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ABSTRACT
The AIRIS Wide Area Detector is an imaging multispectral sensor that has been successfully tested in both ground and airborne configurations for the detection of chemical and biological agent simulants. The sensor is based on the use of a Fabry-Perot based tunable filter with a 256x256 pixel HgCdTe focal plane array providing a 32x32 degree field of regard with 10 meter spatial resolution at a range of 5 km. The sensor includes a real-time processor that produces an infrared image of the scene under interrogation overlaid with color-coded pixels indicating the identity and location of simulants detected by the sensor. We review test data from this sensor taken at Dstl Porton Down, NSWC Dahlgren, as well as from multiple test entries at Dugway Proving Ground. The data indicate the ability to detect release quantities from 0.15 to 360 kg at ranges of ~ 4.7 km including simultaneous multi-simulant releases.

1. INTRODUCTION
The AIRIS-WAD technology was developed by PSI with funding and support from the US Army ECBC and DTRA-JSTO as a candidate for insertion as the next generation standoff chemical sensor. Development of the technology was guided by the specifications described in the Commercial Joint Services Lightweight Standoff Chemical Agent Detector (Commercial JSLSCAD) published in 2003.

As a result of these technology development activities, PSI has conducted numerous field tests in a range of environments demonstrating the ability to achieve a number of the key performance parameters defined for the “Commercial JSLSCAD,” most notably ~5 km range, airborne operation, and over-water detection capability. In this paper we describe specific results from sensor observations conducted from both ground and airborne platforms.

2. DESCRIPTION of TECHNOLOGY and DEMONSTRATED CAPABILITY
The Adaptive Infrared Imaging Spectroradiometer – Wide Area Detector (AIRIS-WAD) has been developed for real-time standoff detection of chemical warfare agent vapors. The technical concept is based on the insertion of a tunable Fabry-Perot interferometer (etalon) into the field-of-view of an infrared focal plane array (FPA). The IR FPA views the far field through the piezoelectric-actuated etalon placed in an afocal region of the optical train. The tunable etalon is operated in low order (mirror spacing comparable to the wavelength of the light transmitted) and functions as an interference filter which selects the wavelength viewed by the FPA. The optical
configuration affords a wide field of view, high optical throughput, and broad wavelength coverage at high spectral resolution. Fore-optics and integrated blackbody calibration sources enable control of the sensor’s field-of-regard and absolute radiometric calibration of the data. The AIRIS system components are shown in Figure 1. The technology is based on the following attributes:

- The use of passive multispectral imaging in the 8 – 11 µm spectral region to detect TICs (NATO ITF-25) and CWAs based on known spectral features. The system’s tunable filter technology allows the optimization of spectral band selection to take advantage of strong chemical absorptions and atmospheric transmission windows to maximize information throughput in its real-time processor.

- Use of wide field-of-view optics (32 x 32 degrees) for wide area monitoring with 360 degrees scanning capability (< 90 sec revisit time) while deployed from fixed and mobile platforms. The 2 milliradian IFOV of the sensor, provided by its 256 x 256 pixel format HgCdTe FPA, enables the detection of small clouds even at extreme ranges. The < 1 second acquisition time freezes cloud and most platform motion.

- Utilization of a real-time integrated processor performing chemical detection and identification in less than 1 second for complex backgrounds (including urban environments) through the use of a highly adaptable ATR algorithm. This algorithm utilizes a spectrally-matched-filter-based approach coupled to a proven statistical (Adaptive Cosine Estimator) scene background estimation algorithm that does not require a priori knowledge of the background, also enabling ‘on-the-move’ detection.

- A compact sensor unit (20 x 18.5 x 11.5 in) operating on 120/240 VAC or 28 VDC with an easy-to-use touch-screen display and control unit. The sensor unit only weighs 57 lbs.

Testing of the sensor technology has been extensive. Over its history there have been observations of over 200 releases, including both sequential and simultaneous releases of two simulants. These observations have been conducted from both ground and airborne platforms, often involving multiple AIRIS sensors looking at the same releases from different locations with different backgrounds. Figure 2 summarizes the test history for the sensor technology through June 2008. Figure 3 shows several examples of simulant detection and identification demonstrated during field testing of the sensor technology. The AIRIS-WAD system was deployed to a UH-1 helicopter and used to detect releases of the simulants R134a and SF6 at Redstone Technical Test Center. During these tests a 2 kg burst release of R134a was successfully detected from an altitude of 2000 ft at ranges to ~2 km (Fig. 3a). The sensor was also deployed to Porton Down, UK in June 2005, where it was used from a ground location to successfully detect the release of the simulants SF6, DMMP, TEP, NH3 at a range of approximately 700 meters (Fig 3b.). Releases were tracked for as long as 15 minutes and simultaneous detection and discrimination of SF6 and NH3 were demonstrated. PSI also deployed AIRIS-WAD sensors on both ground and helicopter platforms to NSWC Dahlgren in August.
2005. During these tests, the sensors successfully performed over-water detection of the simulants TEP, GAA, and SF₆ (Fig 3c.). Sensors were deployed several times (2006, 2007 and 2008) to Dugway Proving Ground where simulant releases were simultaneously observed from several locations around the perimeter of the release grid (Fig. 3d.). Data from these sensors was used to provide 3-D concentration profiles and tracking of vapor releases using computed tomography. In addition, Dugway release observations were also conducted from an UH-1 helicopter platform which demonstrated simulant detection capability from 4 km standoff range.

3. CONCLUSIONS

The resulting field data has been used to determine the performance capability of the AIRIS-WAD sensor. The sensor has demonstrated chemical vapor detection capability from a standoff range of 4.8 km (ground) / 4.6 km (airborne). Simulant column densities as low as 100 mg/m² were observed in several representative environments during both day and night conditions. The sensor is capable of 85% or better probability of detection while providing detection times < 50 sec from fixed sites and < 26 sec from airborne platforms.

4. ACKNOWLEDGMENTS

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