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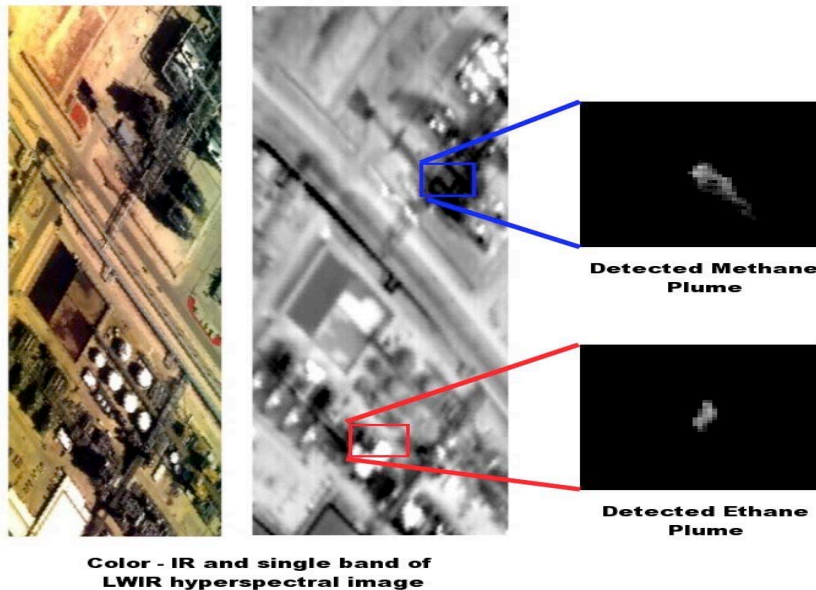
Detection of Gaseous Plumes in LWIR Hyperspectral Imagery Using Physics-Based Signatures

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Auditorium of the Center for Imaging Science

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Abstract

Detection of gaseous effluent plumes from airborne platforms in cluttered environments provides a unique challenge to the remote sensing community. The measured signatures are a complicated combination of phenomenology including effects of the atmosphere, spectral characteristics of the background material under the plume, temperature contrast between the gas and the surface, and the concentration pathlength of the gas. All of these quantities vary spatially further complicating the detection problem. Common detection schemes using laboratory-measured gas absorption spectra for the target signature and a statistical based matched filter do not account for the inherent variability in the measured target signature. We have developed a physics-based, forward model to predict in-scene signatures covering a wide range in gas / surface properties. This "target space" is reduced to a set of basis vectors using a geometrical model of the space. Corresponding background basis vectors are derived to describe the non-plume pixels in the image. A Generalized Likelihood Ratio Test is then used to discriminate between plume and non-plume pixels producing a detection map. Several plume constituent species can be tested for simultaneously. The algorithm is applied to airborne LWIR hyperspectral imagery collected by the Airborne Hyperspectral Imager (AHI) over a chemical facility with some ground truth. Detections of several species, along with comparisons to more traditional detection methods, will be shown.

Bio sketch

Dr. Messinger received a Bachelors degree in Physics from Clarkson University and a Ph.D. in Physics from Rensselaer Polytechnic Institute where his Ph.D. thesis project was a study of interstellar infrared polarization due to spectral absorption. He has worked as an Analyst for XonTech Inc. and on the National Missile Defense Program for Northrop Grumman. He served as an Intelligence Community Postdoctoral Fellow from 2003 – 2005. He is currently an Associate Scientist in the Digital Imaging and Remote Sensing Laboratory at the Rochester Institute of Technology where he leads the Algorithms and Phenomenology group. His research interests are primarily in the area of information extraction from remotely sensed images. Specific research is focused on hyperspectral imagery applications such as target detection and land classification using both the infrared and reflective spectral regimes.