Control Co-Design of a Floating Offshore Wind Turbine

Juan López Muro* and Laurent Burlion

*juan.lopezmuro@rutgers.edu

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INTRODUCTION

- Floating offshore wind turbines (FOWT) are more complex than land-based wind turbines due to:
  - additional degrees of freedom provided by the floating platform,
  - exposure to diverse environmental perturbations, and
  - increased maintenance requirements.
- Nonetheless, wind energy production poses many technical challenges, and overcoming them necessitates advancements in engineering practices for system design.

METHODS

- When considering a **control co-design** (CCD) approach, as opposed to the sequential one, the interaction between subsystems is taken into account, and control concepts are applied in the design process, obtaining an optimal solution that may not be attainable by a sequential design.
- **Reduced-order models** of a FOWT are used through the controller synthesis, specifically capturing the dynamic behavior of the key structural components of the system.
- This approach utilizes a **mixed architecture of robust H∞ and reference governors** to design a controller that effectively rejects external air and water perturbations, manages actuator magnitude and rate saturations, and addresses limitations imposed on the generator speed tracking error and actuator power consumption.

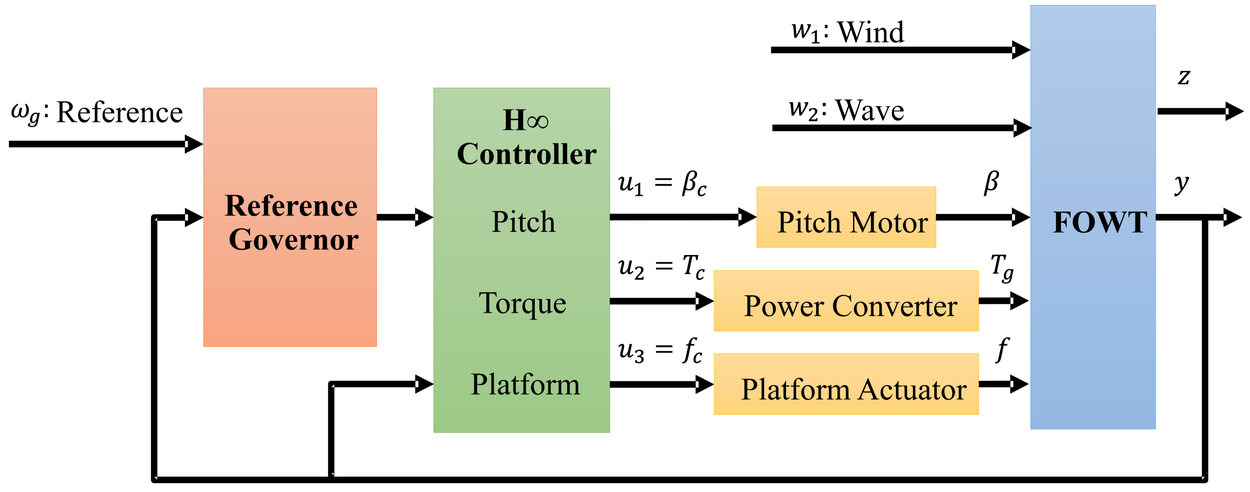
RESULTS AND CONCLUSIONS

- Primary findings indicate that active control of the floating platform effectively reduces the effect of hydrodynamic perturbations, mitigating structural loads.
- Additionally, power analysis suggests a minimal consumption of the generated power by the active control system.
- These have implications for the design of floating offshore wind turbines, improving performance and economic viability.

ACKNOWLEDGEMENTS

This research is supported and funded by the New Jersey Economic Development Authority (NJEDA) Wind Institute Fellowship Program.

CONTROLLER AND REFERENCE GOVERNOR DESIGNS



CSIMULATION RESULTS