

Introduction

Understanding the dynamics of tidal current is necessary for the development of tidal turbine technologies. The highly energetic environment affects power conversion rate, blade fatigue loading, reliability and maintenance. Site data acquisition together with regional hydrodynamic models over a vast range of spatial and temporal scales are required for capturing the key underlying fluid motions, and determining the key industrially-relevant parameters.

[1]

INPUTS

Measurement Data

Hydrodynamic Models

DATA PROCESSING

Characterisation



Parameter Selection

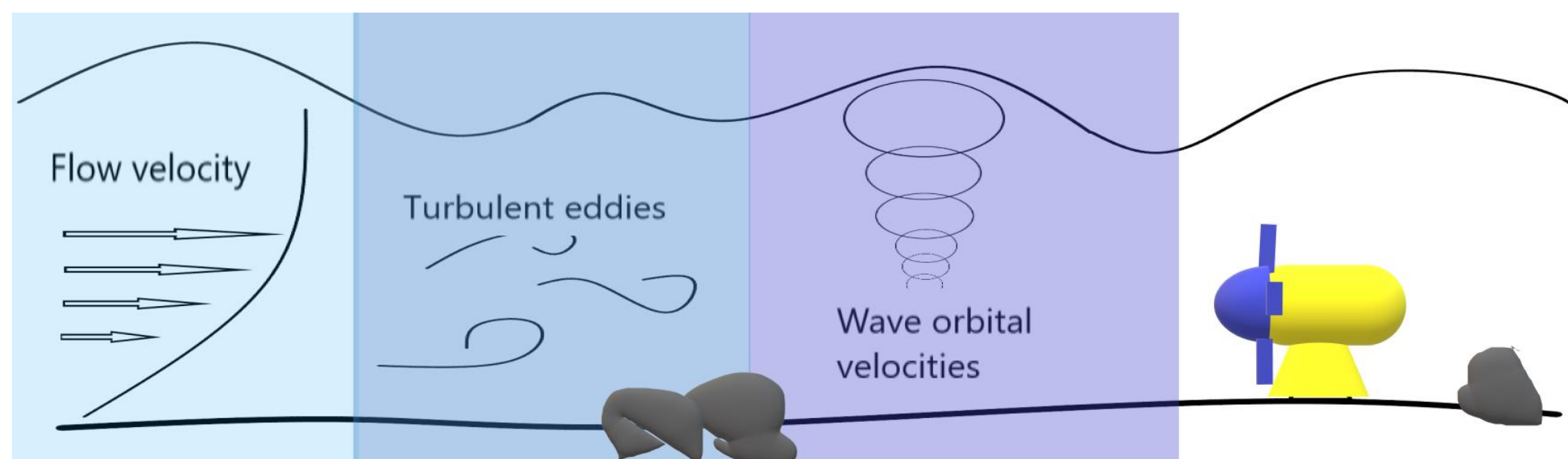
ENGINEERING TOOLS

Physical Simulation

Numerical Simulation

Challenges: Flow measurement

- **Complex environment:** complicated bathymetry, shear flow, turbulence, waves, wave-current interaction
- **Remote operation:** sensor system resilience, power, communication, deployability, data bandwidth



State of the Art: Sensor technologies

Acoustic Doppler Current Profiler (ADCP) is a diverging 4-5 beam instrument that measures the velocity components measured in the direction of each beam and waves. The mean flow velocity is obtained by averaging the beam velocity components, and the turbulence parameters are then derived.

However, homogeneity of the flow between the beams is assumed: turbulence smaller than beam distance, which increases with the distance from the instrument) can not be directly resolved. Large eddies are also often misinterpreted.

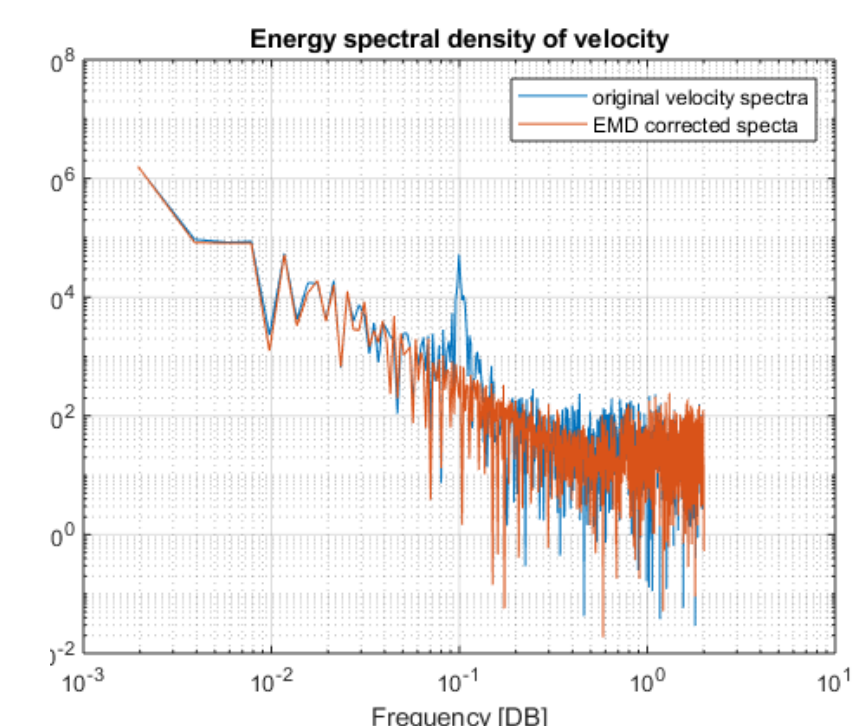
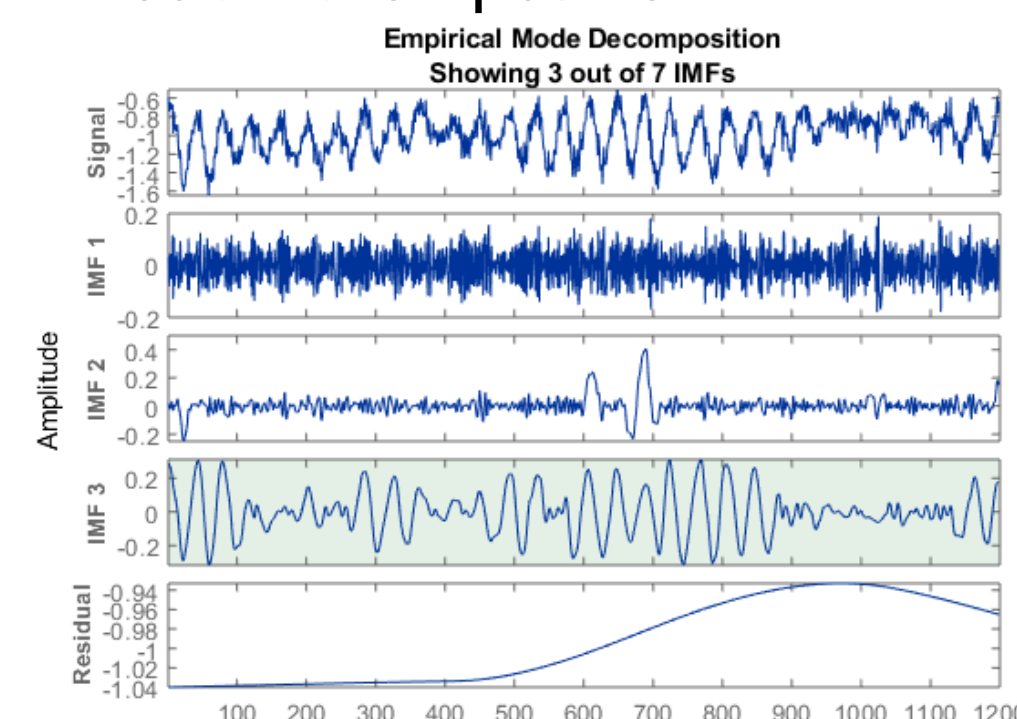
A compromise has to be made between resolution and range, sparse measurements, positioning, size, cost.

References: [1] Draycott, S., et al. "Capture and simulation of the ocean environment for offshore renewable energy." *Renewable and Sustainable Energy Reviews* 104 (2019): 15-29.
[2] *Copernicus Sentinel Data [2018]*"

PhD: 3 months in

Project initiated with the following analysis and design:

- **Signal processing of measured data:** Separation of wave-current turbulence parameters using the Empirical Mode Decomposition.



- **Novel sensor systems:** Design work for mechanically actuated geometrically convergent beam acoustic Doppler profiler for high resolution measurement of 3D tidal flow velocities (RealTide project).



PhD : upcoming

- **Research interest:** achieving improved measurements through high resolution scanning via a phased array of acoustic transducers
- **Why?** Acoustic transducers in phased array enables beam steering and beam shaping
- **How?** Varying the excitation delay of individual element of group of element enables to generate a beam at the desired angle and focal depth through wave interaction.

[2]

