



Online
seminar

Wednesday March 03, 2021 at 16:30

Hosted on: [Zoom](#)

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Machine learning and equation-informed tools for complex tasks in complex flows

Prof. Vaccarino introduces the seminar.

Abstract

We study the applicability of artificial intelligence tools to different problems in fluid dynamics, from the search of an optimal navigation strategy in complex environments to data reconstruction from partial measurements of turbulent flows. To solve navigation problems we follow the Reinforcement Learning approach. Here, we focus on finding the path that minimizes the navigation time between two given points in a fluid flow, known as the Zermelo's problem [1].

Concerning data-assimilation, we explore the capability of Generative Adversarial Network (GAN) to generate missing data in turbulent configurations. In particular, we investigate on a quantitative basis, their use in reconstructing 2d damaged snapshots extracted from a large database of numerical configurations of 3d turbulence in the presence of rotation, a case with multi-scale random features where both large-scale organized structures and small-scale highly intermittent and non-Gaussian fluctuations are present [2,3].

[1] Biferale L, Bonaccorso F, Buzzicotti M, Di Leoni PC, and Gustavsson K (2019). *Zermelo's problem: Optimal point-to-point navigation in 2D turbulent flows using Reinforcement Learning*. *Chaos: An Interdisciplinary Journal of Nonlinear Science* 29.10 (2019): 103138.

[2] Buzzicotti M, Bonaccorso F, Di Leoni PC, and Biferale L (2020). *Reconstruction of turbulent data with deep generative models for semantic inpainting from TURB-Rot database*. arXiv preprint arXiv:2006.09179 (in press *Physical Review Fluids*).

[3] Biferale L, Bonaccorso F, Buzzicotti M and Di Leoni PC (2020). *TURB-Rot. A large database of 3d and 2d snapshots from turbulent rotating flows*. arXiv:2006.07469.

Biography

Luca Biferale received his PhD from Università of Roma La Sapienza in 1992. He then held a post-doctoral position at Università di Roma Torvergata in 1995. At the same university, he became Associate professor in 2005 and Full professor in 2014. From 2006 to 2019 he was visiting professor in institutes in the USA, France, the Netherlands and Cina.

He was granted an ERC-ADG NewTURD in 2014 and an ERC-ADG Smart-TURB in 2021.

He is member of several editorial boards and evaluation committees.

His interests span complex fluids and multi-phase flows, turbulence and deterministic chaos, machine-Learning and information theory, Lattice Boltzmann equations, stochastic processes and Monte Carlo methods.