SMALL UNCREWED AERIAL SYSTEMS DYNAMIC ROUTE PLANNING FOR MOVING VESSEL DETECTION IN MARITIME ENVIRONMENT

Problem

A small Uncrewed Aerial Vehicle (sUAV) is required to fly to a designated area, reacquire a moving vessel on the surface of the ocean and approach to within a required range. We seek research assistance in how to do flight route planning and re-planning autonomously with operational requirements and/or constraints, including but not limited to:

- the sUAV operating completely autonomously during the fly mission;
- the sUAV approaching the vessel of interest to within a minimum range requirement;
- the Size, Weight and Power (SWaP) and payload constraints on/with the sUAV;
- the sensor and computing capabilities on board the sUAV;
- weather effects.

The sUAV is required to approach within the required range at minimum completion times while avoiding obstacles.

Need and relevance to Defence

A modelling and simulation tool, with a collection of autonomy algorithms, that is able to recommend optimal flight route solutions under a range of assumptions and constraints. This capability is relevant to the requirement of situational awareness in the maritime environment. It will also support feasibility and operational analysis of future maritime ISR concepts that may be empowered by robotics and AI in general.

Research question

Questions related to optimisation:

How can we model the optimisation problem? The problem involves defining the objective function according to mission requirements, such as minimum mission time and obstacle avoidance, the input parameters to the function, and the output from the function that should be able to answer the following questions:

- How would autonomous algorithms improve the performance of sUAV compared with pre-planned approaches given a set of constraints around the platform, sensors and environmental effects?
- What would be the key model parameters that will contribute to the performance in terms of better reacquiring the vessel of interest, e.g., better pose estimation?

Questions related to AI technology:

- How can AI techniques adequately handle the uncertainty of the future state of the vessel of interest during ingress?
- How can AI techniques be used in pose estimation for imaging effectiveness?

Questions related to computer vision research:

- How can we distinguish the vessel of interest from other objects according to mission pre-loaded information?

Expected outcomes

A modelling and simulation software that is capable of

- running function optimisation for quantitative analysis;
- autonomously planning a flight path to the vessel of interest based on mission pre-loaded information;
- interfacing with sensors to seek updated information on the position and trajectory of the vessel of interest, and re-planning the flight path autonomously;
- taking weather affects into account for simulation runs, e.g. for best flight path.

Methodology/approach

- Literature review on relevant problem sets and solutions approaches;
- Market survey on robotics and AI technology options to understand the practicality considerations;
- Identify suitable modeling and simulation tools and supporting software libraries to streamline the research – real-time or faster than real-time for batch-run analysis;
- Generate a set of assumptions, gradually increasing the level of complexity;
- Identify and consult with industry partners for industrial standards and requirements in software development and potential integration with suitable hardware for field tests if concepts can be proved.

(*Note:* DSTG has identified suitable industry partner that successful researchers should consider using. Please contact info@defenceinnovationnetwork.com if you would like to be introduced to the industry partner)