Persistent Network Homology from the perspective of Dendrograms

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Introduction

• The modular structure of brain connectivity helps to understand the local module information to their global relationships of brain network [1,2].
  • Usually, we select only one optimal modular network by maximizing the predefined metric such as a modularity. But the optimal network can be changed depending on the metric and it is not yet known which network is truly modular.
  • In this study, we seek the evolutionary changes of modular structures when the threshold in correlation matrix increases, instead of choosing a fixed modular structure. It can be directly related with the hierarchical clustering with the persistent property and visualized by a dendrogram.
  • As an application, we constructed the brain networks using the FDG-PET data of 24 attention deficit hyperactivity disorder (ADHD), 26 autism spectrum disorder (ASD) children and 11 pediatric control (PedCon) subjects.
  • The difference between the changes of the modular structures was compared by Gromov-Hausdorff distance [3,4], which measures the distance between dendrograms.

Outline

• Rips filtration in the persistent homology
• Single Linkage hierarchical clustering (SLHC)
• Multi-scale clustered structure of brain network

FDG-PET data of ADHD, ASD, and PedCon

Validation

Realization

Estimation & Representation

Multi-group clustering analysis based on dendrogram and Gromov-Hausdorff distance

Network Construction

Connectivity Matrix

Adjacency Matrix

Distance = 1 — positive correlation

Multi-scale modular structure of brain networks

ADHD

ASD

PedCon

References