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Turbulent flows over superhydrophobic surfaces with shear-dependent slip length[1] SOHRAB KHOSH AGHDAM, MEHDI SEDDIGHI, PIERRE RICCO, University of Sheffield — Motivated by recent experimental evidence, shear-dependent slip length superhydrophobic surfaces are studied. Lyapunov stability analysis is applied in a 3D turbulent channel flow and extended to the shear-dependent slip-length case. The feedback law extracted is recognized for the first time to coincide with the constant-slip-length model widely used in simulations of hydrophobic surfaces. The condition for the slip parameters is found to be consistent with the experimental data and with values from DNS. The theoretical approach by Fukagata (PoF 18.5: 051703) is employed to model the drag-reduction effect engendered by the shear-dependent slip-length surfaces. The estimated drag-reduction values are in very good agreement with our DNS data. For slip parameters and flow conditions which are potentially realizable in the lab, the maximum computed drag reduction reaches 50%. The power spent by the turbulent flow on the walls is computed, thereby recognizing the hydrophobic surfaces as a passive-absorbing drag-reduction method, as opposed to geometrically-modifying techniques that do not consume energy, e.g. riblets, hence named passive-neutral. The flow is investigated by visualizations, statistical analysis of vorticity and strain rates, and quadrants of the Reynolds stresses.

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