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Poster n°4

CEFIR Project: Control of Floating Wind Turbines and Grid Integration

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Context

More consistent winds → Higher energy efficiency

Less noise pollution compared to land-based parks

Depth > 50 meters require floating wind turbines

Issues

Floater movements tower oscillations, structural fatigue and increased wear

Hydrodynamic forces caused by waves periodic excitations, and vibration amplification

Aerodynamic forces, load variations on the blades and the tower

Impact on electricity generation optimization to maintain energy efficiency

Chalenges

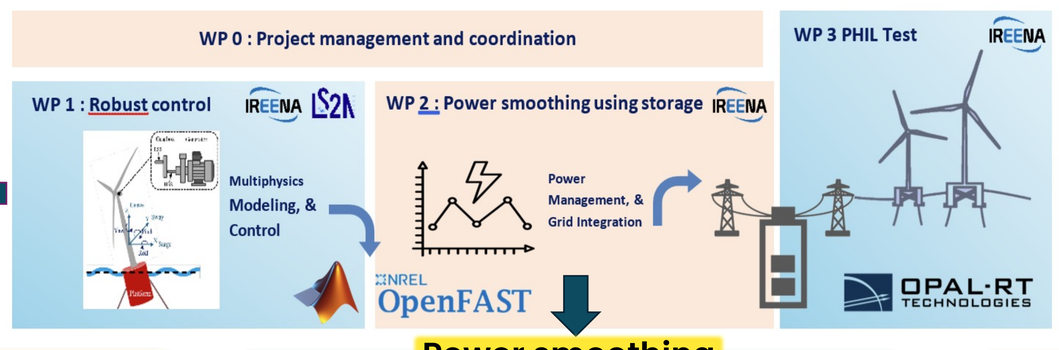
Underactuated, multivariable, and nonlinear systems

Coupled aerodynamic-hydrodynamic dynamics

Complexity of FOWT Control

Negative damping creating potential instability

Fluctuating power output complicates grid compliance



Robust control

Adaptive Sliding Mode Controller
For robustness under untcertainties and disturbances

Event-Triggered Strategy
Only when necessary to minimize requests on the actuators

Lyapunov Formal Analysis
Formal proof of stability for continuous and discrete cases

Operation in regions 2 and 3
Control law operates smoothly in Regions 2 and 3.

Power smoothing

Quantification
Quantifying power fluctuations

Sizing and optimisation
Sizing storage systems and optimizing the architecture

Practical implementation
Developing the power conversion system using a PMSG

Control strategies
Propose control strategies to improve power quality and reduce power ripple

PHIL implementation

RT simulation
Real-time simulation of FOWT dynamics

Sizing and optimisation
Integration of the generator, converters, and storage

Platform validation
Validation using the OPAL-RT platform

System interactions
Assessment of system interactions

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