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Spectral stochastic estimation of high-Reynolds-number wall-bounded turbulence for a refined inner-outer interaction model WOUTIJN J. BAARS, NICHOLAS HUTCHINS, IVAN MARUSIC, University of Melbourne — For wall-bounded flows, the model of Marusic, Mathis and Hutchins (2010) allows one to predict the statistics of the streamwise fluctuating velocity in the inner-region, from a measured input signal in the logarithmic region. Normally, a user-defined portion of the input forms the large-scale content in the prediction. Incoherent smaller scales are then fused to the prediction via universally expressed fluctuations that are subject to an amplitude modulation. Here we present a refined version of the model using spectral linear stochastic estimation, which eliminates a user-defined scale-separation of the input. An empirically-derived transfer kernel comprises an implicit filtering via a scale-dependent gain and phase—this kernel captures the coherent portion in the prediction. An additional refinement of the model embodies a relative shift between the stochastically estimated scales in the prediction and the modulation envelope of the universal small-scales. Predictions over a three-decade span of Reynolds numbers, $Re_\tau \sim O(10^3)$ to $O(10^6)$, highlight promising applications of the refined model to high-Reynolds-number flows, in which coherent scales become the primary contributor to the fluctuating energy.

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