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Streamwise shear stress driven compliant wall for drag reduction TAMÁS ISTVÁN JÓZSA, IGNAZIO MARIA VIOLA, University of Edinburgh, ELIAS BALARAS, The George Washington University — The interaction between a viscous fluid and a solid wall in relative motion to each other leads to wall shear stress, which results in often-undesirable friction drag. In fully turbulent flow, it has been shown that a compliant wall whose streamwise velocity is equal to the streamwise flow velocity fluctuation in the buffer layer can lead to drag reduction (Choi et al., JFM, 1994; 262:75-110). Practical exploitation of this mechanism would require knowledge of the instantaneous velocity fluctuations in the near-wall region and active control of the wall velocity. However, the near-wall fluid velocity can be approximated by the wall shear stresses through a first-order Taylor expansion; therefore we propose a passively controlled compliant wall whose streamwise wall velocity is driven by the streamwise wall shear stress fluctuations. We show that this wall behaviour can be modelled with a damped harmonic oscillator, where the damping coefficient is related to the target distance of the flow fluctuation from the wall. Our results suggest that a passively-controlled shear-stress-driven compliant wall can be developed for drag reduction. On-going works include the use of direct numerical simulation where the proposed slip condition is applied to quantify the potential drag reduction.

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