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Coherent structures in high Reynolds number turbulent shear flows ARMIN ZARE, University of Southern California, JOSEPH NICHOLS, University of Minnesota, MIHAILO JOVANOVIC, University of Southern California
— Spatio-temporal frequency response analysis of stochastically-forced linearized Navier-Stokes equations enables efficient computation of the energy amplification as well as estimation of the convection velocity and spatial structure of fluctuations. For a turbulent channel flow with $R_\tau = 2003$, we build on recent work by Zare, Jovanovic, and Georgiou (J. Fluid Mech., vol. 812, 2017) to determine the forcing statistics to the linearized model that provide consistency with the result of nonlinear simulations in matching one-point velocity correlations. The frequency response of the resulting model can be used to estimate the convection velocity for various spatial length scales as a function of the wall-normal distance. We examine two-point correlations of the fluctuating velocity field and the wall-normal support of the most amplified spatial structures. Our results provide insight into the validity of Taylor's hypothesis as well as the functional forms of two-point correlations that result from Townsend's attached-eddy hypothesis.

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