Magnetoencephalographic Signal Processing and Revealing the Pathways in Parkinson's Disease

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Abstract

This presentation comprises novel theoretical methods and practical applications of magnetoencephalography (MEG) and local field potentials (LFP). The first part demonstrates novel spatial filtering algorithms enabling to grasp the brain signals within user-specified spherical regions. This is achieved using a scheme that exploits the beamspace methodology which relies on a linear transformation maximizing the power of the source space of interest in spherical harmonics domain. The efficiency and accuracy of the algorithms are demonstrated by experiments utilizing both simulated and real MEG data. Second part concerns methods and findings regarding the oscillatory circuits of patients with Parkinson's disease (PD). It consists of three subsections: First, connections between subthalamic nucleus and cortex are revealed with findings showing that the interactions between them can be segregated in frequency domain for low frequency bands of alpha and beta. Second, very high frequency oscillations (200-400 Hz) are shown to have cross-frequency relations with beta oscillations. Moreover, a biomarker underlying levodopa induced motor improvement in Parkinson´s disease is demonstrated. Third, we exhibit novel solutions to some of the common issues confronting neurophysiological data analysis with applications in particular for Parkinson's Disease (PD) LFP-MEG data. These issues include the choice of bands and their limits which have been rather variable in PD studies. We also briefly present coherent source analysis and cross-frequency methodologies in time domain respecting the nonstationary and nonlinear characteristics of the acquired brain activity.

Biography

He was born in 1980 in Istanbul, Turkey. He received the B.Sc. degree in 2002 in electronics and communications engineering and the M.Sc. degree in 2004 in computer science both from Istanbul Technical University. He obtained the Ph.D. degree in 2009 in electrical and computer engineering from University of Pittsburgh, Pittsburgh, PA. Since March 2009, he has been postdoctoral researcher at the Institute for Medical Psychology and Clinical Neuroscience, Heinrich Heine University, Düsseldorf, Germany, where he is working on the effects of deep brain stimulation on the neuronal circuits in patients with Parkinson's disease being supported by ERANET-Neuron European project. His current research interests include neuroimaging and biomedical signal processing. He is listed in the 2010 Edition of Marquis Who's Who in America.