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**Numerical multiscale methods and effective boundary conditions**
SEAN CARNEY, BJORN ENGQUIST, ROBERT MOSER, University of Texas at Austin — Numerical homogenization refers to the numerical extraction of the effective, "macroscopic", or large scale behavior of a complex dynamical system at a reduced cost to resolving the full dynamics at all levels of detail. The no-slip boundary condition (BC) for viscous fluid flow over a solid surface can introduce asymptotically small scales that pose severe challenges for simulation; in this case it can be preferable to replace the no-slip condition with a homogenized BC. This talk discusses numerical techniques for generating slip BC, or wall laws, for laminar flows over rough boundaries, as well as turbulent boundary layer flows for constant favorable, zero, or adverse $\nabla p$. Guided by rigorous mathematics in the former case and recent empirical advances in the latter, numerical strategies are presented to overcome the high computational cost of resolving the full near wall dynamics. In both settings, the main idea consists of running high resolution simulations in a relatively small domain localized to the boundary. Numerical examples presented throughout validate the modeling approach.

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