University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Applied Science

of

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BS (Florida Institute of Technology, 2012)

"Performance Assessment of a 3-Body Self-Reacting Point Absorber type Wave Energy Converter"

Department of Mechanical Engineering

Monday, April 29, 2019
9:30 A.M.
Engineering Office Wing
Room 106

Supervisory Committee:
Dr. Brad Buckham, Department of Mechanical Engineering, University of Victoria (Supervisor)
Dr. Andrew Rowe, Department of Mechanical Engineering, UVic (Member)

External Examiner:
Dr. Aaron Gulliver, Department of Electrical and Computer Engineering, UVic

Chair of Oral Examination:
Dr. Daniela Damian, Department of Computer Science, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

The Variable Inertia System Wave Energy Converter (VISWEC) is a self-reacting point absorber (SRPA) type wave energy converter (WEC) capable of changing its mechanical impedance using an internal reaction mass system. The reaction mass is coupled to a rotating assembly capable of varying its inertia and this changing inertia has the effect of creating an added inertial resistance, or effective mass, to oscillations of the reaction mass. An SRPA has two main bodies, designated Float and Spar, capable of utilizing the relative motion between the two bodies to create power through a power take-off (PTO). The implementation of the reaction mass, a 3rd body, and the variable inertial system (VIS) is designed to change the response of the Spar in order to create larger relative velocities between the two bodies and thus more power. It is also possible to lock the VIS within the Spar, and when this is done the system is reduced to a conventional 2-body SRPA configuration.

To better understand the effects of the implementation of the VIS on the overall stability of the VISWEC and the power conversion performance, a numerical model simulation within ProteusDS, a time-domain modelling software, was created. Power production and paramtric excitation are to be metrics of comparison between the two systems. Parametric excitation is a phenomenon that correlates wave excitation frequency to roll stability and has been shown to negatively affect power production in SRPAs. Simulations of the 2 and 3-body provide a basis of comparison between the two systems and allow the assessment of parametric excitation prohibited or exacerbated by the implementation of the VIS as well as power production.

The simulation executed within the commercial software ProteusDS incorporates articulated bodies defined with physical parameters connected through connections allowing kinematic constrains and relations and hydrodynamics of the hull geometries as they are exposed to regular waves. ProteusDS also has the ability to apply kinematic constrains on the entire system allowing the analysis of isolated modes of motion.

The implementation of the VIS demonstrates a generally higher power production and stabilization of the system with regards to parametric excitation. However, the bandwidth at which rolling motion is induced increased in comparison to the 2-body system. Rolling motions in both the 2 and 3-body systems are characteristic of parametric excitation and show a direct correlation to reduced power production. Overall the 3-body VISWEC outperforms the typical 2body SRPA representation but more research is required.