Homeland Security
Science and Technology

DHS Science and Technology Directorate

Questions for DHS Components to Ask When Researching Counter Unmanned Aircraft Systems

Counter Unmanned Aircraft Systems (C-UAS) Research Questions for First Responders

The increasing availability, affordability and capability of commercially available unmanned aircraft systems (UAS), colloquially referred to as drones, provides opportunities for legitimate, nuisance and nefarious uses. Legitimate applications include the use of UAS by public safety officials to protect critical infrastructure and gain situational awareness during emergencies, by the entertainment industry for movies and television and by agricultural and other industries for inspections over large areas. Nuisance incidents include hobbyists operating illegally but without malicious intent. Nefarious applications may include unpermitted surveillance, the distribution of contraband or a terrorist attack.

This list of questions can be used by Department of Homeland Security (DHS) Components, and other entities with C-UAS authority, to build a more comprehensive understanding of the nuances, capabilities and limitations of C-UAS technologies. These questions do not address legal authorities to operate a C-UAS technology and DHS or other federal partners with C-UAS authority must follow the appropriate guidance, policies and rules regarding the actual operation of C-UAS capabilities.

NUSTL
NATIONAL URBAN SECURITY TECHNOLOGY LABORATORY

General C-UAS

- What types of unmanned aircraft systems (UAS) will your system detect? What types will it not detect? Will it also detect the ground control station and provide its location?
- How many different sensor modalities (i.e., radar, electro-optical/infrared, passive radio frequency (RF), acoustic) does the C-UAS technology have?
- Do any of the sensor modalities serve as the primary sensor type for detection that cues or activates a secondary or tertiary sensor?
- Is the C-UAS technology stationary (fixed to a specific site) or mobile (can easily be moved from site to site)?
  - Can the mobile system be used while moving (e.g., mounted on a vehicle)?
- How many people does it require to set-up and deploy the C-UAS at a new site?
- How long does it take to set up the system?
- What are the calibration requirements for the C-UAS technology?
- What training (type and time) is required to become a novice user? Proficient user? Advanced user?
- What is the required operator workload?
  - Does the C-UAS technology require constant monitoring/human interaction?
  - How well does your system separate UAS from birds, cars, people, etc.?
  - How does it do that? Is it automatic?
- Does the system have an open application programming interface (API) that allows end-users or third party vendors to:
  - Develop new software features, interfaces and capabilities?
  - Add additional sensors or mitigation capabilities?
- Does the system have a mitigation capability? If so, which method best describes how the mitigation capability works?
  - RF broadband jamming: flooding certain frequencies of interest with RF emissions at high power levels?
  - Spoofing: taking advantage of vulnerabilities in the communication protocol, UAS software or UAS hardware to take over, hijack or disrupt UAS operations?
  - Kinetic attack: physically disrupting UAS operations (nets, projectiles, lasers)?
- Is there any portion of the system that reads and interprets any part of the messages between the UAS and the ground controller?
- Is there any portion of the system that transmits messages to the UAS or attempts to jam its communications?
- How does the graphical user interface (GUI) alert the operator to the following:
  - Detection of a UAS aircraft and/or ground controller?
  - Location/track of a UAS aircraft and/or ground controller?
  - Identification or classification of the UAS (is it a UAS and if so, what kind)?
  - For desired modifications, can a user or another vendor make them?
- How does the system handle multiple detections at the same time?
- How is maintenance and updating of the system done and what is the cost for updates?
- Do you have any test results for the environment in which I am interested?
- Is there any safety issue or “keep out zone” for your system?

To learn more about C-UAS test and evaluation activities at NUSTL, contact NUSTL@hq.dhs.gov.

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Questions to Ask When Researching Counter Unmanned Aircraft Systems

Radar Sensor

- What bandwidth and power levels does the radar emit?
- What certifications does the radar have?
- Is it a single antenna rotating radar or a phased array/multi-panel stationary radar?
- What is the radar's azimuth field of regard? For example, a single radar panel may only cover a 90-degree field of regard, requiring four panels to get a full 360-degree coverage of a protected site.
- What is the radar's elevation field of regard? For example, a radar with a very narrow elevation field of regard would be unable to detect threats at very high or very low altitudes.
- How does the radar discern signal (UAS) from noise (birds, planes, ground traffic, etc.)?
- What is the maximum range of detection?
- How long does a UAS need to be within the radar's line of sight to be accurately reported as a UAS?
- What is the relationship between the probability of detection and distance from sensor to the target?
- What are the safe standoff distances when the radar is active?

Passive Radio Frequency Sensor

- What UAS RF signatures and communication protocols are currently part of the detection library? What is missing from the current library?
- How would the library of fielded equipment be updated to include new UAS of concern?
- Are end users provided with a method and means of updating their own library should a custom UAS be seized?
- What is the rate of library updates since the product has been on the market (e.g., once a month, once a week)?
- Does the system have a "white-listing" capability allowing it to recognize known UAS approved for operating in the area?
- What is the estimated error associated with the reported line of bearing (e.g., 2 degrees, 5 degrees)?
  - What type of conditions affect that error?
- Beyond line-of-bearing, does the system also report on estimated range/distance of the UAS?
- Under ideal operating conditions (i.e., open field with low RF background noise), what is:
  - The maximum distance for detecting a UAS and providing a line-of-bearing?
  - The maximum distance a UAS can be from the C-UAS and still be classified/identified as a UAS?
- What is the noisiest RF environment in which the system has been used or operated?
  - What effect did that environment have on detection, location and classification?
- How long does a UAS signal need to be received by the C-UAS for it to accurately report a UAS (e.g., in urban environments there may be very short periods of line of sight exposure to a UAS or ground controller, on the order of 2 to 5 seconds)?
- Will multiple antennas provide triangulation/geolocation of the UAS/ground controller?
  - If yes, is it simply a plug-and-play upgrade or is there additional configuration needed?
- What is the relationship between the probability of detection and distance between sensor and the target?

Electro-Optical/Infrared Sensor

- What is the camera's azimuth field of regard?
- What is the camera's elevation field of regard?
- How does the camera discern signal (UAS) from noise (birds, planes, ground traffic, etc.)?
- What is the maximum range of detection?
- How long does a UAS need to be within the camera's line of sight to be accurately reported as a UAS?
- What is the probability of detection (as a function of range)?

Acoustic Sensor

- Which UAS acoustic signatures are in the detection library? Which are missing?
- How would the library of fielded equipment be updated to include new UAS of concern?
- Under ideal operating conditions (i.e., open field with low noise background) what is:
  - The maximum range for detecting a UAS? Providing a location or track?
  - The maximum distance a UAS can be from the sensor and still be classified/identified as a UAS?
- What is the noisiest environment the system has operated in?
  - What effect did that environment have on detection, location and classification?