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Persistent homology of time varying conditional independence networks

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Time varying brain activity networks have been studied using persistent homology, typically by estimating marginal interactions between network nodes via the linear Pearson correlation coefficient. Correlations give an indirect measure of link strength between each pair of network nodes, whereas classical graph analysis or topological data analysis techniques require the distance between nodes is a proper distance (metric), which corresponds to finding the conditional (in)dependence associations between network nodes.
In this work we present a new method for constructing large time varying conditional independence networks from multivariate time series. The networks are constructed by estimating the time varying inverse spectrum and calculating a distance between each pair of nodes at each time point. The method is demonstrated on fMRI data of resting state brain activity, and we show example results of the differences in time varying persistent homology between the new approach and standard time varying correlation networks.