Next Generation Technologies Fund

SMALL BUSINESS INNOVATION RESEARCH FOR DEFENCE (SBIRD)

Topic description

Title: Adaptive camouflage for Uninhabited Aerial Systems (UAS)

Topic statement: Defence is seeking proposals from Australian small businesses to contribute to the development of adaptive camouflage for uninhabited aerial systems.

Specifically, novel solutions are sought that can:

1. adapt to changing conditions to reduce the visual detectability against a sky background; and/or
2. reduce/change the acoustic signature of these small aircrafts to make them less acoustically detectable in different environmental conditions.

Defence is encouraging research and development in this field with a view to producing signature management solutions that can later be developed and applied to larger, more detectable platforms.

Background: The Australian Defence Force uses remotely piloted fixed-wing aircraft for some tactical surveillance operations. When deployed over a surveillance area, the aircraft is exposed to visual and acoustic detection from the ground.

Visually, the aircraft is silhouetted against the sky, which varies in luminance and colour, making traditional, single-colour aircraft coatings less effective in certain conditions.

Similarly, the acoustic noise generated by the aircraft may be detected prior to its visual observability.

While the use of uninhabited aerial systems allows smaller aircraft to be used which helps to minimise both the visible and acoustic signature, further steps can be taken.

Responsive visual camouflage: Tactical surveillance aircraft such as the RQ-7 Shadow 200, are deployed in a range of sky conditions. Typically such surveillance craft are fixed-wing aircraft with wingspans of 4 – 6 m and painted grey or blue aiming to minimise the colour differences between the platform and the sky. However, new materials and systems technologies may allow for smarter responses that can extend the range of sky colours against which we can effectively camouflage a uas ~~drone.~~ Systems that can sense sky luminance or colour and intelligently choose to change their properties to adapt are made feasible by technology such as electrochromic materials (already in production on automotive mirrors and for aircraft windows), materials with micro-structured surfaces, and doped liquid crystal displays.

Acoustic signature control: The noise generated by the engine, rotating propeller or rotors, and associated vibration are the main contributors to an aircraft's acoustic signature. One of the aims of this topic is to reduce detection of these aircraft by implementing innovative technical solutions for acoustic signature control. This may include active and passive methods for broadband noise mitigation, especially at low frequencies; suppression of narrowband (tonal) components of noise; and flexible control of radiation diagram. Technically this may also include some minor modifications to the propeller, such as changing materials or introducing special ducts; implementing a new vibro-isolation approach; or applying vibro-elastic coatings.

The current situation: The use of smaller aircraft that are autonomous or remotely piloted is a basic signature management technique, minimising the visual and acoustic footprint.

The situation is also managed by adopting a 'best-bet' paint colour,and following prescribed Tactics Techniques and Procedures (TTPs). This includes tactical flight patterns that:

- keep the aircraft high enough so that it appears too small for ground based observers to see and cannot be detected acoustically
- approach surveillance targets tactically to minimise the possible exposure time from the ground

Design parameters:

The solution should:

- Be adaptive/responsive to changing conditions and environments;
- **For visual camouflage**, reflect or reproduce sky colour/luminance on the aircraft as exposed to ground-based surveillance and suppress 'glint' from the surface;
  For acoustic camouflage, minimise or manage the noise generated by aircraft, and control the radiation pattern so that the acoustic signal can be radiated away from the ground.
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Technical Considerations:

The solution should impose no significant penalty on the performance of the aircraft. The proposed test platform for initial testing in Stage 1 is the X-8 Skywalker which has the following performance parameters:

- Maximum flight altitude: 2,000 feet
- Maximum flight time at altitude: 1 - 2 hours
- Maximum Speed: 10 m/s
- Wingspan: 2.5m
- Weight: 1kg (without payload)
- Payload weight: up to 3kg

The proposed test platform for testing in Stage 2 is the MQM-170 Outlaw which has the following performance parameters:

- Maximum flight altitude: 4,900 m
- Maximum range at altitude: 220 km

- Maximum Speed: 195 kph
- Wingspan: 4.15m
- Weight: 54 kg (without payload)
- Payload weight: up to 18 kg

The target operational platform is either the RQ-7 Shadow 200, or the ScanEagle.

Additionally, the solution must be:

- Low power (very little additional power could be feasibly supplied to a system on board a small aircraft)
- Lightweight – additional weight must be less than 3 kg.
- Robust to ultraviolet radiation, wind, precipitation, and launch and recovery operations
- Solution must not interfere with surveillance and data transmission functions

Cost and time: *proposals for Stage 1 need to be scoped around what is achievable within a maximum budget of $100,000 in a timeframe of between 6 – 9 months. Proposals also need to reflect how the outcomes of Stage 1 are positioned for potential additional work in Stage 2 and ultimately the provision of the desired capability.*

Proposals for Stage 2 need to be scoped around what is achievable within a maximum budget of $750,000 in a timeframe of between 12 – 24 months. To be eligible to apply for Stage 2 an applicant must have successfully complete a Stage 1 project. Stage 2 outcomes should aim to provide a prototype to demonstrate that the technology / idea provides a concept solution to the problem.

Design benefits:

The key benefits the solution needs to demonstrate are

- Reduced detectability (either in the visual or acoustic spectrum, or both) of a remotely piloted aircraft from ground based observation, when compared to current implementation
- No significant disruption of operation of aircraft
- Cost effective solution with potential applicability to reducing signature for other Defence platforms or installation components

The desired project end-state:

A successful project would be one which, upon completion:

Stage 1

- Demonstrates that the proposed technology / idea has real viability to function (does not need to be applied, as this is the focus of Stage 2).

Stage 2

- Demonstrates that the proposed technology / idea has real potential to be a solution to the problem;

Working with the project sponsor, will have identified potential transition pathways for acquisition of an operational capability based upon the technology or idea.

What we don't want:

Stage 1 and Stage 2

- Alternative surveillance technology - as one key benefit sought is potential applicability to improved camouflage (either in the visual or acoustic spectrum) for other Defence applications, replacing drones with a different surveillance system is not a desired solution mode for this project (proposals of this type may be presented to the Army Innovation portal, or Army Innovation Day).
- paper-based studies (simulation based studies are acceptable) or literature reviews,
- solutions that don't offer significant benefit to Defence,
- solutions which require unreasonable volumes of training data,
- projects that only offer a written report (a practical demonstration is the desired end),
- projects that can't demonstrate feasibility within the timeframe.

How will applications be assessed?

Applications to this SBIRD topic will be assessed by an evaluation panel assembled by DST in accordance with relevant Commonwealth Procurement policies.

Applications will be assessed against the following criteria:

1. Suitability – Proposals Achieving Outcomes (Weighting: 30%)
    a. How well does the proposed solution support the requirements of the topic and deliver the benefits sought?
    b. How clearly articulated is the proposed solution?
    c. Has the proposal been thoroughly considered (technical hurdles identified and addressed)?
2. Organisational Capability (Weighting: 25%)
    a. Does the applicant/s have the experience, skills and capacity to achieve the desired outcomes?
    b. Does the applicant/s have access to all the resources required?
    c. How feasible is achieving the proposed solution within the framework of the SBIRD program?
    d. Would this project help create new jobs in your organisation?
3. Innovation and Benefit (Weighting: 25%)
    a. The innovative nature of the proposed solution
    b. To what extent does the proposed solution lend itself to other applications?
    c. Is the implementation of the solution financially viable?
    d. To what extent has the strategy for scalability been defined?
4. Fair Market Value and Proposal Structure (Weighting: 20%)
    a. To what extent does the proposed research activity represent fair market value?
    b. Is the proposed budget clearly articulated, logical with identified deliverables/milestones and associated costs?

Key Dates

Event	Date
SBIRD Special Notice & Video Published	14 June 2018
Applications Open	14 June 2018
Applications Close	9 July 2018

For further information or assistance, please contact SBIRD@dst.defence.gov.au