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Entitled

MAXIMISING CAPTURED POWER AND BATTERY MANAGEMENT FOR HEAVING WAVE ENERGY CONVERTERS

By

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Date & Venue

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Abstract

Sea waves are considered the most potent energy carriers among all sources of renewable energy. This research work is concerned with developing technologies to enhance performance and improve power capturing and conversion capabilities of a single heaving wave energy converter (WEC) actuated by a PMLG (Permanent Magnet Linear Generator). The objective of this dissertation is achieved by three techniques. The first one considers maximizing conversion between the mechanical and electrical powers. It is implemented by designing intrinsic resistance using a rapid procedure involving the mechanical and electrical models of the converter and considering its operating constraints. A robust PID (proportional – integral – derivative) controller is synthesized using complex polynomial stabilization to satisfy robust performance specifications and is utilized in the servo feedback control system to follow the velocity reference which is generated by the designed intrinsic resistance. The method is tested in several nominal and perturbed scenarios and its performance is compared with existing control strategies. It is also verified experimentally on a hardware in the loop experiment rig. In the second technique, a novel simple resonance circuit is implemented to maximize the ac-dc power conversion of a PMLG. A procedure is developed for designing a two-sided planner PMLG considering the corresponding physical parameters. The resonance circuit is composed of a three-phase rectifier with a shunt connection of capacitors between its diodes. The performance of the proposed circuit is compared with an existing resonance circuit. The designed resonance circuit generates more power, requires fewer components and presents fewer harmonics. Finally, a novel operation and control strategy for a wave power system consisting of a WEC, a battery storage unit, and a set of loads, is proposed to control the power flow at DC-link terminal.

Keywords: Battery management, hardware-in-the-loop, heaving point absorbers, marine energy, permanent magnet linear generator, renewable energy, resonance circuits, wave energy converters.