Abstract Submitted
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Multi-parameter prediction of roughness function and drag profiles in turbulent channel flows over rough walls[1] MOSTAFA AGHAEI JOUYBARI, GILES J. BRERETON, JUNLIN YUAN, Department of Mechanical Engineering, Michigan State University, East Lansing, MI 48824 — We report on numerical experiments in which DNS is carried out for turbulent fully-developed channel flows over rough walls, describing 42 different surfaces at two frictional Reynolds numbers of 500 and 1000. The surfaces differ in roughness area distribution, effective slope, average inclination, porosity and degree of randomness. The dependence of equivalent sand-grain-height k_s on different texture parameters was explored by using dimensional analysis and a differential evolutionary algorithm to optimize the coefficients of a single low-order multidimensional fitting function for all surfaces. It shows a strong dependence of k_s on mean roughness height, effective slope and skewness, and fits the k_s data with an error of no more than 20% in any of the 42 surfaces, even though the actual value of k_s^+ varies from 20 to 300 in these simulations. This corresponds to less than 10% error in prediction of the roughness function $\Delta u^+(k_s^+)$ for $k_s^+ \geq 25$. The same procedure is then used to model the total drag term in the Navier-Stokes equations when the Reynolds stress is described by the v^2-f model of Durbin (1991). It indicates a strong dependence of the drag profile on the roughness area distribution and on the profiles of uv and v^2.

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