Robot Swarms for Environmental Monitoring: Investigating Functional Heterogeneity

Type of award	PhD Research Studentship
Department	Engineering Mathematics, Collective Dynamics Research Group
Scholarship Details	Minimum £18,000 p.a. subject to confirmation of award.
Duration	3.5 years
Eligibility	Home (UK)
Start Date	Available now

PhD Topic Background/Description

Autonomous robot teams or 'swarms' have great potential to enhance monitoring of different environments, by providing a mobile sensor network that can cover a complex, dynamic area. This PhD project will help to develop important principles for the deployment of robot swarms in the field, with a focus on security applications. These principles will be validated through meaningful experimental data collected in robot field trials.

The classic starting point for robot swarm research is to assume agents are identical in their characteristics, for example in the 'behavioural rules' they follow in reacting to the environment and each other. However, in biology it is increasing recognised that diversity (heterogeneity) among group members can be functional (useful) for the whole group. Such heterogeneity includes variation in behaviour, robot form (e.g. rover, quadruped) and sensory capabilities. Such variation can confer important benefits, such as enhanced awareness of the environment, better response to risk, or more accurate collective decision-making.

This studentship will investigate heterogeneity in robot characteristics – starting with behaviour – to assess its effect on performance in relation to detecting anomalies that may be a security concern. The student will develop realistic simulations of ROS-based rover robots in the Gazebo simulator and carry out real robot trials at a University of Bristol field site. Experimental work (simulated and real) will be complemented by development of a conceptual framework to measure and predict the positive (or negative) impact of swarm heterogeneity.

The project is supported by FCDO Services, part of the Foreign, Commonwealth & Development Office (FCDO) of the UK. FCDO Services supports UK diplomacy, defence and development for the UK government and other global partners. It has a vital mission to protect its customers' physical assets, data, and people in secure government facilities.

Further Particulars

Candidate Requirements

Applicants must hold/achieve a minimum of a Master's degree (or international equivalent) in robotics, computer science, engineering (e.g. mechanical, electronic), physics, mathematics or other relevant discipline. Applicants without a Master's qualification may be considered on an exceptional basis, provided they hold a first-class undergraduate degree. Please note, acceptance will also depend on evidence of readiness to pursue a research degree.

Basic skills and knowledge required:

- **Essential:**
  Excellent analytical skills and some experience with coding (C++/Python preferred).
  Excellent teamwork skills and a proactive attitude.
- **Desirable:**
  Prior experience with robotics, including ROS and simulation in Gazebo.

There will be travel to a field site to carry out robotics trials, therefore a UK driver's license to use a university/hire vehicle would be beneficial. Travel expenses will be covered.

Scholarship Details

Enhanced tax-free stipend of £18,000 p.a. and the scholarship will also cover tuition fees. An additional £1,500 p.a. research and training funding is available to cover the costs of conference visits and travel. There is an equipment budget to cover the cost of buying and developing robots, sensors and other computing hardware.

Informal enquiries

For questions about the **research** topic please contact Dr Edmund Hunt at edmund.hunt@bristol.ac.uk

For questions about **eligibility and the application** process please contact SCEEM Postgraduate Research Admissions sceem-pgr-admissions@bristol.ac.uk

Application Details

Prior to submitting your application, please contact Dr Hunt with your CV attached for an informal discussion. There will be a shortlisting of the best applications before an interview with Dr Hunt and the industrial partner (FCDO Services).

By applying to this PhD, the applicant is agreeing to undertake UK security vetting if it becomes necessary during the PhD. Applicants are asked to declare any reasons why they might not be eligible to work in this area. https://www.gov.uk/guidance/united-kingdom-security-vetting-applicant

To apply for this studentship, submit a PhD application using our online application system [www.bristol.ac.uk/pg-howtoapply]

Please ensure that in the Funding section you tick "I would like to be considered for a funding award from the **Engineering Mathematics** Department" and specify the title of the scholarship in the "other" box below along with the name of the supervisor.

Interested candidates should apply as soon as possible.