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Methods for reconstructing sets of ordinary differential equations from time series data MANUEL MAI, Department of Physics, Yale University, New Haven, CT, USA, COREY O'HERN, Department of Physics, Department of Computational Biology and Bioinformatics, Yale University, New Haven, CT, USA, MARK D. SHATTUCK, Benjamin Levich Institute and Physics Department, The City College of New York, New York, NY, USA — We propose a novel method for reconstructing the underlying nonlinear ordinary differential equations (ODE) for a physical system from time series data. Common methods for ODE reconstruction generate suitable candidate equations for the system and then fit the ODE parameters to the time series data. Candidate sets of ODEs are evolved using genetic programming methods and candidates that poorly fit the data are discarded. Such schemes are computationally expensive. We develop an alternative more efficient approach to ODE reconstruction. In the first step, we identify key features of the set of ODEs (such as the number and stability of fixed points) from the data. In the second step, we develop functional forms for the right-hand sides of the ODEs that interpolate between fixed points and saddles. We will show a number of examples where we can reconstruct nonlinear ordinary differential equations that capture the equivalent dynamics as that found in the original time series data.

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