

Signal Processing and Pattern Classification for Anti-Tank Landmine Detection in NIITEK Ground Penetrating Radar Data

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Recent advances in ground penetrating radar (GPR) fabrication and signal processing have made high fidelity detection of buried anti-tank landmines a practical possibility under field scenarios. As testing and algorithm development continues, more stringent road conditions are being explored for the GSTAMIDS/CMOTM program with the NIITEK radar. In this work we focus our attention on a comparison of statistical pre-screening and feature-based pattern classification approaches for anti-tank landmine detection in heterogeneous soil conditions and present results from blind tests on those soils.

One approach to processing and cancellation of subsurface soil GPR responses to mitigate false alarm rates requires modeling and estimation of subsurface soil response characteristics followed by subsurface soil response cancellation. In this work we provide comparisons of adaptive and static auto-regressive models for subsurface soil response cancellation as well as geo-physically motivated subsurface cancellation techniques. We also consider the constrained optimization of residual contrast enhancement filters for landmine detection. Current results indicate similar performance levels under homogeneous road conditions, but varying performance under more heterogeneous conditions, with our physics-motivated approaches out-performing other statistical models.

We have also previously developed several texture-based features for landmine detection under heterogeneous soil conditions and here we show that these features continue to improve performance over pre-screening results. We have also developed several new features for this data set and we will show results (see Figure 1) indicating significant reductions in false alarm rates for combinations of these features with our previous texture features.

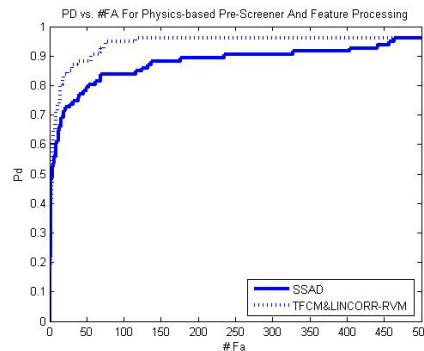


Figure 1: Comparison of Pre-Screener and feature-based landmine detection algorithm performance.