Guest Editorial: Special Issue on Pattern Recognition in Neuroimaging

This special issue of the International Journal of Imaging Systems and Technology (IJIST) – Neuroimaging and Brain-Mapping has brought the latest technical advancements in the emerging area of pattern recognition of neuroimaging data that aims to automatically decipher the human minds employing statistical and mathematical algorithms (*i.e*., brain decoding). This special issue is intended to broaden the attention not only to the researchers who are currently working on these areas but to the general scientific audience who are interested in issues of the brain decoding as well.

This special issue includes thirteen papers that presented an up-to-date progress of the pattern recognition methods as well as an innovative brain modulation technique employing five neuroimaging modalities: electroencephalography (EEG), electrocorticography (ECoG), structural magnetic resonance imaging (sMRI), functional magnetic resonance imaging (fMRI), and focused ultrasound (FUS).

Employing the non-invasive EEG modalities, there were four papers as below:

In the first paper, ''Subject and Class Specific Frequency Bands Selection for Multi-class Motor Imagery Classification'' by Suk and Lee, a novel feature selection method to select subject- and class-specific frequency bands on the analysis of a channel-frequency matrix, so-called a 'channel-frequency map' was proposed and outperformed the widely applied Common Spatial Pattern (CSP) algorithm.

In the next paper, ''A Hierarchical Stimulus Presentation Paradigm for a P300-based Hangul Speller'' by Lee *et al*., an efficient presentation paradigm of the P300-based Hangul (Korean script) input system was proposed utilizing the distinctive hierarchical structure of the Hangul word compared to previous row/column stimulus presentation paradigm suited to English word.

The paper, ''Decoding of Multichannel EEG Activity from the Visual Cortex in Response to Pseudorandom Binary Sequences of Visual Stimuli'' by Nezamfar *et al*., presented the utility of employing multiple sequences of visual stimuli with different flickering frequencies and subsequently investigated the classification accuracy depending on the number of channels and flickering frequency.

In the next paper, ''Single Trial Variability in Brain-Computer Interfaces based on Motor Imagery: Learning in Presence of Labeling Noise'' by Gouy-Pailler *et al*., the authors proposed a two-step procedure that includes the identification of trial-dependent temporal variability and frequency-dependent linear spatial filters to deal with the brain rhythms with distinct frequency bands such as mu or beta band.

Employing the ECoG modalities, there were two papers as below:

In the first paper, ''Decoding the Non-stationary Neural Activity in Motor Cortex for Brain Machine Interfaces'' by Zheng *et al*., the authors developed a general regression neural network with an extension of a dynamic pattern layer to track time-changing neural activity during the nonlinear decoding process.

The next paper, ''A Study on Combining Local Field Potential and Single Unit Activity for Better Neural Decoding'' by Zhang *et al*., suggested that the combination of the local field potential and single unit array is a promising strategy to improve neural decoding performance in brain machine interfaces demonstrating from the experiments on the rats' primary motor cortex.

The structural information of the brain measured from magnetic resonance imaging (MRI) has also been employed in the context of the pattern classification as introduced the following three papers:

In the first paper, ''Pattern Analysis in Neuroimaging: Beyond Two-class Categorization'' by Filipovych *et al*., a limitation of two-class classification approach to disease detection using MRI-based biomarkers was illustrated using heterogeneity of populations and continuous progression of diseases and was suggested clustering-based and high-dimensional pattern regression approaches to address these issues.

The next paper, ''Dissimilarity-based Detection of Schizophrenia'' by Ulas *et al*., proposed a novel feature vector selection approach based on both dissimilarities between regions-of-interest and integration of the MRI and diffusion weighted images (DWI) based structural information to enhance the classification accuracy of affected subjects.

The paper, ''Fully Automated Pipeline for Quantification and Localization of White Matter Hyperintensity in Brain Magnetic Resonance Image'' by Jeon *et al*., described a fully automated method for white matter hyperintensity quantification and localization using T_1-weighted and fluid-attenuated inversion-recovery images based on Markov random field model.

The functional information of the brain from fMRI modality has been also employed in regard to the brain decoding as in the following three papers:

In the first paper, ''Beyond Topographic Representation: Decoding Visuospatial Attention from Local Activity Patterns in the Human Frontal Cortex'' by Kalberlah *et al*., the authors investigated a localized brain regions in a broad cortical network that contains information of the locus of visual attention such as the right middle frontal gyrus and right ventrolateral prefrontal cortex by applying multi-voxel pattern analysis to fMRI data.

The next paper, ''Investigation of Spectrally-Coherent Resting-State Networks using Nonnegative Matrix Factorization from fMRI Data'' by Lee *et al*., introduced a novel application of a nonnegative matrix factorization algorithm toward the decomposition of the

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frequency-specific intrinsic neuronal networks using the resting-state fMRI data.

In the paper, ''Large Sample Group-ICA of fMRI using Anatomical-Atlas based Reduction Bagging and Clustering'' by Anderson *et al*., it was proposed a computationally efficient group independent component analysis (ICA) approach based on clustering and resampling via bagging of pooled single-subject ICA results, which is potentially applicable in the context of a real-time state classification.

Last but not least, an innovative functional modulation technique via pulsed sonication of focused ultrasound (FUS) modality was introduced in the paper, ''Focused Ultrasound Modulates the Level of Cortical Neurotransmitters: Potential as a New Functional Brain Mapping Technique'' by Min *et al*. In this paper, the evidence that the FUS sonication alters the level of the extracellular concentration of the dopamine and serotonin neurotransmitter was presented.

We sincerely hope that the studies published in this special issue have drawn attention to colleagues who are currently working on these research areas and a broader scientific audience who are interested in to reveal the ulterior goal of understanding human minds.

In closing this editorial, we would like to acknowledge with our sincere gratitude to the Prof. Z.H. Cho, the Editor-in-Chief of the IJIST - Neuroimaging and Brain-Mapping. Our special thanks go to the authors who make this publication possible and Ms. S.-J. Lee, Journal Administrative Assistant, for her dedicated support throughout the publication process. It is again our great pleasure to show the present works in this special issue to readership to IJIST and we are very confident that the presented works by the authors will move one step forward to the holy grail of the automated decoding of the human minds.

Guest Editor:
Seong-Whan Lee
Department of Brain and Cognitive Engineering
Korea University
Seoul, Korea