Mechanical Engineering Colloquium

January 19, 2016

Macdonald Engineering Building (MD) 267 from 2:30-3:30pm

Dr. Ugo Piomelli

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Numerical simulations of turbulent flows over rough walls

Abstract:

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. Recent results will be presented to highlight how the flow inside the roughness layer affects the outer layer, causing the increased instability of the flow and the decreased anisotropy of the turbulence.

Biography:

Ugo Piomelli obtained a Laurea in Ingegneria Aeronautica from the Università di Napoli "Federico II" in 1979. He then earned an MSc Degree in Aerospace Engineering from the University of Notre Dame and a PhD in Mechanical Engineering from Stanford University in 1988. From 1987 to 2008 he was on the faculty of the Department of Mechanical Engineering at the University of Maryland, first as Assistant, then Associate and finally Full Professor. He served as Associate Chair and Director of Graduate studies from 2002 to 2007. In August 2008 he joined the Department of Mechanical and Materials Engineering at Queen's University in Kingston, Ontario, where he is a Tier 1 Canada Research Chair in Turbulence Simulation and Modelling, and the HPCVL-Sun Microsystems Chair in Computational Science and Engineering.

Professor Piomelli has published over 85 refereed journal articles in the fields of turbulence and transition modelling and simulation. As of January 2016, his work had been cited over 5,900 times (Web of Science). He was elected Fellow of the Royal Society of Canada in 2015, of the American Society of Mechanical Engineers in 2009, of the Institute of Physics (UK) in 2004 and of the American Physical Society in 2002. He was also elected Associate Fellow of the American Institute of Aeronautics and Astronautics in 2004. Since 2015, he is the Editor-in-Chief of the Journal of Turbulence. His present research includes studies of the flow in rivers and lakes, turbulent boundary layers over smooth and rough surfaces, model development for large-eddy simulations, and flows in hydro-electric turbines.