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Restricted nonlinear large eddy simulations: Investigating RNL dynamics at infinite Reynolds number[1] DENNICE F. GAYME, JOEL U. BRETHEIM, CHARLES MENEVEAU, Johns Hopkins University — The restricted nonlinear (RNL) model for wall-bounded turbulent flows is a quasi-linearization of the Navier-Stokes equations with a streamwise averaged mean flow; a choice motivated by experimental and analytical evidence of the central role of streamwise elongated coherent structures in these flows. The resulting RNL model is inherently less costly computationally. It has been shown to accurately reproduce key flow features and be useful in studying the dynamics of wall-turbulence at low to moderate Reynolds (Re) numbers. This work explores a recent extension of the RNL framework to large-eddy simulations (RNL-LES) at infinite Re. This RNL-LES system retains certain behaviors previously observed in the low Re context, including an amenability to streamwise Fourier component "band-limiting;" a procedure which improves the accuracy of the RNL turbulence statistics. For the band-limited RNL-LES system, we demonstrate that the small scale band of wavelengths necessary to obtain accurate statistics can be determined using a surrogate dissipation spectra of LES data. Furthermore, we identify two grid size dependent regimes: 1) a small-scale only regime and 2) a bimodal regime where a large scale must be included due to a sufficient separation in scales.

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Dennice F. Gayme
Johns Hopkins University

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