Accepted Manuscript

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PII: S0165-2125(17)30076-8
DOI: http://dx.doi.org/10.1016/j.wavemoti.2017.06.005
Reference: WAMOT 2171

To appear in: *Wave Motion*

Received date : 5 May 2016
Revised date : 16 June 2017
Accepted date : 19 June 2017

Please cite this article as: S. De Chowdhury, R. Manasseh, Behaviour of eigenmodes of an array of oscillating water column devices, *Wave Motion* (2017), http://dx.doi.org/10.1016/j.wavemoti.2017.06.005

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Behaviour of eigenmodes of an array of oscillating water column devices

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Abstract

The eigenmodes of an array of wave energy converters is derived using the self-consistent method, which circumvents some of the problems of multiple scattering. The aim is a rapid, intuitive method of estimating the optimum array configuration. The equations of motion are derived in the time domain for an array of oscillating-water-column devices. The eigenmodes under the self-consistent method are solutions for the relative displacements of all devices. The interactions of the devices owing to wave radiation are accounted for by coupling-magnitude and time-delay constants relating the response of a device and that of an interacting partner. This gives a system of delay differential equations which is solved with and without time delays. The resulting coupled-oscillator model is used to study the eigenmodes of linear and triangular arrays. It is found that the inter-device spacing is the dominant control on the complex eigenfrequencies, the ordering of which can reverse as spacing varies. Identification of the dominant eigenmode of an array may lead to smaller individual machines, which are more economical to construct, install and maintain.

Keywords: Arrays, Oscillating water columns, Multiple scattering, Delay Differential Equations, Hydrodynamics, Eigenmode.

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