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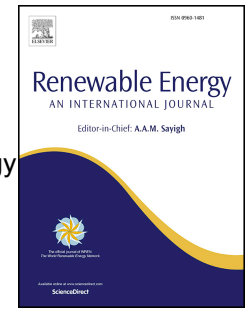

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Numerical and Experimental Studies of Excitation Force Approximation for Wave Energy Conversion

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Abstract

Past or/and future information of the excitation force is useful for real-time power maximisation control of Wave Energy Converter (WEC) systems. Current WEC modelling approaches assume that the wave excitation force is accessible and known. However, it is not directly measurable for oscillating bodies. This study aims to provide accurate approximations of the excitation force for the purpose of enhancing the effectiveness of WEC control. In this work, three approaches are proposed to approximate the excitation force, by (i) identifying the excitation force from wave elevation, (ii) estimating the excitation force from the measurements of pressure, acceleration and displacement, (iii) observing the excitation force via an unknown input observer. These methods are compared with each other to discuss their advantages, drawbacks and application scenarios. To validate and compare the performance of the proposed methods, a 1/50 scale heaving point absorber WEC was tested in a wave tank under variable wave scenarios. The experimental data were in accordance with the excitation force approximations in both the frequency- and time-domains based upon both regular and irregular wave excitation. Although the experimental data were post-processed for model verification, these approaches can be applied for real-time power maximisation control with excitation force prediction.

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