FROM SENSING TO MAKING SENSE

Improved Standoff Threat Detection And Situational Awareness Using Multimodal Lidar-asi System

Jeff Pruitt S3   Nathan Blume S3   Doug McGregor S3   Geofrey Showalter S3   Chris Peterson S3

Advance warning of chemical and biological (CB) threats is of critical importance to our warfighters and continues to be a major challenge for the CB Defense (CBD) Science & Technology (S&T) community. Recent research and development in the CBD S&T community has emphasized Integrated Early Warning (IEW) architectures that rely upon a layered sensing strategy that includes CBD-specific sensors such as lidar, but also incorporates a Force Protection (FP) sensing layer that provides complementary Intelligence, Surveillance and Reconnaissance (ISR) data that can be fused with the CBD data.

With the support of JPEO and DTRA, S3 has developed the Real-time Eyesafe Visualization, Evaluation and Analysis Lidar (REVEAL) system that detects, maps and tracks CB aerosol plumes to ranges beyond 5 km and derives wide-area 2-D horizontal vector wind fields by measuring the motion of aerosol features in the plumes and surrounding atmosphere. These real-time data products are packaged in an ISA-compliant message that is sent over the IEW network for visualization on a common operating picture, cueing other sensors to anomalous plumes, and fusion of the lidar data with data from other sensors.

The REVEAL capability continues to be extended through SBIR funding focused on adding two unique capabilities. First, using an unsupervised machine learning anomaly detection algorithm, REVEAL has demonstrated the capability to use patterns and features within aerosol plumes to identify anomalous plumes that may represent a CB threat compared to typical plumes generated within the operating environment. Second, becoming a multimodal CBD/FP sensor by adding a Shortwave Infrared (SWIR) camera to create an Active SWIR Imaging (ASI) mode. This ASI mode was demonstrated as part of a counter-UAS sensor suite where the lidar was cued to the region of interest and continued to capture UAS signatures as the radar and cameras lost acquisition due to the UAS hovering in front of a cluttered background. Using these two recently developed capabilities, the REVEAL-ASI system provides increased situational awareness and understanding of the threat environment through the combination of CBD and ISR data in a single sensor.

However, the capability of REVEAL-ASI to provide long-range plume tracking and characterization is ultimately limited by the fact that it is a ground-based asset that will often encounter terrain that restricts the range and field-of-regard (FOR) of the system. An opportunity exists to address this limitation by developing a Micro-REVEAL (mREVEAL) system that is integrated onto a UAS for long-range deployability and flexibility in addressing range/FOR limitations of a ground-based system. The resulting UAS-mounted mREVEAL system will augment and complement the current ground-based REVEAL-ASI system in fixed-site scenarios and provide a critical standoff detection capability in expeditionary deployments where on-the-move operation is required.