The University Of Sheffield.

Automatic Control and Systems Engineering

The Department of Automatic Control & Systems Engineering
is pleased to announce the following seminar:

How to obtain laws in fluid mechanics using computational optimization

Dr Andrew Wynn
Department of Aeronautics
Imperial College London, UK

Wednesday, 13 December 2017 at 14:00
LT02, Sir Henry Stephenson Building

Abstract

In fluid mechanics, a common problem of is to determine how average properties of a given fluid flow vary as a function of external forcing parameters. For example, in aircraft design, one would like to know the average drag of an aircraft's wing as a function of its flight-velocity; or, alternatively, one may want to know the rate of heat transfer in a layer of fluid as a function of a source of heat applied to its boundary. Obtaining such *scaling laws* is challenging since the average quantities of interest (drag, heat transfer) typically depend on the turbulent solution to a nonlinear partial differential equation (e.g. Navier-Stokes, Raleigh Bénard), meaning that expensive numerical simulations or experimental campaigns are often used to approximate them. In this talk, a different approach is presented in which rigorous bounds may be placed on the quantities of interest by working directly with the governing PDEs. In particular, we couple traditional analytical methods with Semidefinite Programming to provide semi-automated bounds on the long-term behaviour of hydrodynamical systems. The application of this approach to canonical systems such as shear-driven Couette flow, the Kuramoto-Sivashinsky model for flame-front propagation and Bénard-Maragoni convection will be discussed.

Biography

Dr Andy Wynn is a Senior Lecturer in the Department of Aeronautics at Imperial College London. He joined the department as a Lecturer in 2012 having previously held postdoctoral positions in the same department and in the Department of Mathematics, University College London. Andy holds a PhD in Mathematical Control Theory, which he obtained in 2009 as a member of the Functional Analysis Group at the University of Oxford. His doctorate concerned resolvent-type characteriations of input-to-state stability of infinite dimensional control systems, while his current research focus is flow control and optimization-based analysis of fluid flows.

Light refreshments will be served in the foyer of
the Sir Henry Stephenson Building