Master thesis project: CFD modelling of a water power turbine

companies involved: HKV lijn in water (http://www.hkv.nl/), Deepwater Energy (http://www.oryonwatermill.com/)

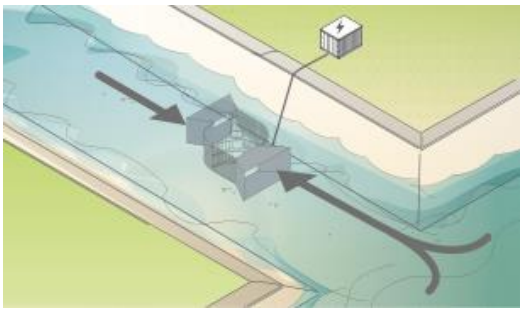

Figure 1: Sketch of the OryonWatermill

Deepwater Energy has developed the Oryon Watermill (OWM), a horizontal water power turbine which is intended for application in situations with low head differences e.g. on rivers. In this way the OWM enables sustainable energy generation in places where this hasn't been possible before. By the end of this year the first two OWMs will be placed at the weir Doesburg on the Oude IJssel. The OWM will also be tested in the Tidal Testing Centre Grevelingendam (TTC).

So far the OWM has been tested during physical experiments in hydraulic laboratories. Computational Fluid Dynamics (CFD) software is used to model detailed hydraulic and hydrodynamic phenomena in 2D or 3D. It is therefore suitable to give insight into the flow pattern inside the OWM taking into account the flow conditions at the weir Doesburg or the TTC. A CFD model of the OWM can be used to gain insight into the flow pattern inside the OWM, identify and minimize hydraulic losses, optimize the design of the OWM and maximize the power generation.

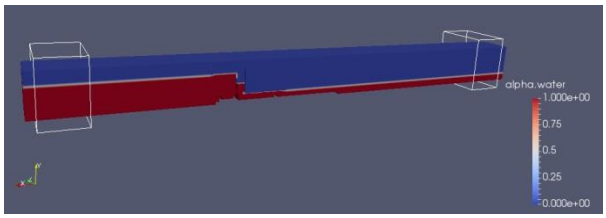

Figure 2: Example of an OpenFoam model (TTC)

Aim: modelling of a water power turbine

At the moment the exact flow pattern within the OWM is unknown. Therefore, the shape of the rotor and the power generation are best guesses. The aim of this Master thesis is to:

- Develop a dynamic CFD model of the OWM including housing and rotor. In a dynamic CFD model the rotor is forced to move by the flow of the water.
- Validate the model by comparison with measurement data obtained from physical experiments in a hydraulic laboratory.
- Analyse the momentum generated by the rotor. Estimation of an average momentum for a given rotational speed in order to derive the power generated.
- Analyse the force distribution along the blade in order to evaluate the shape of the rotor blades.

This Master thesis topic offers the unique opportunity to work on a real problem in cooperation with two companies working in the field of hydraulics, mathematical modelling and small scale hydropower production. The student will work in a project team which has been working on the OWM before (OpenFoam models without the turbine are already available) and the results and recommendations of the thesis might be implemented into the real design.

Period: June-December 2016

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