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Effective Boundary Conditions for Viscous Incompressible Flow Over Rough Boundaries SEAN CARNEY, BJORN ENGQUIST, University of Texas at Austin — The direct numerical simulation of viscous flow over a rough boundary is challenging due to the large number of degrees of freedom required to adequately resolve the flow structures near the boundary. Previous mathematical analysis of the problem in the laminar regime has shown that replacing the no-slip condition on the rough boundary with a Navier-slip condition on a smooth boundary captures the average effect of roughness on the flow near the boundary, where the slip length is given by the average to a solution of an auxiliary cell problem. We describe a numerical multiscale method designed to estimate the slip length by coupling a coarse scale computation in the full domain with a high resolution computation localized to patches along the rough boundary. The method reproduces the proper slip length from the mathematical theory where it is applicable, and numerical results demonstrate the utility of the method even where the theory is no longer valid. We will also briefly comment on the application of this coupling strategy as a wall model in a high Re LES. The physics is of course very different than the laminar regime considered here, but there are preliminary indications (Sandham et al, 2017) that this approach can successfully produce accurate turbulent flow statistics.

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