

Implementation of Tidal Stream Turbines in Telemac-3D Model

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Abstract

Tidal stream energy is an emerging sector of the energy generation industry with advantages of predictability. Scotland has a remarkable tidal stream resources, and it has an ambition to build the first commercial-scale tidal stream energy project. However, the practical use of tidal stream energy requires an efficient energy extraction.

Tidal stream turbine arrays are considered as one of the most efficient extraction methods. Nevertheless, it is not always easy to design an efficient array compared to a single turbine. The current knowledge of the effects of tidal stream turbine arrays on hydrodynamic processes is still limited. The study explores various numerical modelling approaches to simulate the flow alteration patterns due to the presence of tidal stream turbines. The Methodology to represent a turbine in a hydrodynamic model differs based on the dimensions of the model (i.e. 2D or 3D), and it varies from one numerical solver package to another. For example, in Delft3D, the turbine is represented as a porous plate [1], while in FVCOM as a momentum sink. In Telemac2D, the influence of the turbine is modelled as a drag force induced by the turbine opposing the flow [2].

The work in this study concentrates on developing a method to represent a tidal turbine in Telemac3D by adopting and combining drag force and head loss approaches. The drag force is applied at the turbine location on the 2D mesh of each layer of the three-dimensional model. Then, using the Source Term subroutine, the computed drag force is used to implement local head losses at the location of the turbine.

This study is still work in progress. It is divided into two stages. Firstly, to validate the model without the implementation of the tidal turbines. Secondly, to validate the proposed approach to represent tidal turbines in Telemac3D. The developed method will be validated by comparing the model outputs with recorded measurements upstream and downstream tidal turbine acquired from ReDAPT project [3].

Summary

The work in this study concentrates on developing a method to represent a tidal turbine in Telemac3D by adopting the drag force and the head loss approaches. The model outputs are validated against real measurements upstream and downstream tidal turbine acquired from ReDAPT project.

References

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