PhD Open Days

Renewable Energy Forecast using Soft Computing Techniques for Predictive Control

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Abstract

Negative impacts of fossil fuels → Renewable energy investment → High variability and unpredictability → Need to optimize → Operate at the highest efficiency point

Ocean waves → Clean, abundant and powerful → Forecasting models can be valuable → Optimal control of Wave Energy Converter → Increase overall efficiency

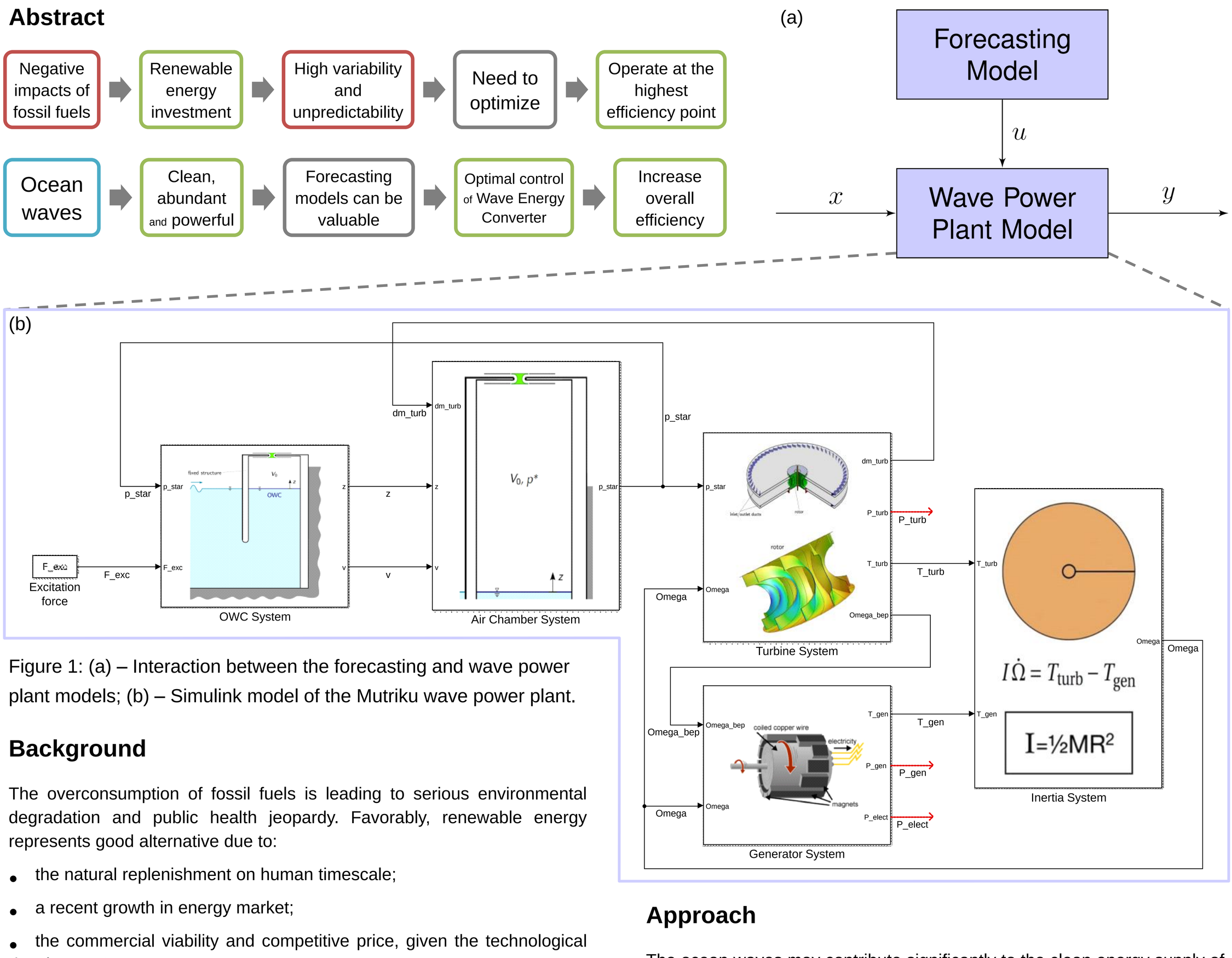

Figure 1: (a) – Interaction between the forecasting and wave power plant models; (b) – Simulink model of the Mutriku wave power plant.

Background

The overconsumption of fossil fuels is leading to serious environmental degradation and public health jeopardy. Favorably, renewable energy represents good alternative due to:

- the natural replenishment on human timescale;
- a recent growth in energy market;
- the commercial viability and competitive price, given the technological development.

A common characteristic among renewable energy resources is related with their high variability and resulting fluctuations in the power grid.

Therefore, it is important to optimize the renewable energy extraction, by operating at the highest efficiency point. This can be achieved by applying a forecasting model to the power plant, as illustrated in Figure 1a: by means of a control action u, the input x can now originate an optimized output y.

Approach

The ocean waves may contribute significantly to the clean energy supply of countries with coasts facing the sea. The Oscillating-Water-Column (OWC) is widely regarded as the most reliable type of Wave Energy Converter (WEC). Short-term wave forecasting models, characterized by their high interpretability, are relevant for control strategies in WEC devices.

A computational model based on the Mutriku wave power plant (in the north of Spain) was developed in Simulink (Matlab) (Figure 1b). It comprises the systems: OWC, air chamber, turbine, inertia and generator. The next step is to study control strategies to apply on the generator.

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