

WEC control strategies for the WECfarm project

Louis De Beule¹, Timothy Vervaet¹, Nicolas Quartier¹, Vasiliki Stratigaki¹, Peter Troch¹

¹ Department of Civil Engineering, Ghent University, Technologiepark 60, 9052, Ghent, Belgium

E-mails: louis.debeule@ugent.be; timothy.vervaet@ugent.be; nicolas.quartier@ugent.be;
vicky.stratigaki@ugent.be; peter.troch@ugent.be

This abstract refers to an ongoing master's thesis at the department of Civil Engineering of Ghent University (Belgium) on control strategies of a wave energy converter which is being prepared for the upcoming WECfarm project. A new experimental campaign within the WECfarm project is planned in a new wave basin; the Coastal & Ocean Basin (COB) in Ostend. WECfarm will deliver a database for validation of new advanced numerical models which are worldwide employed for WEC array modelling. At the time of the 3rd Online WECANet General Assembly (November 2020), dry-testing of the first WEC is occurring.

The working principle of the WEC is the one of a point absorber operating in heave. The power take-off consists of a rack and pinion system in combination with a rotational Permanent-Magnet synchronous motor (PMSM). To control the WEC, a Simulink 'Real Time torque control' model is used. This model is built on a development computer and subsequently loaded on a Speedgoat Performance real-time target machine. In this context, real-time is the capability of the algorithm to execute within a prescribed update rate. The control model on the target machine processes the input signals from the laser sensor, accelerometer and load cells to provide, depending on the control strategy, the torque request as output to the drive.

Within this master thesis, the performance of a single WEC (the so-called "Master WEC") will be evaluated for different control strategies. The baseline strategy will be a passive controller, consisting of a force proportional to the velocity. A literature study will identify possible other advanced strategies. Model Predictive Control (MPC), Latching control, Reactive loading control and Linear Quadratic (LQ) Control are among the possibilities [1], [2]. Although the performance evaluation will be for the single Master WEC, the later extension to an array of five WECs will be taken into account as this is the WEC number that will be used in the WECfarm project. The passive control and the selected advanced control strategies will be implemented in the MATLAB Simulink model.

Firstly, the efficiency of the MATLAB Simulink control model will be evaluated in a dry set-up. Secondly, the passive controller will be evaluated in wave flume tests. Tests in a wave basin will allow to determine the power production for the passive control strategy. If possible, tests with the selected advanced control strategies will be executed to compare the power production relative to the baseline strategy. These consecutive steps will allow us to make recommendations for the control of the arrays of



COST is supported by the EU Framework Programme Horizon 2020. COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. COST Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers.

up to five WECs, to be experimentally tested at the COB in 2022. This part of the research is situated in the topics of “Working Group 3: Technology of WECs and WEC arrays”

References

- [1] D. Wilson, G. Bacelli, R. G. Coe, D. L. Bull, O. Abdelkhalik, U. A. Korde, and R. D. Robinett III, (2016) A comparison of WEC control strategies. Sandia National Labs, Albuquerque, New Mexico, Tech. Rep. SAND2016-4293.
- [2] Beatty, S., Ferri, F., Bocking, B., Kofoed, J.P., Buckham, B., (2017). Power Take-Off Simulation for Scale Model Testing of Wave Energy Converters. Journal Article, Energies.

Acknowledgements:

This work is supported by the the FWO (Fonds Wetenschappelijk Onderzoek - Research Foundation Flanders), Belgium, through the following funding: 1) Timothy Vervaeke is Ph.D. fellow (fellowship 11A6919N); 2) Nicolas Quartier is an SB Ph.D. fellow (fellowship 1SC5419N); Vasiliki Stratigaki is a postdoctoral researcher (fellowship 1267321N) and has been also granted an ‘FWO Research Grant’ for constructing the WEC experimental set-up (FWO-KAN-DPA376).



COST is supported by the EU Framework Programme Horizon 2020. COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. COST Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers.



A pan-European Network for Marine Renewable Energy with a Focus on Wave Energy

BOOK OF ABSTRACTS

of the General Assembly 2020 (online event) of the WECANet COST Action CA17105

Editors:

- Vasiliki Stratigaki
- Matt Folley
- Peter Troch
- Evangelia Loukogeorgaki
- Moncho Gómez-Gesteira
- Aleksander Grm
- Lorenzo Cappiotti
- Francesco Ferri
- Irina Temiz
- Constantine Michailides
- George Lavidas
- Milen Baltov
- Liliana Rusu
- Xenia Loizidou

Online | November 26-27, 2020



ISBN: 9789080928107



COST is supported by the EU Framework Programme Horizon 2020. COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. COST Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers.



Book of Abstracts of the General Assembly 2020 (online event) of the

WECANet COST Action CA17105:

A pan-European Network for Marine Renewable Energy with a Focus on Wave Energy

Edited by

**Vasiliki Stratigaki, Matt Folley, Peter Troch, Evangelia Loukogeorgaki,
Moncho Gómez-Gesteira, Aleksander Grm, Lorenzo Cappiotti, Francesco Ferri,
Irina Temiz, Constantine Michailides, George Lavidas,
Milen Baltov, Liliana Rusu and Xenia Loizidou**

ISBN: 9789080928107

This publication is based upon work from the WECANet COST Action CA17105, supported by COST (European Cooperation in Science and Technology). Support is also provided by the FWO (Fonds Wetenschappelijk Onderzoek - Research Foundation Flanders), Belgium. Vasiliki Stratigaki is a postdoctoral researcher (fellowship 1267321N) of the FWO.

www.wecanet.eu

COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. COST Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation.

www.cost.eu



Funded by the Horizon 2020 Framework Programme
of the European Union