Masters project starting April 2017

Refractive index matching of Particle Image Velocimetry around obstacles

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In experimental fluid mechanics it is common that flow measurements have to be performed inside or in between solid objects, should that be a flow between models of rocks, plants, inside a turbine or a blood vessel. Modern flow measurement methods are predominantly based on optical techniques where a flow seeded with small particles, used as tracers, is filmed with one or several cameras. However, if it is relatively straightforward to perform such measurements around an obstacle, what happens inside or in between solid objects remains unknown. The goal of this work is to develop a new technique that will allow optical measurements or, more precisely, Particle Image Velocimetry (PIV), in regions that are not optically accessible through regular methods.

In Particle Image Velocimetry (PIV) the small particles seeded into the water flow are filmed while being illuminated by a laser sheet (Figure 1). The videos are then processed and analysed to extract the velocity data and other statistics through tracking of particles throughout the image sequence. This technique allows to obtain non-intrusive spatially and timely resolved information about the flow field.

Since the goal of this study is to measure in between solid objects, an experiment will be setted up in which the vortex interaction with an array of solid stems is investigated. In a shallow basin, a dipole flow will be generated with the aid of two flaps (Figure 2). This flow will go over and between a patch of stems inside which the PIV measurements will be performed. The candidate is expected to perform these experiments in the IfH laboratory, analyse the data, and write-up a Masters thesis. The starting date is flexible, though preferably around April 2017.

Requirements

The candidate must have background and, most importantly, curiosity in fluid mechanics, interest in experimental techniques and their development, and willingness to tackle challenging problems.

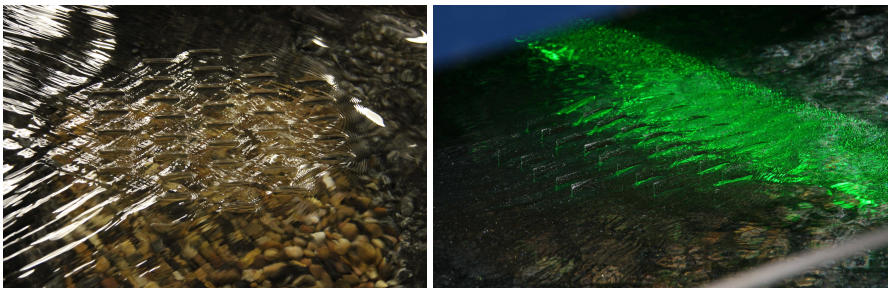

Figure 1: A patch of flat glass stems illuminated by a laser sheet (on the right).

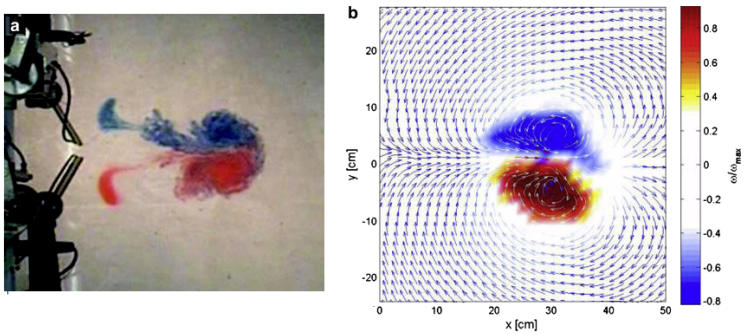

Figure 2: Shallow dipole propagating away from the generating flaps. a) The vortices are dyed with different colours. b) corresponding surface velocity field with the vorticity field (in colors) superimposed (Jirka and Seol, 2010).