The School of Informatics, Computing and Engineering (SICE)

INTELLIGENT SYSTEMS ENGINEERING COLLOQUIUM SERIES

BRAIN CONNECTIVITY-INFORMED REGULARIZATION METHODS FOR REGRESSION

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Abstract

One of the challenging problems in brain imaging research is a principled incorporation of information from different imaging modalities. Frequently, each modality is analyzed separately using, for instance, dimensionality reduction techniques, which result in a loss of mutual information. We propose a novel regularization method to estimate the association between the brain structure features and a scalar outcome within the linear regression framework. Our regularization technique provides a principled approach to use external information from the structural brain connectivity and inform the estimation of the regression coefficients. Our proposal extends the classical Tikhonov regularization framework by defining a penalty term based on the structural connectivity-derived Laplacian matrix. The approach is first illustrated using simulated data and compared with other penalized regression methods. We then apply our regularization method to study the associations between the alcoholism phenotypes and brain cortical thickness using a diffusion imaging derived measure of structural connectivity. Using the proposed methodology in 148 young male subjects with a risk for alcoholism, we found negative associations between cortical thickness and drinks per drinking day in bilateral caudal anterior cingulate cortex, left lateral OFC and left precentral gyrus.

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