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Empirical resolvent mode decomposition AARON TOWNE, TIM COLONIUS, OLIVER SCHMIDT, California Institute of Technology — The computation of resolvent modes is a popular method for studying the input/output behavior of fluid dynamical systems. These modes maximize the linear gain between the inputs and outputs of the system as a function of frequency and are computed via a singular decomposition of the linearized operator relating these quantities. Typically, the inputs are meant to represent the nonlinear interactions that are otherwise omitted in linear models. Here, we develop a data-based input/output methodology. The method constructs orthogonal input and output modes from ensembles of flow data that maximize the gains. The essential difference compared to traditional resolvent modes is that the empirical modes are constrained to lie within the subspace spanned by the data. The empirical modes can be shown to be equivalent to either traditional resolvent modes or proper-orthogonal-decomposition modes in appropriate limits. We demonstrate the properties and utility of the method using the complex Ginzburg-Landau equation and LES data from a Mach 0.9 turbulent jet, and compare the empirical modes to traditional resolvent modes in both cases.

Aaron Towne
California Institute of Technology

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