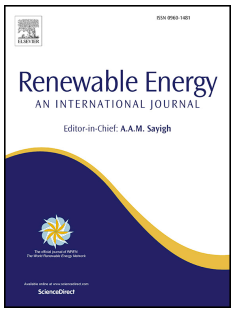
Accepted Manuscript



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PII: S0960-1481(16)31005-9

DOI: 10.1016/j.renene.2016.11.036

Reference: RENE 8310

To appear in: *Renewable Energy*

Received Date: 17 March 2016

Revised Date: 13 November 2016

Accepted Date: 17 November 2016

Please cite this article as: Zou S, Abdelkhalik O, Robinett R, Bacelli G, Wilson D, Optimal control of wave energy converters, *Renewable Energy* (2016), doi: 10.1016/j.renene.2016.11.036.

Optimal Control Of Wave Energy Converters

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Abstract

Optimal control theory is applied to compute control for a single-degree-of-freedom heave wave energy converter. The goal is to maximize the energy extraction per cycle. Both constrained and unconstrained optimal control problems are presented. Both periodic and non-periodic excitation forces are considered. In contrast to prior work, it is shown that for this non-autonomous system, the optimal control, in general, includes both singular arc and bang-bang modes. Conditions that determine the switching times to/from the singular arc are derived. Simulation results show that the proposed optimal control solution matches the solution obtained using the complex conjugate control. A generic linear dynamic model is used in the simulations. The main advantage of the proposed control is that it finds the optimal control without the need for wave prediction; it only requires the knowledge of the excitation force and its derivatives at the current time.

Keywords: Wave Energy Conversion, Singular Arc Control, Optimal Control, Bang-Bang Control

1. Introduction and Background

Waves can provide a reliable source of renewable energy compared to the solar and wind sources. There is a wide variety of wave energy extraction concepts depending on the mechanism of absorbing energy from the waves, on the water

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