

## **CLASSIFICATION OF SMALL TOI IN HIGHLY CLUTTERED AREAS**

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This paper describes the procedures and approaches used by our team to detect and classify small targets of interest (TOI) at high-density contaminated UXO Live Sites. Namely, results presented here were obtained as part of

Live Site UXO classification demonstration study at the former Fort Ord, CA conducted under the Environmental Security Technology Certification Program (ESTCP). Fort Ord was established in 1917 as a training and staging facility for infantry troops. The site was used by cavalry, field artillery, and infantry units for manoeuvres, target ranges, and other purposes. From 1947 to 1974, Fort Ord was a basic training center. After 1975, the 7th Infantry Division occupied Fort Ord. Fort Ord was officially closed in September 1994. Military munitions were fired and used on the facility, including artillery and mortar projectiles, rockets and guided missiles, rifle and hand grenades, land mines, pyrotechnics, bombs, and demolition materials. A small portion (Units 11 and 12) of the site was selected for demonstrations because it was high-density contaminated area and contains a wide range of munitions, such as 37mm, 40mm, 57mm, 60mm, 75mm, 90mm, 105mm, and 155mm projectiles. Our team received and processed all 2803 cued data sets collected over demonstration area. All data were analyzed using our advanced, electromagnetic induction (EMI) models (such as orthonormalized volume magnetic source (ONVMS)), joint diagonalization (JD) and differential evolution (DE) techniques. A multi-step process was utilized. First, data were pre-processed using a multi-static response data matrix eigenvalue approach. Next, for each anomaly, extrinsic features (locations and orientations) and intrinsic features (total ONVMS, i.e. effective polarizabilities) were calculated using the combined ONVMS-DE algorithm for one, two and three sources. Next, the extracted total ONVMS features were clustered using the attributes of both size and decay, facilitating the creation of custom training lists.