University of Southern California

USC

Department of Biomedical Engineering Division of Biokinesiology and Physical Therapy

Standing in balance: Translating high-level intentions into low-level motor commands in animals, humans, and robots

Abstract

How do humans and animals move so elegantly through unpredictable and dynamic environments? And why does this question continue to pose such a challenge? We have a wealth of data on the action of neurons, muscles, and limbs during a wide variety of behaviors, yet these data are difficult to interpret, as there is no one-to-one correspondence between a desired movement goal, limb motions, or muscle activity. Using combined experimental, theoretical, and robotic approaches, we are teasing apart the neural and biomechanical influences on muscle coordination of during standing balance control in cats and humans. During balance control, the body's center-of-mass is the important task-level variable that must be maintained over the base of support formed by the feet. How are muscles activated to perform this task, especially across different strategies, such as such as taking a step versus keeping feet in place, or using joint motions centered primarily at the hip versus the ankle? We demonstrate that both spatial and temporal patterns of muscle activation are modulated by just a few task-level variables related to the motion of the center of mass.

I will present a framework for understanding motor variability whereby functional groups of muscles called *muscle synergies* are activated as the fundamental building blocks for movement. Like musical chords, each muscle synergy specifies how particular muscles (or notes) are concurrently activated. Just as one note belongs to several different chords, each muscle belongs to more than one muscle synergy. When chords are played simultaneously, the underlying structure is no longer evident in the multitude of notes. Similarly, when several muscle synergies are activated concurrently across time, the observed spatiotemporal muscle patterns give the appearance of unstructured complexity. Muscle synergies allow us to understand previously incomprehensible multi-channel data from multiple muscles in a functional context. Muscle synergies also have strong implications for the organization and structure of the nervous system, providing a mechanism by which task-level motor intentions are translated into detailed, low-level muscle activation patterns perhaps allow rapid flexibility and adaptability—key components for the success of organisms and species.

Engineering Neuroscience & Health

Seminar Series

Presents:

Dr. Lena Ting

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Monday
November 3, 2008
4:00 p.m.

Refreshments will be served 3– 4 p.m.

Locations:

Seminar is simultaneously presented

UPC: HNB 100 - LIVE
Hedco Neurosciences Building
UPC Campus Map/Directions:
http://www.usc.edu/about/visit/upc/

HSC: 147 - Video Conference
Center for the Health Professional
HSC Campus Map/Directions:
http://www.usc.edu/about/visit/hsc/

Bio sketch:

On Sabbatical 2008-2009

Visiting Miller Professor (August - December 2008) Department of Integrative Biology
University of California, Berkeley

Visiting Scientist (March - July 2009) Laboratoire de Neurobiologie des Reseaux Sensorimoteurs
Laboratoire de Neurophysique et Physiologie - Universite de Paris, V

Associate Professor Wallace H. Coulter Department of Biomedical Engineering, Emory University and Georgia Institute of Technology http://www.neuro.gatech.edu/groups/ting/Ting.html

Web Cast
http://capture.usc.edu/college/Catalog/?cid=af180d48-ceff-42b9-a35c-eb199daed320

Information about all seminars can be found at
http://www-clmc.usc.edu/~heiko/ENH