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Sparse Identification of Nonlinear Dynamics (SINDy) STEVEN BRUNTON, University of Washington, JOSHUA PROCTOR, Institute for Disease Modeling, NATHAN KUTZ, University of Washington — This work develops a general new framework to discover the governing equations underlying a dynamical system simply from data measurements, leveraging advances in sparsity techniques and machine learning. The so-called sparse identification of nonlinear dynamics (SINDy) method results in models that are parsimonious, balancing model complexity with descriptive ability while avoiding over fitting. The only assumption about the structure of the model is that there are only a few important terms that govern the dynamics, so that the equations are sparse in the space of possible functions; this assumption holds for many physical systems in an appropriate basis. We demonstrate the algorithm on a wide range of problems, from simple canonical systems, including the chaotic Lorenz system, to the canonical fluid vortex shedding behind an circular cylinder at Re=100. We also show that this method generalizes to parameterized systems and systems that are time-varying or have external forcing. With abundant data and elusive laws, data-driven discovery of dynamics will continue to play an increasingly important role in the characterization and control of fluid dynamics.

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