TECHNICAL PAPER

STANDARDIZED UXO DEMONSTRATION SITES

ENGINEERING RESEARCH AND DEVELOPMENT CENTER (ERDC) – EM63/PUSHCART – *BLIND GRID SCORING RECORD NO. 304*

The EM63 in the pushcart platform is shown being demonstrated by the Engineering Research and Development Center (ERDC).

The EM63 in the pushcart platform was demonstrated by the Engineering Research and Development Center (ERDC) at the Aberdeen Proving Ground Standardized Demonstration Site's Blind Grid Area. This technical paper contains the results of that demonstration. This is a reference document only and does not serve as an endorsement of the demonstrator's product by the US Army or the Standardized UXO Technology Sites Program.

For more information

US Army Environmental Center
Public Affairs Office
410-436-2556, fax 410-436-1693
e-mail: usaecpao@aec.apgea.army.mil
http://aec.army.mil
http://www.uxotestsites.org

Technologies under development for the detection and discrimination of unexploded ordnance (UXO) require testing so that their performance can be characterized. To that end, Standardized Test Sites have been developed at Aberdeen Proving Ground (APG), Maryland and Yuma Proving Ground (YPG), Arizona. These test sites provide a diversity of geology, climate, terrain, and weather as well as diversity in ordnance and clutter. Testing at these sites is independently administered and analyzed by the government for the purposes of characterizing technologies, tracking performance with system development, comparing performance of different systems, and comparing performance in different environments.

The Standardized UXO Technology Demonstration Site Program is a multi-agency program spearheaded by the U.S. Army Environmental Center (USAEC). The U.S. Army Aberdeen Test Center (ATC) and the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC) provide programmatic support. The program is being funded and supported by the Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP) and the Army Environmental Quality Technology Program (EQT).

DEMONSTRATOR'S SYSTEM AND DATA PROCESSING DESCRIPTION

The EM63 is a commercially available sensor (produced by Geonics, Ltd., of Mississauga, Ontario, Canada, who also produces the EM61). It is a high power, high sensitivity, wide bandwidth full time domain UXO detector. The EM63 consists of a powerful transmitter that generates a pulsed primary magnetic field which induces eddy currents in nearby metallic objects. The time decay of the currents is accurately measured over a wide dynamic range of time. The output of the main sensor is measured and recorded by the main console at 20 to 30 geometrically spaced time gates, depending on the used repetition rate, covering a time range from 180 μs to 63 ms. The second receiver coil, axially mounted with the main coil, is used for target depth determination. The acquisition is either free running or controlled by wheel odometer or manual fiducial.

The EM63 system consists of three major hardware subsystems including the EM63 Control Console Sub-System, the Antenna Cart Sub-System and the GPS Navigation Sub-System. The EM63 Control Console Sub-System consists of receiver and transmitter unit, controlled by an integrated field computer. The control console also houses the system battery. The Antenna Cart Sub-System consists of the transmitter antenna (the 1- by 1- meter bottom coil) and receiver coils.

The GPS Navigation Sub-System. Local positioning and georeferencing of the Geonics EM63 system is accomplished using a Trimble 5700 real time kinematic (RTK) GPS system. The Trimble system consists of two receivers that are in radio communication with each other. A roving GPS antenna is mounted in the center of the EM63 coils and 2 meters above the bottom coil. The operator or assistant carries the controller for the roving antenna. The antenna is positioned so that it minimizes any influence on the EM63. The roving GPS system constantly receives corrections to the GPS signal from the base station.

Performance Summary

Results for the Blind Grid test broken out by size, depth and nonstandard ordnance are presented in the table below. Results by size and depth include both standard and nonstandard ordnance. The results by size show how well the demonstrator did at detecting/discriminating ordnance of a certain caliber range. The results are relative to the number of ordnance items emplaced. Depth is measured from the geometric center of anomalies.

The Response Stage results are derived from the list of anomalies above the demonstrator-provided noise level. The results for the Discrimination Stage are derived from the demonstrator's recommended threshold for optimizing UXO field cleanup by minimizing false digs and maximizing ordnance recovery. The lower 90 percent confidence limit on probability of detection and Pfp was calculated assuming that the number of detections and false positives are binomially distributed random variables. All results have been rounded to protect the ground truth. However, lower confidence limits were calculated using actual results.

Summary of Blind Grid Results for EM63/Pushcart

Metric	Overall	Standard	Nonstandard	By Size			By Depth, m		
				Small	Medium	Large	< 0.3	0.3 to <1	>= 1
RESPONSE STAGE									
P_d	0.75	0.85	0.65	0.80	0.70	0.90	0.95	0.70	0.30
P_d Low 90% Conf	0.69	0.76	0.50	0.68	0.55	0.66	0.87	0.59	0.13
P_d Upper 90% Conf	0.82	0.91	0.74	0.87	0.79	0.99	0.99	0.83	0.49
P_s	0.80	-	-	-	-	-	0.75	0.80	1.00
P_s Low 90% Conf	0.72	-	-	-	-	-	0.67	0.68	0.63
P_s Upper 90% Conf	0.84	-	-	-	-	-	0.85	0.87	1.00
P_{fp}	0.05	-	-	-	-	-	-	-	-
DISCRIMINATION STAGE									
P_d	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_d Low 90% Conf	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_d Upper 90% Conf	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_s	NA	-	-	-	-	-	NA	NA	NA
P_s Low 90% Conf	NA	-	-	-	-	-	NA	NA	NA
P_d Upper 90% Conf	NA	-	-	-	-	-	NA	NA	NA
P_{fp}	NA	-	-	-	-	-	-	-	-

Response Stage Noise Level: 2.00
Recommended Discrimination Stage Threshold: 0.05

Note: *The recommended discrimination stage threshold values are provided by the demonstrator. No discrimination algorithm was applied. Therefore, the discrimination stage results are not applicable.*

To view the full Scoring Record for this demonstration and for all other demonstrations conducted at the Aberdeen and Yuma Proving Grounds in support of the Standardized UXO Technology Demonstration Sites Program please visit our Web site at: www.uxotestsites.org.