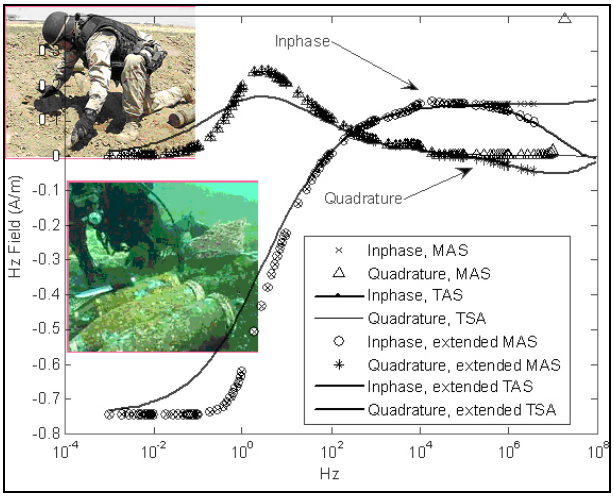
Buried Objects Detection and Discrimination: Combining Fast, Accurate and Physically Complete Forward and Inverse Models for UXO Identification Problems

Description

It is proposed the development of software package for signals processing, based on new forward and inverse modeling approaches to address today's most pressing environmental problem: detection and discrimination a buried subsurface objects, such as landmines, unexploded ordnances (UXO), geophysical deposits, and etc. The landmines and UXOs cleanup problems are not only well-defined issues for Georgia, (Note: in last decade several ethnic conflicts took place in Georgia) these are as one of most urgent problem in the world as well. The high costs that are associated of excavating all geophysical anomalies are well known and are one of the greatest impediments to efficient clean-up of landmines and UXO contaminated lands at former military sites. Recently, low frequency electromagnetic induction sensing has been identified as one of most promising technologies for both detection and discrimination; however, classifying between an object of interests and metallic clutter continues to be a major environmental cleanup problem. For example, field experiences indicate that 75% of the costs to clean up UXO sites are currently spent on excavating targets that pose no threat.



Innovative Aspect and Main Advantages

Innovative discrimination techniques that can reliably distinguish between object of interests and non-important metallic items are required, particularly in areas where the geological background causes a measurable response in the sensor. Currently used discrimination procedures can be divided into two steps: (1) geophysical and (2) mathematical step. The geophysical step involves determining the object's EM response at the measurement surface due to time-varying, very low frequency (zero's Hertz' up to several hundred's of kilo Hertz's) distributed primary/ transmitter current sources, and in mathematical step inverts object's EM and geometrical parameters by combining forward models and geophysical data. Usually, these two approaches have been developed separately. In low frequency regime, considered here, the induced volume currents inside the object depend on frequency and the electromagnetic parameters of the surrounding geology. The resulting total EM response at the surface of the receiver is a combination of the responses of the object and background/soil. However, in most existing approaches to buried metallic object discrimination, the object of interest is assumed to be embedded in a medium with the same electromagnetic properties as free-space. Any influence of the background medium is assumed to have been removed by pre-processing or filtering before the data are submitted to an inversion routine. However, "geologically hostile" sites can cause significant problems for magnetometers and electromagnetic induction sensors, in terms of both decreased probability of detection and increased probability of false alarm. For instance, during production surveys carried out on Kaho'olawe island approximately 30% of identified anomalies were from false positives due to geology. These problems were due to the strong magnetic viscosity exhibited by the basaltic soils at the site, exacerbated by the rough micro-topography on the site. Similar magnetically susceptible soil exists in Georgia, between Adjaria and Guria administrative borders. Notice that during the Rose revolution in 2004, on the border area several anti personal and antitank land mines were resided and lost. Thus for a public safety it is important to detect and remediate them.

Areas of Application

UXOs cleanup of contaminated areas, Geophysical Engineering.

Stage of Development

Currently, computational code is developed for an object that is placed in a conducting and permeable soil; Computed and analyzed the interaction effects between object and its surrounding medium. Inversion methodology and computational codes to invert an object's and its surrounding medium's EM parameters simultaneously are developed.

Contact details

Organization: Faculty of Exact and Natural Sciences, Tbilisi State University;
Contact person: Kakulia David;
Address: 3,Chavchavadze ave., 0128, Tbilisi, Georgia.
Tel: +99532 231397 *Fax*: +99532 290845
E-mail: dkakulia@laetsu.org
URL: www.laetsu.org