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Reproducing second order statistics of turbulent flows using linearized Navier-Stokes equations with forcing[1] MIHAILO JOVANOVIC, TRYPHON GEORGIOU, University of Minnesota — We study the problem of reproducing second order statistics of turbulent flows using linearized Navier-Stokes (NS) equations with forcing. This forcing is represented by a stochastic excitation that enters into the equations as an additive spatio- temporal body force. For homogeneous isotropic turbulence, we show that the steady-state velocity correlation tensors can be exactly matched by the linearized NS equations subject to a temporally white solenoidal forcing with appropriately selected second order statistics. For turbulent channel flows, however, forcing of the linearized equations by colored-in-time stochastic process is required. The forcing spectra, which are consistent with DNS data, are obtained from a solution of the maximum entropy optimization problem. We show how this forcing can be generated as an output of a spatio-temporal filter driven by white-in-time stochastic process with appropriately selected second order statistics. Our results can be used to model forcing correlations in, (i) receptivity analysis of a free-stream turbulence induced transition in boundary layers and (ii) design of flow estimators and controllers for turbulence suppression in wall-bounded shear flows.

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Mihailo Jovanovic
University of Minnesota

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