature of the nervous system. A better understanding of how this structure comes about how it is used for information transmission will enhance our ability to build better decoders for restoring movement to those who are paralyzed.

Short CV:

EDUCATION AND TRAINING

Undergraduate:

1974-1978	University of Minnesota Minneapolis, MN	B.S.	1978	Biological Sciences
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Graduate:

1978-1984	University of Minnesota Minneapolis, MN	Ph.D.	1984	Physiology
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Post Graduate:

1984-1987	Johns Hopkins University School of Medicine			Postdoctoral Fellow with Apostolos
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Department of Neuroscience
Baltimore, MD

Georgopoulos

APPOINTMENTS AND POSITIONS

2021- present	Brain Institute University of Pittsburgh School of Medicine	Director, Center for Advanced Neural Sys.
2014	Department of Neurobiology University of Pittsburgh School of Medicine	Chair in Systems Neuroscience
2014	Department of Neurobiology University of Pittsburgh School of Medicine	Distinguished Professor
2002 - present	Department of Neurobiology University of Pittsburgh School of Medicine Pittsburgh, PA Joint appointments in the Depts.of Bioengineering and Physical Medicine & Rehabilitation. Member of the Center for the Neural Basis of Cognition, the McGowan Institute and the Robotics Institute at Carnegie Mellon University	Professor
1996-2003	Department of Chemical, Bio and Material Engineering College of Engineering Arizona State University Tempe, AZ	Research Professor (Adjunct Faculty)
1995-2002	The Neurosciences Institute La Jolla, CA	Senior Fellow
1994-1995	Division of Neurobiology Barrow Neurological Institute Phoenix, AZ	Associate Staff Scientist
1993-1995	Department of Chemical, Bio and Material Engineering College of Engineering Arizona State University Tempe, AZ	Associate Research Professor
1991-1995	Department of Exercise and Sport Science Arizona State University Tempe, AZ	Adjunct Professor

1990-1995	Department of Physiology University of Arizona School of Medicine Tucson, AZ	Research Assistant Professor
1987-1994	Division of Neurobiology Barrow Neurological Institute Phoenix, AZ	Assistant Staff Scientist
1984-1987	The Johns Hopkins University School of Medicine Department of Neuroscience Baltimore, MD	Instructor

HONORS

Neurosurgery Research Fellowship 1974- 1981
 Bacaner Award for Outstanding Ph.D. thesis. 1984
 Fellow, Institute of Physics, 2004
 Lecture to the Caucus for Bioscience, US Congress, 2004
 Presidential Lecture, Society for Neuroscience, 2005
 IEEE Distinguished Lecturer, 2006-
 Elected to International Psychophysical Society, 2007
 Carnegie Science Award for Life Sciences, 2010
 IBMISPS Pioneer in Medicine Award, 2010
 Popular Mechanics Breakthrough Award, 2012
 Clinical Research Forum Research Achievement Award, 2013
 Chancellor's Distinguished Research Award (Senior Scholar), 2014

PUBLICATIONS

Ninety-plus peer-reviewed research papers, book chapters, and review.
 150 conference abstracts and proceedings