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Autoencoders for discovering coordinates and dynamics from data KATHLEEN CHAMPION, University of Washington, BETHANY LUSCH, Argonne National Laboratory, NATHAN KUTZ, STEVEN BRUNTON, University of Washington — Understanding and efficiently modeling high-dimensional scientific data such as fluid flows require methods for identifying interpretable reduced models from the data. Deep learning methods are extremely flexible, showing a remarkable ability to behave as universal function approximators and demonstrating impressive performance at modeling and predictive tasks; however the resulting models have many parameters and are notoriously difficult to interpret. On the other hand, methods such as the sparse identification of nonlinear dynamics (SINDy) provide parsimonious interpretable models, but require knowledge of the proper coordinates for representing dynamics. In this work, we present a method that combines an autoencoder network with SINDy for the simultaneous discovery of reduced coordinates and parsimonious dynamical models from high-dimensional data. The resulting models are interpretable, containing a small number of active terms that describe the dynamics in the reduced space. We demonstrate the success of this approach on data from a number of example systems.

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