Investigating the Hydrodynamic Performance of a Tidal Turbine

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Work stream 1:Numerical and physical convergence

Introduction

Ultimately tidal turbines will be installed in arrays, and determining the optimal spacing between tidal turbines in these arrays is required. The wake generated by a tidal turbine is an essential factor in determining this.

The wake may impact on downstream turbines by:

- Reducing flow velocity, resulting in less energy produced by turbines downstream.
- Increasing flow turbulence intensity which impact the energy capture factor, and may also increase the fatigue loading on devices downstream.

Research Approach

The wake downstream of a tidal energy device is influenced by four components; inflow current conditions, the support structure wake, the structure movement and the wake generated by the turbine itself.

Primarily 10th scale test have been conducted using Evopod, a tidal energy device under development by Ocean Flow Energy.

Figure 1 – Evopod tidal energy device

An initial period of testing in Strangford Lough highlighted difficulties in isolating the characteristics of the turbine wake. Leading to 10th scale towing tests in a lake, which took place in September 2009.

Large Scale Towing Test

The towing test removed two contributing components of the wake, the variable inflow current and the movement of the support structure. This allowed benchmarking of the turbine performance and the interaction of the turbine with a steady, uniform flow, and the wake generated.

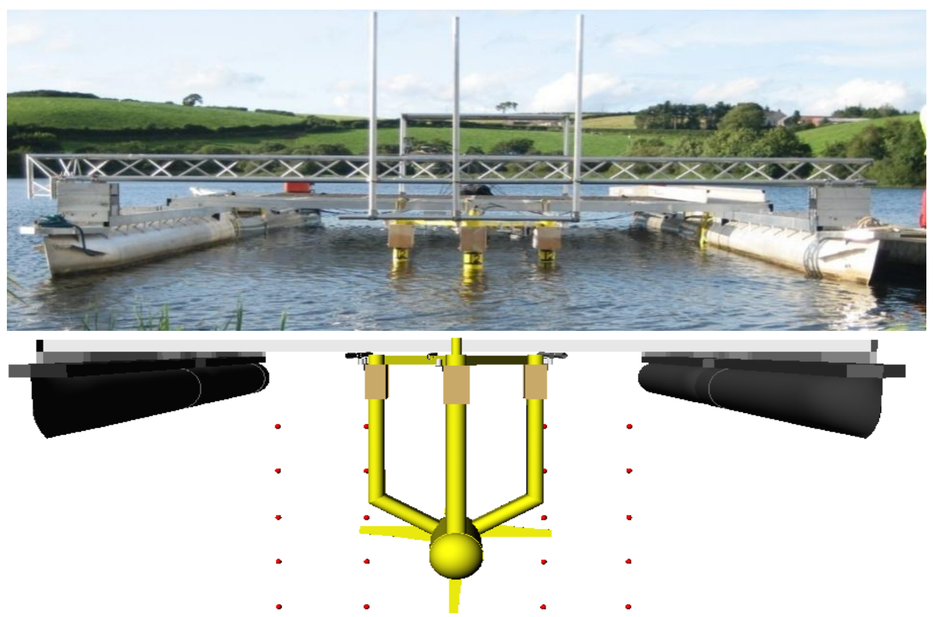

Figure 2 – Towing experiment set-up, acoustic Doppler velocimeter (ADV) measurement matrix shown in red behind the device

Towing Test Results

Towing tests were carried out with both Evopod's turbine attached and removed. Preliminary results are presented in Figure 3.

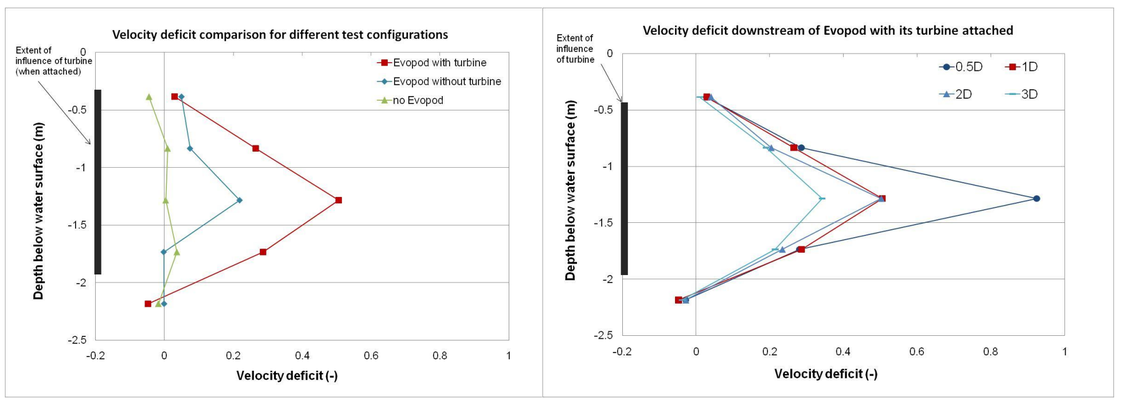

Figure 3 – Preliminary towing test results

Future Research

A second phase of towing tests are being carried out after significant improvements have been made to the towing rig set up. A new traversable measurement platform and a streamlined instrument mounting structure have been designed and constructed to improve the test procedure. Results from these tests will be used to:

1) Investigate the development of the wake both laterally and downstream at different inflow speeds.
2) Compare turbulence measurements taken using ADVs and acoustic Doppler current profilers in the wake.
3) Validate a numerical model being developed at QUB, which will predict the wake generated by a horizontal axis tidal turbine.

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