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A framework for studying the effect of compliant surfaces on wall turbulence[1] MITUL LUHAR, California Institute of Technology, ATI SHARMA, University of Southampton, BEVERLEY MCKEON, California Institute of Technology — It has long been recognized that compliant surfaces can serve as passive controllers for turbulent flows. However, the lack of a physics-based, computationally cheap theoretical framework that predicts the effect of compliant surfaces on turbulence has restricted progress towards designing performance-improving walls. To address this gap, we extend the resolvent analysis of McKeon & Sharma (2010, *J. Fluid Mech.*). Under this analysis, the turbulent velocity field is expressed as a linear superposition of propagating modes, identified via a gain-based decomposition of the Navier-Stokes equations. Compliant surfaces, modeled as a complex wall-admittance linking pressure and velocity, affect the gain and structure of these modes. Using a pattern search, we show that walls with unphysical negative damping are required to interact favorably with modes resembling the energetic near-wall cycle, which could explain why previous studies have met with limited success. Our results suggest that positive-damping walls could be effective for modes resembling the so-called very large-scale motions (VLSMs). Since the VLSMs have an organizing influence on smaller-scale turbulence, they may serve as a pathway for compliant walls to affect the entire flow.

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