Biography

Natsue Yoshimura is an Associate Professor at Institute of Innovative Research, Tokyo Institute of Technology, since 2015. She received the MS degree from Tokyo Medical and Dental University, Japan, in 2006, and the Ph. D. degree from The University of Electro-communications, Japan, in 2009. She was a post-doc researcher at Tokyo Institute of Technology from 2009 to 2010 and became an assistant professor. She is also a visiting researcher at Integrative Brain Imaging Center, National Center of Neurology and Psychiatry. Her research interests include brain machine/computer interfaces, brain activity information decoding relating to motor control, speech, and emotion, using non-invasive brain activity recording methods such as electroencephalography, and functional magnetic resonance imaging. She is a member of Society for Neuroscience, the Japan Neuroscience Society, and Japanese Society for Medical and Biological Engineering.

Neural representations of wrist motor coordinate frames and their application

Abstract:
How the brain transforms body part positioning in the extrinsic environment into an intrinsic coordinate frame during motor control? To explore the human brain areas representing intrinsic and extrinsic coordinate frames, functional magnetic resonance imaging (fMRI) was used to examine neural representation of motor cortices while human participants performed isometric wrist flexions and extensions in different forearm postures, thereby applying the same wrist actions (representing the intrinsic coordinate frame) to different movement directions (representing the extrinsic coordinate frame). A multivariate analysis revealed that critical voxels involving pattern information that specifically discriminates wrist action (flexion vs. extension) and movement direction (upward vs. downward) were identified within the primary motor and premotor cortices. Results are consistent with existing findings using non-human primates and demonstrate the distributed representations of independent coordinate frames in the human brain.

These findings could be applied for brain-machine interfaces to offer improved quality of life for people with motor impairments. Using a variational Bayesian multimodal encephalography (VBMEG) method, electroencephalography (EEG) cortical current source signals were estimated from EEG sensor signals, and muscle activity signals of the wrist were reconstructed from the estimated current source signals by applying a sparse regression method. Since the estimation of EEG cortical current source signals could improve spatial discrimination of EEG while preserving its high temporal discrimination, findings from fMRI studies could be employed to EEG-based brain machine interfaces. As an example, the reconstructed muscle activity signals were used to control an electromyography (EMG)-based power assist device, and EEG cortical current source signals showed higher performance in controlling the device than EEG sensor signals.