Abstract Submitted
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Toward a Transfer Function Model of Scale Interactions in Wall-Bounded Turbulence[1] IAN JACOBI, Technion, DANIEL CHUNG, University of Melbourne, SUBRAHMANYAM DUVVURI, Indian Institute of Science, BEVERLEY MCKEON, Caltech — The phase relationship between isolated, streamwise large-scales and their corresponding stress fluctuations is described using a transfer-function approach with semi-empirical mode shapes. The dynamical equations for the isolated scales and stresses are obtained by Fourier decomposition of the Navier Stokes equations and then simplified to obtain a transfer-function relating the stresses to their isolated scales, where the mode shapes are modeled as critical-layer (resolvent) modes that scale with the critical layer thickness. The transfer function is used to identify the phase lag between the scales and stresses. This lag relates directly to the amplitude modulation coefficient used to study scale interactions in wall-bounded flows, where the fluctuating stress can be taken to represent the envelope of small-scale fluctuations. Consistent with experiments, the transfer function predicts that the zero-crossing height of the amplitude modulation coefficient corresponds to a spatial lead of the small-scale fluctuations at the location of the peak spectral energy of the very large-scale motions.

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