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Turbulent flow structure response to a varying wall-roughness arrangement: a modelling study SUAD JAKIRLIC, BENJAMIN KRUMBEIN, Technical University of Darmstadt, Germany, POURYA FOOROGHI, FRANCO MAGAGNATO, BETTINA FROHNAPFEL, Karlsruhe Institite of Technology, Germany, DARMSTADT COLLABORATION, KARLSRUHE COLLABORATION —
Presently adopted approach to the modelling of rough surfaces relies on introducing an additional drag term in the appropriately 'filtered' Navier-Stokes equations, accounting for the form drag and blockage effects, the roughness elements exert on the flow. A non-dimensional drag function D(y) accounting for the shape of roughness elements is introduced. It is evaluated by applying a reference DNS of an open channel flow over a wall characterized by varying arrangement (aligned/staggered) of differently-shaped/sized roughness elements at a bulk Reynolds number Re=6500 by Fooroghi et al. (2016, 11th ETMM Symposium; an immersed boundary method is used to resolve the roughness geometry). The prime objective of the present work is to assess the roughness model capability to predict mean velocities and turbulent intensities in conjunction with a recently formulated hybrid LES/RANS (Reynolds-Averaged Navier–Stokes) model (Chang et al., 2014, IJHFF 49), based on the Very Large Eddy Simulation (VLES) concept of Speziale (1998, AIAA J. 36(2)). A seamless transition from RANS to LES is enabled depending on the ratio of the turbulent viscosities associated with the unresolved scales corresponding to the LES cut-off and those related to the turbulent properties of the VLES residual motion.

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