Meeting the Information Threshold for Acoustic Detection, Location and Identification of UAS/RPA

Acoustic Detection Can Address the Emerging UAS/RPA Threat

The growth in availability of unmanned or remotely-piloted aircraft systems (UAS or RPA) is an emerging threat in conflicts around the world. Very capable, very small systems are available in the commercial market. The Black Hornet Personal Reconnaissance System, for example, has a total length of 5 inches, weighs less than a tenth of a pound, delivers 25 minutes of flight time and streams live video to a handheld device up to 1.5 km away. The entire system (two aircraft, base station, and storage) weighs less than 3 pounds and can fit in your pocket.

Adversaries can deploy these micro UAS to observe and locate ground forces or provide real-time surveillance of an installation. Technologies normally used to detect airborne threats such as radar or lidar are ineffective against these UAS given their size, construction, and low-altitude flight. Acoustic detection addresses this gap. The motors, propellers, and other moving parts on a UAS always emit acoustic signatures, even if faint. The analytic techniques for threat detection, identification and location using an array of acoustic sensors are well known and have been used in the maritime arena for decades. The defense and security community recognizes this potential and is working to develop acoustic UAS detection systems.

The Challenge

Acoustic detection, identification, and location of a UAS is a complex task. For such a system to be effective, it must have very high quality information on the acoustic field it is measuring. Separating a faint or distant noise source from ambient noise requires high sensitivity and a very low noise floor. Identification requires rigorous measurement to match a detected source to a known signature. Measurement accuracy must extend over a broad frequency range to detect all of the components of a typical acoustic signature: one or more base frequencies and a unique pattern of low frequency oscillations and high frequency harmonics. Locating the noise source similarly requires very accurate phase measurement.

Existing Solutions Are Limited by Quality of Measurement and Information

Condenser microphones, the current gold standard for acoustic measurement and the only previously available devices approaching the sensitivity required for acoustic UAS detection, are based on a capacitive transducer. The physics that govern a condenser microphone produce measurement errors that limit the ability of the condenser mic to deliver the quality of information required for UAS detection. The output of a condenser mic varies with frequency, requiring filtering or other correction to accurately represent a complex acoustic signature. Equally important, frequency range is limited at both ends of the spectrum (a consequence of low frequency noise in the pre-amp and impedance in the capacitor). Condenser mics are also very sensitive to changes in temperature or moisture.

When deployed in array applications, condenser microphone systems adjust for these errors by applying complex signal processing and combining signals from a large number of sensors. Both adjustments reduce the system's ability to provide real-time, accurate threat detection. Additional error correction for frequency or temperature introduces further measurement uncertainty. Advanced signal processing algorithms expand the time and computing power required to resolve the noise source. More measurements from more sensors only add to this problem. And even with all the corrections and adjustments, identification and location accuracy is very limited.

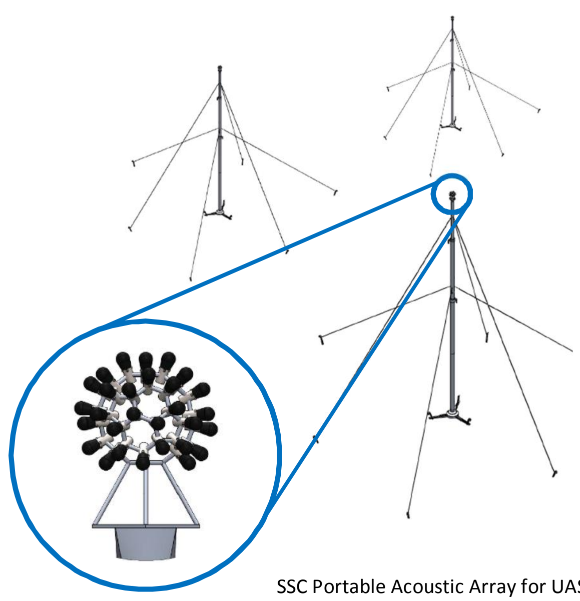
The Solution: a New Approach Unlocks Acoustic Detection of UAS/RPA

Intensity modulated optical acoustic sensors provide a generational advance in acoustic sensing technology and eliminate the information barrier to real-time acoustic UAS detection. This technology was developed by the U.S. Naval Research Laboratory (NRL) to provide very sensitive, very accurate measurement in harsh operational conditions. NRL invested over 30 years to perfect this approach. SmartSenseCom, Inc. (SSC), under exclusive license to NRL, adapted this technology for other applications, among them an atmospheric acoustic sensing platform with exceptional performance in the field.

The passive optical design eliminates electronic and thermal noise in SSC sensors and the company's proprietary electronics are purpose built to minimize system noise. Coupled with very high intrinsic sensitivity, SSC systems can extend detection range by an order of magnitude compared to other acoustic monitoring systems. They also provide exceptional uncorrected accuracy across a wider frequency range, with the capability to measure from fractional Hertz to 200 kHz. The result is more accurate identification (fewer false positives or negatives), more accurate location (+/- 2%), reduced signal processing burden, and a reduction in the number of sensors and physical footprint required.

Equally important, the simple mechanical structure and passive design of the SSC platform is inherently more robust in the field. Compared to condenser microphone systems, SSC acoustic sensor systems have a low power budget (less than 2 W per channel), provide size and weight savings, do not require recalibration, and are substantially more environmentally robust -- SSC acoustic systems deliver nearly identical performance in the lab or in the field.

Building on the Navy's robust, proven sensing technology, SSC acoustic monitoring systems meet the information threshold required for a field deployable threat detection system to mitigate the UAS threat.



SSC Portable Acoustic Array for UAS Detection, Identification and Location

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