Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Spatio-temporal frequency responses of turbulent shear flows ARMIN ZARE, MIHAILO JOVANOVIC, TRYPHON GEORGIOU, University of Minnesota - Minneapolis — Low-dimensional approximations of the Navier-Stokes equations are commonly used for the purpose of analysis and control of turbulent flows. In particular, stochastically-forced linearized models can capture statistical signatures observed in experiments and numerical simulations. In such models the dynamics of forcing play a critical role. It has been recently recognized that white-in-time forcing cannot explain the observed second-order statistics. In contrast, such statistics can be exactly matched with colored-in-time forcing. In order to account for partially-available second-order statistics of turbulent flows, we identify the dynamics of forcing using a convex-optimization procedure. We also provide a constructive method for designing linear filters that generate the colored-in-time forcing and show that our forcing models can be interpreted as perturbations to the original linearized dynamics subject to white-in-time stochastic excitation. Finally, we utilize spatio-temporal frequency response analysis to show that our models not only capture turbulent flow statistics but also identify energetically significant flow structures and provide reasonable estimation of the convection velocity of the individual modes.

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Date submitted: 01 Aug 2015 Electronic form version 1.4