Visual Swarming for GPS Denied UAV Operations

Who can apply?

- Australian Citizens & Permanent Residents
- New Zealand Citizens
- Onshore international students from Five Eyes Alliance Nations (United States, the United Kingdom, Canada)

Program of study available
Doctor of Philosophy (PhD)
Masters by Research

Industry partner and funding body

- Geodrones Pty Ltd
- Defence Trailblazer

Total annual stipend amount

- A base scholarship of $40,000pa plus $10,000pa top-up scholarship

Start date

- PhD - no later than 23/06/2024
- Masters - by January 2025

Benefits

- Work closely with experts on defence industry led projects
- Translate research into a tangible solution
- $50,000 p.a. tax-free* stipend (pro-rated for eligible part-time students)
- No tuition fees apply
- Acquire a unique set of skills and expertise
- Enhance your employability skills sought after by industry; graduates are highly regarded by employers
- Opportunities for local and international travel
- Work alongside world-leading researchers
- Gain industry experience and grow your networks
- Solve real life problems through industry engaged projects
- Publish your contributions
- Become an expert and make a real impact
- Access paid annual, parental and personal leave.

About the project

Swarms of UAVs are an effective means with which to achieve an objective requiring greater redundancy or greater area coverage than can be provided with a single UAV. However, controlling a large number of UAVs becomes problematic for the operator and places great strain on communication networks. State of the art drone shows are a good example of using large numbers of small drones to great effect but rely on preplanning the trajectories of all the drones before flight to ensure zero collisions and are also reliant on augmented GPS positioning systems to ensure drones fly precise trajectories that do not conflict with one another. This approach does not work in environments having a military context which might be highly dynamic or largely unknown prior to launch and will also not work in GPS degraded environments.

This project aims to solve these limitations by developing neural network architectures capable of outputting control actions which enable a UAV to emulate the sophisticated flocking behaviour of birds. Whilst existing approaches require relative position and velocity of neighbouring UAVs as input, we propose to replace this explicit state information using the raw camera feed from each UAV. The outcomes will contribute to the advancement of communication-free flocking behaviour and pave the way for the adoption of vision-based swarm control in real UAV systems.

The benefits of this work are twofold. Firstly, it will permit a swarm of UAVs to operate using a distributed control architecture with passive visual sensing on each drone which does not require individual control of each drone by a human operator. Secondly, it will improve the resilience of the flocking collective motion in UAVs in GPS degraded environments as the swarm will be reliant on vision for maintaining the swarm whilst avoiding obstacles and inter-UAV collisions.

The project will be conducted in both simulation and on real UAV platforms with hardware-in-the-loop experiments. Algorithms will be developed for Edge AI enabled devices using approaches such as imitation learning and reinforcement learning.

Eligibility criteria

- Australian citizens and defence industry professionals are encouraged to apply.
- Applicants with strong experimental and numerical skills in robotics, computer vision or control systems will be considered favourably.
- Be willing to share Intellectual Property with the industry partner and University by way of a Student Deed Poll.

* Conditions apply

More about Defence Trailblazer

The Defence Trailblazer for Concept to Sovereign Capability is a once in a generation opportunity to strengthen the collaboration between defence, academia and industry whilst accelerating research and commercialisation.

In partnership with the University of Adelaide (UoA), the University of New South Wales (UNSW), industry partners and supported by the Australian Government, the initiative will skill the workforce of the future, support defence-focussed innovation, and play a leading role in accelerating the delivery of sovereign capabilities for the nation's security and prosperity...at-speed and at-scale.

Learn more: https://dtb.solutions/

Industry Research Program

All students supported under the Defence Trailblazer initiative will participate in the Defence Trailblazer Industry Research Program (IRP).

Candidates will be located on-site at both university and industry offices for at least 60 FTE days (pro-rated for eligible Masters candidates), to enable professional development opportunities in an industry setting.

Defence Research Capability

Academics participating in the Defence Trailblazer IRP are leaders in their fields.

UNSW adds a critical dimension to preparing defence forces across areas as diverse as Autonomous Systems, Hypersonics, Sensors and Space. The UNSW Defence Capability Portfolio showcases UNSW's excellence in defence research and technology and highlights work across academia, government and industry, as well as with global policy makers, to create a hub of defence-related knowledge. The vision is to translate this knowledge into impact which can transform Australian and global societies.

There's no greater reassurance for our community than knowing we're well prepared to prevent or avert threats to our security. UoA researchers support this in very domain: on land and online; in space, the air and at sea, working extensively with the Department of Defence and defence-related organisations in a variety of ways—as an advisor, research partner and producer of high-quality, career-ready graduates equipped to make our world a better and more secure place.

Find out more about defence research at the UNSW.

Further information

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Defence Trailblazer, together with UoA and UNSW, are actively working to support equity groups. We strongly encourage applications from people with a disability, veterans and women interested in working in non-traditional work settings
UNSW CRICOS Number 00098G