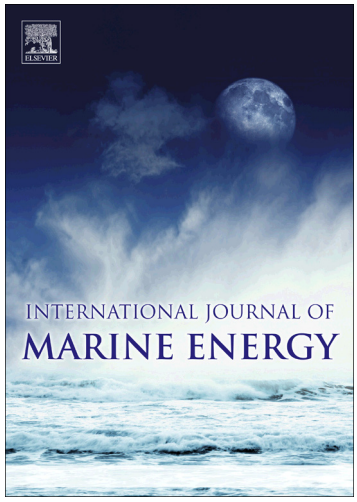

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Actuator line simulation of a tidal turbine in straight and yawed flows

F. Baratchi[a,*], T.L. Jeans[a], A.G. Gerber[a]

[a] *Mechanical Department, University of New Brunswick, Fredericton, NB, Canada*

Abstract

In this numerical study a tidal turbine in straight and yawed flows is simulated using the actuator line (AL) method coupled with Large Eddy Simulation (LES) of turbulence for the turbine previously studied experimentally by Bahaj et al [1]. Importantly, the AL model is fully coupled to an existing GPU based computational fluid dynamic solver, enabling high resolution simulations in reasonable time frames using desktop size server systems. Simulation results using the blade element actuator disk (BEAD) method are also presented to support the results from the AL method and highlight its advantages over the BEAD method. Results obtained from this study show that the AL method is capable of capturing wake unsteadiness and the tip and root vortices resulting from the turbine blades. Predicted power and thrust coefficients agree well with experimental data, being within 0.77 % and 1.91 %, respectively, at the design tip speed ratio. However, the absence of hub geometry in this method affects the downstream wake pattern along its centerline.

Keywords: Tidal turbine, CFD, Actuator line method, LES, GPUs

2010 MSC: 00-01, 99-00

Nomenclature

A	Area
a	Axial induction factor
B	Number of rotor blades

*Corresponding author