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Modal decompositions in fluid mechanics: an overview TIMOTHY COLONIUS, Department of Mechanical and Civil Engineering, California Institute of Technology, AARON TOWNE, Center for Turbulence Research, Stanford University, OLIVER SCHMIDT, Department of Mechanical and Civil Engineering, California Institute of Technology — We provide an overview of modal decompositions that are used for educing coherent structures in unsteady flows, and we discuss ways in which the modes can be exploited for data compression, compressed sensing, reduced-order modeling, and controller development. We compare and contrast a number of popular data-driven techniques for modal decomposition including POD, DMD/Koopman, DFT and spectral POD. We highlight connections between modes educed from data and modes associated with the spectrum of linear operators associated to disturbances to basic flows, including both laminar flows (i.e. stability analysis) and turbulent mean flow fields (i.e. resolvent analysis). For stationary turbulent flows, recently established connections between DMD, resolvent analysis and spectral POD are discussed. Applications to turbulent wall-bounded and free-shear flows are highlighted.

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