Dynamic Functional Connectivity Change-point Detectionbased on Random Matrix Theory

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Abstract: Most statistical analyses of fMRI data assume that the nature, timing and duration of the psychological processes in the controlled experiment. However, it is often hard to specify this information a priori. In this work we introduce develop a method that leverages the special structure of our covariance model with regions of interest (ROIs). The technique enables relatively fast and efficient change-point estimation.

Estimating the eigenvalues of a population covariance matrix from a sample covariance matrix is a problem of fundamental importance in multivariate statistics; the eigenvalues of covariance matrices a key role in many widely used techniques. We apply the Tracy-Widom transformation (Tracy and Widom 1996) for the largest eigenvalue of the covariance matrix ratio up to time t, and that after time t, for each time-point t. For resting state fMRI data, the covariance function is probably one of the most important quantities of interest. Change-point analysis based on the maximum eigenvalue and canonical correlation approach are useful tools in situations where high-dimensional data are collected. We further examine dynamic FC properties by estimating change-points and performing group comparisons. Using our proposed method, we conduct simulation study and analyze fMRI data from a study of epilepsy patients. The method is applied to various simulated data sets as well as to an fMRI data set from epilepsy study.