



Monitoring of Floating Offshore Wind Turbines Using Model-Based Observers

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Introduction

➤ Load monitoring

...is a means for OEMs and operators to predict and monitor the system's and its components' lifetime

➤ Methodologies

- Sensors: Strain gauges, inclination sensors, accelerometers, GPS
 - Required loads: Tower, drivetrain, floater, mooring fatigue & ultimate loads
- Direct load estimation
- Model-based load estimation

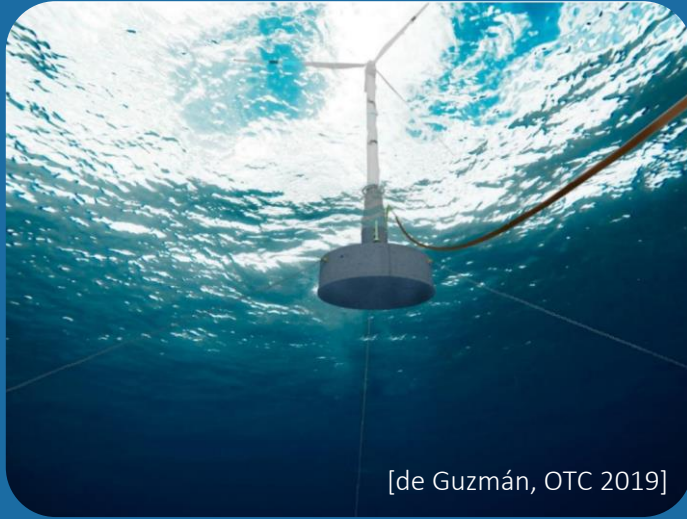
➤ Unified control and monitoring-oriented model

- Both, controller and load monitoring system benefits from one single real-time model



Credits: V. Joncheray, IDEOL, ECN, BYTP

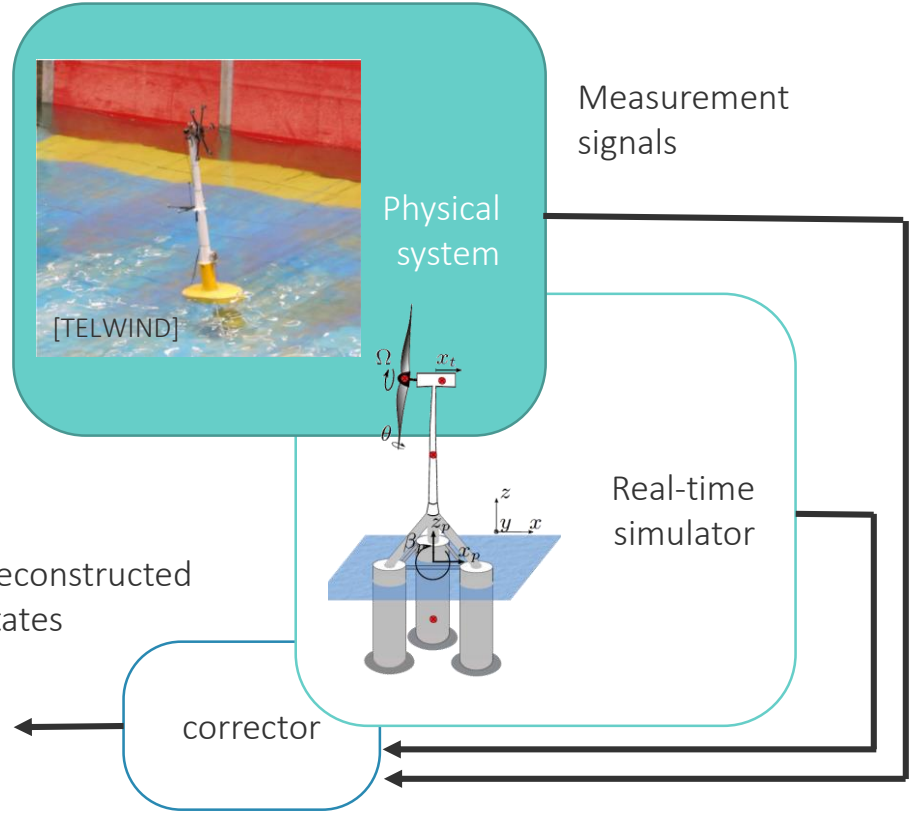
Project CROWN & Monitoring Methodology



- Partners: Seaplace, University of Stuttgart, sowento, (+IH Cantabria)
- Objectives: Testing of Reduced-Draft Spar concept with advanced controller & monitoring

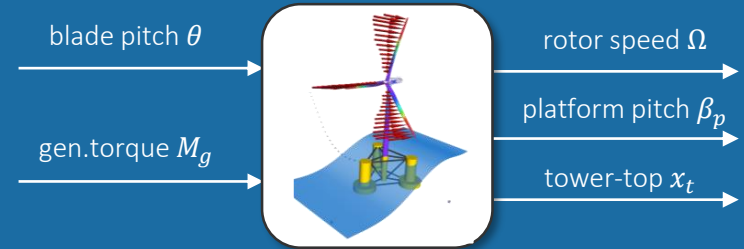
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➤ Methodology:

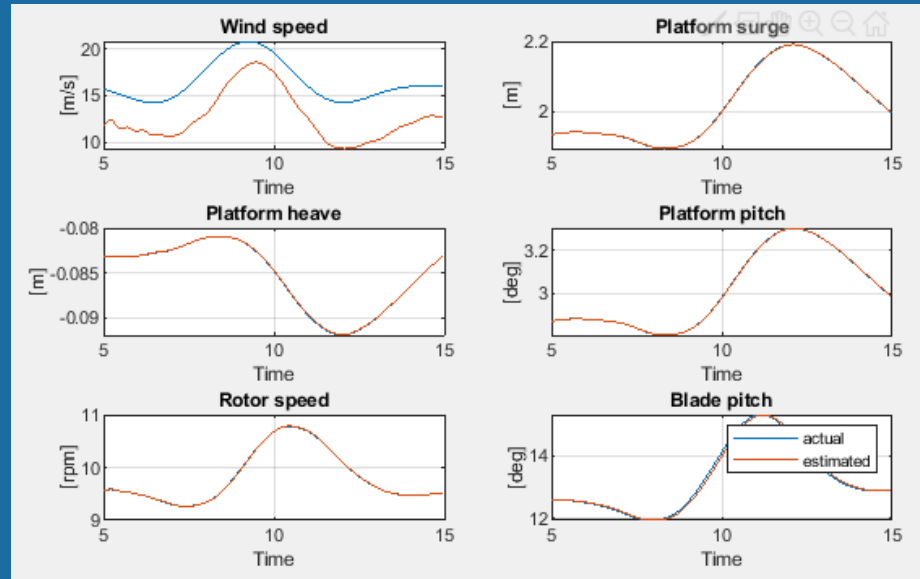


Results

- Luenberger-Observer aligns sensor and simulation data
- Advanced multivariable LQR state feedback controller uses observed states for load reduction



	Controls/States/ Disturbances	Measured	Estimated
Controls	Dem. generator torque	x	
	Dem. blade pitch	x	
States	Surge, Heave, Pitch	x	x
	Azimuth	x	x
	Blade pitch	x	x
	Surge, Heave, Pitch rate		x
	Rotor speed	x	x
	Blade pitch rate	x	x
Disturbances	Rotor-eff. wind speed		x



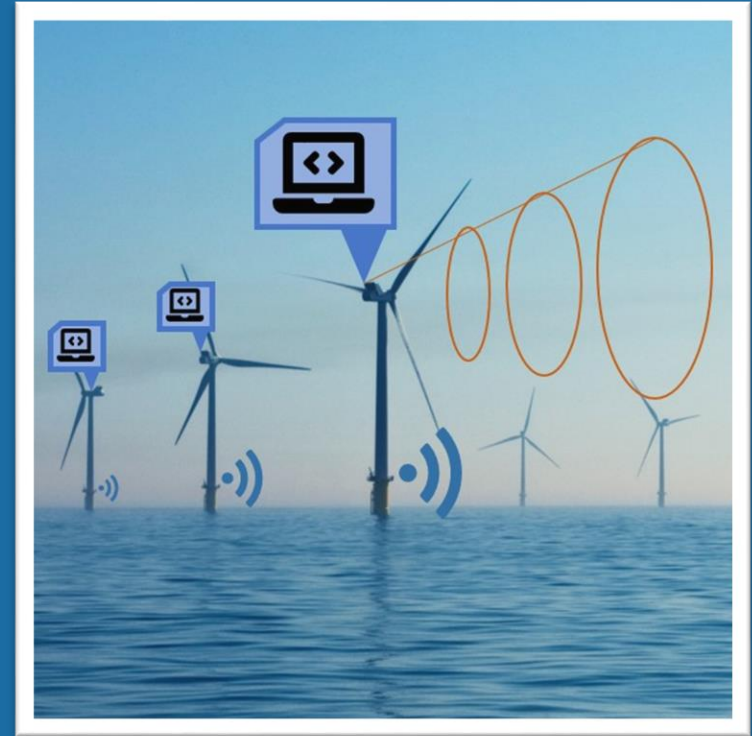
Conlusions & Outlook

➤ Unified control and monitoring-oriented model

- Both, controller and load monitoring system benefits from one single real-time model

➤ Next steps:

1. Verification within simulation environment with mapping of sensors vs. load estimate and uncertainty
2. Integration of Lidar estimated rotor effective wind speed into monitoring and control
3. Full-scale testing and demonstration
4. Deployable software and hardware solution



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Let's talk...



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