MEMS Acoustic Sensor for Drone Detection [video]

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MEMS acoustic directional sensor for UAV detection

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Current Capabilities

DoD UAV

Small DoD UAVs today span three orders of magnitude

- ***Black Hornet:*** electric propulsion, 18 g and span of 12 cm, range and duration of 5miles and 25minutes

- ***Scan Eagle***: gas powered, 22kg/3m, range and duration of 1000miles and 24hours

Army Black Hornet

Commercial UAV

- ***Cheerson CX-10:*** 13g, flight time of about 5minutes. Cost is $18. Cheerson released its recent version with a 640x480 color VGA camera, the UAV is gyro stabilized and easy to fly

- ***Phantom 2:*** 1160g, flight time of about 25minutes. Cost $500. Lightweight, multi-functional integrated aircraft and camera, Wi-Fi distance to 300m

- Hobbyist have developed UAVs with jet engines that can routinely exceed 288mph (128m/s). A 25kg UAV with a 50% fuel mass fraction could fly a distance of 240km, and still carry several kilograms of payload.

Parrot UAV that nearly landed in front of the podium of German Chancellor Angela Markele at a campaign stop in 2013

Quadcopter, strapped to 3 pounds of inert explosive, a newer version of the very drone that would land at the White House in 2015

Detection of Class I/II (low-slow flying) UAVs

- Of the detect-to-engage sequence of UAVs, detecting Low Slow Flyers is considered the least developed and most challenging
- Most, if not all, US based systems are designed and tuned for threats that have a large radar cross section and specific flight patterns
- By contrast, UAVs have an inherently small signature, fly at low speeds and pre-planned flight profiles. There is also the ability to deploy hundreds of assets and engage using swarming tactics

Lockheed Martin Demonstrates Q-53 Radar Counter-UAS Capability

Defense Daily | 06/27/2016 | Dan Parsons

Four Counter-Drone Technologies We Need Now

Posted Feb 23, 2016 by Joshua Pavlak (@JoshuaA) August Cole

D13 leads anti-drone technology race

JULY 4, 2016 2:49PM

AAP

US-based technology company Department 13 is leading the global race to develop counter-drone technology to defeat the rise of drones as tools of international terrorism.

Legal Issues Raised by Hacking into, or Interfering with, the Errant Drone's Command and Control Link or Its Navigation System

- Under the Federal Wiretap Act (18 U.S.C § 2510 et seq.) it is illegal to wiretap "electronic communications" without the consent of at least one party to the communication

- "Electronic communications" is broadly defined by the Act to include many types of signals, including potentially the signals sent or received by drones

- Interception of electronic communications to or from a drone might well violate the Federal Wiretap Act, even if the interception is merely for the purpose of detecting, tracking or identifying the drone or its operator

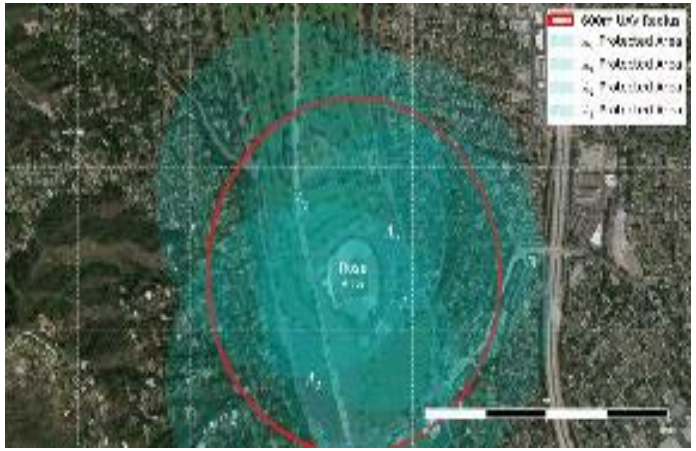
directional radio antennas that works like a gun

Detection Capabilities and Vulnerabilities

- Current detection range from radar, optical and acoustic
- Vulnerabilities
  - Optical systems degrade with weather
  - Radars have issues with clutter, serious $$$
  - Acoustics are limited by environmental noise and range detection

UAV detection using optics

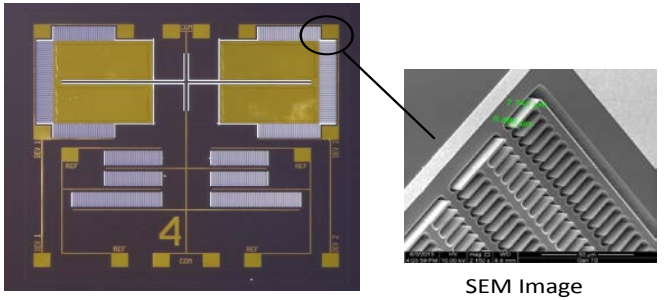
- Stateside, unmodified consumer based UAVs will greatly outnumber custom-designed UAVs. As such, acoustic detection is the **most viable, near term solution**
  - Simple acoustics serve as an effective, low cost, easy to deploy mechanism to detect UAVs with a one minute, 1 km warning



KM range detection by acoustic sensor

NPS Acoustic solution

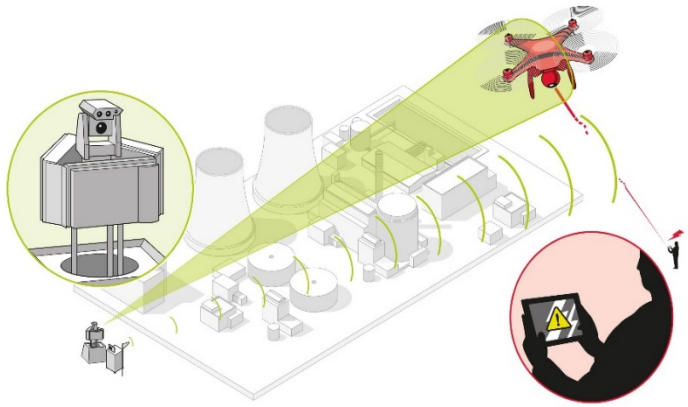
- NPS sensor research laboratory successfully demonstrated a MEMS acoustics sensor for detecting specific harmonic frequencies
    - Narrow band response
    - Removes ambient/environmental clutter
    - Can be tuned to specific UAV harmonics



MEMS Acoustic detector

- By deploying MEMS sensors; an acoustic system could provide (directional) early warning on simple, ready available technology

- Apps can be created (from the acoustic signature) that can display information about the type of UAV detected, which will then determine appropriate engagement methods



Acoustic detect to classify system

Summary

- UAV operations are ***NOT*** limited to overseas battlefields; they have already been used to disrupt our daily routines and ***WILL*** violate traditional security measures surrounding DoD facilities, nuclear facilities and public venues

Detect to Engage system

- Numerous commercial and Federal organizations are exploring products that will disrupt and destroy Low Slow UAVs
    - Engagement methods range from air blasts, small munitions, and water jets –to- more sophisticated Peregrine/counter attack UAVs, precision missiles and various forms of electronic warfare attack

- Successful field testing of MEMS acoustic sensor can provide a complimentary role in the detect to engage sequence of Class I/II UAVS

Back-up

Legal Issues Raised by Destroying or Disabling Errant Drone

- **Potential criminal liability under Federal Law**
  - A drone is considered an "aircraft" under the FAA Modernization and Reform Act of 2012 and the Federal Aviation Regulations
    - Under 18 U.S.C § 32 ("Destruction of aircraft or aircraft facilities"), destroying or disabling an aircraft is a Federal crime punishable by a fine of up to $250,000, a prison sentence of up to 20 years, or both
  - In addition, the Federal Communications Act of 1934 makes it Illegal to interfere with wireless communications (See 47 U.S.C. §§ 301, 302a(b), 333)
    - Most Counter-Drone technology that involves the use of a radio transmitting device to interfere with the drone's wireless communications would be illegal under the Communications Act, and could give rise to both civil and criminal liability
      - For example, it would be illegal to use a transmitting device to interfere with a drone's:
        - Radio communications
        - GPS link
        - Wi-Fi
        - Bluetooth connection