

# Dynamic Analysis of Anchor Loads for a Floating Offshore Wind Farm

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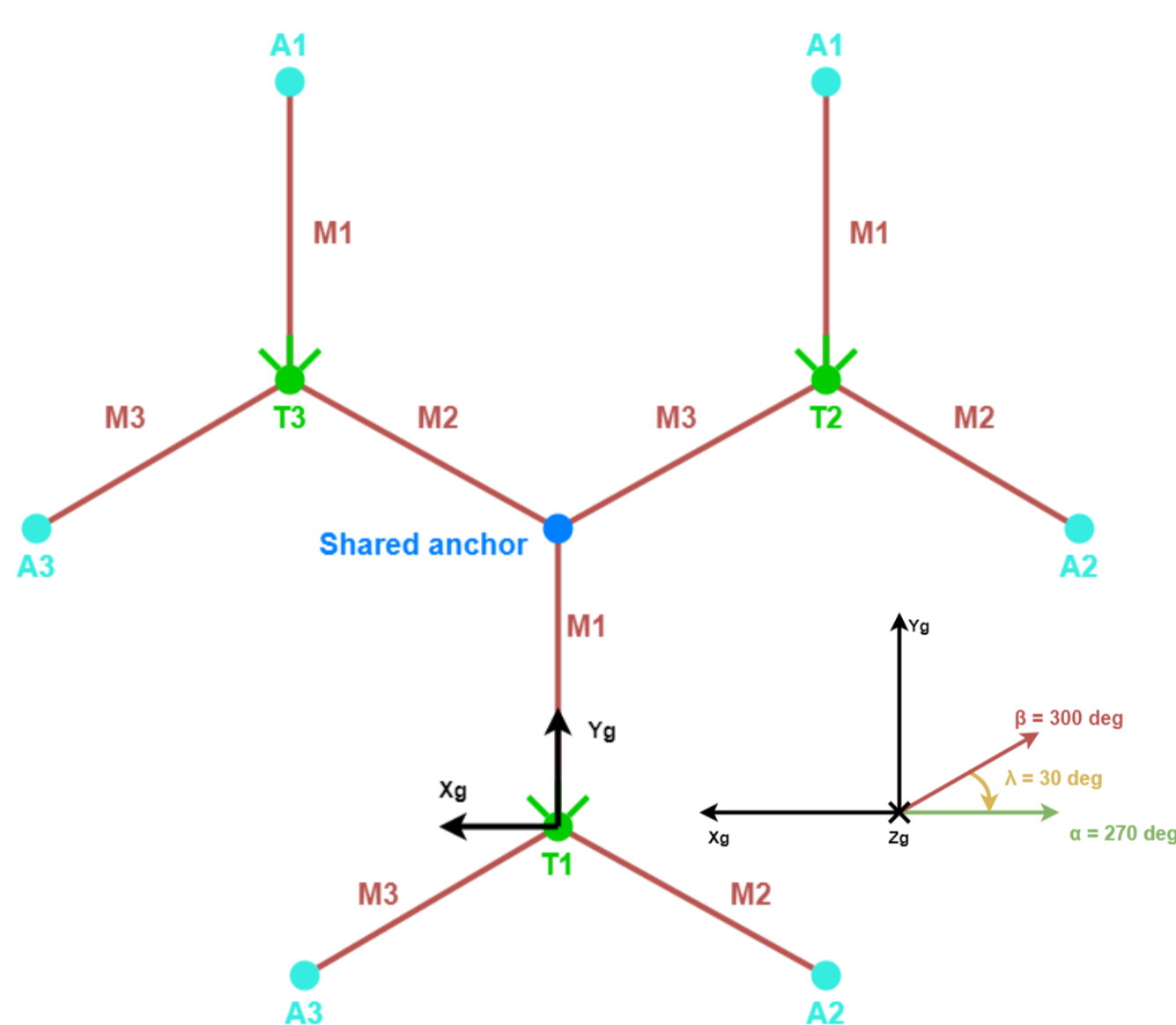
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**This study highlights the importance of considering multiple wind and wave directions and their misalignment in anchor load analysis to improve mooring design.**

A well-designed shared anchor system can reduce the total number of anchors needed in a windfarm, potentially lowering costs.

Compared with the single anchors of a single turbine, the shared anchors in the wind farm experience a reduction in the peak anchor loads, and wind-wave misalignment may significantly reduce the anchor loads.

## Case Study



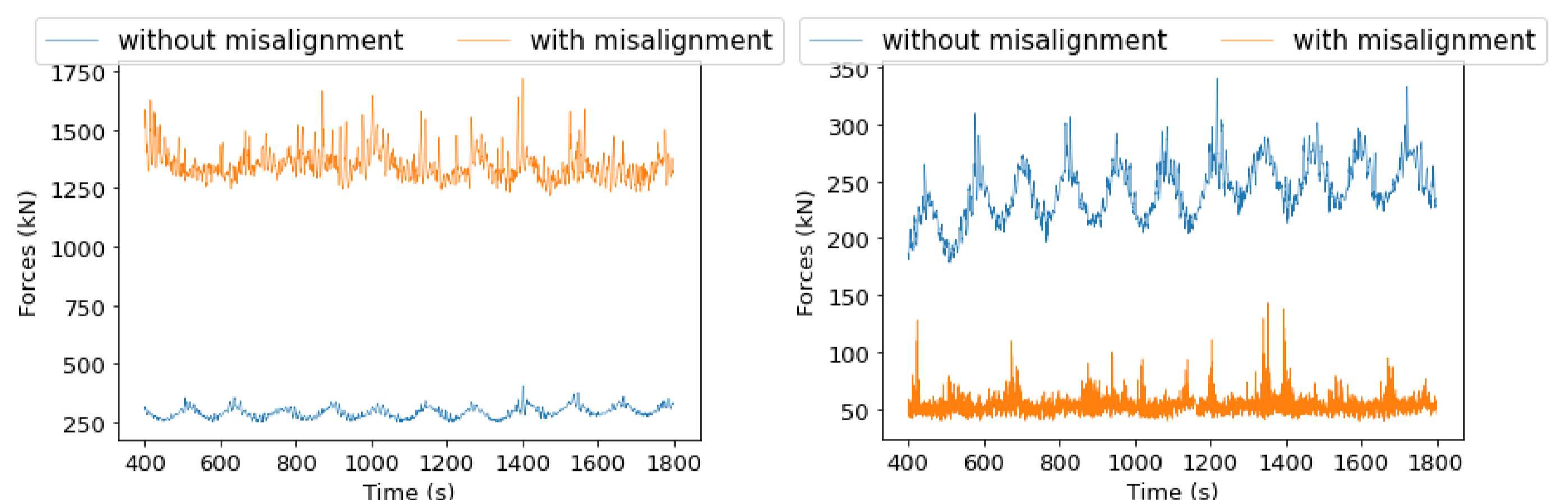
- IEA 15MW reference turbine
- VolturnUS-S semi-sub platform
- North Sea conditions at 200 meters water depth
- 50-year return period
- Parked condition
- Wind and wave conditions co-aligned with mooring lines
- Compared with 30 degrees off-set between wind and wave directions

w-w direction	Turbine-anchor pair	Maximum load single anchor (kN)	Reduction in SA (%)
180 deg	T1 A1	4153.7	9
180 deg	T2 A1	4338.5	13
180 deg	T3 A1	4312.6	12
240 deg	T1 A1	3426.8	46
240 deg	T2 A1	3228.7	42
240 deg	T3 A1	3447.7	46
240 deg	T3 A3	2174.6	14
300 deg	T1 A3	2115.4	8
300 deg	T2 A3	2001.7	3
300 deg	T3 A3	2108.6	8

*Reduction in peak load comparing shared anchor (SA) with the same configuration without shared anchor for collinear wind and wave directions*

Misalignment	w-w direction	Turbine-anchor pair	Maximum load single anchor (kN)	Reduction in SA (%)
+30 deg wind	180 deg	T3 A1	4431.9	35
-30 deg wind	240 deg	T2 A1	4521.8	41
+30 deg wave	180 deg	T3 A1	4603.9	14
-30 deg wave	180 deg	T2 A1	4519.8	14

*Reduction in peak load comparing shared anchor (SA) with the same configuration without shared anchor for misaligned wind and wave directions*



Peak load of T1 A2 for 180 degrees w-w directions and -30 degrees wind misalignment

Peak load of T1 A2 for 180 degrees w-w directions and +30 degrees wind misalignment

## Conclusions

- Anchors in a three-turbine setup and those in a single-turbine configuration show similar behavior. The shared anchor experiences a reduction in peak loads ranging from 3% to 46%.
- Wind-wave misalignment significantly affects the loads on the anchors, as it is observed that the loads tend to increase when the misalignment moves the wind turbine away from its original position, particularly in the direction opposite to that of the anchors. The peak load increases from 4338.5 kN for shared anchor T2 A1 to 4603.9 kN for single anchor T3 A1 in the three-wind turbines configuration.