LA-UR- 03-2063

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Title: Characterization of Background Reflectivity for MEDUSA

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Submitted to:
MSS Meeting on Active E-O Systems
NIST, Boulder Colorado
25-28 August 2003

Los Alamos
NATIONAL LABORATORY

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Title: Characterization of Background Reflectivity for MEDUSA

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Category: Threat ID

Abstract:

The DARPA MEDUSA program goal is to detect, locate, and identify electro-optical threats in the vicinity of a moving platform. Laser sensing will be employed to find these threats by looking for anomalous reflections from threat sensors. However, the reflectivity variability (clutter) in both natural and manmade backgrounds will inherently limit target detection levels. In parallel with advanced component development by several aerospace contractors, a study of this clutter limitation was initiated in the long-wave (LW) and mid-wave (MW) infrared spectral regions to properly drive system design parameters. The analysis of clutter and associated limits on detection has been a major component of LANL efforts in laser remote sensing for non-proliferation. LANL is now analyzing existing data and conducting additional selected measurements in both the LWIR (9 and 10.6 μm) and MWIR (4.6 μm) in support of the DARPA program to increase our understanding of these clutter limitations and, thereby aid in the design and development of the MEDUSA system. The status of the LANL effort will be discussed. A variety of different natural and man-made target types have been investigated. Target scenes range from relatively low clutter sites typical of a southwestern desert to higher clutter downtown urban sites. Images are created by conducting raster scans across a scene interest. These images are then analyzed using data clustering techniques (e.g. K-means) to identify regions within the scene that contain similar reflectivity profiles. Data will be presented illustrating the reflectivity variability among different samples of the same target type, i.e. within the same cluster, and among different data clusters. In general, it is found that the variability of reflectivities among similar targets is well represented by a log-normal distribution. Furthermore, man-made target tend to have higher reflectivities and more variability than natural targets. The implications of this observation for MEDUSA systems designed to locate and identify threat sensors will be discussed. The implications for chemical sensing applications will also be addressed.

Outline:

- Brief description of Lidar apparatus
- Examples of data images and discussion of data clustering approach
- Results showing variability within clusters and among clusters, for high, medium, and low clutter scenes
- Examples of return signals from surrogate optical threats
- Comparison of anticipated returns from surrogate threats and various backgrounds
- Implications for MEDUSA type applications
- Implications for chemical sensing applications

Comments:

This work has not been presented before at conferences. At this time, we believe that the paper will be classified SECRET/NF. The implications of our observations to the

MEDUSA program will be presented in terms of notional or surrogate threats. However, classified information regarding actual threats will also be addressed. Furthermore, the discussion regarding chemical sensing applications will refer to sensitivities for specific chemical of interest. Hence, we believe that this MSS conference is an appropriate forum.