Effects of Postprocessing on Topology of FMRI Connectivity in Spatial and Temporal Domains

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Abstract

Functional MRI connectivity is a technique that uses the synchrony of functional magnetic resonance imaging (MRI) signal over time to infer a ”wiring diagram” between brain regions, or a brain network graph. Recent advances have suggested that topological data analysis may be used to obtain novel information about the structure and function of brain networks using functional MRI connectivity data. However, there is controversy in the field about what data should be used for constructing brain graphs. Specifically, the postprocessing steps taken to remove noise from functional MRI data may substantively affect the results obtained through topological data analysis. Moreover, it is unclear whether topological measures are more useful when applied to spatial or temporal components of functional MRI data.

A dataset from the Human Connectome Project from 1003 subjects, each with four independent high-quality functional MRI scans, was used to compute differences in graph-theoretic metrics and topological data analysis results for four distinct postprocessing pipelines that attempt to correct for different aspects of physiological noise within functional MRI data. Reproducibility of measures, as well as their ability to discriminate one subject from another (brain fingerprinting), was used to assess the relative strength or weakness of a postprocessing pipeline to yield informative data.