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# Hydrodynamic loads applied on a tidal turbine model in turbulent flow : from the implementation to the first measurements

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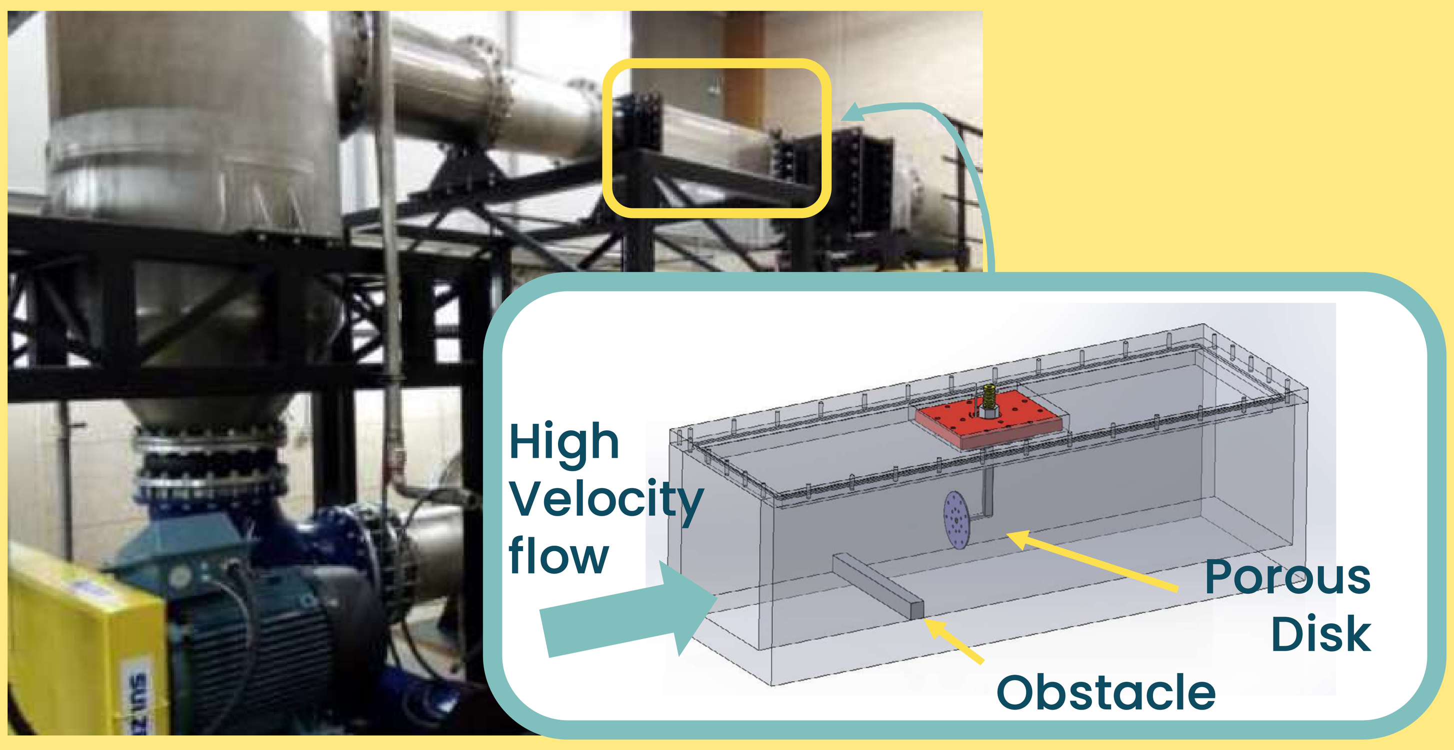
## Contexte and Objective

The objective of this experimental work is to study the interaction between a turbulent flow and the hydrodynamic loads applied on a tidal turbine of horizontal axis.

The sweeping surface of the wings is represented by a Porous Disk (PD) placed in an Hydrodynamic Tunnel (HT) providing a high velocity flow. This work deals with the implementation of the data acquisition method. Later, we will study the impact of the presence of a canonical representation of seabed bathymetry (an obstacle anchored on the test section bottom) on the flow organization and the hydrodynamic load. The topology of the wake produced downstream these obstacles has been studied in previous works [1, 2].

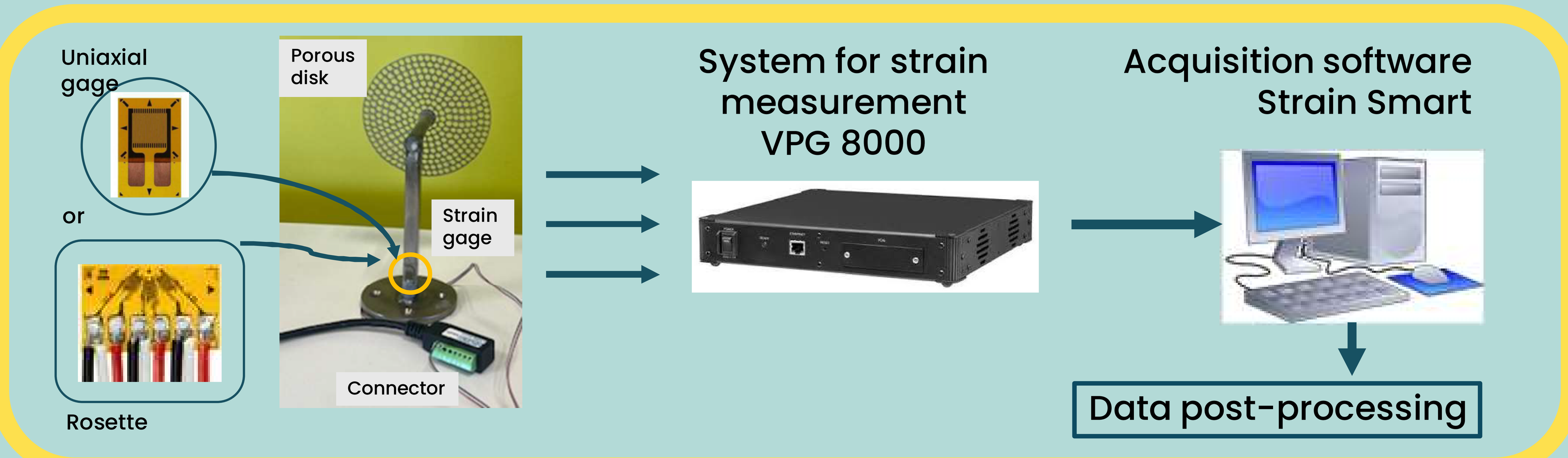



Porous disk placed in the test section of the Hydrodynamic Tunnel.

## Data Acquisition System

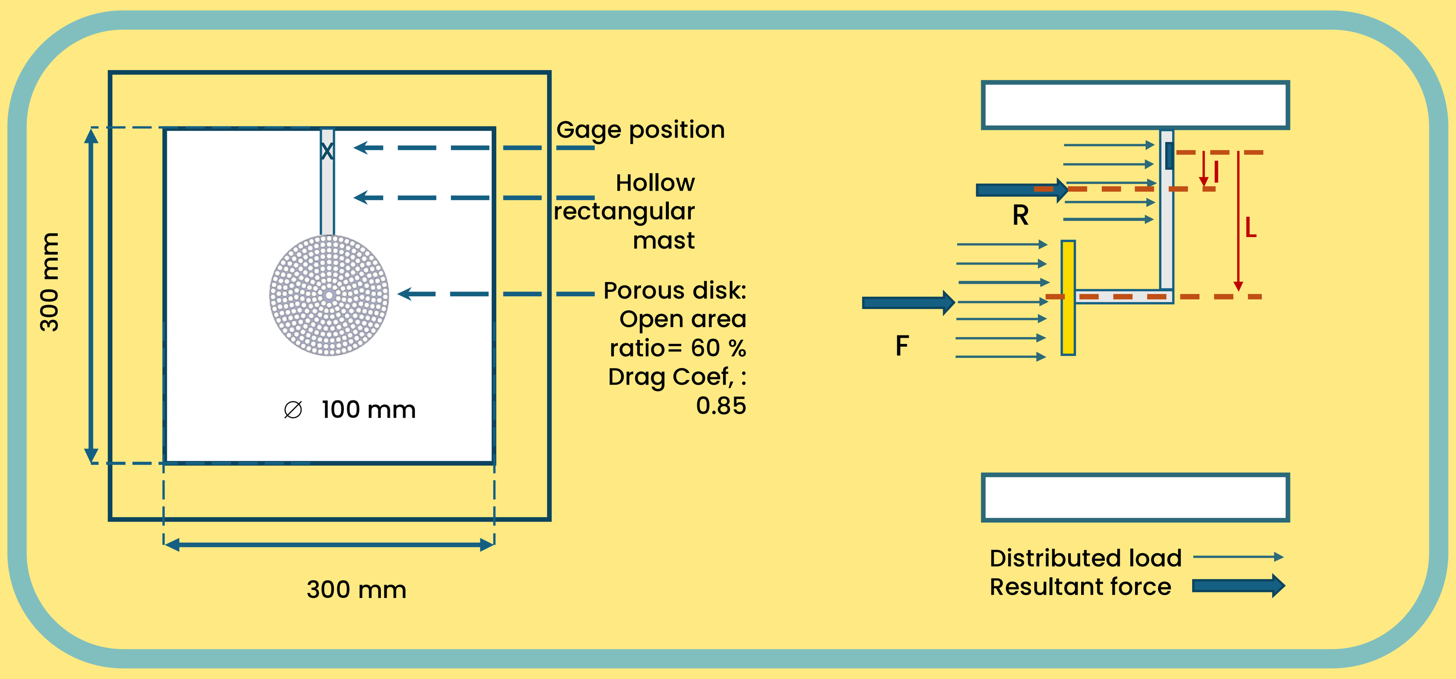
The PD was implemented with strain gages, placed in the mast of the PD. In a first time an uniaxial gage has been connected to the strain measurement system, which has a sampling frequency adapted to the flow dynamics imposing the hydrodynamic load.

A static characterization was carried out before the introduction of the PD into the HT.




## Hydrodynamic Load

The strain gauge is used to measure the local deformation of the mast resulting from the distributed loads induced by the flow into the HT. Due to the intrinsic turbulence of the flow we have a dynamic load applied on the PD.




Actuator disk momentum theory [3] provides a relationship between the open area ratio $\theta$ of the porous disk and the thrust coefficient $C_T$ :

$$\theta^2 = \frac{1}{(1+K)} \quad \text{and} \quad C_T = \frac{K}{(1+0.25K)^2}$$

where K is the resistance to the flow through the disk.

Moreover, the resultant hydrodynamic load, F, applied on the disk is equal to : $0.5\rho C_T U_0^2 A$

with $\rho$ the water density, A the projected area of the disk and $U_0$ the incoming flow velocity.

As observed in the state of arts [4], in a confined domain, blockage effects are observed. The blockage ratio between the area of the PD and the cross sectional area of the HT leads to the correction of the thrust coefficient and of the hydrodynamic load applied on the PD.

The bending momentum measured within the gage is the sum of the bending momentum du to the resultant force R and the bending momentum due to the resultant force F.

The first measurements are now underway.

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