# ABSTRACT

Several aspects of the IR signatures of land mines are examined. Three-dimensional thermal and radiometric models are developed to predict the infrared (IR) signatures of buried mines. A finite element method (FEM) based thermal model is developed to study temporal variations, the spatial structure of the signature, and environmental effects. A reference solution is presented for the integral equation that governs the temperature distribution in the case of a time invariant convection coefficient and air temperature. The integral equation solution is compared with the FEM model to assess the effects of various assumptions in the latter approach. A detailed representation of the TM-62 AT mine is developed for the thermal FEM model, and automatic mesh generation and adaptive mesh refinement algorithms are employed to improve the model's accuracy. A radiometric model, which addresses both the spatial and spectral characteristics of the environment, is also presented to predict the IR signatures of buried mines. The effect of surface roughness on the mine signatures is investigated for several surfaces. Polarimetric IR signatures of surface mines were studied. A model based on a second order small perturbation method/small slope approximation is developed to examine the effects of material composition, geometry, and statistical surface properties. From these numerical simulations, it is possible to explain phenomena observed in IR mine signatures and to suggest techniques for improving detection.