



THE UNIVERSITY OF
MELBOURNE

Department of Mechanical Engineering

MERIT FELLOWSHIP SEMINAR

SEMINAR SERIES 2012

For over more than a decade, we have validated a numerical capability that allows for exact 3D, time-varying solutions of turbulence from first principles, using direct numerical simulations (DNS). The accuracy of the data sets has been validated against experiments at matching conditions. The increased computational resources and prolific algorithm development have revolutionized our research, and we are generating numerical data sets with unprecedented scope and accuracy. Simultaneous advances in digital data collection technology are proceeding at an even faster pace, and we are generating enormous scientific datasets routinely. Our current validated database is over 100 Terabytes and increasing weekly. Our main efforts today are based on data-intensive science that is revolutionizing our understanding of the physics underlying the vast volumes of data, which is massive, complex stochastically and chaotic, and includes multi-scale dynamics, and long time behavior.

In DNS, the temporal evolution of and all scales of motion are captured, from the smallest eddies that are of the order of the "Kolmogorov length scale" to the largest eddies that scale on the boundary layer thickness. One interpretation of the (friction) Reynolds number, Re_τ , is that it represents the ratio of the largest scales to the smallest scales. DNS requires fine grids to capture the smallest scales, so that, given the present limitations on computational resources, DNS is restricted to low Reynolds number flows, about five orders of magnitude smaller than those found in the atmospheric boundary layer. Even with such limitation on the Reynolds number, the fidelity of DNS data makes the technique unique for studying flow physics, including the long term flow dynamics induced by coherent features in boundary layer flow.

In this talk, I will present a sample problem, the interaction of a shockwave and a turbulent boundary layer, where spatially and temporally resolved data was indispensable to unveil the physical mechanisms at play. Then, I will show how we are using statistical descriptions of the data to validate (1) discrete definitions for the hierarchy of structures in wall bounded turbulence and (2) the resulting data interpretations, and how in turn we are using these to develop a catalog of feature-activity and feature-evolutions to semantically characterize data across time and space.

M. Pino Martín has been an Associate Professor of Aerospace Engineering in the University of Maryland since 2009. She is also a Senior Research Scholar in the Mechanical and Aerospace Engineering Department in Princeton University and Affiliate Faculty in the University of Maryland Institute for Computer Studies, which hosts her laboratory and about 100 Terabytes of detailed and validated numerical simulation data of turbulent flows. Her research interests include interdisciplinary approaches to the study and control of turbulent flow using joined theoretical, numerical and experimental studies.

Prof M. Pino Martín

Aerospace Engineering Department, and
University of Maryland Institute for
Computer Studies
University of Maryland
USA

Tuesday 24th January, 3pm

Brown Lecture Theatre
Level 1, Building 193
Electrical & Electronic Engineering
Parkville

Descriptions of wall turbulence from DNS data.

MORE INFORMATION

For more Mechanical Engineering seminar information contact:

Professor Ivan Marusic
Department of Mechanical Engineering
E: imarusic@unimelb.edu.au