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Direct numerical simulation of open channel flow over smooth-to-rough and rough-to-smooth step changes AMIRREZA ROUHI, DANIEL CHUNG, NICHOLAS HUTCHINS, University of Melbourne — Direct numerical simulations (DNSs) are reported for open channel flow over streamwise-alternating patches of smooth and fully rough walls. Owing to the streamwise periodicity, the flow configuration is composed of a step change from smooth to rough, and a step change from rough to smooth. The friction Reynolds number varies from 443 over the smooth patch to 715 over the rough patch. The flow is thoroughly studied by mean and fluctuation profiles, and spectrograms. The detailed flow from DNS reveals discrepancies of up to 50% among the various definitions of the internal-layer thickness, with apparent power-law exponents differing by up to 60%. The definition based on the logarithmic slope of the velocity profile, as proposed by Chamorro *et al.* (*Boundary-Layer Meteorol.*, vol. 130, 2009, pp. 29–41), is most consistent with the physical notion of the internal layer; this is supported by the defect similarity based on this internal-layer thickness, and the streamwise homogeneity of the dissipation length-scale within this internal layer. The statistics inside this internal-layer, and the growth of the internal layer itself, are minimally affected by the streamwise periodicity when the patch length is at least six times the channel height.

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