DETECTION AND CHARACTERIZATION OF MILITARY MUNITIONS USING ELECTROMAGNETIC ARRAYS DEPLOYED FROM REMOTELY OR UNMANNED VEHICLES

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Important seafloor applications, including mine countermeasures, unexploded ordnance (UXO) surveys, salvage, and underwater hazards, require the detection, geo-registration, and characterization of man-made targets on, or below, the seafloor. Investigations in littoral environments can be time-consuming and expensive due to the challenges of accurately tracking underwater assets, the difficulty of quick or effective site reconnaissance activities, high levels of clutter in nearshore areas, and lack of situational awareness and real-time feedback to operators. Consequently, a high payoff exists for effective methods using robotic mobile platforms, sensor and data fusion, and effective payload integration and deployment of UXO sensor arrays for near-shore surveying. We present technology development and demonstration results from multiple field experimental data collection campaigns over the last 3 years. These technology demonstrations have been focused on advancing seafloor target detection, tracking, and classification for specific military munition remediation missions. We demonstrate the challenges overcome in integrating and testing controlled-source electromagnetic sensors on a variety of remotely and autonomously operated sensing platforms (ROVs, AUVs and bottom crawling systems). In particular, we present aspects of the design, development, and testing of array configurations of multi-dimensional time-domain electromagnetic (EM) sensor arrays. Results from nearshore (surf zone and marsh in North Carolina) and littoral experiments (reef areas of Florida Keys) are presented. The primary demonstration system is based on a tow sensor sled pulled from a robotic bottom crawler tailored for onshore/offshore use and ruggedized for operations in challenging surf zone conditions. Metrics such as system mobility, autonomy, detection localization, and target discrimination against clutter and environmental noise are analyzed.