Droned But _NOT_ Confused: FAA Perspectives on C-UAS Technology in the Airport Environment

Federal Aviation Administration

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The Basics

<u>Detection, Tracking & Identification Technologies</u>
- **May be active or passive = legal implications**
- **These determinations are not necessarily easy to make and may not apply to all types of systems in a category of technologies**
- **Good detection is vital to successful mitigation**
- **Secondary & tertiary sensor types desirable**

<u>Counter-UAS Systems</u>
- **Engages the UAS with intent to control, disrupt, disable, damage, or destroy UAS**
- **Always has active interdiction**
- **May or may not include a detection capability**

UAS Detection, Tracking & Identification Technologies

Radio Frequency (RF): Identifies the presence of unmanned aircraft by scanning for the frequencies on which most drones are known to operate. Algorithms pick out and geolocate RF emitting devices in the area that are likely to be unmanned aircraft or their ground control stations. More specific UAS identification requires a library of signatures.

Radar (Radio Detection and Ranging): Detects the presence of small unmanned aircraft by their radar signature, which is generated when the aircraft encounters electromagnetic pulses emitted by the detection element.

Electro-Optical (EO) / Infrared (IR): Detects unmanned aircraft based on their visual signature.
- EO detection senses visible light reflecting off of an object.
- IR detection senses heat or non-visible light from an object.

Acoustic: Acoustic systems detect UAS using the unique sounds produced by an unmanned aircraft and their motors. An acoustic system relies on a library of known unmanned aircraft sounds and matches them to sounds detected in the operating environment.
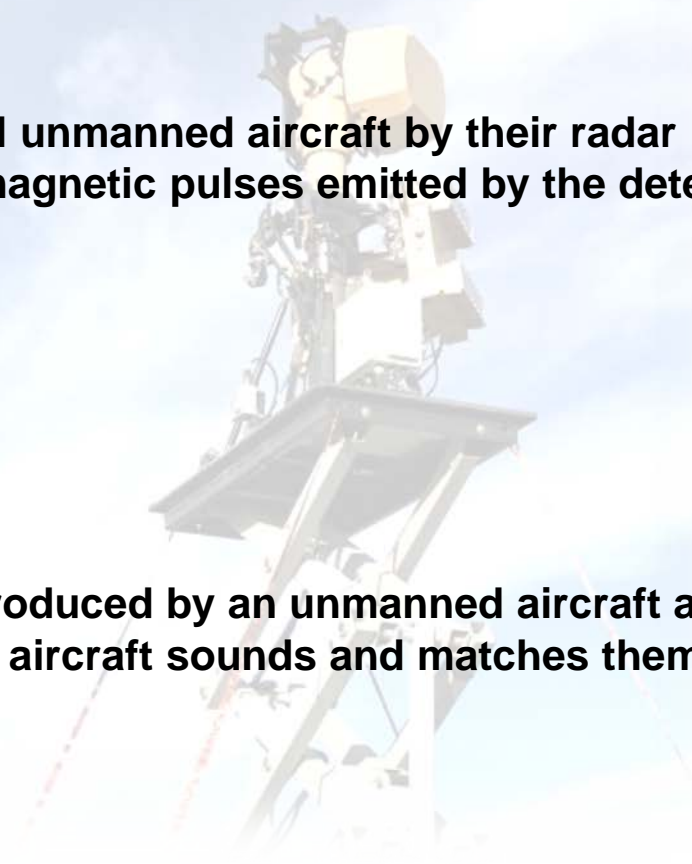
UAS Detection, Tracking & Identification Capabilities

ELEMENT	Sensor Technology			
	📡 RF	◎ RADAR	📹 EO/IR	🔊 Acoustic
Detect	🔻	🟢	🔻	🟢
Identify	🔻	🔻	🔻	🟢
Track	🔻	🔻	🔻	🛑

🟢 Capable for most scenarios

🔻 Limited capabilities in one or more scenarios

🛑 Not capable

C-UAS Mitigation & Countermeasure Technologies

Kinetic: Active, physical engagement or interdiction of a target

- **Projectiles and Firearms**
- **Net guns**
- **Capture systems (Hunter/Gatherer)**
- **Water jets and hoses**
- **Birds of prey**

**Only for use by authorized USG D/As**

Non-kinetic: A non-physical provision of affects against a target, such as sound, light or electronic means

Non-kinetic mitigation could lead to a "kinetic outcome" in that the engaged unmanned aircraft could be rendered impaired, inoperable, or crashes due to uncontrolled flight.

Electronic Warfare (EW): Involves the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy. This can include but is not limited to:

- *Jamming* - A form of EW, deliberately blocks or interferes with wireless communications, by emitting high output RF or other electronic means.
- *Redirection* - A form of EW, manipulation of the control *signal*, or overpowering of the control signal by sending the same signal at a higher power level with a different set of commands.

Directed energy: The emission of highly focused energy, transferring that energy to a target to disrupt or damage it.
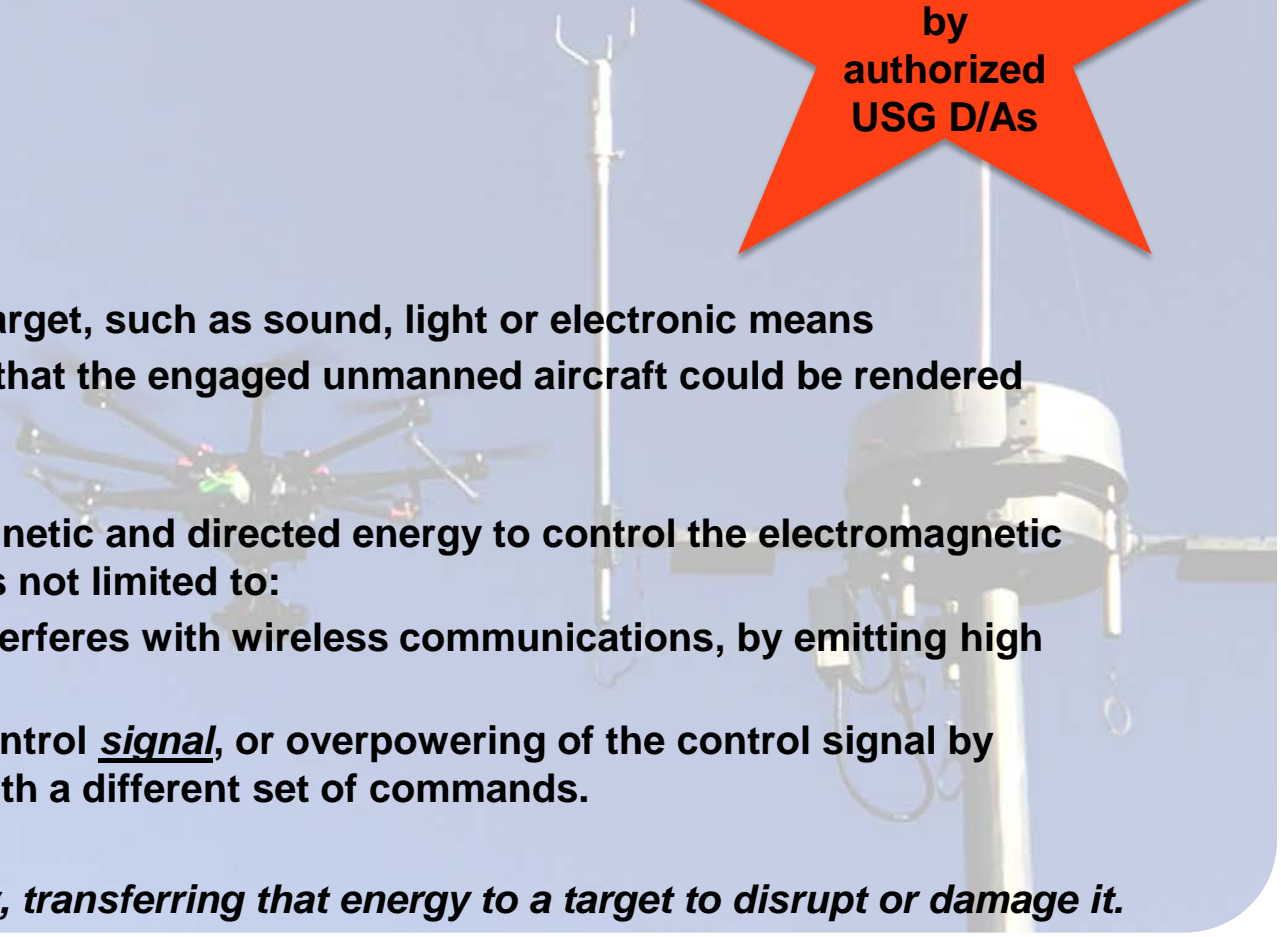
C-UAS Mitigation & Countermeasure Capabilities*

Legend:
- 🟢 Capable for most scenarios
- 🔻 Limited capabilities in one or more scenarios
- 🔴 Not capable

ELEMENT	Sensor Technology				Countermeasures	
	📡 RF	📡 RADAR	📹 EO/IR	🔊 Acoustic	Kinetic	Non-Kinetic
Aircraft: Fixed Wing	N/A	🟢	🔻	🔻	🔻	N/A
Aircraft: Fixed Wing: Glider	N/A	🟢	🔻	🔴	🔻	N/A
Aircraft: Rotary Wing	N/A	🔻	🔻	🟢	🔻	N/A
Aircraft: Composition Materials	N/A	🔻	🔻	N/A	🔻	N/A
Flight Mode: Piloted: Comms Link	🟢	🟢	🔻	N/A	N/A	🟢
Flight Mode: Autonomous: Guidance / Nav Sensors	🔴	🟢	🔻	N/A	N/A	🔻
Flight Mode: Control Station: GeoLocation	🟢	🔴	🔻	🔴	🔴	🔻

* Does not include classified capabilities; can vary by specific product and specific environment.

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UAS Detection & C-UAS System Considerations & Concerns

Considerations for UAS Detection Systems

- **Technical readiness**
  - Level of automation & dependence on human input & assessment (e.g. libraries)
  - Integration of multiple sensor types
  - Data validation capability & response times, including false-positive detections
  - Capabilities across multiple aircraft operational states (e.g., hovering) and differing degrees of flight
  - Environmental factors
- **Legal constraints**
- **Cost vs. Capability vs. Coverage**
  - Coverage ranges and the quantity of sensors needed to cover desired range
  - Rapidly changing UAS technology
  - Technology obsolescence
- **FAA coordination of operational procedures to manage airspace safety & spectrum/obstruction impacts**

UAS Mitigation and Countermeasure Technologies:

- **Authorized for specific missions of four U.S. Gov't Agencies (DOD, DOE, DHS, DOJ) — airport "steady-state" protection not included**
- **May affect the performance of air navigation services equipment on the ground and/or onboard aircraft equipment**
  - Exacerbated in airport environment
- **Congress prescribes high degree of coordination with FAA to implement C-UAS authority**
- **The use of countermeasure technology and the potential response of the targeted UAS when engaged could introduce greater hazards to the NAS than the UAS-based hazard it is intended to mitigate**

So What's FAA Doing? Three Lines of Effort to Address UAS Risks

- **Airport-Focused Activities**
  - **Engagement on & Coordination of Airport UAS Detection System Deployment**
  - **Working with USG security partners on development of National Federal Response Concept of Operations**

- **Congressional Directives, including 2018 FAA Reauthorization Section 383**
  - **Airport Hazard Mitigation Pilot Program @ five U.S. airports**
  - **Development of standards for use of C-UAS systems in NAS**
  - **Development of a plan for authorizing use of C-UAS**
  - **Supporting C-UAS deployments of DOD, DOE, DHS & DOJ**
  - **Partnering on DHS-led Section 1602 study of risk & requirements at large hub airports & critical infrastructure sites**

- **Rulemaking**
  - **Remote ID—vital to threat discrimination, enforcement & education—predicate for finalizing Ops Over People Rule**
  - **Safe & Secure Advanced Notice of Proposed Rulemaking**
  - **UAS Flight Restrictions over Fixed Site Critical Infrastructure Facilities (Section 2209 from 2016 FESSA)**