

Innovative Software Tool to Improve UXO Detection and Discrimination

Unexploded ordnance (UXO) site characterization is often inefficient, expensive, and incomplete because of limitations of current technology and survey practices. Not all buried UXO are routinely detected, and UXO is not distinguished from other items in the ground that pose no risk. Over the past several years, SERDP and ESTCP have invested in developing data analysis and processing techniques for use with commercial geophysical sensors that can improve UXO detection as well as discrimination between UXO and site clutter. These techniques include estimating target features, such as ordnance size, shape, depth of burial, and orientation, from survey data. In addition, feature-based characterization and classification decision algorithms have improved discrimination performance in many demonstrations. However, historically, these feature-based algorithms have not been readily available to the user community and have had limited exposure to data acquired under constraints encountered in field surveys.

The primary objective of the ESTCP project *Feature-Based UXO Detection and Discrimination (UX-0210)* is to transfer anomaly characterization and classification algorithms to the user community by creating a *UXAnalyze* module for the Oasis montaj™ software program developed by Geosoft Incorporated. The project will demonstrate the efficacy of the feature-based approach in *UXAnalyze* through multiple demonstrations at sites with a variety of

conditions and target objects. These demonstrations also will establish data quality requirements to support accurate feature extraction and advanced classification of buried objects.

The *UXAnalyze* software module consists of multiple databases, customized graphical interfaces, and data visualizations. This module provides the tools required to systematically identify and extract anomalies from the dataset, call the characterization routines, store the fitted source parameters for each anomaly, perform target classification, and document the analysis—all essential components of UXO site characterization. Once the analysis is complete, individual images for each anomaly can be produced automatically for documentation purposes.

To date, the project team from AETC Incorporated and Duke University has applied *UXAnalyze* on one controlled site and one field site. The first demonstration used *UXAnalyze* to examine and report results for magnetic and electromagnetic induction data acquired from an EM61 sensor at a controlled site on the Aberdeen Proving Ground Standardized Test Site. For the second demonstration, investigators are in the process of characterizing and classifying sensor data collected using an EM61 MKII sensor at Lake Success Business Park, a former Remington Arms facility in Bridgeport, Connecticut. The objective of this field site effort is to determine discrimination capabilities using data acquired in a moving



Dissemination of feature-based decision algorithms via a *UXAnalyze* module for the Oasis montaj™ software program will improve UXO detection and discrimination.

survey mode. Additional demonstrations are planned over the next 2 years to critically evaluate the efficacy and benefits of *UXAnalyze* for various field conditions and target objectives.

The primary advantages of this software are improved detection of UXO by transitioning robust analysis of geophysical data to field use and advanced tools that can discriminate UXO from site clutter based on survey data. If successful discrimination capabilities can be achieved from routinely collected, high quality survey data, significant savings in excavation costs can be realized by leaving nonhazardous items unearthed. Transitioning *UXAnalyze* to the UXO community via Oasis montaj™ will improve UXO detection and reduce cleanup costs for the Department of Defense.

For more information about *UXAnalyze*, please contact Dr. Dean Keiswetter, AETC Incorporated, Cary, NC, at (919) 653-0215 or via e-mail at dkeiswetter@nc.aetc.com. ♦

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tools to ESTCP for full-scale demonstration and validation.

ESTCP Project of the Year. The ESTCP Project-of-the-Year Award was presented to **Dr. Herb Nelson** of the Naval Research Laboratory (NRL) and **Dr. Jim McDonald** of AETC Incorporated (formerly with NRL) for the successful demonstration of an airborne analog of the vehicular Multi-Sensor Towed Array Detection System (MTADS) for UXO detection and mapping. The Airborne MTADS will permit surveys of areas that are not

conducive to vehicular towed arrays or that require large areas to be nonintrusively surveyed. Vehicular MTADS, originally developed under ESTCP, provided a reliable UXO surveillance system that typically surveys tens of acres per day. However, at this rate, it would take approximately 750 days at \$400 to \$800 per acre to survey a typical 15,000 acre range. The Airborne MTADS has demonstrated survey production rates up to 500 acres per day at an estimated cost of \$100 per acre. Researchers

conducted geophysical investigations on several ranges, including the Badlands Bombing Range in South Dakota, the Aberdeen Proving Ground in Maryland, and Isleta Pueblo in New Mexico, successfully demonstrating the Airborne MTADS to be an effective and reliable means for UXO detection and mapping. The most significant benefit of this effort will be the ability to conduct accurate wide-area digitally referenced geophysical surveys that permit large expanses of land to be declared free of UXO contamination.

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