The good, the bad and the beautiful. Leonardo's studies of turbulence

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Aspects of fluid dynamics appear often in Leonardo da Vinci's notebooks: sketches of water flow, plans for flying machines, studies of bird flight. He seemed fascinated by the eddying movement of water, and designed ingenious experiments to try and understand the causes of these complex motions. He lacked the advanced mathematical tools required to study this subject properly, however, and his attempts to use geometrical reasoning for the analysis of fluid flows were unsuccessful. This limitation is reflected in many of the machines he designed, which we now know cannot work. His observational powers, however, allowed him to make some exceptionally perceptive remarks that foreshadow techniques used today, both in the experimental and the theoretical analysis of flow problems, observations illustrated by striking drawings and sketches. In this talk, some of Leonardo's reflections on turbulence will be discussed, *vis a vis* the present understanding of this captivating but baffling subject, perhaps the last unsolved problem in classical physics.

Biographical sketch

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 the 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 100 refereed journal articles in the fields of turbulence and transition modelling and simulation. As of November 2018, his work had been cited over 7,700 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.