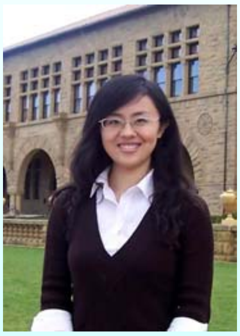
The Chinese University of Hong Kong
Biomedical Engineering Seminars Series

Time: 5:30pm-6:30pm, 28 Jan 2016 (Thur)

Venue: Rm.222, Ho Sin Hang Engineering Building, CUHK



Tracking neural plasticity in motor cortex for brain machine interfaces

Prof. Yiwen Wang

Faculty of Qiushi Academy for Advanced Studies,
Zhejiang University, Hangzhou, China

Abstract

A fundamental aspect of biological behavior is the ability to learn and to adapt to the environment. Brain has developed remarkable mechanisms to achieve this ability. As part of the overall effort to permit the brain to control neuroprosthetic devices via brain-machine interfaces (BMI), it is critical to model and or recreate such adaptive mechanisms. Classic BMI approaches 'decode' patterns of neural signals from the brain responsible for achieving specific motor movements; these 'codes' are subsequently used to command similar movements in prosthetic devices (e.g. prosthetic limb). However, such approaches (static neural tuning models) have been limited by fixed codes, resulting in a decay of decoding performance over the course of the trials and across days and subsequent instability in motor performance.

To achieve stable performance, reinforcement learning based technique is developed to cope with the day-to-day neural population variability with more efficiency in exploring the high dimensional neural-state action space. To further model and shape the plasticity of individual neural tuning, we propose to decode the non-stationary tuning property (either gradually-changing or abruptly changing) directly from the spike timing structure in a computational manner, which consequentlyand contributes to the stable BMI performance.

To test this approach, we used multi-channel neural spike trains from the primary motor cortex of adult monkeys trained to perform movement tasks using a joystick. Our results show that our computational approach successfully tracks neural tuning curves over time with better goodness-of-fit than classic static neural tuning models. Our estimation of kinematics results in smaller errors between desired kinematics and in vivo data. Our novel decoding approach suggests that the brain may employ such strategies to achieve stable motor output and that plasticity of neural tuning is essential for non-stationary, adaptive neural systems. Moreover, BMI users may benefit from this adaptive algorithm to achieve more complex and controlled movement outcomes.

Biography

Yiwen Wang received the B.S. and M.S. degrees in electrical engineering from University of Science and Technology of China (USTC), Hefei, Anhui, China in 2001 and 2004 respectively. She received the Ph.D. degree from University of Florida, Gainesville, FL, USA in 2008. She then joined the Department of Electronics and Computer Engineering as a Research Associate at the Hong Kong University of Science and Technology, Kowloon, Hong Kong. In 2010, she joined the faculty of Zhejiang University, Hangzhou, China, where she is currently an Associate Professor. Her research interests are in neural decoding of brain-machine interfaces, adaptive signal processing, computational neuroscience, neuromorphic engineering. She serves in the IEEE EMBS Neural Engineering Tech Committee, and is an associate editor of the IEEE Transactions of Neural Systems and Rehabilitation Engineering. She holds one US patent and has authored more than 60 peer-reviewed publications.