

Tuesday, April 14, 2009

4:00 pm

in Room 303 MAE-A

Low-order models for control of fluids

Clancy Rowley, Associate Professor
Mechanical and Aerospace Engineering
Princeton University

Abstract

The ability to effectively control a fluid would enable many exciting technological advances, including the design of quieter, more efficient aircraft. Many of the flow control strategies tried so far have been largely ad hoc, and have not used tools available from control theory and dynamical systems, which can guide controller design as well as placement of sensors and actuators. These tools require knowledge of a model of the system in terms of a system of differential equations, and the equations governing a fluid, though known, are too complex for these tools to apply.

This talk addresses model reduction techniques, which are used to simplify existing models, to obtain low-order models tractable enough to be used for analysis and control, while retaining the essential physics. These techniques provide a bridge between complex problems and the mathematical tools useful for their analysis. The talk will focus on recent developments of two techniques, Proper Orthogonal Decomposition (POD) and balanced truncation. Each of these techniques has strengths and weaknesses; ideas from both techniques may be combined, to exploit their strengths. We illustrate the methods by obtaining reduced-order models for an incompressible channel flow, and the separating flow over an airfoil at large angles of attack.

Biography

Clancy Rowley is an Associate Professor in the Mechanical and Aerospace Engineering department at Princeton University. He received his undergraduate degree from Princeton in 1995, and his doctoral degree from Caltech in 2001, both in Mechanical Engineering. He returned to Princeton in 2001 as an Assistant Professor and was appointed Associate Professor in 2007. His research interests lie at the intersection of dynamical systems, control theory, and fluid mechanics, and focus on reduced-order models suitable for analysis and control design.

Refreshments served in 303 MAE-A beginning at 3:50 pm

