LOCALIZING CHEMICAL AND BIOLOGICAL THREAT DETECTION

Improved Chemical Gas Detection and Identification for Thermal Infrared Hyperspectral Remote Sensing

Frederick Marcotte Telops **Martin Lariviere-Bastien** Telops **Antoine Dumont** Telops **Benjamin Saute** Telops **Jean-Philippe Gagnon** Telops **Vince Morton** Telops **Martin Chamberland** Telops **Joseph Carrock** Telops

Being able to efficiently detect, identify and determine the potential threat risk of chemical agents is a critical goal of the defense research community. Hyperspectral remote sensing offers a way to accurately characterize gases from a distance, offering a safe and quick way to determine the threat level of an unknown gas. Telops hyperspectral systems have been at the forefront of gas detection, identification and quantification through remote sensing using thermal infrared detectors. It is still a constant challenge to improve the spectroscopic accuracy of hyperspectral imaging system that can spatially resolve infrared signature, especially when compared to the high spectral resolution of one-dimensional instruments. To push the capabilities of hyperspectral analysis, a new algorithm was developed to improve multiple factors within the detection process. The main points that were focused on were: 1) The non-negligeable odds to detect multiple types of gases, false positives, when doing a single release, with infrared signatures close to the expected peaks. 2) Moving objects within a scene would cause significant distortion artefacts that would cause the system to also give false positives. 3) Reflective surfaces would cause many false alarms, especially with sky reflection causing the detection of multiple gases. 4) The acquisition parameters optimized for a specific gas detection were also found to not be ideal for another gas detected within a same scene.

This presentation will go over three measurement campaigns to test this new algorithm, with six different gas targets over various backgrounds (rocks, sand, vegetation, snow, asphalt). Three hyperspectral instruments were used: a portable ground system, an airborne system installed in a fixed-wing aircraft, and a drone-controlled system. The results demonstrate a strong increase in the overall true positive to false positive ratio through an analysis of the receiver operating characteristic (ROC) curves. As the systems are meant to be used below a 10% false positive ratio, the integral of the ROC curves is accomplished within the 0 to 0.1 false positive range to establish the actual accuracy of the algorithm. The integral value is shown to more than double, drastically improving the performance of the detection system. A clear reduction in issues mentioned in points 1-2-3 above is clear from the results and the algorithm helps regulate the measurement analysis to minimize the need to frequently change parameters between gases as mentioned in point 4. The introduction of this new algorithm is hoped to raise the standards of hyperspectral remote sensing even higher and improve chemical threat assessment.