



Dipartimento di Ingegneria Meccanica e Aerospaziale

Venerdì 16 dicembre ore 10:00

Sala Ferrari II piano

Luca Magri

Title:

Physics-aware data-driven prediction and optimization of extreme fluids

Abstract:

The ability of fluid mechanics modelling to predict the evolution of a flow is enabled by physical principles and empirical approaches. Physical principles, for example conservation laws, are extrapolative (until the assumptions upon which they hinge break down): they provide predictions on phenomena that have not been observed. Human beings are excellent at extrapolating knowledge because we are excellent at finding physical principles. Empirical modelling provides correlation functions within data. Artificial intelligence and machine learning are excellent at empirical modelling. In this talk, the complementary capabilities of both approaches will be exploited to achieve adaptive modelling and optimization of nonlinear, unsteady, and uncertain flows. The focus of the talk is on computational methodologies for modelling and optimization of increasingly complex flows: (i) data assimilation with a Bayesian approach for controlling thermoacoustic oscillations in rockets/gas turbines; and (ii) auto-encoders for reduced-order modelling of turbulent flows, which generalise POD/DMD methods to nonlinear dynamics. The flows under investigation are relevant to aerospace propulsion, with a focus on thermoacoustics, and turbulence.

Short bio:

Luca is a Reader in data-driven fluid mechanics at Imperial College London, Aeronautics Department; Fellow of The Alan Turing Institute, Hans Fischer Fellow of the Institute for Advanced Study (TU Munich) and Affiliated Faculty at Cambridge University Engineering Department. Prior to joining Imperial, Luca was a Lecturer at Cambridge University Engineering Department, Royal Academy of Engineering (RAEng) Research Fellow, and Fellow of Pembroke College. Prior to becoming a lecturer and RAEng Research Fellow at Cambridge, he was a postdoctoral Fellow at Stanford University Center for Turbulence Research. He obtained his PhD in Engineering at the University of Cambridge. His research is currently funded by an ERC Starting Grant; UKRI; and Rolls Royce. At Imperial and The Alan Turing Institute, Luca is group leader of Physics-Informed Machine Learning and Data Assimilation under the Data-Centric Engineering Programme with about 14 people under direct supervision.