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► **To cite this version:**

Ali Rahimi Khojasteh, Dominique Heitz, Sylvain Laizet. Lagrangian structure-function using stationarised fluid trajectories in the wake of a smooth cylinder. 14th European Fluid Mechanics Conference (EFMC14), European Mechanics Society, Sep 2022, Athens, Greece. 1 p. hal-03861633

**HAL Id: hal-03861633**

**<https://hal.inrae.fr/hal-03861633>**

Submitted on 20 Nov 2022

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

Ali Rahimi Khojasteh<sup>a</sup>, Dominique Heitz<sup>b</sup> and Sylvain Laizet<sup>c</sup>

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)<sup>1</sup> 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)<sup>2</sup>. 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).

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<sup>1</sup> Viggiano et al., *J. Fluid Mech.* **918**, 25 (2021).

<sup>2</sup> Khojasteh et al., *Phys. Fluids* **33**, 095113 (2021).

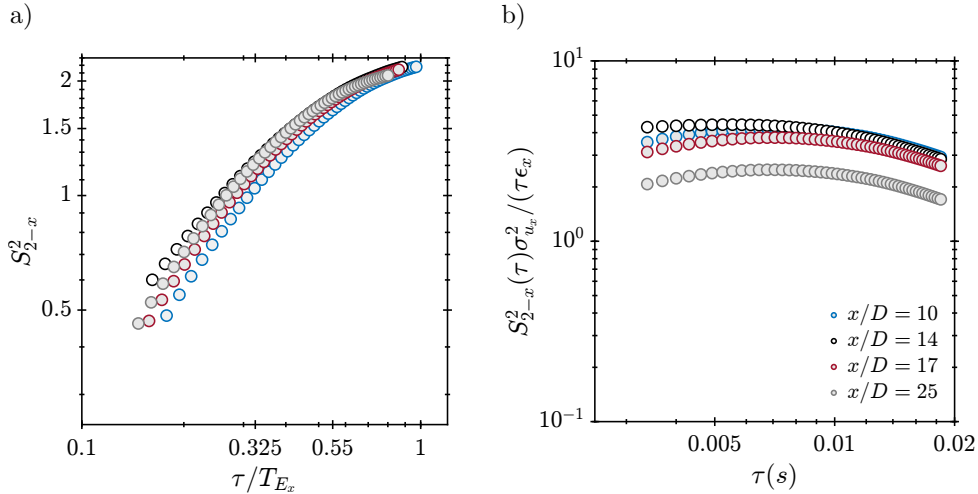


Figure 1: Lagrangian second order structure function of the streamwise direction at four downstream locations. (a) As a function of non-dimensional timescale. (b) Re-dimensionalised structure function representing the  $C_0$  constant.