AALBORG UNIVERSITY

Name: Andrew Stephen Zurkinden

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Abstract: In recent years, the interest in developing new technologies to produce energy with low environmental impact by using renewable sources has grown exponentially all over the world. Wave energy converters that derive electricity from waves are of particular interest. The SDWED (Structural Design of Wave Energy Devices) project focuses on the development of design tools and a common design basis for wave energy devices in order to make these devices more competitive. The research project is divided into five work packages (WP), each one covering a field of technology. The present PhD study is relied to WP 4 and focuses on wave-to-wire modelling of wave energy devices. The project will involve the following issues:

i) Development of numerical models to simulate the energy conversion of several wave energy devices, (wave-to-wire models). These include heave-motion models for a semi-submerged sphere, two body floating devices and a floating oscillating water column (OWC).

ii) Develop a range of control strategies in order to optimize the energy output. These strategies include phase control by means of latching control, adaptive control by means of wavelets analysis. Besides the more advanced control methods, simple but very robust control strategies will also be a subject of the study. Numerical simulations will be carried out for the most of the control strategies and in selected cases by laboratory experiments.

iii) In order to validate the numerical models, several laboratory experiments will be carried out. Emphasis will be given on the validation of the control strategies, evaluated in the former desk-study. An independent study will be carried out to investigate the validity of linear hydrodynamic theory for a single degree of freedom heave absorber.

iv) Apart from the control strategy, the influence of site constraints like e.g. yield stress functions of defined structural components will be investigated. At least for one wave energy device, it is foreseen to carry out a structural analysis by means of fatigue lifetime analysis. The application of advanced control strategies may result in an increased power output ratio but yet may not be in favor of the overall structural response of the system.

Supervisor: Associate Professor Jens Peter Kofoed

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