AI-driven power train and prediction assisted control for TALOS wave energy grid integration

EPSRC funded PhD studentship with full fee waiver and £21,805 pa stipend (2026/27 rate)

Project Code: DLA_DTP_2026_23

Main Supervisor: Dr Yiheng Hu

Co-Supervisor: Professor Nigel Schofield

Project Introduction

This project develops an AI driven power train system to enable reliable grid integration of the TALOS Wave Energy Converter. Wave energy is highly variable, creating challenges for stable power delivery and power quality. The research combines advanced modelling, FFT based spectral prediction, and AI-driven control to anticipate short term wave power fluctuations and coordinate generator, converter, and storage subsystems. A prototype power train will be designed, optimised, and experimentally validated using laboratory and wave tank facilities. The project aims to increase the technical readiness of TALOS and advance the viability of marine renewable energy for future net-zero energy systems.

Project Details

The integration of renewable energy sources such as wave energy into the grid is essential for achieving a sustainable energy future. However, wave energy's variability and intermittency pose significant barriers to reliability and performance in grid-connected systems. This PhD project focuses on developing an advanced power train system and control framework to enable reliable grid integration of the Technologically Advanced Learning Ocean System (TALOS) wave energy converter (WEC). TALOS is a multi-axis, point-absorber device capable of harvesting energy from several degrees of freedom, but its output is inherently variable, making a stable grid connection challenging.

The project will design a complete power train to convert mechanical energy from the TALOS device into grid-compliant electricity. The system will include:

- A device-side subsystem incorporating a multi-phase generator and AC–DC converter.
- A DC-link subsystem integrating hybrid energy storage for power smoothing and stability.
- A grid-side subsystem with DC–AC conversion and compliant grid interface controls.

The objective is to convert fluctuating mechanical energy into predictable, controllable, and grid-compliant electrical power through integrated modelling, optimisation, short-term prediction, and AI-driven control.

Work packages (WPs) and Timeline:

WP1. System Modelling and Requirements Definition [M1–M6]: Develop detailed mathematical models of the TALOS mechanics, generator dynamics, power converters, and storage subsystems. These models will capture full wave-to-wire interactions and define grid-code and performance requirements.

WP2. Power Train Design and Optimisation [M7–M18]: Design and optimise the integrated power train architecture, considering efficiency, transient behaviour, component sizing, thermal limits, and grid compliance. System-level studies will be conducted using MATLAB/Simulink-based simulations.

WP3. Spectral Analysis and Short-Term Prediction [M19–M24]: Apply Fast Fourier Transform (FFT) analysis and variational Bayesian harmonic modelling to wave excitation, mechanical motion, generator torque, and electrical output. These methods will identify dominant frequency components, support short-horizon power prediction, and quantify uncertainty. Predictions will inform energy smoothing and storage scheduling.

WP4. AI-Driven Control [M25–M30]: Develop AI-driven control strategies coordinating generator-side and grid-side converters with storage. Reinforcement learning and model predictive control approaches will incorporate spectral predictions to balance energy capture, component stress, and power quality.

WP5. Validation [M31–M36]: Validate the system using laboratory hardware and wave tank experiments. A small-scale prototype will be tested using TALOS motion data or physical excitation to evaluate efficiency, stability, and prediction-assisted performance.

The project is scoped to produce a complete thesis within three years, delivering models, algorithms, optimisation results, and experimentally validated hardware demonstrations.

Project-specific entry requirements

- Candidates should have a relevant degree at First Class or Upper Second-Class Honours degree or equivalent in Electrical and Electronic Engineering or closely related disciplines.
- UK applicants only.
- A good background in electrical machines and power electronics is desirable.
- Excellent oral and written communication skills with the ability to prepare presentations, reports, and journal papers to the highest levels of quality.
- Excellent interpersonal skills to work effectively in a team consisting of PhD students and postdoctoral researchers.

Further Information

This call is open to **UK Applicants only**.

Applicants should be of outstanding quality and exceptionally motivated.

The studentships are funded for 3 years (subject to satisfactory annual performance and progression review) and will provide for tuition fees and a tax-free stipend paid monthly.

Please note that there are more projects than funded studentships available and therefore this is a competitive application process which will include an interview. Shortlisted candidates will be contacted for an interview in person or via Teams. After interview the most outstanding applicants will be offered a studentship.

Queries about the application process are welcome and should be emailed to pgrscholarships@hud.ac.uk.

Informal enquiries about this project should be directed to Dr Yiheng Hu.

Type of Award: Doctor of Philosophy (PhD).

Eligibility: UK applicants only. First Class or Upper Second-Class Honours degree or equivalent in a relevant subject area, please refer to the entry requirements on the specific projects being advertised.

Location: Huddersfield.

Funding: 3 years full time research covering tuition fees and a tax-free bursary (stipend) starting at £21,805 for 2026/27 and increasing in line with the EPSRC guidelines for the subsequent years. Funded via the Engineering and Physical Sciences Research Council Doctoral Training Programme.

Duration: 3 years full-time plus 12 months writing up (please note no funding available for writing up period).

Closing date: 28th April 2026

Start date: 1st October 2026

Application details

- Go to the EPSRC webpage and download the Expression of Interest Form 2026.
- Provide copies of transcripts & certificates of all relevant academic and professional qualifications.
- Provide references from two individuals – please contact your referees and ask them to send them directly to pgrscholarships@hud.ac.uk from their email address.
- Proof of eligibility – e.g. scan of passport photo page.
- Completed forms, including all relevant documents should be submitted via-email to pgrscholarships@hud.ac.uk.

Please note: if you do not attach all the relevant documentation prior to the closing date your application will not be considered.

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