Robust Detection of Small Airborne Targets for Secure Society

Description

This project is funded by the Department of Transport on Future of Aviation Security Solutions (FASS) programme, and supported by the Rutherford Appleton Laboratory and Aveillant Limited. The overarching aim of this PhD programme is to develop a suite of next generation-ready, artificial intelligence (AI)-inspired signal processing algorithms for surveillance of small drones using staring radars and handle the vast volumes of data generated by such sensors. A particular focus will be given to achieve performance levels surpassing what is currently achievable.

Drones are becoming an integral part of today's society, from entertainment to aiding with disaster recovery. However, when these small drones, intentionally or unintentionally, share a part of the airspace used by civilian and military aircrafts, it can be catastrophic both to national security and to public safety. For instance, the incident in 2018 near Gatwick airport caused a significant financial damage, resulting in thousands of flights being cancelled.

The technological challenge here are many-fold: early detection of drones, differentiating them from other similar-looking targets, such as birds, and thereby enabling the authorities to take appropriate action within short period of time. On this note, University of Birmingham is leading a ground-breaking research on three-dimensional staring radar for surveillance of small airborne targets and have purchased two Aveillant Gamekeeper radars to provide a dedicated test-bed for a number of research programmes that leverages this technology. Unlike a conventional rotating radar, the staring radar provides unprecedented visibility of all targets with much better temporal coverage. Although the staring radar technology provides several advantages, the key challenge is that the increased sensitivity in detection comes with the need for identifying relevant targets among a huge volume of data. Although ad-hoc approaches, such as enhancing existing tracking algorithms or even using AI on top of available technologies, can address this problem for now, those approaches are of short-term in nature, and will not scale with the data volume or with the technology. Hence, developing unified approaches that are theoretically sound and robust, is rather crucial for ensuring that the UK remains at the forefront of aviation security.

This PhD project will be aimed at building the necessary mathematical and computational framework for intelligently detecting, tracking and discriminating small drone-like targets against others. The objectives of the PhD programme are to:

- Investigate AI-driven solutions for the detection of faint targets in complex data space;
- Develop AI-driven models for generating synthetic data, that can complement the real data, so as to address complex scenarios;
- Develop an integrated algorithm that would leverage both real and synthetic data for improving the detection and differentiation of drones;

- Develop AI-inspired algorithms for managing fragmented tracks (such as track stitching), to handle untimely track termination and/or track-initiation, and to improve the quality tracks.

The project is ideally suited to graduates with a good quality degree in Electrical Engineering, Physics or similar subject. Some knowledge of radar signal processing or machine learning and familiarity with MATLAB and C/C++ programming would be an advantage. The successful candidate will conduct their research at the Microwave Integrated Systems Laboratory at the University of Birmingham, which comprises some 30 researchers on radar technologies and has a suite of state-of-the-art radar testing facilities and instrumentation.

Funding note:

The studentship covers home tuition fees and a standard stipend, along with funding to travel for international conferences and meetings with industrial collaborators.

The candidate must be UK or EU resident eligible for home student finance funding. Start time: Early January 2021 at the latest.

Informal enquiries to Dr Mohammed Jahangir m.jahangir@bham.ac.uk or telephone 0781 5775971 and Professor Chris Baker, c.j.baker.1@bham.ac.uk