



## **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](mailto:y.zhou@napier.ac.uk))
- 2<sup>ND</sup> SUPERVISOR: Dr Yanchao Yu

**Subject Group:** Engineering & Mathematics

**Research Areas:** Engineering control system

**Project Title:** Advanced Control Systems for Energy Storage Technologies

#### **Project description:**

The rapid expansion of the energy storage industry presents unique challenges, particularly in optimizing the performance and longevity of battery systems used in sectors such as telecommunications, renewable energy, and large-scale energy storage. This project aims to address these challenges by developing and implementing cutting-edge control strategies that leverage stochastic control, distributed control, and Kalman filtering techniques.

The research will focus on improving the operational efficiency and reliability of energy storage systems, particularly lithium-ion and lead-carbon batteries. The goal is to design robust control algorithms that can manage uncertainties and variabilities inherent in real-world applications, ensuring optimal performance under diverse operating conditions. This project will explore the integration of these control methods into the design of advanced energy storage systems, paving the way for innovations that could significantly enhance the competitiveness of these technologies in the global market.

The PhD candidate will be responsible for developing theoretical models, conducting simulations, and validating the developed control strategies through experimental setups. The project is highly collaborative, providing opportunities to work with leading experts in the field and contribute to advancements that have both academic and industrial relevance.

## **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