Identification and Detection of Gaseous Effluents from Hyperspectral Imagery Using Invariant Algorithms

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Abstract

The ability to detect and identify effuent gases is, and will continue to be, of great importance. This would not only aid in the regulation of pollutants but also in treaty enforcement and monitoring the production of weapons. Considering these applications, finding a way to remotely investigate a gaseous emission is highly desirable. This research utilizes hyperspectral imagery in the infrared region of the electromagnetic spectrum to evaluate an invariant method of detecting and identifying gases within a scene. The image is evaluated on a pixel-by-pixel basis and is studied at the subpixel level. A library of target gas spectra is generated using a simple slab radiance model. This results in a more robust description of gas spectra which are representative of real-world observations. This library is the subspace utilized by the detection and identification algorithms. The subspace will be evaluated for the set of basis vectors that best span the subspace. The Lee algorithm will be used to determine the set of basis vectors, which implements the Maximum Distance Method (MaxD). A Generalized Likelihood Ratio Test (GLRT) determines whether or not the pixel contains the target. The target can be either a single species or a combination of gases. Synthetically generated scenes will be used for this research. This work evaluates whether the Lee invariant algorithm will be effective in the gas detection and identification problem.