Master's Thesis: **Wave energy converter design optimization**

Ocean waves represent a substantial and largely untapped source of renewable energy. Wave energy will play a critical role when transitioning to emission-free energy systems worldwide. The Swedish company CorPower Ocean, one of the leading companies in wave energy conversion, is currently in the demonstration phase of their full-scale wave energy converter (WEC), see Figure 1. It utilizes the combination of innovative mechanical solutions and optimal control methods to maximize power output while ensuring survival.

Figure 1: CorPower C4 WEC during operation

At CorPower Ocean various modelling approaches are used for different purposes. For the energy-maximizing control of a single device, a nonlinear three degree-of-freedom (DoF) time-domain model is utilized to formulate an optimal control problem. This controller optimizes energy conversion with defined constraints on stroke, velocity and generator power. However, as this controller is defined for a given design, with certain hull geometry and mass distribution, further optimization is possible by applying an optimization routine on an extended parameter space. This thesis is performed in collaboration with CorPower Ocean and offers a unique opportunity to contribute to cutting-edge renewable energy research.

Scope

The goal of this master thesis is to develop and evaluate an optimization tool for a single CorPower Ocean wave energy converter. The optimization objective will be the Annual Energy Production (AEP) of the device for a given deployment site while considering system loads. For the selected parameters to be included in the optimization routine, a maximum realistic deviation from the latest generation of the device will be defined. A simplified model of the wave energy converter with implementation in Python and Matlab will be made available as a starting point for the developments within this thesis. The following points should be addressed:

- Literature overview
- Selection of optimization solver and integration of CorPower Ocean WEC modelling
- Definition of parameter space, constraints and development of optimization routine
- Quantification of sensitivity of AEP optimization objective on defined parameters
- Formulation of optimized device definition

Required skills

Applicants should have knowledge in the following areas: nonlinear system modelling, optimization solvers, and programming skills in MATLAB/Simulink and Python.

Stefan Koch stefan.koch@tugraz.at Martin Steinberger martin.steinberger@tugraz.at TU Graz, Graz, Austria	Timothy Vervaet timothy.vervaet@corpowerocean.com Gabriel Forstner gabriel.forstner@corpowerocean.com CorPower Ocean, Stockholm, Sweden https://corpowerocean.com/