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Spectral analysis of nonlinear flows CLARENCE ROWLEY, Princeton University, IGOR MEZIC, UC Santa Barbara, SHERVIN BAGHERI, PHILIPP SCHLATTER, DAN HENNINGSON, KTH, Stockholm — We present a technique for describing the global behavior of complex, nonlinear flows, by decomposing the flow into modes determined from spectral analysis of the Koopman operator, an infinite-dimensional linear operator associated with the full nonlinear system. These modes, referred to as Koopman modes, are associated with a particular observable, and may be determined directly from data (either numerical or experimental) using a standard Arnoldi algorithm. They have an associated temporal frequency and growth rate and may be viewed as a nonlinear generalization of global eigenmodes of a linearized system. They provide an alternative to Proper Orthogonal Decomposition, and in the case of periodic data the Koopman modes reduce to a discrete temporal Fourier transform. We illustrate the method on an example of a jet in crossflow, and show that the method captures the dominant frequencies and elucidates the associated spatial structures.

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