Q-Analysis of Brain Network Architectures Across Multiple Scales

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Human behavior across diverse contexts is intricately linked to corresponding neural connectivity patterns, which can be effectively characterized through functional brain networks. The objective analysis of these networks, employing graph-theoretic methodologies, has significantly enhanced our understanding of neural functions. Conversely, the investigation of multi-brain interactions and the underlying interconnections that drive human social behavior remains an area that is largely uncharted. The exploration of higher-order connectivity, alongside the concealed structures present within the brain's more advanced topological layers, offers an alternative perspective that traditional methodologies may overlook. In particular, simplicial complexes, with their combinatorial aspect known as Q-analysis, can illuminate the pivotal hubs within neural networks and across various brain regions, drawing attention to higher-dimensional connectivity that transcends mere pairwise interactions. Our research focused on analyzing the human connectome derived from fMRI studies [1,2] and on brain networks sourced from EEG data during spoken communication [3,4]. This interdisciplinary approach facilitates a deeper understanding of the complex interplay between brain connectivity and social behavior.

References:

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