
***School of Computing, Engineering, and the Built Environment***
**Edinburgh Napier University**

# PHD STUDENT PROJECT

**Application instructions:**
Detailed instructions are available at :
https://www.napier.ac.uk/research-and-innovation/doctoral-college/how-to-apply

*Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.*

## Project details

**Supervisory Team:**

- DIRECTOR OF STUDY: Dr Yuyang Zhou (Email: y.zhou@napier.ac.uk)
- 2ND SUPERVISOR: Dr Yanchao Yu

**Subject Group:** Engineering & Mathematics

**Research Areas:** Engineering control system

**Project Title:** Advanced Regulation for Energy Storage Technologies

**Project description:**

The energy storage industry is crucial for achieving environmental sustainability and supporting net-zero goals by enabling efficient renewable energy integration and reducing reliance on fossil fuels. However, stabilizing and enhancing the reliability of battery systems, particularly in sectors such as telecommunications, renewable energy, and large-scale storage, remains a significant challenge. This project aims to address these issues by developing theoretical frameworks that leverage stochastic methods and distributed approaches.

The research focuses on improving the stability, operational consistency, and lifespan of energy storage systems, especially lithium-ion and lead-carbon batteries. By addressing uncertainties and variabilities in real-world applications, the project seeks to produce robust theoretical solutions that ensure reliable performance under diverse conditions. These insights will lay the groundwork for designing advanced energy storage systems, supporting

the global transition to sustainable energy solutions and contributing to the realization of net-zero objectives.

## Candidate characteristics

**Education:**

A first degree (a minimum 2:1) in Control Systems Engineering, Electrical and Electronic Engineering

**Subject knowledge:**

Control Theory: Understanding the principles of feedback control, stability, and system dynamics, which are essential for designing robust control algorithms for energy storage systems.

Distributed Systems: Familiarity with distributed control systems, which are increasingly important in managing complex networks of energy storage devices, ensuring coordinated and efficient operation

Stochastic Processes: Knowledge of probability theory, stochastic modelling, and how randomness impacts system behaviour is crucial for implementing and optimizing control strategies in unpredictable environments.

Battery Technology and Energy Storage: A basic understanding of battery chemistry, energy storage technologies, and the operational challenges associated with these systems will be beneficial for applying control strategies effectively

**Essential attributes:**

- Strong Analytical Skills: The ability to analyze complex systems, develop innovative control strategies, and critically assess the performance of these strategies in various scenarios
- Technical Proficiency: Expertise in programming and simulation tools (e.g., MATLAB, Python) to develop and test control algorithms. Familiarity with simulation environments used in control system design is essential
- Fundamental Knowledge in Control Systems: A solid grounding in control theory, including feedback mechanisms, stability analysis, and system dynamics, which are crucial for developing advanced control solutions for energy storage systems
- Understanding of Stochastic Processes: Knowledge of how stochastic processes influence system behaviour and the ability to incorporate these factors into control strategies for real-world applications

**Desirable attributes:**

- Problem-Solving Ability: The capability to tackle complex, unpredictable challenges, especially in the context of dynamic and distributed energy storage systems
- Adaptability and Innovation: Willingness to explore new ideas and approaches, and the ability to adapt to evolving research challenges and technologies
- Effective Communication Skills: The ability to clearly articulate complex concepts and collaborate with team members, industry partners, and the broader research community

- Self-Motivation and Initiative: A strong drive to work independently, manage time effectively, and take ownership of research projects
- Teamwork and Collaboration: Ability to work collaboratively within a multidisciplinary team, contributing to collective goals and leveraging the expertise of others