Introduction to Classification Methods for Military Munitions Response Projects

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Objective of the Course

Provide a tutorial on the sensors, methods, and status of the classification of military munitions using geophysical methods

- Advanced processing of data collected with existing commercial instruments
- Promising results from emerging optimized systems

SERDP and ESTCP have supported a number of investigators over the years who have

- developed processing approaches to extract target-specific attributes from data collected by commercial geophysical sensors, and
- demonstrated advanced sensors designed with the munitions response problem in mind.

These research efforts have resulted in an impressive ability to classify the source of geophysical anomalies as “targets-of-interest” or non-hazardous items under simple conditions with the promise of expansion to a wider range of conditions as the newest sensors mature.

This course is intended as a tutorial on these classifications methods. We begin with a brief introduction to some of the terminology and concepts that will be used, introduce the basics of the two primary geophysical instruments used in munitions response, discuss the methods used for classification and illustrate them with two case studies, preview the next generation of EM sensors emerging from the research program, and conclude with a brief summary and presentation of a idealized cost model for classification.
The success of this course is due to the hard work of our three primary presenters.

Dr. Steve Billings from Sky Research will introduce the terminology to be used and discuss the concepts of magnetics.

Dr. Tom Bell from SAIC will discuss the basics of EM sensors and later in the course present examples of the capabilities of the emerging EM sensors.

Dr. Dean Keiswetter of SAIC will discuss the methods used for classification and follow with two case studies that illustrate the performance that can be achieved using commercially-available sensors.
The Munitions Problem

- There are over 3,000 sites suspected of contamination with military munitions
- They comprise 10s of millions of acres
- The current annual cleanup effort is on the order of 1% of the projected total cost
- To make real progress on this problem, we need a better approach

There are a very large number of sites in the US suspected of being contaminated with military munitions but the remediation budget each year represents only about 1% of the multi-billion dollar projected total remediation cost. This leads to remediation projects having planned completion dates late in this century. Given budget realities, the only way to accelerate this effort is to develop methods to accomplish more remediation with the available funding.
This chart, from the 2003 report of the Defense Science Board Task Force on UXO [http://www.acq.osd.mil/dsb/reports/uxo.pdf], shows us one approach to the savings we seek. On a typical munitions clean-up project, an overwhelming fraction of the money is spent removing non-hazardous items from the site. If a method can be devised to identify these non-hazardous items and remove them with fewer safety precautions or leave them in the ground, this money could be transferred to other projects.
As we saw in the last slide, classification (sorting the sources of geophysical anomalies into “targets-of-interest” and non-hazardous items) holds the promise of real cost savings.

Many stakeholders, however, are leery of applying classification methods at their site. It is important that they recognize that classification is being performed implicitly now. In an analog geophysical survey (often termed Mag & Flag), the operator decides on the instrument sensitivity to select and what level of response to call a “hit.” Neither of these choices can be revisited after the survey is complete. Even if digital geophysical mapping techniques are used, the data analyst makes decisions about what to call an anomaly, often on-the-fly and without defined procedures.

What we seek is a principled, data-driven approach to classification. This involves data collection and analysis methods as well development of a process in which all stakeholders can have confidence.