Parametric resonance in a 2:1 Wave Energy Converter: investigating the feasibility of the design space

Thesis proposal at the Marine Offshore Renewable Energy Lab

Department of Mechanical and Aerospace Engineering, Politecnico di Torino

Recommended profile:
Mechanical engineering, Mechatronic engineering, Aerospace Engineering

Topics involved:
Mathematical modelling; Nonlinear hydrodynamic modelling; Wave energy conversion

Skills required or suggested:
Matlab

Proposal description

The effort to increase the converted power is a common challenge in the field of wave energy conversion, both academic and industrial. When devices are found to be prone to parametric resonance, it typically has a negative impact on power harvesting and survivability. However, parametric resonance may not a danger to be avoided, but rather a chance to achieve a broader response bandwidth and ultimately increase the amount of power available at the power take-off. Parametric resonance is caused by a time-varying wetted surface, so linear models are unable to capture this instability; therefore, nonlinear Froude-Krylov forces should implemented via a computationally effective method that is compatible with both exhaustive simulation and real-time computinge. A novel pendulum-based device is **intentionally but arbitrarily** defined to exhibit a 2:1 ratio between heave and pitch natural frequencies. Results demonstrate that, by using the designed attitude to develop parametric instability, a second region of meaningful response develops near the heave natural period, in addition to the linear resonance in pitch. Thus, the free response bandwidth is increased, making more energy available at the power take-off axis.

The purpose of this thesis is to investigate the design space in order to determine the conditions to actually achieve the 2:1 parametric resonance condition. Consequently, the performance and potential of feasible devices is analysed.

Relevant references: paper and toolbox

Contact references:
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