# Lagrangian structure-function using stationarised fluid trajectories in the wake of a smooth cylinder

Ali Rahimi Khojasteh, Dominique Heitz, Sylvain Laizet

# Lagrangian structure-function using stationarised fluid trajectories in the wake of a smooth cylinder

Ali Rahimi Khojasteh[a], Dominique Heitz[b] and Sylvain Laizet[c]

We present here a statistical study to determine the Lagrangian structure function in the anisotropic and inhomogeneous wake behind a smooth cylinder. Based on the extension of the stationary Lagrangian diffusion theory to self-similar flows, we stationarise velocity components in order to obtain Lagrangian statistics. Viggiano et al. (2011)[1] have shown how to obtain fundamental Lagrangian statistics from the anisotropic and inhomogeneous dynamics of a jet flow by normalizing the trajectories based on local Eulerian scales. In particular, computing the Lagrangian structure-function scaling constant $C_0$ is a crucial parameter in modelling turbulent transport. A similar role is played by the $C_0$ constant in the Lagrangian framework as a Kolmogorov constant in the Eulerian framework. We performed direct numerical simulations (DNS) and time-resolved particle tracking velocimetry (4D-PTV) experimental analyses in the wake behind a smooth cylinder for Reynolds numbers between 300 to 3900. Details of the tracking algorithm used in the present study are addressed in Khojasteh et al. (2021)[2]. Preliminary results of the experiments indicated reasonable agreement between the stationarised Lagrangian trajectories of the wake flow and the hypothesis of Lagrangian self-similarity at inertial scales (see Fig. 1).

[a] INRAE, OPAALE, 35044 Rennes, France

[b] Department of Aeronautics, Imperial College London, London, United Kingdom

1 Viggiano et al., J. Fluid Mech. **918**, 25 (2021).

2 Khojasteh et al., *Phys. Fluids* **33**, 095113 (2021).

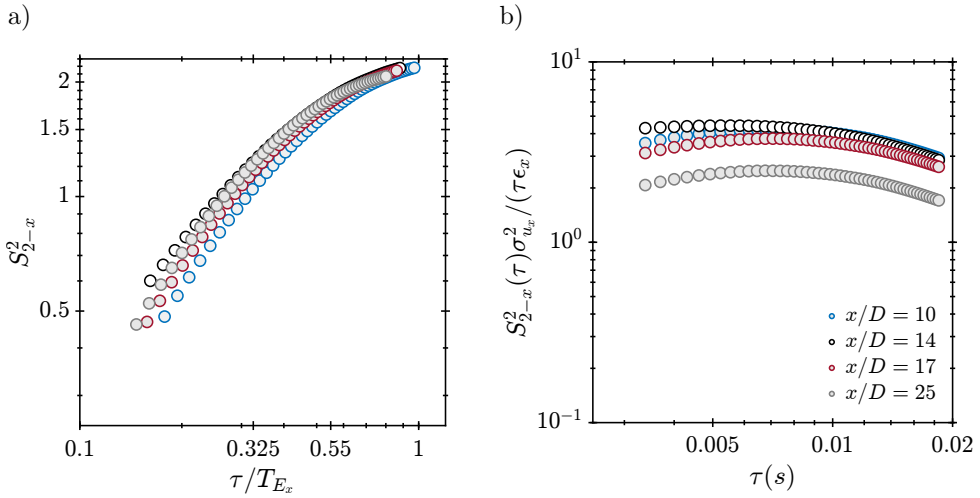


Figure 1: Lagrangian second order structure function of the streamwise direction at four downstream locations. (a) As a function of non-dimensional timescale. (b) Re-dimensionalised structure function representing the $C_0$ constant.