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/machine learning

Project Title: UAV Obstacle Avoidance Using Learning Algorithm and Stochastic Regulation

Project description:

The field of UAV navigation poses significant challenges in managing dynamic and unpredictable environments. Traditional methods often struggle to address these complexities due to their reliance on static models and predefined paths. This project focuses primarily on theoretical research, aiming to develop robust solutions for the stabilization of UAV systems operating under uncertain and variable conditions.

By integrating Learning method with advanced stochastic techniques, the research seeks to address fundamental issues in stabilizing UAV systems amidst moving obstacles and environmental uncertainties. The primary goal is to produce theoretical solutions that ensure system reliability and safety across diverse scenarios.

Although the emphasis is on theory, the project aims to provide foundational insights that can inform practical applications in areas such as disaster response, agriculture, and urban logistics. This approach ensures that the solutions developed are not only rigorous but also have the potential to address key challenges in UAV system stability.

Candidate characteristics

Education:

A first degree (a minimum 2:1) in Control Systems Engineering, Electrical and Electronic Engineering, Computer Science, Mathematics (with a focus on stochastic processes or optimization)

Subject knowledge:

Control Theory: Understanding of feedback systems, stability analysis, and control design is crucial for developing UAV navigation algorithms.

Machine Learning: Familiarity with supervised, unsupervised, and reinforcement learning methods, particularly as they apply to dynamic environments and real-time decision-making.

Programming: Proficiency in programming languages commonly used in control systems and machine learning, such as Python, MATLAB, or C++, is necessary for implementing and testing algorithms.

Robotics and Automation: Basic principles of robotics, including kinematics, dynamics, and path planning, are important for understanding UAV motion and control.

Essential attributes:

- Strong Analytical Skills: The ability to analyse complex problems, develop innovative solutions, and critically assess the performance of algorithms is essential for this research.
- Proficiency in Programming: Strong coding skills in languages such as Python, MATLAB, or C++, which are commonly used for developing and testing control algorithms and machine learning models.
- Foundational Knowledge in Control Systems: A solid understanding of control theory, including feedback mechanisms, stability, and system dynamics, is crucial for the development of UAV navigation strategies.
- Understanding of Machine Learning: Familiarity with various machine learning techniques, particularly reinforcement learning, and their application to dynamic and uncertain environments.

Desirable attributes:

- Knowledge of Stochastic Processes: An understanding of stochastic modelling, probability theory, and how to manage uncertainties in control systems
- Problem-Solving Ability: The capability to tackle complex and unpredictable challenges, particularly in the context of autonomous systems and dynamic environments
- Attention to Detail: Precision in designing and implementing algorithms, as well as in analyzing experimental data.
- Good Communication Skills: The ability to articulate complex concepts clearly, both in writing and verbally, is important for collaborating with team members and presenting research findings
- Self-Motivation and Initiative: The drive to work independently, manage time effectively, and take ownership of the research project
- Collaboration and Teamwork: The ability to work well within a multidisciplinary team, as collaboration with other researchers and industry partners is a key aspect