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Numerical simulations of flow over realistic rough surfaces JUNLIN YUAN, UGO PIOMELLI, Queen's University — Large-eddy simulations are carried out on open-channel flows over multiple types of rough surfaces occurring in hydraulic turbine in both transitionally and fully rough regimes with the Kármán number ranging from 400 to 1000. The roughness imposed using an immersed boundary method is spatially resolved by the grid. The roughness functions are used to test several correlations proposed in the literature to relate surface parameters to the equivalent sand-grain height; agreement is obtained with experimental results on gas turbine roughness, despite slight differences in model coefficients. For relatively sparse distributions, the realistic roughness yields a higher drag compared to modeled roughness. The mean-flow ejecting and sweeping motions as part of the channeling phenomenon contribute to vertical momentum transports and correlate closely to regions of positive surface slope. It is observed that a stronger mean flow effect corresponds to higher frequency of relatively strong bursting events in the near-wall region, while the average size of these events is controlled by roughness length scales that are separated from the ones determining the event frequency. Further discussions will be given on possible indications of important surface parameters.

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