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On the structures of streamwise wall-shear stress fluctuations in turbulent channel flows CHENG CHENG, WEIPENG LI, School of Aeronautics and Astronautics, Shanghai Jiao Tong University, LOZANO-DURN ADRIN, Center for Turbulence Research, Stanford University, HONG LIU, School of Aeronautics and Astronautics, Shanghai Jiao Tong University — Wall-shear stress fluctuations are of obvious importance for noise radiation, structural vibration, drag properties, and wall heat transfer mechanisms. A growing body of studies have reported that the generation of streamwise wall-shear stress fluctuations (τ_x') is linked to the large-scale motions. In the present study, we investigate the scale-based structures of τ_x' in turbulent channel flows at at Re_τ = 550, 950, and 2000. The wall-shear stress structures are identified using a two-dimensional clustering methodology. Depending on the sign of τ_x', these structures can be classified as positive-friction events (PF_s) and negative-friction events (NF_s). The statistical properties of the structures, including geometrical characteristics, spatial distribution, population density, fluctuating intensity, and correlations with outer motions are comprehensively investigated. Particular attention is paid to the asymmetries between PF_s and NF_s, and their connection with wall-attached energy-containing eddies. In virtue of our results, only the large-scale NF_s are the footprints of the inactive part of wall-attached eddies, and may serve as indicators for identifying Townsend's attached eddies in wall turbulence.

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