Point Process Analysis of Geophysical Data for Characterization of UXO Sites*

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Characterization of sites potentially contaminated with UXO has often used SiteStats/GridStats and UXO Calculator methodology. Although better tools are not readily available, these tools have been shown to have some serious drawbacks including unrealistic assumptions, arbitrary stopping rules, and absence of spatial information. We report on a project that addresses methods for spatial statistical characterization of a site based on samples of geophysical measurements. We emphasize rigorous assessment of uncertainty that is present in the spatial characterization. Our approach is to apply model-based methods for Poisson count data to point patterns derived from geophysical data. Bayesian estimation of all model parameters from the count data provides predictions for areas not sampled along with a complete distribution estimate for each pixel. The estimation and prediction proceeds via Markov chain Monte Carlo and requires substantial computation that can be completed in reasonable time with current PC technology. The computation allows us to make fewer and more realistic assumptions to generate uncertainty estimates.

Our conceptual site model emphasizes three independent sources of correlation: instrument response correlation (electromagnetic and/or magnetic response for a single ordnance scale), ordnance placement correlation (single target, multiple ordnance scale), and target placement correlation (site or multiple target scale). We represent information in our estimates by three components that roughly correspond to the correlation scales: the ordnance list (OL), the ordnance intensity map (OIM), and the target intensity map (TIM). We recommend two or more iterations where an initial site model based on an Archive Search Report and related information is updated with optimally designed samples until a site-specific criterion is met.

Survey design methods are incorporated in this project. The projected performance of geophysical sensors and platforms is considered in development of the first survey, and dig results from each iterative survey are used to refine statistical parameters (e.g. ROC curves) for improved accuracy in the OIMs and TIMs. Information about topography, vegetation, and geology can also be used in the survey design for sample location and selection of sampling technology.

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