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 Keng Goh

Subject Group: Engineering & Mathematics

Research Areas: Engineering control system

Project Title: Stochastic randomized stabilization on bicycle balance

Project description:

Bicycles are commonly used for transportation, exercise, and recreation, contributing significantly to urban mobility. Cycling offers individuals a healthy, cost-effective means of travel and, in urban areas, can sometimes be faster than other modes of transport by allowing users to avoid traffic congestion. For society, the benefits of cycling include promoting environmental sustainability, requiring less expensive infrastructure, and improving public health outcomes.

Despite these advantages, there are challenges associated with bicycles available on the market, particularly for older adults and individuals with limited mobility. These challenges include:

1. The inherent instability of bicycles when stationary or at low speeds.
2. The impact of external disturbances, which make maintaining balance and stability more difficult.

This project focuses on designing and testing an adaptive algorithm to address these challenges. The algorithm will be developed theoretically before being tested on a physical bicycle in the laboratory. The aim is to enhance balance and stability under a range of real-world conditions by using probabilistic design methods. Sensors will be used to gather relevant data, and an actuator will be employed to apply corrective forces.

References:

[1] Herzallah R, Zhou Y. A tracking error–based fully probabilistic control for stochastic discrete-time systems with multiplicative noise[J]. Journal of Vibration and Control, 2020, 26(23-24): 2329-2339.

Candidate characteristics

Education:

A first-class honours degree, or a distinction at master level, or equivalent achievements in Electrical Electronic Engineering, Mechanical Engineering, or control automation

Subject knowledge:

- With a good fundamental knowledge of basic mechanical/electrical engineering and mathematics, control theory, and probability theory

Essential attributes:

- Experience in fundamental of Electrical Electronics, microcontrollers, and ensor implementations
- Competent in BEng, MSC, MEng
- Knowledge of control theory, basic Engineering mathematics
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

- probability theory,
- mathematical modelling,
- advanced control methods,
- c programming
- matlab programing