

System-level Co-design and Control of Large Capacity Wave Energy Converters with Multiple PTOs

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The Consortium

- Queen Mary University of London:
 - Guang Li (Control)
- Exeter University
 - Mike Belmont (Wave prediction)
- University of Manchester
 - Judith Apsley (Test rig design and dry testing)
 - Matteo Iacchetti (Power electronics)
 - Samuel Draycott (Hydrodynamics)
- Industrial partners: M4 Wave Power, Mocean Energy, Eco Wave Power.

M4WavePower

Moored MultiMode Multibody



Outline of the project

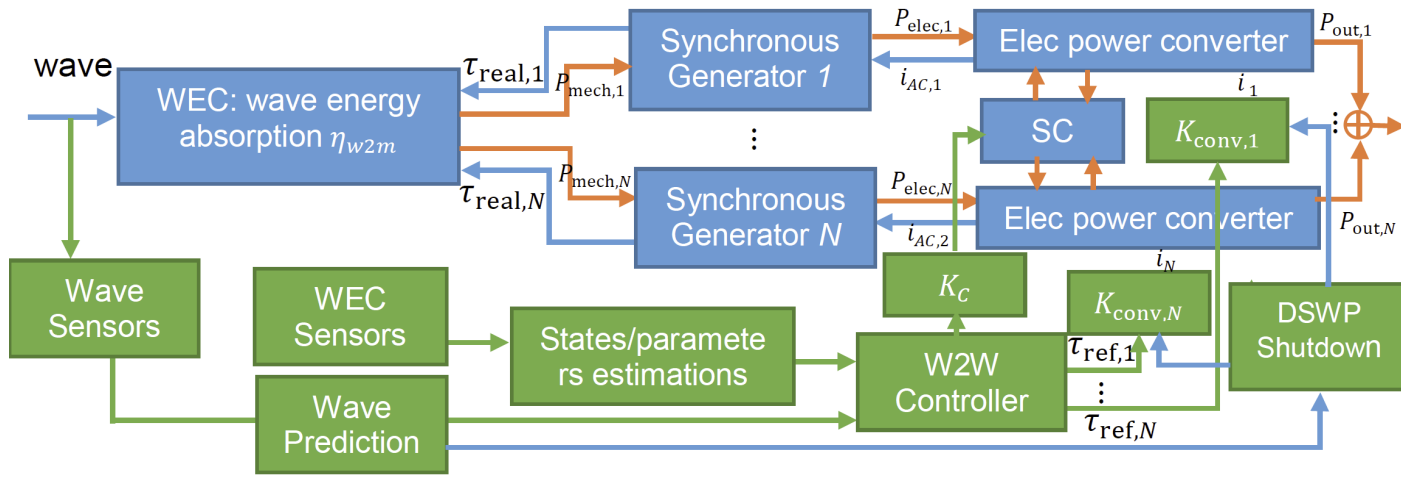


Fig. 2: Control system block diagram

- WP1: Modelling for all the subsystems: wave-to-wire model.
- WP2: Multi-directional wave prediction and shutdown.
- WP3: Control framework based on the wave-to-wire model.
- WP4: Co-design of the whole system.
- WP5: HIL for validation of control and co-design.

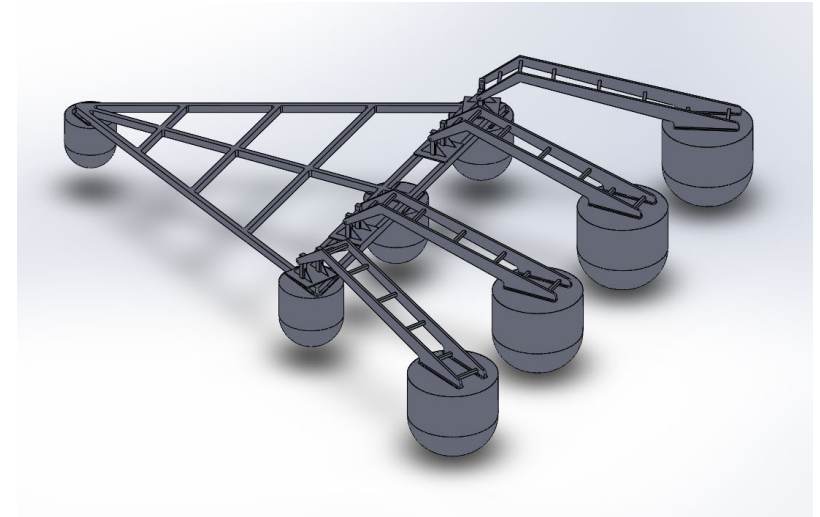


Fig. 1: M4 with 3 PTOs

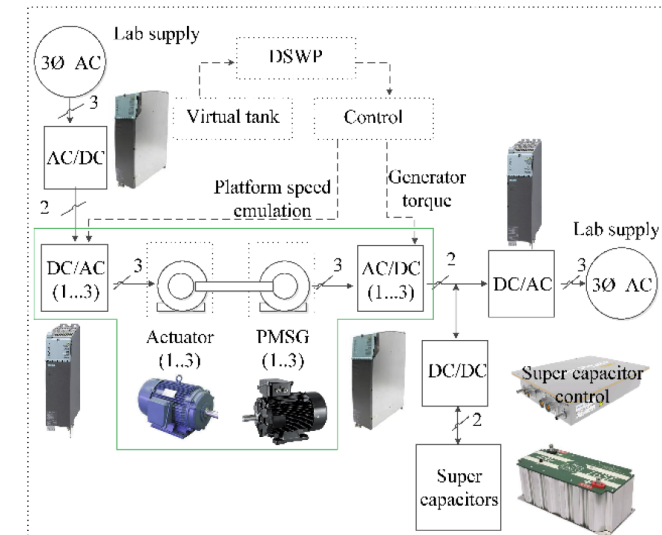
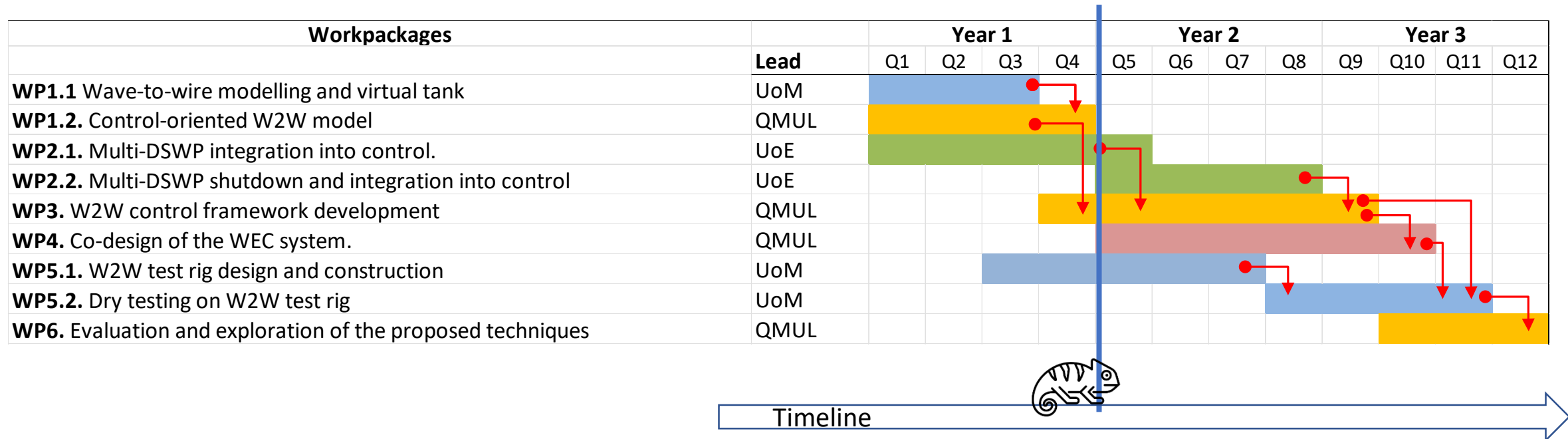


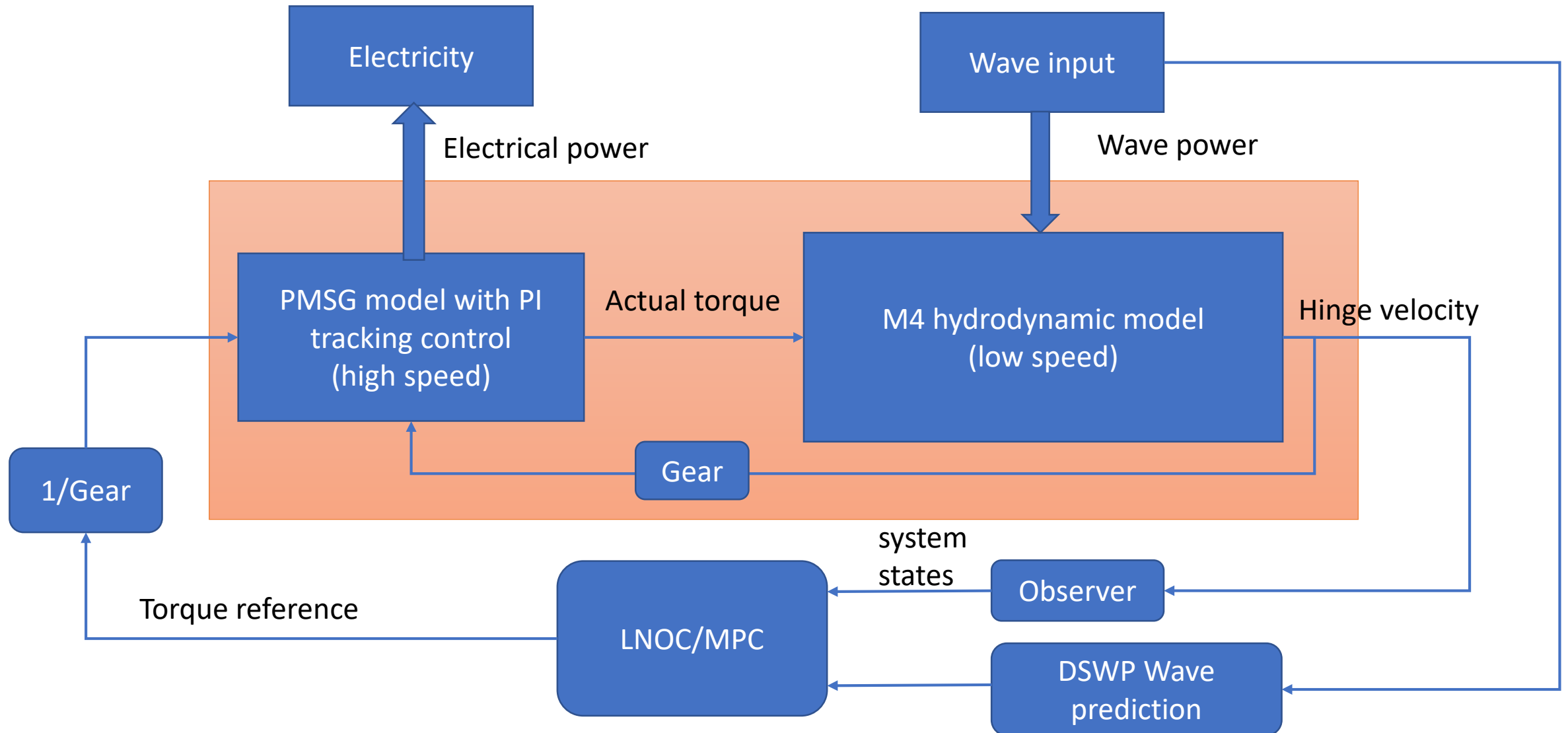
Fig. 3: HIL test rig for M4 control: Components: Gear box, generator, supercapacitor, electronic converters, microcontroller and numerical tank

Progress

- Modelling of all sub-systems (hydrodynamic, electrical) are finished.
- Control-oriented wave-to-wire model of the multi-PTO WEC is built and validated.
- Fast Wave Profile Estimation created for Multi-directional Deterministic Sea Wave Prediction (DSWP).
- The HIL test rig has been designed. (Poster presentation by Xiaotao)
- Two controllers (LNOC, MPC) have been designed for the W2W WEC system.
- **Our next steps: Set up HIL test rig and validate control performance experimentally.**



Two-layer control scheme



W2W LNOC Control Simulations

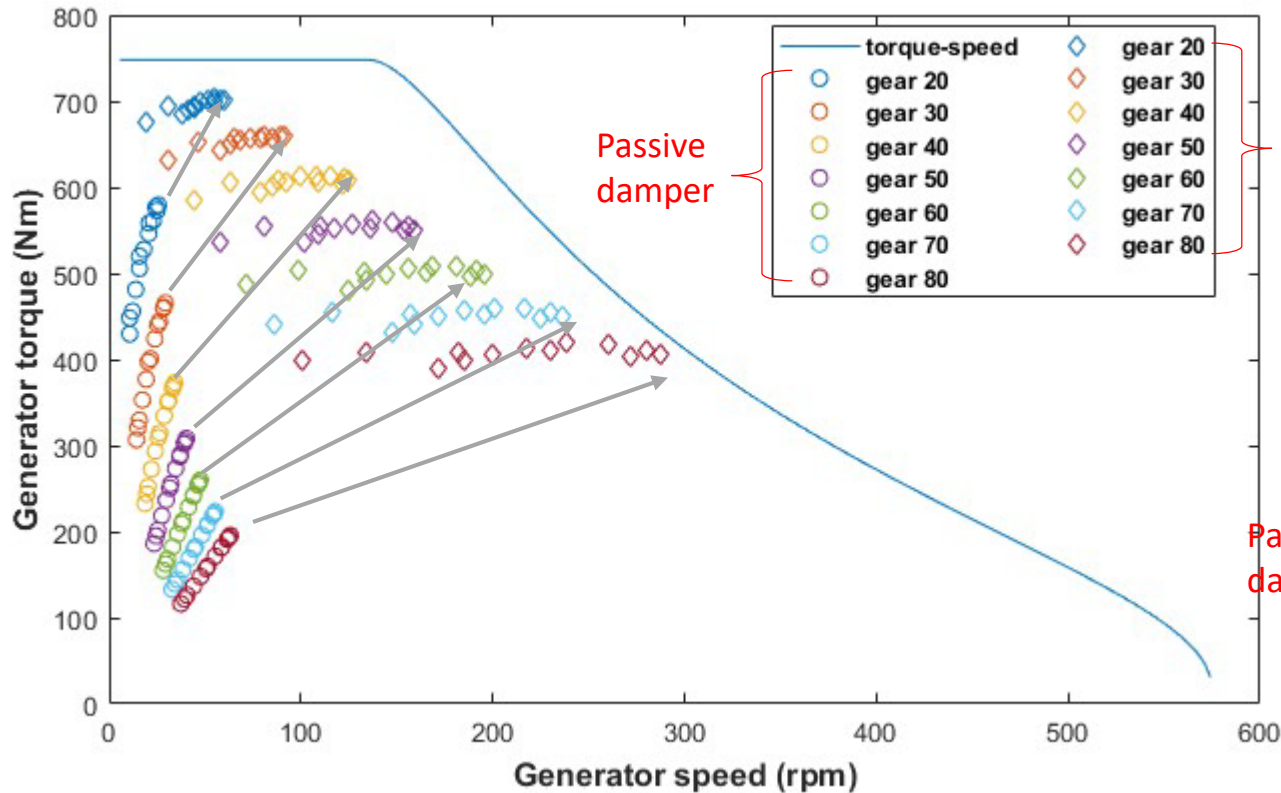


Fig. 4: Operating region of the PM generator. Circle marks for passive damper, diamond marks for LNOC control. RMS value.

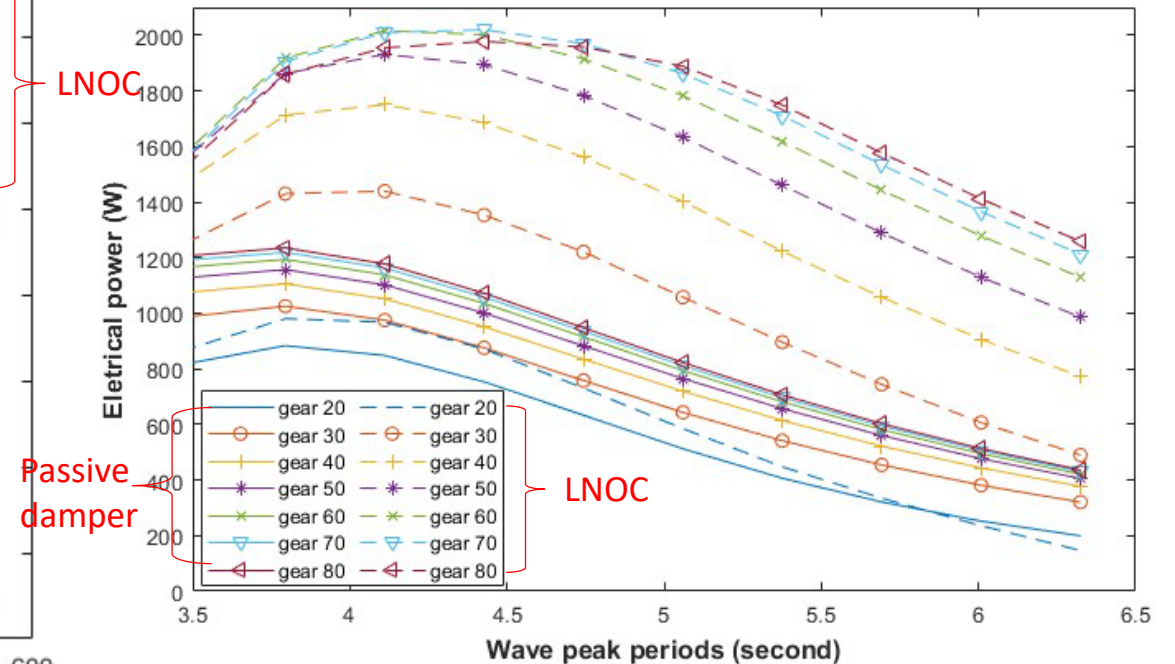


Fig. 5: Mean generated electrical power. Solid lines for passive damper, dashed lines for LNOC control.

Thank you!