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Unified functional network and nonlinear time series analysis for complex systems science: The pyunicorn package

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We introduce the pyunicorn (Pythonic unified complex network and recurrence analysis toolbox) open source software package for applying and combining modern methods of data analysis and modeling from complex network theory and nonlinear time series analysis. pyunicorn is a fully object-oriented and easily parallelizable package written in the language Python. It allows for the construction of functional networks such as climate networks in climatology or functional brain networks in neuroscience representing the structure of statistical interrelationships in large data sets of time series and, subsequently, investigating this structure using advanced methods of complex network theory such as measures and models for spatial networks, networks of interacting networks, node-weighted statistics, or network surrogates. Additionally, pyunicorn provides insights into the nonlinear dynamics of complex systems as recorded in uni- and multivariate time series from a non-traditional perspective by means of recurrence quantification analysis, recurrence networks, visibility graphs, and construction of surrogate time series. The range of possible applications of the library is outlined, drawing on several examples mainly from the field of climatology. pyunicorn is available online at https://github.com/pik-copan/pyunicorn.

Reference:

J.F. Donges, J. Heitzig, B. Beronov, M. Wiedermann, J. Runge, Q.-Y. Feng, L. Tupikina, V. Stolbova, R.V. Donner, N. Marwan, H.A. Dijkstra, and J. Kurths,
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