

On detecting dynamical regime change using a transformation cost metric between persistent homology diagrams.

Journal Article

[Dr Debora Correa](#)

Authors: Dee Algar, S., Corrêa, D.C. and Walker, D.M

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Relevance to the Centre

This work outlines a pipeline for time series analysis that incorporates a measure of similarity not previously applied between homological summaries. Specifically, the well-established, but disparate, methods of persistent homology and Transformation Cost Time Series (TACTS) are combined to provide a metric for tracking dynamics via changing homological features. TACTS allows subtle changes in dynamics to be accounted for, gives a quantitative output that can be directly interpreted, and is tunable to provide several complementary perspectives simultaneously. Our method is demonstrated first with known dynamical systems and then with a real-world electrocardiogram dataset. This paper highlights inadequacies in existing persistent homology metrics and describes circumstances where TACTS can be more sensitive and better suited to detecting a variety of regime changes. Persistent homology was originally designed for static data. Its adaptation to the analysis of time series is typically achieved by observing the evolving homology from windows of the time series. The similarity between homological summaries must be properly quantified to be informative of transitions through dynamical regimes. Currently, there are several measures used to track changing dynamics via the changing homology. A new interpretation of each window's homological summary as an event series allows a transformation cost to fill gaps in this space for improved regime change detection

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