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Turbulence interaction with fractal trees in a turbulent boundary layer over a rough surface[1] HYUNG-SUK KANG, CHARLES MENEVEAU, Johns Hopkins University — An experimental study is performed of turbulence interacting with multi-scale fractal objects placed in turbulent boundary layer flows. The main objectives of the study are to quantify drag forces generated by such interactions and to compare with the simulation results of Chester et al. (Journal of Computational Physics, volume 225, 2007) who used renormalized numerical simulation (RNS) to predict the forces. In the present study, fractal trees with branches in a single cross-plane are considered. Each branch has three subbranches and the scale ratio is 0.5, so the similarity fractal dimension is about 1.58. The models are placed in a wind-tunnel model of the atmospheric-like turbulent boundary layer over a rough surface. The inflow is generated by a combination of an active grid and a row of strakes. Six trees corresponding to increasing generations of branchings are considered. The fractal trees are mounted on a load cell unit, which enables us to measure the drag forces depending on the included generation of branches. The averaged total drag coefficients agree well with a branch-resolved simulation (Chester et al. 2007). Also, turbulence data are sampled at 4 different downstream locations of the fractal trees by using an X-type hot-wire probe. The effects of generation number on the turbulence spectra and PDFs are quantified.

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