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Defence Innovation Network Grant Scheme: Pilot Project

SOLDIER (TUAS) NAVIGATION IN GPS-DENIED ENVIRONMENTS

PROBLEM

When piloting a Tactical Unmanned Aircraft System (TUAS) in a GPS-denied environment, our current method of navigation is "map-to-ground." What are the optimum training methods to prepare soldiers for piloting a TUAS in a GPS-denied environment? Are there inexpensive technologies that do not have to be applied to the air vehicle that can assist with navigating in a GPS-denied environment?

https://www.army.gov.au/our-future/modernisation-projects/aviation-projects/shadow-200

https://www.army-technology.com/projects/shadow200uav/

https://www.textronsystems.com/sites/default/files/resource-files/TS%20US%20Shadow%20V2%20Datasheet.pdf

https://www.youtube.com/watch?v=tkQUZIG0h30

NEED AND RELEVANCE TO DEFENCE

The Australian Army's 20 Surveillance and Target Acquisition Regiment uses the RQ-7 Shadow Tactical Unmanned Aircraft System (TUAS) to gather detailed intelligence about hostile activity. The Shadow TUAS is piloted through a portable ground control station (GCS) and supported by a ground data terminal that allows ground troops to view in real time footage and data collected by the platform's payload sensors.

The Shadow TUAS navigates by GPS. Loss of the GPS signal triggers a "return home" Emergency Procedure requiring the operator on the ground to fly the vehicle back to the launch and recovery site using the only the on-board sensor imagery to navigate "map-to-ground". If the ground crew lose the TUAS, it must be recovered by parachute.

Navigating map-to-ground requires using the on-board camera to visually identify and locate landmarks. This is difficult due to a limited field of view and errors associated with existing on-board navigation sensors (e.g., compasses).

The Army plans to replace the Shadow TUAS through Project LAND 129 Ph3 in the mid-2020s. (https://www.defenceconnect.com.au/land-amphibious/2252-defence-releases-land-129-phase-3-survey). In the meantime, it seeks a near-term (within 3-4 years) non-GPS navigation solution that it can use to inform capability upgrades.

NOTE: proposals for TUAS capability upgrade must exclude options that require re-certifying the aircraft, a process that can take years. Technical recertification of the platform is generally required for any modifications of the airframe, including flight control system, power and propulsion, or the existing payload suite. Experience suggests that even attaching a self-

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contained system to the vehicle - with its own antenna, sensors and power - would require technical re-certification.

RESEARCH QUESTION

What technologies and/or training methodologies can be applied to piloting a TUAS that will obviate the need to default to emergency 'return home' procedures in GPS-denied environments, and allow the operator to fly the vehicle accurately and routinely without GPS?

The proposal should include the types of sensors, data streams and communication systems that would be used, as well as the level of navigation accuracy and precision that could be achieved. It should also include what sort of trials, test platforms, and end-user resources are required for rigorous system testing and evaluation.

EXPECTED OUTCOMES

The outcome is an off-board technology or training solution that will enable a ground operator to continue flying a TUAS mission 'routinely and accurately' in a GPS-denied environment.

The outcome includes testing and evaluation of prototype systems to inform the ADF on future upgrades to its current tactical airborne battlefield ISR capability.