LOCALIZING CHEMICAL AND BIOLOGICAL THREAT DETECTION

Chemical Aerosol Remote Sensing: The Intelligent Chemical Aerosol Transmission Spectrometer (iCATS) Aerosol Test Chamber

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Many chemical threats can be delivered as aerosols, including chemical warfare agents (CWAs), toxic industrial chemicals and materials (TICs and TIMs), pharmaceutical based agents (PBAs), and riot control agents (RCAs). The need to rapidly identify these types of particles is imperative to health and protection of the warfighter and to national security. While the importance of aerosol detection and classification cannot be understated, it is a challenging technical problem particularly in complex environments.
The iCATS standoff detection system is being developed under the IARPA PICARD program. The PICARD program intends to develop fieldable sensing platforms for the rapid chemical classification of aerosol particles in plumes. The development of the iCATS sensor focuses on the challenge of distance from the chemicals of interest, low concentrations, arbitrarily shaped particles, and challenging environments.

The iCATS custom aerosol chamber is being designed and constructed to enable the algorithm development effort with experimental iCATS sensor and particle characterization data. The chamber utilizes a modular design to allow for static or dynamic flow systems and for variable cloud depth. Specifically, the cloud depth is modifiable with six discrete modular units accommodating ~1.3 to 10 meters in physical depth, but with two beam passes, up to ~2.6 to 20 meters for a two-pass field system. The chamber design includes a recirculation system for aerosol homogeneity capabilities as well as extended aerosol suspension time throughout an experiment. No special venting is required during data collection due to material being recovered through the recirculation loop. The main chamber houses both solid and liquid aerosol generators as well as monitoring instrumentation for collecting ground truth data. The dry aerosol generator is a Pitt-3 design, provided by InnovaPrep. The liquid aerosol generators are commercially available and support both polydisperse and monodisperse aerosol distributions. Specifically, a multi-fluid Blaustein atomizing module (BLAM), electronic Micronice© nebulizers from Tekceleo, and an Aeroneb® Lab Micropump Nebulizer from Nektar Therapeutics are intended for this chamber design. We monitor the aerosol concentration and particle size distribution in real-time using a combination of two instruments from TSI, Inc. An aerodynamic particle sizer (APS) monitors particles between 0.5 and 20 microns, and a scanning mobility particle sizer (SMPS) with an integrated neutralizer monitors sub-micron particles down to 10 nm in diameter. This dedicated chamber supports ongoing, near-continuous data collection. The custom chamber is designed by teammate Innovaprep and built by Leidos. It is based on the chamber currently operated by InnovaPrep at its facility in Drexel, MO, with modifications to enable creation of a 20-meter total optical path and ability to include arbitrary scattering surfaces.