Artificial Aerodynamics

Mark Runacres
FLOW research group, and
Brussels Institute for Thermal-fluid systems and clean Energy (BRITE)
Vrije Universiteit Brussel
Belgium

The seminar will discuss recent work on the use of machine learning methods for unsteady fluid mechanics, with a focus on aerodynamic systems exhibiting strong nonlinear dynamics. We take an approach to machine learning that is heavily influenced by nonlinear system identification. This approach is illustrated using canonical systems, including a pitching aerofoil and an oscillating circular cylinder, which are well understood and easy to explain, but still present the typical modelling challenges of real-life systems. Particular emphasis is placed on the design of input signals and the use of synthetic data generation to obtain high-quality data-driven models with the shortest possible experiment length. The methodology is further demonstrated through an application to floating offshore wind turbines, where unsteady aerodynamics and platform motion lead to complex coupled dynamics of direct relevance to control and design.

The seminar is intended to be accessible to students without a background in machine learning; key concepts will be introduced carefully, with ample opportunity for discussion and questions.