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On validating Quasi-Steady Quasi-Homogeneous nature of the relationgship between large-scale and small-scale structures in a turbulent boundary layer CHI ZHANG, SERGEI CHERNYSHENKO, Imperial College London — A formal definition to the two hypotheses of the quasi-steady and quasi-homogeneous (QSQH) theory was proposed. The theory is supposed to explain the phenomenon of the large-scale structures influencing the small-scale structures in a turbulent boundary layer. Multi-objective optimisations were performed to find the optimal cut-off parameters for the new large-scale filters. The new filters were proved to obtain much more clear large-scale structures than the filter suggested by the previous studies. Calculations and comparisons for a set of statistical flow properties extracted from the databases of the direct numerical simulations of a plane channel flow were conducted. The accuracy of the predictions based on the QSQH theory was observed improving when the Reynolds number increases. Extrapolations of u_{rms} and two-points correlation from medium to high Reynolds number based on the QSQH approach were preformed and about 10% accuracy was reported. The more interesting thing is that the QSQH theory implies a dependence of the mean profile log-law constants on the Reynolds number. The main overall result of the present work is the validations of the two hypotheses of the quasi-steady quasi-homogeneous theory in near-wall turbulent flows.

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