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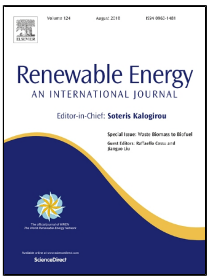

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Flexible multibody dynamics modelling of point-absorber wave energy converters

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Abstract

As an inexhaustible and environmentally-friendly energy resource, ocean wave power, which is extracted from ocean waves through WECs (wave energy converters), is highly valued by coastal countries. Compared to other types of WECs, point-absorber WECs, the main body of which can be fixed on a platform (e.g. ship), save on installation costs and therefore have concentrated significant interest among researchers and technology developers. In the development of point-absorber WECs, it is crucial to develop a reliable structural model to accurately predict the structural dynamic responses of WECs subjected to wave loadings. In this work, a FMBD (flexible multibody dynamics) model, which is a combination of MBD (multibody dynamics) and FEA (finite element analysis), has been developed for point-absorber WECs. The FMBD model has been applied to the structural modelling of the NOTC (National Ocean Technology Centre) 10kW multiple-point-absorber WEC. The floater arm tip displacement and velocity obtained from the FMBD model are validated against the values obtained from an analytical model, which is also developed in this work. The results from the FMBD model show reasonable agreement with those from the analytical model, with a relative difference of 10.1% at the maximum value of the floater arm tip displacement. The FMBD model is further used to calculate the stress distributions, fatigue life, deformations, modal frequencies and modal shapes of the structure. The results indicate that WECs are prone to experience fatigue failure, with the shortest fatigue life (2 years) observed in the floater arm. The FMBD model developed in this work is demonstrated to be capable of accurately modelling point-absorber WECs, providing valuable information for designers to further optimise the structure and assess the reliability of WECs.

Keywords: Wave energy converters (WECs); Point-absorber WECs; Flexible multibody dynamic (FMBD); Multibody dynamics (MBD); Finite element analysis (FEA); NOTC 10kW multi-point-absorber WEC

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