Parametric modelling of wave energy converters via data-based interpolation/extrapolation

Master thesis proposal at the Marine Offshore Renewable Energy Lab

Department of Mechanical and Aerospace Engineering

Politecnico di Torino

Recommended profile:
Mechanical engineering, Mechatronic engineering, Applied mathematics

Topics involved:
Control theory and applications, modelling, system dynamics, wave energy conversion

Proposal description

Optimisation of ocean wave energy conversion systems, commonly referred to as **wave energy converters** (WECs), can be an intricate process, which requires simultaneous evaluation of various parameters of a given conversion concept in order to maximise productivity and, ultimately, minimise final costs associated with the device. Such an optimisation process is commonly based on mathematical models representing the device dynamics, in an attempt to predict performance behaviour, design adequate control systems, and assess final productivity.

Dynamical models for WEC systems are virtually always computed in terms of so-called boundary element methods (BEMs), which provide, for a given (fixed) geometry, a characterisation of the hydrodynamics of such a device. Though highly versatile, BEM-based software potentially necessitates a substantial computational time to determine the hydrodynamics of an associated geometry with a given degree of resolution, hence being less than ideal for iterative procedures, such as those normally employed within performance optimization (see diagram below).

Since geometry can be a key parameter within optimisation of WEC design, and BEM models are shape-dependent, fast and reliable numerical modelling for different geometries is of paramount importance to achieve efficient iterative loops for performance enhancement. In the light of this requirement, and based on finite-dimensional output data computed with BEM codes, this project will aim at providing interpolation-based techniques to tackle efficient WEC modelling for use within optimisation procedures. Static and dynamic structures will be considered for interpolation (and extrapolation) of hydrodynamics, based on standard techniques from the field of function approximation.

Relevant reference: https://www.sciencedirect.com/science/article/abs/pii/S1364032120308777?via%3Dihub

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