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EXPERIMENTAL TESTING OF A WAVE ENERGY CONVERTER FOR THE WECFARM PROJECT

Background: A wave energy converter (WEC) is an interesting option to generate blue energy. To keep costs of these installations low it is important to install WECs in WEC arrays or farms. The WECfarm project is a large scale test campaign where arrays of up to five WECs will be tested to investigate the influence of multiple WECs on each other's performance ("near-field interactions") and their influence on the wave height behind the WEC array ("far-field interactions").
This project is a follow-up of the WECwakes project [1][2] where both near-field and far-field effects of large WEC arrays of up to 25 WECs have been investigated. In the present research, one single WEC for the WECfarm project is tested.

The WEC that is considered during the present research consists of a Power Take-Off (PTO) mechanism and is a point absorber operating in heave (illustrated in Fig. 1). The heave motion is translated into rotational movement by a rack and pinion system with the use of a rotational Permanent-Magnet Synchronous Motor (PMSM) which is controlled by a Matlab Simulink model.

Optimising the WEC model to be able to scale testing up to an array of five WECs in 2022, in the Coastal and Ocean Basin in Ostend, Belgium, is another target.

Initial tests: First of all, wave diffraction tests [5] will be executed by keeping the WEC in a fixed position in a wave basin where both regular waves (single sinusoidal wave) and irregular waves are generated by paddle movements. To have a wide enough application area, white noise multisine input signals which have a flat power spectrum and pink noise multisine input signals which have a decreasing power spectrum will be used to simulate the irregular waves. Wave radiation tests [6] will be carried out as well, in a calm basin (no waves). Here the WEC will be forced to move in an oscillating movement by an electric motor (again both regular and irregular motions will be used).

A final test will be the power absorption test with the use of a passive damping method. Depending on the COVID19 situation these tests will all be performed with one WEC within the timeframe of this thesis in the wave basin at Aalborg University, Denmark.

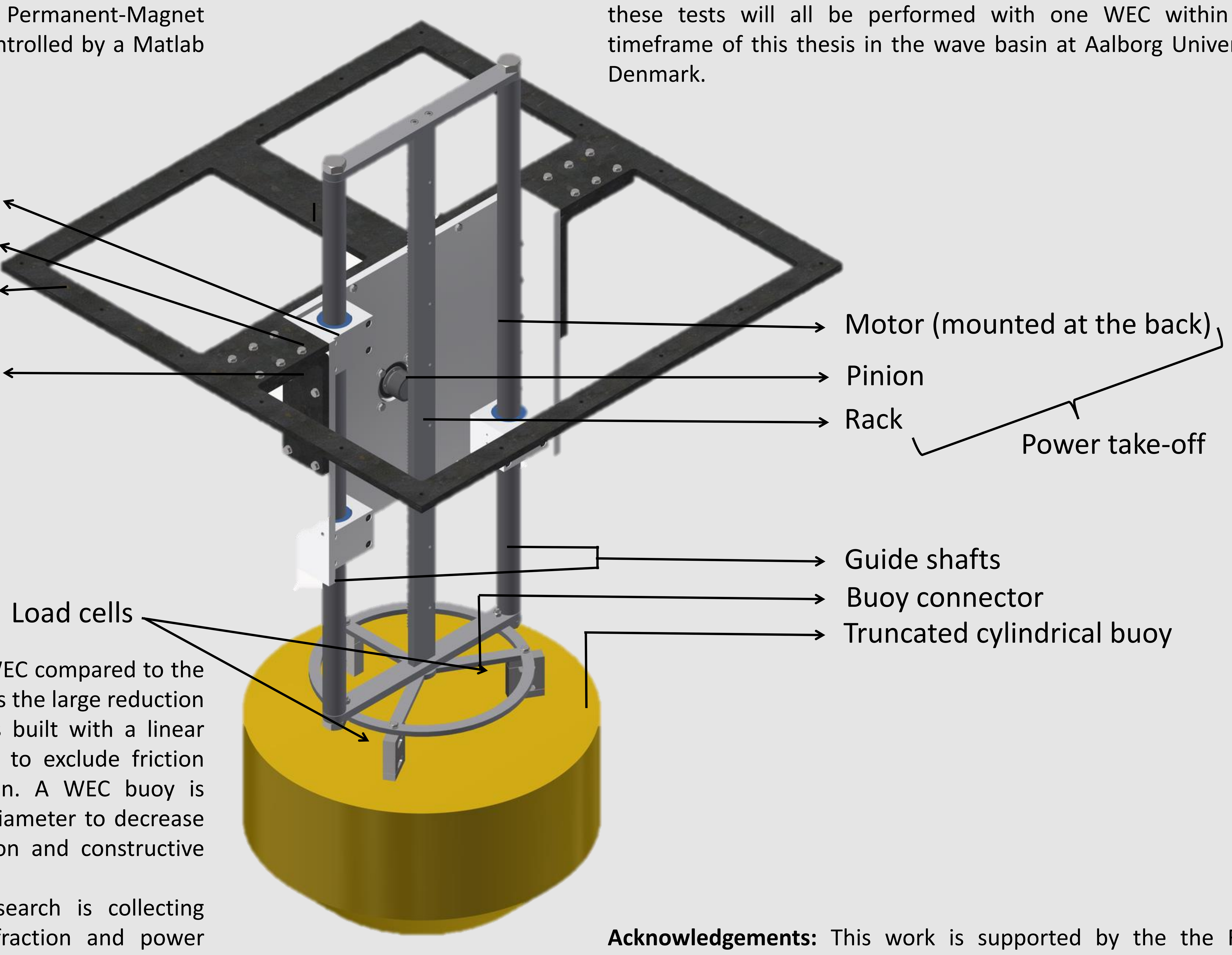

Fig. 1: Rendering of the design of the WEC

A major improvement of the WECfarm WEC compared to the WEC used during the WECwakes project is the large reduction of friction losses. The improved WEC is built with a linear guiding system with three air bushings to exclude friction resulting in losses of power absorption. A WEC buoy is installed with a lower draft and larger diameter to decrease surge forces and increase wave radiation and constructive near-field interactions.
Target: The target of the present research is collecting measurement results of radiation, diffraction and power absorption to compare with existing numerical models. Consequently, recently developed non-linear numerical models of the near-field and far-field interactions in a WEC array will be optimized by employing the targeted experimented data from the WEC of the WECfarm project. System identification process will be used to compare the experimentally obtained excitation forces, radiation damping and added mass with what can be theoretically anticipated using numerical models such as WAMIT [3] and Nemoh. [4]

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