HIGH RESOLUTION MULTISPECTRAL IMAGING FOR DETECTING EXPLOSIVES ON SOIL

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Abstract: Contamination of the environment by explosives is a growing problem because of the many explosives used and their increasingly recognized toxicity. Duds and low order detonations of munitions can release fragments of explosives to the environment during battle and training exercises. The typical size distributions of these fragments range up to several cm diameter on hundreds of thousands of acres of Department of Defense land in the United States alone. The larger fragments deposited on the surface soil pose the longer-term risk as sources of explosive contamination. Thus, early detection and removal of these larger fragments can greatly reduce subsequent permeation of the contaminants into soil and groundwater. Currently the best techniques for determining contamination source zone locations and strengths use manual methods including soil sampling. No technology currently is used for remote sensing of explosives for cleanup purposes. We demonstrate that high resolution multispectral imaging shows promise in detecting some explosives on soil. Instead of the intense illumination required by scanning with the slits traditionally used in dispersive spectroscopy systems, we used multiple ordinary narrow-band (10 nm width) filters in filter wheels with an ordinary charge coupled device focal plane array camera. The optical throughput is sufficient to acquire useful images at video speeds (30 milliseconds exposure time) even on cloudy days. Centimeter sized fragments of 2,4,6-Trinitrotoluene, Tritonal, and Composition B are shown to be discriminated from soil, pebbles and other environmental surfaces by exploiting their increasing spectral reflectivity as the wavelength increases from 400 to 800 nm. We also demonstrate some enhanced detection using color reagents applied to the fragments. We suggest high resolution spectroscopic imaging can also detect other contamination.

Keywords: Explosives, contamination, multispectral, spectroscopic imaging

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