Development and Evaluation of an Underwater Advanced Time-Domain Electromagnetic System for Munitions Response Classification

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Background/Objectives. Over 400 underwater sites have been identified by the U.S. Army Corps of Engineers and the U.S. Navy as potentially containing munitions. The cost to characterize munitions risks at underwater sites is significantly greater than performing the same activities at terrestrial sites. Current technologies allow for detection of metallic items in the underwater environment, but few allow for classification. Identification and characterization are currently performed through expensive and time-consuming process of manual inspection by Explosive Ordnance Detonation (EOD) experienced divers.

Approach/Activities. The overall objective of this project, funded as Environmental Security Technology Certification Program project MR-201313, is to design, build, and demonstrate an underwater advanced time-domain electromagnetic (TEM) system capable of cued data collection and classification of UXO in the underwater environment. The emphasis of this project is to design a system that can demonstrate classification effectiveness in the marine environment (as opposed to solving longer term issues such as positioning, deployment methods, system rigor). The phased approach consists of initial design and modeling (Phase 1 – completed), engineering design and construction (Phase 2 – completed), an underwater evaluation of the system in a controlled freshwater environment (Phase 3 – completed), and a demonstration of the system in a dynamic saltwater environment (Phase 4 – completed).

Results/Lessons Learned. Initial design and modeling of TEM response in an underwater conductive environment supported the pursuit of constructing the system. Initial underwater testing was performed using single-coil TEM components to support the results of modeling. The full system was fabricated as an array of transmitters and receivers by adapting existing TEM hardware components, and required development of electronics and data acquisition software capable of handling the larger data sets. Results from the October 2016 initial underwater demonstration in a freshwater testing pond indicated the system was capable of collecting data to support classification of a variety of munitions. The latest demonstration was the May 2018 testing of the system in a dynamic saltwater environment, at a depth of approximately 30 ft immediately off the beach at Duck, North Carolina. Tests for this demonstration included data collection and analyses to evaluate the ability to classify munitions types as small as 20 mm projectiles. Results indicate the system is capable of classification in a dynamic saltwater environment. Future demonstrations of the system may be performed to evaluate the effect of sediment type and sediment moisture content on background response, and their overall effect on the system's ability to classify munitions.