ETH zürich

Institute of Fluid Dynamics
Institute of Energy and Process Engineering

# Colloquium Thermo- and Fluid Dynamics

## Data driven tools for Lagrangian Turbulence

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We present a stochastic method for generating and reconstructing complex signals along the trajectories of small objects passively advected by turbulent flows [1]. Our approach makes use of generative Diffusion Models, a recently proposed data-driven machine-learning technique. We show applications to 3D tracers and inertial particles in highly turbulent flows, 2D trajectories from NOAA's Global Drifter Program and dynamics of charged particles in astrophysics. Supremacy against linear decomposition and Gaussian Regression Processes is analyzed in terms of statistical and point-wise metrics concerning intermittency and multi-scale properties. Preliminary results concerning generalizability and model collapse will also be discussed, as well as a personal point of view concerning long-term goals and potentialities of black-box data-driven approaches for turbulence.

[1] Li, T., Biferale, L., Bonaccorso, F. et al. Synthetic Lagrangian turbulence by generative diffusion models. Nat Mach Intell 6, 393–403 (2024).

*Luca Biferale is a full Professor of Theoretical Physics at the University of Rome ‹Tor Vergata›, with 30+ years of experience in Turbulence using both, numerical and phenomenological modeling. He is the author of 300+ papers and was awarded two ERC Advanced Grants (NewTURB 2014-2019 and Smart-TURB 2021-2026). He has been elected a fellow of the APS (2008) and of the Euromech (2010).*

Date: Wednesday, 25 September 2024
Time: 16:15- 17:15h
Place: ETH Zurich, ML F 36
Host: Prof. Filippo Coletti

Further information: https://ifd.ethz.ch/events/ktf.html

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