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EXPERIMENTAL STUDY OF WAVE ENERGY CONVERTER ARRAYS: DEVELOPMENT OF A SINGLE DEVICE FOR THE WECFARM PROJECT

Background

To make **wave energy converters (WECs)** economically attractive as an alternative energy source, the **levelized cost of energy (LCOE)** needs to be competitive with other renewable energy sources. Increasing the power output can be achieved by placing a large number of WECs at the same site in a **WEC array** layout, see Fig. 1.

Fig. 1: Artist impression of a WEC array

Since an efficient wave absorber is also an efficient wave generator, one can theoretically benefit from placing the WECs in an well-considered geometrical layout. The motion of a single WEC will positively or negatively affect the power absorption of neighbouring WECs, called **near-field interactions**. On the other hand, the power absorption of the entire WEC array reduces the wave height behind the array, called **far-field effects**.

In the framework of the EU Hydralab IV **'WECwakes' project** coordinated by Ghent University (UGent), the above phenomena have been experimentally investigated for layouts of up to 25 heaving WECs [1]. The obtained unique database served for validation purposes of numerical models, such as for numerical coupling methodologies for studying wave-WEC interactions (near-field interactions) and wave propagation through WEC arrays (far-field effects) [2-5].

Scientific question

However, since the completion of the 'WECwakes' project, many numerical models have progressively advanced. To allow validating these new advanced models, the new experimental **'WECfarm' project** has been introduced by UGent and its partners (Queens University Belfast, Aalborg University, University of Vigo and The University of Edinburgh).

The main objective is to experimentally investigate near-field interactions and far-field effects for different **WEC array layouts** and **WEC inter-distances,** for configurations of up to ten WECs. This new experimental campaign aims to cover the scientific gap of experimental data necessary for the **validation** of recently developed (non-linear) **numerical models**. The WEC arrays will also be tested under **(extreme) wave conditions** which induce non-linear effects.

Methods

The 'WECfarm' experiments will be conducted in the **Coastal and Ocean Basin** (COB) (see Fig. 2) in Ostend in 2020, while in 2019 a single **'Master WEC'** is being developed, tested and fine-tuned prior to the array layout tests.

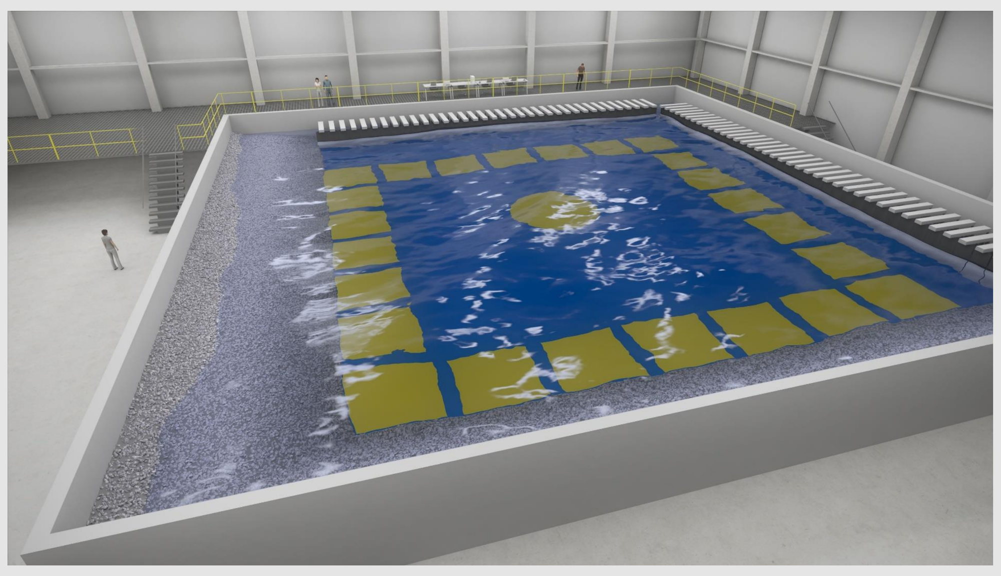

Fig. 2: Artist impression of the Coastal and Ocean Basin (cob.ugent.be)

Results

Fig. 3 shows a rendering of the design of the 'Master WEC'. The **hydrodynamic part** of the design consists of a truncated cylindrical buoy. The buoy is designed with a relative large diameter compared to the draft, which aims at maximizing wave radiation and thus inducing positive near-field interactions. The small draft is to limit the surge force, since the WEC will only operate according to the heave mode.

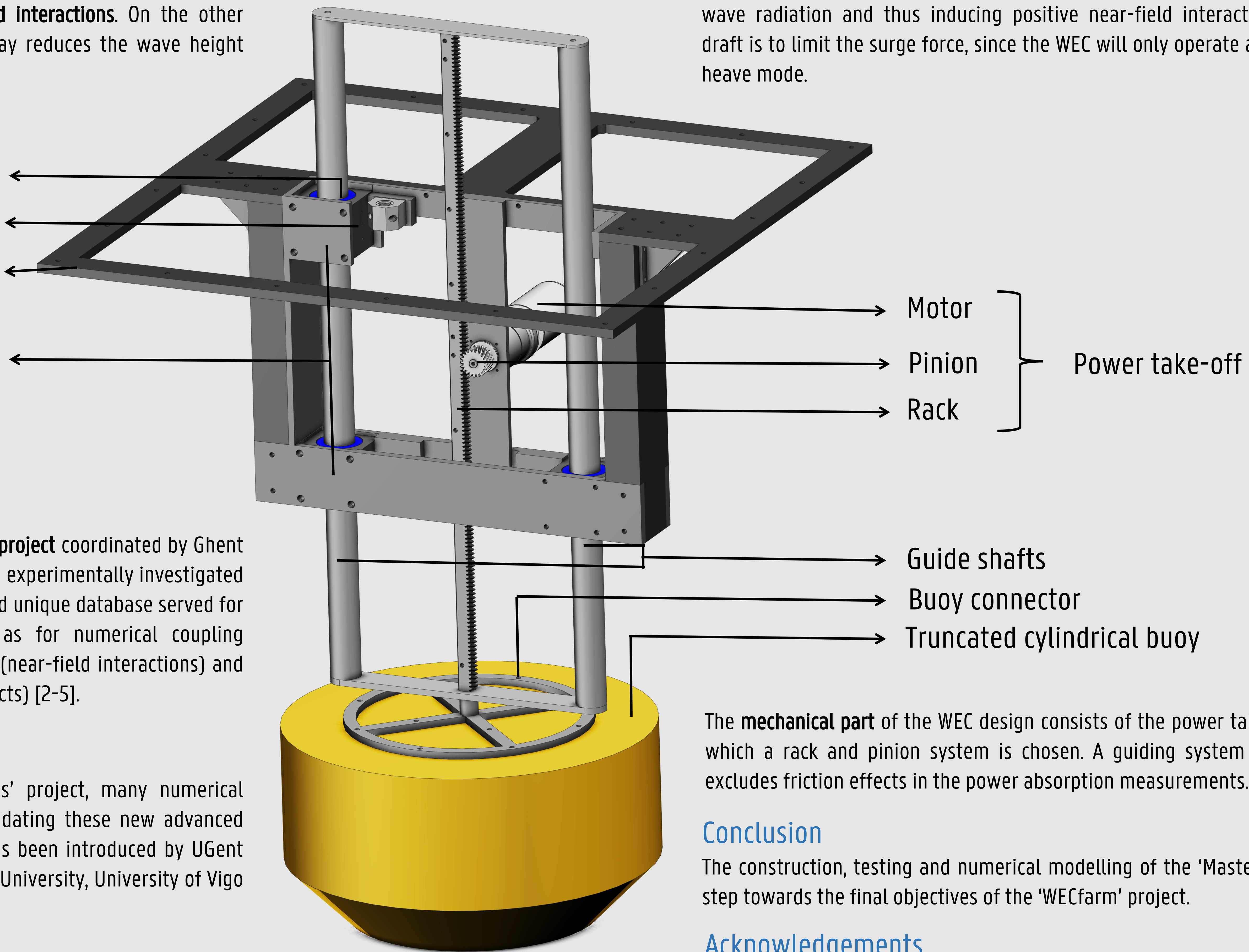

Fig. 3: Rendering of the design of the 'Master WEC'

The **mechanical part** of the WEC design consists of the power take-off (PTO) for which a rack and pinion system is chosen. A guiding system of air bushings excludes friction effects in the power absorption measurements.

Conclusion

The construction, testing and numerical modelling of the 'Master WEC' is a first step towards the final objectives of the 'WECfarm' project.

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