



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

### **PHD STUDENT PROJECT**

#### **Funding and application details**

**Funding status:** Self-funded students only

**Application instructions:**

Detailed instructions are available at <https://www.napier.ac.uk/research-and-innovation/research-degrees/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: Jubaer Ahmed (Email: [J.Ahmed@napier.ac.uk](mailto:J.Ahmed@napier.ac.uk))
- 2<sup>ND</sup> SUPERVISOR: Fadi Kahwash

**Subject Group:** Cyber-security and system engineering

**Research Areas:** Energy Technologies, Electrical Engineering, Electronic Engineering

**Project Title:** Developing a coordinated control for hybrid ac/dc microgrids with renewable sources-battery storage under dynamic generation and load conditions

**Project description:**

Due to the ongoing high penetration of renewable energy sources into the grid, the energy landscape is going through a major transformation. Since many small-scale renewable energy sources are built near the load points, the requirement of decentralized microgrid control is inevitable. To facilitate that several studies are reported in the literature in recent years. In [1], a wind/hydrogen/supercapacitor hybrid power system was proposed to coordinate different sources to make the power injected into the grid controllable. However, the dynamic load changes were not considered. In several works, [2-4] hybrid ac/dc microgrid that can operate in

grid-tied or islanded modes were proposed. Although the presented control mechanisms are efficient, fluctuating natures of renewable sources were ignored for the simplicity of the designed algorithm. Recently, some research efforts have been made to develop more advanced energy management strategies. For example, energy management and control systems are developed for AC/DC hybrid microgrids [5-6]. Despite their effectiveness, more optimized control mechanisms can be developed using metaheuristic algorithms. Designing coordinated controls for the microgrid is still an open problem due to numerous operating variables are being involved. Thus, there are many opportunities to do innovative research and develop control mechanisms depending on different scenarios and operating conditions.

#### **References:**

- [1] Mi Y, Chen X, Ji H, Ji L, Fu Y, Wang C, Wang J. The coordinated control strategy for isolated DC microgrid based on adaptive storage adjustment without communication. *Applied Energy*. 2019 Oct 15;252:113465.
- [2] Zhou H, Bhattacharya T, Tran D, Siew TST, Khambadkone AM. Composite energy storage system involving battery and ultracapacitor with dynamic energy management in microgrid applications. *IEEE Trans Power Electron* 2017;26(3):923–30.
- [3] Xia Y, Peng Y, Yang P, Yu M, Wei W. Distributed coordination control for multiple bidirectional power converters in a hybrid ac/dc microgrid. *IEEE Trans Power Electron* 2017;32(6):4949–59.
- [4] Zhou X, Zhou L, Chen Y, Guerrero JM, Luo A, Xu W, et al. A microgrid cluster structure and its autonomous coordination control strategy. *Int J Electr Power Energy Syst* 2018;100:69–80.
- [5] Li P, Guo T, Zhou F, Yang J, Liu Y. Nonlinear coordinated control of parallel bidirectional power converters in an AC/DC hybrid microgrid. *Int J Electr Power Energy Syst*. 2020 Nov 1;122:106208.
- [6] Wen S, Wang S, Liu G, Liu R. Energy management and coordinated control strategy of PV/HESS AC microgrid during islanded operation. *IEEE Access*. 2018 Dec 17;7:4432-41.

## **Candidate characteristics**

#### **Education:**

A second class honour degree or equivalent qualification in Electrical and Electronic Engineering

#### **Subject knowledge:**

- Control Engineering;
- Renewable Energy

#### **Essential attributes:**

- Modelling in Simulink;
- Matlab Coding;
- Control System Design

#### **Desirable attributes:**

- Prior experience in PV system Design; Grid-connected energy storage System design

