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

PHD STUDENT PROJECT

Funding and application details

Funding status: Fully funded project (worldwide)

Application instructions:
Detailed instructions are available at https://blogs.napier.ac.uk/scebe-research/available-phd-student-projects/

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: Brian Davison (Email: B.Davison@napier.ac.uk)
- 2ND SUPERVISOR: Luigi La Spada

Subject Group: Computer science

Research Areas: Artificial Intelligence, Software Engineering, Control Systems, Robotics, Systems Engineering

Project Title: Locomotion and navigation strategies for quadrupedal robots

Project description:

Robotic systems can be used in remote or hazardous environments to perform tasks that would be harmful for human beings. Several modes of locomotion are available, but the majority of surface-based robots use either wheels or legs. Wheeled robots have the advantage of simplicity; however, wheels work best on flat surfaces that are free of obstacles. Legged robots have the advantage that they can maintain stability on unstructured terrain, but they come with a host of control challenges related to balance (Agrawal et al., 2017) and gait (Xu et al., 2022). In addition, robots need to be capable of navigating their immediate environment

autonomously, processing sensor data to generate a model of their surroundings and then using that information to control signals for the hardware.

The aim of this project is to build on existing work on the control of legged robots with a particular focus on locomotion and navigation. It will begin by exploring the state of the art of quadrupedal robotic locomotion and autonomous navigation by means of a thorough literature review. This will be followed by an iterative practical phase in which designs will be tested in simulation and on physical devices. Biologically-inspired designs will be preferred. Inspiration can be taken from existing work in the field such as SpaceBok, developed at ETH Zurich for space exploration applications (Arm et al., 2019).

References:

[1] Agrawal, A., Jadhav, A., Pareekutty, N., Mogili, S., Shah, S.V. (2017) Terrain adaptive posture correction in quadruped for locomotion on unstructured terrain. In: Proceedings of the Advances in Robotics on - AIR ’17, New Delhi, India, pp. 1–6, doi: 10.1145/3132446.3134910.

[2] R. W. Xu, K. Chin Hsieh, U. H. Chan, H. Un Cheang, W. K. Shi and C. Tin Hon (2022) Analytical Review on Developing Progress of the Quadruped Robot Industry and Gaits Research. 2022 8th International Conference on Automation, Robotics and Applications (ICARA), Prague, Czech Republic, pp. 1-8, doi: 10.1109/ICARA55094.2022.9738583.

[3] Arm, P. et al. (2019) SpaceBok: A Dynamic Legged Robot for Space Exploration. 2019 International Conference on Robotics and Automation (ICRA), Montreal, QC, Canada, pp. 6288-6294, doi: 10.1109/ICRA.2019.8794136.

Candidate characteristics

Education:

A first-class honours degree, or a distinction at master level, or equivalent achievements in Computer science, Mechanical engineering

Subject knowledge:

- Mechanical engineering
- Computer science

Essential attributes:

- Experience working with cyber-physical systems
- Competent in software project management and Linux systems
- Excellent problem-solving skills
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

- Experience with techniques for robot control and navigation