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Modeling and advanced control of fully coupled wave energy converters subject to constraints: The wave-to-wire approach

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Ocean wave energy is a promising renewable source to contribute to supplying the world's energy demand. The Division of Electricity at Uppsala University is developing a technology to capture energy from ocean waves with a wave energy converter (WEC) consisting of a linear permanent magnetic generator and a point absorber. The linear generator is placed on sea bed and is driven directly by the floating absorber. Since March 2006, multiple wave energy converters have been deployed on the Swedish west coast outside the town of Lysekil. The technology is verified by long-term operation during at sea and satisfactory reliability of the electricity generation. This thesis focuses on developing advanced control strategies for fully coupled wave energy converters subject to constraints. A nonlinear control strategy is studied in detail for a WEC subject to constraints under regular and irregular waves. Besides, two coordinated control strategies are developed to investigate the performance of a wave energy farm subject to constraints. The performance of the WECs using these control strategies are investigated in case studies and optimal PTO damping coefficients are found to maximize the output power. The results show that these control strategies can significantly improve the performance of the WECs in terms of mean power compared to a conventional control. Besides these control strategies, a wave-to-wire simulation platform is built to study the power generation control of the WEC subject to constraints. The wave-to-wire simulation platform allows both nonlinear and linear control force. The results show that there is a good agreement between the desired value and the actual value after advanced control.

Biography

Liguo Wang has received his PhD degree in September 2017 from Department of Engineering Sciences, Uppsala University and currently is a researcher at the same university. He has seven years of research experience on Renewable Energy with specialization in Ocean Wave Energy. Research covers key areas relevant to wave energy converters e.g. fluid-structure interaction, power take-off systems, energy storage and control strategies. These activities are conducted through analytical analysis, numerical simulation, water tank test of prototypes and sea test of full-scale devices under supervision of internationally recognized experts in wave energy.

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