FROM SENSING TO MAKING SENSE

Standoff Snapshot Spectral Sensor For Uav Based Chemical Vapor Sensing

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Passive long wave infrared (LWIR) standoff sensing of chemical warfare agents is a critical capability for the chemical defense infrastructure of the U.S. military. This sensing technique relies on the unique infrared absorption signatures of chemical warfare agents over the 8 to 12-micron spectral range to identify threat plumes. The utility for existing passive standoff sensors is limited by the both the cost and SWaP (size, weight, and power) of the instruments which are only deployed at fixed sites or on heavy vehicles such as the nuclear biological chemical reconnaissance vehicle (NBCRV) Stryker. Existing standoff systems interrogate regions in direct line of sight from deployment and have no over-the-horizon capability.

Through an internal research and development effort, Laboratory staff have begun development of a Snapshot Standoff Spectral Sensor with SWaP characteristics that are compatible with operation on unmanned aerial vehicles (UAV) in the Group 1 category, which weigh less than 20 lbs and operate at altitudes less than 1,200 ft above ground level. This standoff sensor is based on an integrated chip scale spectrometer that is created by directly coupling a 640 x 512 element commercial-off-the-shelf (COTS) LWIR camera detector array with a 32 x 24 element array of fixed bandwidth Fabry-Perot filters where each filter element covers a 20 x 20 set of detectors. The Fabry-Perot filter array was fabricated in the Lincoln Laboratory Microelectronics Laboratory to pass 132 narrow optical wavelength bands to elements of the detector array. The sensor frames are recorded at 30 Hz and each sensor frame would provide a single representative spectrum of the radiant intensity at 132 wavelengths over the 7.36 to 12.64-micron range. The spectra would be compared to a threat library for real time detection and identification of chemical vapor threats.

The Snapshot Standoff Spectral Sensor could be used in many defense and environmental applications including monitoring of large indoor areas, perimeter defense systems, and for detection of environmental fugitive emission sources of methane, carbon dioxide, and other greenhouse gases. A particular use case of interest involves mounting the sensors on Group 1 UAVs to detect, identify, and map a vapor phase chemical warfare agent threat in over-the-horizon field forward operations. Each sensor-equipped UAV could act independently to monitor a defined area of regard. If a UAV detects a threat plume, it would signal to other UAVs to move to the area of detection, and the UAVs together would begin to cooperatively map and track the release plume.

This material is based upon work supported by the Lab Services under Air Force Contract No. FA8702-15-D-0001. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Lab Services