JOHNS HOPKINS
Center for Environmental
& Applied Fluid Mechanics

Friday, April 5, 2019
3:00 PM, 132 Gilman Hall

"Numerical Simulations of Turbulent Flows over Rough Walls"

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Roughness is present in many applications in engineering, meteorology and the geophysical sciences, and its effects on the fluid flow have been studied for almost a century. Early studies measured only the drag (resulting, for instance, in the well known Moody diagram); more recently, turbulence statistics have been collected in many geometries. It is very difficult and expensive, however, to measure the flow between the roughness elements; thus, most studies concentrate on the region above the roughness crest, where similarity exists: the roughness determines the velocity scale that makes turbulent statistics collapse. Over the last decade, the development of efficient Immersed Boundary Methods has allowed the numerical simulation of flows over very complex geometries to become feasible. The increase in available computational power, furthermore, has allowed the achievement of Reynolds numbers sufficiently high that the effects of roughness are significant while the roughness elements are small enough that the global characteristics of the flow are not affected. Numerical simulations have made the flow between the roughness elements accessible, allowing more complete studies of the momentum and energy transfer mechanisms due to roughness. Examples will be presented of flows subjected to favourable or adverse pressure gradients, or system rotation, to highlight the effects of the interaction between roughness and non-equilibrium turbulence.