Report from 2015 OHBM Hackathon (HI)

Highly Comparable Time-Series Analysis in Nitime

Project URL: https://github.com/benfulcher/hctsa_python

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1 Introduction

The aim of this project was to demonstrate that an existing Matlab-based package for implementing thousands of time-series analysis methods, hctsa (https://github.com/benfulcher/hctsa), could be extended to a python-based implementation, for potential future inclusion into Nitime (http://nipy.org/nitime/).

Recent work has contributed a comprehensive library of over 35,000 pieces of diverse time-series data, and over 7,000 unique structural features extracted from hundreds of different time-series analysis methods [1], which can be explored through an associated website (www.comp-engine.org/timeseries) and implemented using the Matlab-based code package, hctsa. The *hctsa* software provides a systematic, algorithmic platform for computing a wide range of structural properties from a single time series, including basic statistics of the distribution, linear correlation structure, stationarity, information theoretic and entropy measures, methods from the physical nonlinear time-series analysis literature, linear and nonlinear model fits, and others. Thus, hctsa can be used to map a time series to a comprehensive vector of structural features and these features can then be systematically compared to determine and interpret the most useful features for a given scientific objective.

In order to apply highly comparative time-series analysis in the neuroscience community, it would be desirable to implement some time-series analysis methods into Nitime, a python-based software package for performing time-series analysis on neuroscience data. While the Nitime data format supports unevenly sampled data, *hctsa* does not; although for evenly sampled data it is trivial to extract the data vector from the Nitime Timeseries class and run important time-series algorithms on these data vectors. Implementation of useful time-series features into python, and potential integration with Nitime, would not only facilitate their use by the neuroscience community, but also their maintenance and development within an open source framework.

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2 Approach

An illustration of the approach is shown in Fig. 1. Each time series is converted to a vector of thousands of informative features using the *hctsa* package; machine learning methods can then be used to determine the most useful features (e.g., that best discriminate patient groups, and where in the brain the best discrimination occurs). In this project, we wanted to demonstrate a feasible pathway for incorporating these useful features into the Nitime package.

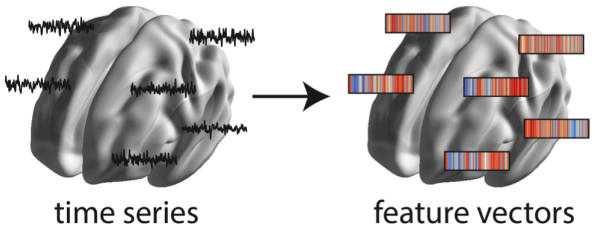

Figure 1 Illustration of the highly comparative approach to time-series data from neuroscience.

3 Results

I successfully implemented a handful of basic time-series analysis functions from Matlab into python us-

ing partials, with basic support for the Nitime data format. This proof-of-principle is here.

4 Conclusions

Our results demonstrate that time-series analysis methods, discovered using the hctsa package, can be implemented natively in python in a systematic way, with support for the time-series format used in Nitime. This will help facilitate future work on time-series analysis to be incorporated straightforwardly into an open source environment.

Availability of Supporting Data
More information about this project can be found at: https://github.com/benfulcher/hctsa_python. Further data and files supporting this project are hosted in the *GigaScience* repository REFXXX.

Competing interests
None

Author's contributions
BF wrote the software and the report.

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References

1. Fulcher, B.D., Little, M.A., Jones, N.S.: Highly comparative time-series analysis: the empirical structure of time series and their methods. J. Roy. Soc. Interface **10**(83), 20130048 (2013)