APPLICATION NOTE

Detection and Identification of Solid Substances on Various Surfaces

Detection and identification of solid and liquid substances on various surfaces can be a key asset for uncovering illicit activities. The collection of measurement and signature intelligence (MASINT) data that leads to detection and identification of such substances is a strategic advantage in the war against terrorism.

The Hyper-Cam-LW sensor from the Telops Hyper-Vision product line is well suited to perform the real-time detection and identification of small quantities of such substances. The Hyper-Cam hyperspectral camera, shown in Figure 1, is unique for several key aspects: commercially available, 2D staring (no line scan required) and optimized for thermal infrared (Fourier-transform infrared technology). It has established itself over the past few years as the world leading long-wave infrared (7.8 to 11.8 microns) hyperspectral camera. A Hyper-Cam-MWE version is also available. It covers the 1.5 to 5 micron range, enabling the detection of substances with signatures in the short-wave and mid-wave infrared bands.

Figure 1. Hyper-Cam-LW Sensor

The Hyper-Cam-LW has demonstrated several successful field applications of detection and identification of various types of substances on surfaces including: chemical residues [1], explosive powders [2], ethylene glycol [3] and silicon oil [4]. In a recent experiment at Telops, the Hyper-Cam-LW has performed real-time detection and identification of ammonium sulfate powder residue from a range of 20 meters in an urban environment. Figure 2 shows a visible image of the target. Ammonium sulfate powder residue was deposited at three different locations; on sunlit asphalt, on shaded asphalt and on the bumper of a car. Other common chemical residues were also deposited near the ammonium sulfate locations to verify sensitivity to false alarms.

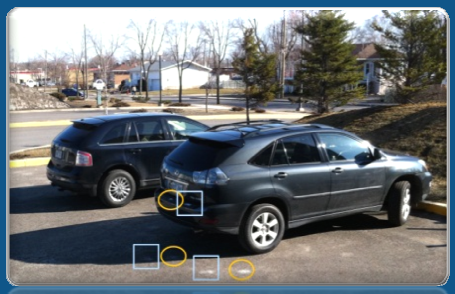

Figure 2. Picture showing the locations containing sugar (blue rectangles) and ammonium sulfate (yellow circles)

A combination of a Spectral Angle Mapper (SAM) and Generalized Likelihood Ratio Test (GLRT) algorithm was used in the real-time signature detection and identification software to identify the ammonium sulfate. The result is presented in Figure 3. All three ammonium sulfate spills were successfully detected, and no false alarm was generated in the image.

The experiment validates that the Hyper-Cam is an ideal tool for the detection and identification of solid substances. The Telops new real-time signature based detection software now allows users to have an immediate detection and identification response.

Figure 3. Detection map obtained from the real-time detection & identification algorithm. The yellow spots indicate the regions where ammonium sulfate was identified.

References:

[1] Puckrin, E., Turcotte, C. S., Lahaie, P., et al., "Airborne infrared-hyperspectral mapping for detection of gaseous and solid targets," Proceedings of SPIE Vol. 7665, 766516 (2010).

[2] Blake, T.A., Kelly, J.F., Gallagher, et al., "Passive standoff detection of RDX residues on metal surfaces via infrared hyperspectral imaging," Anal Bioanal Chem. 2009 Sep; 395(2):337-48 (2009).

[3] Farley, V., Vallières, A., Villemaire, A., et al., "Chemical Agent Detection and Identification with a Hyperspectral Imaging Infrared Sensor," Proceedings of SPIE Vol. 6739, 673918 (2007).

[4] Theriault, J.M., Montembeault, Y., Lavoie, H., et al., "A novel infrared hyperspectral imager for passive standoff detection of explosives and explosive precursors," Proceedings of SPIE Vol. 8018, 801819 (2011).