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Network broadcast mode analysis and control with respect to time-varying base flow1[1] CHI-AN YEH, MURALIKRISHNAN GOPALAKRISHNAN MEENA, KUNIHIKO TAIRA, University of California, Los Angeles —

We present a network-based modal analysis that identifies the key dynamical paths along which perturbations amplify in highly unsteady flows. This analysis is built upon the Katz centrality to reveal the flow structures that can effectively spread perturbations over the time-evolving network of vortical elements. Motivated by the resolvent form of the Katz function, we take the singular value decomposition of the resulting communicability matrix, complementing resolvent analysis for fluid flows. The right-singular vector, referred to as the broadcast mode, gives insights into the sensitive regions where introduced perturbations can be effectively spread over the entire fluid-flow network as it evolves over time. We apply the developed formulation to the example of two-dimensional decaying isotropic turbulence. The broadcast mode identifies vortex dipoles as the important structures in amplifying perturbations. By perturbing the flow with the broadcast mode, we demonstrate the effective modification of turbulent flows. The current network-inspired work presents a novel use of network analysis to guide flow control efforts for time-varying base flows.

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