



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 control on bicycle balance

Project description:

Bicycles are widely used for transportation, exercise, and recreation and play an important role in urban mobility. Individuals benefit from the fact that cycling is a healthy and cheap form of transport. Moreover, in urban areas, cycling can sometimes prove to be faster than other transport modes and also allows cyclists to avoid traffic jams. For society, the advantages of cycling include environmental sustainability, cheap infrastructure requirements, and improvements in public health. However, there are some challenges for the existing bicycles in the market including:

1. Bicycle is statically unstable, especially for old and less flexible people.
2. Bicycles commonly are subjected to various sources of disturbances, making bicycle control more challenging.

This project is to develop a randomized control algorithm to address the aforementioned issues. The randomized controller will be designed firstly in theory and then implemented on a real bicycle to test. This control method will be based on a fully probabilistic design where the control goal is to keep the bicycle stay

balanced while subjecting various sources of randomness. Then, the developed controller will be implemented on a bike provided in the lab, while different sensors will be used to collect the signals and a motor to provide the torque. This project is suitable for people who have basic control theory knowledge and electrical electronic knowledge. The applicants should have good experimental skills, mathematical skills and programming skills. The c programming skill is desirable but not essential.

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 sensor 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 programming