Position: **Doctoral Candidate #11 (DC 11)**
Project: **Information theoretic based collaborative environment sensing for agriculture applications**
Host Institution: Loughborough University - UK
PhD programme: Automotive Engineering

Research project description

The project aims to develop a novel online learning and planning framework to coordinate heterogeneous sensing platforms for more effective information gathering in agriculture settings. More specifically, the Doctoral Candidate (DC) will design and verify adaptive environment sampling strategies to enable collaborative sensing of key agri-environmental attributes (e.g., crop stress and soil properties) by using both aerial platforms and ground robotics. The remote sensing data from aerial platforms will be used to generate a prior probabilistic spatial map of the concerned crop property, which will be used to inform the path planning process of the ground robots to collect more informative in-situ measurements. The travel budget, in-situ sampling time and relative spatial distribution of robotic platforms will be combined with information gains to evaluate the utility of the candidate paths. Based on the utility design, the sampling-based path generation with Monte Carlo tree search techniques will be developed to solve the non-myopic planning and coordination problem. It is envisaged that the methodologies and tools developed in this project will generate a highly accurate map of crop status and environment factors to support the decision-making process for farming.

Objectives:

1. To enable collaborative sensing and sampling for agriculture applications by combining the remote sensing capability from UAV and the under canopy and soil level sensing capability from the ground robot.
2. To calibrate and interpret remote sensing results based on the high accuracy sensing data collected by ground vehicle.
3. To generate a near real-time and accurate map of crop status and environment factors to inform the decision-making for end-users.

Expected Results:

- Information path planning solution to generate informative sampling locations/paths for both the aerial vehicles and ground robots
- Information fusion solution to update and calibrate the remote sensing prior map based on point measurements with higher accuracy using Bayesian learning
- Determine the criteria to evaluate the proposed architecture both for single-robot and multi-robot applications.
- Integrate the approach in different robotic platforms endowed with multimodal sensing and validate the developments.
- Disseminate the results in world-class international conferences and journals.

Keywords: *informative path planning; robotic perception; machine learning; multi-robot coordination.*

Secondments

The secondments planned for this research project are at:

- Universidad de Extremadura (in Spain)
- Gamma Solutions, S.L. (in Spain)

Desirable skills, qualifications and specific requirements

- Your application should respect the **AIGreenBots** general requirements and eligibility criteria as described in https://aigreenbots.eu/recruitment/general-info.

- You should have <u>preferably</u> a valid MEng/MSc degree, or equivalent, in robotics, electrical engineering, computer science, mathematics, physics, or related fields.
- Python/Matlab programming skills
- Some experience on robotics, machine learning, AI, coding. Motivation, sense of responsibility, autonomy and problem-solving skills are highly desirable.
- Some experience on academic publications, e.g., conference or journal papers

Benefits

- Very attractive salary - living allowance (gross): £48,621/year
- Excellent conditions including - social security tax, food allowance, PhD tuition fee, mobility allowance, family allowance (if eligible)
- Mobility allowance (if applicable): £522/month
- Family allowance (if applicable): £430/month
- Research, training and networking costs covered: Registration and attendance at international conferences.

How to apply

You should submit your application through this channel: https://aigreenbots.eu/recruitment/apply-now

Deadline: 02 of March 2025, 23:59.

Additional information

Supervisors of this PhD project: Prof. Cunjia Liu, Dr Matthew Coombes, Prof. Wen-Hua Chen

Host institution and living conditions: Loughborough University (LU), is a top 10 university in the UK in each of the most recent UK national league tables. LU has a diverse campus and versatile research environment with a community of more than 17,800 students from over 130 different countries/regions. The University has extensive experience and high-quality administrative support for overseas researchers to help them transition their work and life smoothly.

The Loughborough University Centre for Autonomous Systems (LUCAS) in the Department of Aeronautical and Automotive Engineering, where the DC researcher will be based, is one of few which bring together the excitement and challenge of multidisciplinary aspects of autonomous system research with 15 years' experience and over £12m research projects. Housed in purpose-built facilities that include an autonomous systems laboratory, workshops, wind tunnels, and access to an outdoor flight test area, the research group has conducted high-profile research programmes ranging from fundamental research on autonomous situation awareness to cross-nation Agri-tech projects.