Laboratoire de Mécanique des Fluides de Lille
Kampé de Fériet

centralelille

Stage de Master 2

Characterizing unsteady turbulence in a wind tunnel

Experimental study

Although turbulent flows are ubiquitous in everyday life, industrial processes, environmental issues, etc., turbulence remains one of the greatest unsolved mysteries of fluid dynamics. It is therefore a very active field of scientific research. For this purpose, experimental facilities generating well controlled turbulent flows are required. One of the most widely studied and well characterized generic class of turbulent flow is obtained by considering the flow behind a grid placed in a mean flow, typically generated by a so-called wind tunnel (figure 1). The use of grids presents several advantages from an experimental point of view, as the turbulent flow generated presents good levels of homogeneity and isotropy.

Turbulent flows are primarily characterized by the fact that structures (turbulent eddies) co-exist over a wide range (called inertial range) of space and time scales simultaneously, from the large energy injection scale down to the viscous dissipation scale. Due to the difficulties characterizing the instantaneous properties of a flow across all scales, even using state-of-the art techniques, many experiments collect results that are averaged in time and/or space.

Figure 1: grid installed in Modane's wind tunnel (left). It is one of the largest grids ever built to study turbulent flows, having a diameter of 8 meters. Picture of the wind tunnel available at LMFL (right), that will be used for experiments in the present project.

In the present project, we propose an experimental study in the unsteady turbulent flow generated by a grid in LMFL large wind tunnel. Particle imaging velocimetry will be performed using several cameras, with different fields of view, aiming to capture both large- and small-scale properties of the flow (such as the integral length scales and the turbulent kinetic energy dissipation, respectively). To disentangle spatial and temporal statistics, the inlet velocity of the tunnel will be modulated following a known pattern. As particle image velocimetry produce instantaneous spatial fields, sets of measurements spanning different stages of the modulation will be used to characterise several unsteady properties of the turbulent flow.

Tasks:

The trainee will be in charge of performing the experiments and in collecting and analysing data. They will also be part on the interpretation of results. They will follow the method developed by Gomes Fernandes et al. (2012), that allows to quantify small and large scales simultaneously thanks to the use of multiple cameras.

Background and skills required:

The trainee will be following or had followed a diploma that includes training in fluid mechanics. Experience with matlab and/or python is recommended.

Further information:

- The experiments will be performed at LMFL lab, site campus Centrale Lille Institut.
- The duration is of six months.
- The salary will be the one stipulated by law (around 550 €/month).
- Acceptance conditional to clearance obtention to work in a 'Zone à Régime Restrictif' (ZRR).

Contacts:

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References:

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Mora, D.O., Pladellorens, E.M., Turró, P.R., Lagauzere, M. and Obligado, M., 2019. Energy cascades in active-grid-generated turbulent flows. *Physical Review Fluids*, *4*(10), p.104601.

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