# FLOATECH

## D3.2. Controller development, findings and validation against numerical simulations


DATE OF DELIVERY - 29/12/2022
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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101007142


FLOATECH
THE FUTURE OF FLOATING WIND TURBINES

# PUBLISHABLE SUMMARY


In the last years, the Floating Offshore Wind Turbines (FOWTs) development has significantly accelerated. The is referred to the fact that higher quality wind resources are often located offshore in waters that are very deep, and cannot accommodate the conventional fixed bottom offshore wind turbines. Considering the rough operating conditions of the FOWTs, environmental disturbances can affect their operation. The most predominant disturbances include wind gusts that can cause the turbine to oscillate, which can lead to fatigue in the structure and potentially cause failure, waves that can cause the floating platform to move, which can lead to changes in the position of the turbine and affect its performance. Wind disturbances have been well investigated in the past [25, 19]. The well-established LiDAR feedforward technology is used to mitigate the influence caused by the wind. Regarding wave disturbances, on the other hand, wave feedforward technology is still immature.

This deliverable describes the design process of a new wave feedforward controller for FOWTs with the objective of avoiding wave disturbances on the FOWTs. However, in order to do that, a control oriented model-based approach was followed, which requires deriving a mathematical model describing the system of the FOWT. After deriving the non-linear model, it was linearized at different operating points, namely wind speeds.

Before looking at the feedforward controller, some challenges in the feedback controller were discussed. The negative damping problem has predominantly been investigated, as it limits the feedback controller performance, and thus the system performance. The different control strategies adopted to deal with such limitation were discussed, and a new strategy was introduced including a new structure of the feedback controller.

Afterwards, the wave feedforward design approach was introduced and discussed.

It was found that the new feedback control structure overtakes all the current methodologies, as the controller bandwidth can be significantly increased to higher frequencies, which means a much-improved performance. It was also shown that wave feedforward is beneficial in theory, as the perturbations of the rotor speed, hence power, occurring due to wave excitation forces can be mitigated, but that comes at the cost of increased control effort and loading. So, it is questionable if wave feedforward will pay off in practice. However, we still showed that performance can be increased with the introduction of the novel pitch feedback controller.