LOCALIZING CHEMICAL AND BIOLOGICAL THREAT DETECTION

Leveraging Analytical Chemistry And Advanced Flow Visualization For The Identification Of Trace Levels Of Threat Material

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Due to the ease of material procurement and device development, the use of improvised explosive devices (IEDs) and homemade explosive devices (HMEs) is becoming a prominent focus of explosive mitigation. To address this, sensor technology is often employed by the warfighter to rapidly identify explosive threats and evade incident. Most commonly, explosive detection canines (EDCs) are utilized as sensors and trained to the odor of bulk levels of explosives for detection tasks. However, the challenge for the EDC is to detect trace amounts of the trained odor, as the containment system for the device may limit the amount of odor that is available to the canine. Leveraging analytical chemistry, the amount of odor coming from the improvised device can be measured to better inform canine training to trace levels of threat materials when they are enclosed in a containment system.

This presentation will focus on coupling quantitative analytical chemistry measurements of odorant with qualitative flow visualization of vapor transport in a variety of relevant scenarios. Schlieren imaging enables the visualization of odors and vapors in the air and ultimately informs best practices for canine training and trace sampling in the field. Seeing how vapors from HMEs and IEDs leak out of various objects helps identify the best approaches for sampling and detecting these threats. Using an anatomically-correct artificial dog nose and schlieren imaging, we show how the dog is an active aerodynamic sampling system, utilizing fluid dynamics to increase its ability to sample vapors and aerosols from large distances. Additionally, a new Background Oriented Schlieren (BOS) system was recently developed that enables large scale visualization of how the human thermal plume interacts with the environment and has interesting and important impacts on the nature of odor plume dynamics around the human body. Fluid dynamics govern the transport of trace vapors, so these lessons learned apply not only to HMEs and IEDs, but also chemical and biological threats. This work can equip scientists and working dog operators with a bolstered comprehension of odor detection, both on a technical and operational level.

This work was partially supported through the U.S. Army Explosives Forensics Program and partially funding by NIST internal research.