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Restricted Nonlinear Comparisons of Turbulent Flows over Spanwise Heterogeneous Roughness[1] DENNICE GAYME, BENJAMIN MINNICK, XIAOWEI ZHU, Johns Hopkins University — Turbulent flow over surfaces with spanwise heterogeneities is ubiquitous in both engineering applications and atmospheric science. These flows are represented in a variety of ways including spanwise-varying micro-grooves (riblets) or more abstractly as spanwise variations in roughness functions. Studies of these flows have revealed high and low momentum pathways influence secondary structures perpendicular to the mean flow that are related to the skin-friction drag generated. However, the nature of these pathways has been shown to vary across different studies. Here we do a detailed comparison of the two roughness models, using an immersed boundary method (IBM) to represent the riblets and an equilibrium log-law wall model in large eddy simulations (LES) with varying roughness heights. Our parametric study exploits the order reduction of the restricted nonlinear (RNL) methodology, which we first show reproduces the structures from respective direct numerical simulations (DNS) of flow over riblets and LES over spanwise variations in roughness. We then do a detailed comparison over a range of parameters to gain insight into the similarities and differences in flows arising through the two roughness models.

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