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## Army Researchers Work to Enable Chemical Threat Scanning on the Fly

*By Dr. Brian B. Feeney*

**Aberdeen Proving Ground, MD** — U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) researchers are developing a way to scan for chemical biological agent on surfaces on the fly. Literally on the fly as it consists of an AI-enabled spectrometer mounted on an unmanned aerial vehicle (UAV) or unmanned ground vehicle (UGV) sending back vital data in real time. It is called Hyperspectral Threat Anomaly Detection, or HyperThreAD for short.

A spectrometer is a device that can separate light into individual ranges -- much like a prism -- and measure them. It does this through band processing, meaning it is calibrated to use a series of distinct wavelengths that bounce off a surface. The returning light is altered in accordance with the ratio of absorption to reflection characteristic of each surface substance it hits. Spectrometers have long been used in mining to locate minerals, in agriculture to identify soil characteristics such as moisture, and even for food safety and infrastructure inspections.

Things change with hyperspectral spectrometry. Rather than a series of distinct wavelengths, hyperspectral sensors cover a wide range of the spectrum with no delineation into categories. The advantage is that you do not have to know what substance you are looking for. Any anomaly encountered will be identified, hence it is called substance agnostic.

For CBRNE applications, that means a hyperspectral spectrometer can find whatever chemical or biological agents, explosives or pharmaceutical based substances that may be present on a surface. This form of presumptive anomaly detection makes it a very useful screening device. If, for example, it is used to scan a suspected clandestine laboratory, it can be used to identify anomalies on tabletops, walls and floors. Only in those areas where anomalies are spotted is it necessary to conduct a further sweep using specialized sensors.

Currently, hyperspectral spectrometers can be mounted on UAVs, UGVs, manned vehicles or are hand-held. However, thus far, the spectrometer has had to be tethered to a laboratory device back on the ground and analyzed in a computer. There, an algorithm uses machine learning and statistical variables form a 3D graph of the scanned area. The graph then functions as a map delineating the most promising areas for further sensing in real time.

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A DEVCOM CBC research team plans to greatly enhance real-time hyperspectral anomaly detection by in two ways. First, by condensing the data to be analyzed so results are produced many times faster. Second, by integrating an AI/ML-enabled graphics processing unit (GPU) into the spectrometer. With the supped-up system mounted on a UAV or UGV, it can travel to the interrogation area and perform the computations needed to generate the 3D graph in near real-time. As it is moving it sends data back to command and control – literally creating maps of suspected contamination on the fly.

DEVCOM CBC research chemist Dr. Eric Languirand, who is leading the research effort, explained how his research aims to improve the technology. “For a long time, the disadvantage of hyperspectral spectrometry has been the sheer volume of the data it generates. For example, a sensor may cover 267 wavelengths generating 174,000 pieces of information per sweep.” His research team has developed a method for condensing that data down to 807 pieces of data, or around 1 percent of the original, opening promising new possibilities.

The DEVCOM CBC research team, funded through the Army Explosive Forensic Program, established a Cooperative Research and Development Agreement in 2021 with a Boston-area technology company, Headwall Photonics, that specializes in remote sensing. Together, they plan to further develop the technology and ultimately realize its commercial potential. The goal is to arrive at a system mature enough to place in warfighters hands for field trials.

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For more information about the DEVCOM Chemical Biological Center, visit <https://cbc.DEVCOM.army.mil>



DEVCOM CBC research chemist Dr. Eric Languirand operates an AI-enabled spectrometer to scan for the presence of chemical threats in powders found on a surface. (U.S. Army photo by Ellie White.)

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# News Release

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The DEVCOM Chemical Biological Center is the primary DOD technical organization for non-medical chemical and biological defense. The DEVCOM Chemical Biological Center fosters research, development, testing and application of technologies for protecting our military from chemical and biological warfare agents. The Center possesses an unrivaled chemical biological defense research and development infrastructure staffed by a highly-trained, multidisciplinary team of scientists, engineers, technicians and specialists located at four different sites in the United States: Edgewood Area of Aberdeen Proving Ground, Maryland; Pine Bluff Arsenal, Arkansas; Rock Island Arsenal, Illinois; and Dugway Proving Ground, Utah.

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