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Skin Friction Reduction Through Large-Scale Forcing[1] SHIBANI BHATT, SRAVAN ARTHAM, EBENEZER GNANAMANICKAM, Embry-Riddle Aeronautical University — Flow structures in a turbulent boundary layer larger than an integral length scale (δ), referred to as large-scales, interact with the finer scales in a non-linear manner. By targeting these large-scales and exploiting this non-linear interaction wall shear stress (WSS) reduction of over 10% has been achieved. The plane wall jet (PWJ), a boundary layer which has highly energetic large-scales that become turbulent independent of the near-wall finer scales, is the chosen model flow field. Its unique configuration allows for the independent control of the large-scales through acoustic forcing. Perturbation wavelengths from about 1 δ to 14 δ were considered with a reduction in WSS for all wavelengths considered. This reduction, over a large subset of the wavelengths, scales with both inner and outer variables indicating a mixed scaling to the underlying physics, while also showing dependence on the PWJ global properties. A triple decomposition of the velocity fields shows an increase in coherence due to forcing with a clear organization of the small scale turbulence with respect to the introduced large-scale. The maximum reduction in WSS occurs when the introduced large-scale acts in a manner so as to reduce the turbulent activity in the very near wall region.

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