UX-Analyze for Classifying Unexploded Ordnance

Authors: Dean Keiswetter, Acorn SI, Tom Furuya, Geosoft Inc., Nick Valleau, Geosoft Inc., Darren Mortimer, Geosoft Inc.

NAOC Annual Meeting – St. Petersburg Florida, December 2018

What is UX-Analyze?

It is software that provides the means and methods to analyze electromagnetic induction (EMI) sensor data for the purposes of classifying unexploded ordnance (UXO). UX-Analyze addresses the problem of classifying a buried object as UXO or not, based on analysis of electromagnetic induction (EMI) data.

It is transparent, modular, and available. It includes:
- data quality control;
- target plodding from dynamic EMI data;
- classification analysis; and
- mapping of basic and advanced geophysical sensor data.

UX-Analyze has undergone major updates and development over the last two years. It can be used for dynamic and static survey data in both underground and terrestrial environments.

Typical Advanced Geophysical Classification (AGC) Project Workflow

AGC Process Oversimplified

Advanced EM Data Collection Technology

Advanced electromagnetic (EM) sensors allow for the classification of UXO.

- adequate sampling of the EMI transients;
- broadbandwidths.

Quality Control

Consistent and thorough quality control throughout the AGC process is paramount to making defensible decisions. Lessons learned during past projects have been institutionalized into the UX-Analyze workflow.

The five major quality control checks include:
1. Sensor data acceptance checks to verify all data are operating within specifications.
2. Sensor function tests to verify correct EMI sensor functionality.
3. Instrument verification strips to verify performance of the sensor as well as the GPS data and software performance.
4. Background location validation to ensure appropriate background locations to obtain readings absent of anomalous data.
5. Background measurements to enable leveling (removing geologic and instrument noise).

Classification

Classification decisions are made by matching polarizabilities derived from unknown source items to those from a library of classification decision data derived from munition types suspected to exist at the site.

Classification Product

The final product of the data analysis is a dig list, ranking all detected targets by their similarity to the library. UX-Analyze produces the data products above to evaluate and document clean locales.

Benefits to UX-Analyze in the Cloud

- Unprecedented management efficiencies;
- Ultimate transparency;
- Optimum collaboration for contractor, government buyer, and regulator;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Benefits of using UX-Analyze for AGC

- Prioritized dig list;
- Detailed, digital record of decision process;
- Detailed quality control measures;
- Measured and derived attributes for all buried metal items;
- Millions of dollars saved in reduced excavations.

Approved Sensors and Acquisition Modes

• Library bundle to process DoD HDF5 Library sources during processing.
• Ultimate transparency;
• Cloud computing speeds;
• Automatic version control;
• Project auditing;
• State-of-the-art security;
• No local software installations.

AGC-QAPP & Quality

The DoD Advanced Geophysical Classification Quality Assurance Project Plan (AGC-QAPP) was developed in 2017 and specifies quality-related requirements and encourages structure, schedule, and standard products.

Adhering to the AGC-QAPP may be difficult, but the truth is, the AGC-QAPP strengthens our classification decisions. The quality control tools enable contractors to meet these requirements.

UX-Analyze: Current Version

The current version of UX-Analyze v4.9.4D and provides a complete workflow for both static and dynamic data processing and analysis. New features include:
- Static MPV processing and analysis;
- Library bundle to process DoD HDF5 library data;
- Master database to document and track progress of work/QC on a project.

Multiple UX-Analyze versions have been validated for use on DoD projects by the EDCQW – Advanced Geophysical Classification Subgroup. Most commercial entities successfully carrying out their AGC-DAGK accreditation demonstration at Aberdeen Proving Ground have used UX-Analyze. The chart below provides details on the versions of Oasis montaj and UX-Analyze that have been validated. More details can be found at www.geosoft.com/products/ux-analyze/validated-versions.

Recent Validated UX-Analyze Versions

<table>
<thead>
<tr>
<th>Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UX-Analyze: Current</td>
<td>v4.9.4D</td>
</tr>
</tbody>
</table>

Technology Transfer

UX-Analyze is available to U.S. government employees, regulators, and contractors for U.S. government projects at no cost. It requires Geosoft’s commercial Oasis montaj and UXO Land software as a platform.

Benefits of using UX-Analyze for AGC

- Prioritized dig list;
- Detailed, digital record of decision process;
- Detailed quality control measures;
- Measured and derived attributes for all buried metal items;
- Millions of dollars saved in reduced excavations.

Approved Sensors and Acquisition Modes

- Library bundle to process DoD HDF5 Library sources during processing.
- Ultimate transparency;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Benefits to UX-Analyze in the Cloud

- Unprecedented management efficiencies;
- Ultimate transparency;
- Optimum collaboration for contractor, government buyer, and regulator;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Approved Sensors and Acquisition Modes

- Library bundle to process DoD HDF5 Library sources during processing.
- Ultimate transparency;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Benefits of using UX-Analyze for AGC

- Prioritized dig list;
- Detailed, digital record of decision process;
- Detailed quality control measures;
- Measured and derived attributes for all buried metal items;
- Millions of dollars saved in reduced excavations.

Approved Sensors and Acquisition Modes

- Library bundle to process DoD HDF5 Library sources during processing.
- Ultimate transparency;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Benefits to UX-Analyze in the Cloud

- Unprecedented management efficiencies;
- Ultimate transparency;
- Optimum collaboration for contractor, government buyer, and regulator;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Approved Sensors and Acquisition Modes

- Library bundle to process DoD HDF5 Library sources during processing.
- Ultimate transparency;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Benefits of using UX-Analyze for AGC

- Prioritized dig list;
- Detailed, digital record of decision process;
- Detailed quality control measures;
- Measured and derived attributes for all buried metal items;
- Millions of dollars saved in reduced excavations.

Approved Sensors and Acquisition Modes

- Library bundle to process DoD HDF5 Library sources during processing.
- Ultimate transparency;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Benefits to UX-Analyze in the Cloud

- Unprecedented management efficiencies;
- Ultimate transparency;
- Optimum collaboration for contractor, government buyer, and regulator;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Approved Sensors and Acquisition Modes

- Library bundle to process DoD HDF5 Library sources during processing.
- Ultimate transparency;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Benefits of using UX-Analyze for AGC

- Prioritized dig list;
- Detailed, digital record of decision process;
- Detailed quality control measures;
- Measured and derived attributes for all buried metal items;
- Millions of dollars saved in reduced excavations.

Approved Sensors and Acquisition Modes

- Library bundle to process DoD HDF5 Library sources during processing.
- Ultimate transparency;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Benefits to UX-Analyze in the Cloud

- Unprecedented management efficiencies;
- Ultimate transparency;
- Optimum collaboration for contractor, government buyer, and regulator;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Approved Sensors and Acquisition Modes

- Library bundle to process DoD HDF5 Library sources during processing.
- Ultimate transparency;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Benefits of using UX-Analyze for AGC

- Prioritized dig list;
- Detailed, digital record of decision process;
- Detailed quality control measures;
- Measured and derived attributes for all buried metal items;
- Millions of dollars saved in reduced excavations.

Approved Sensors and Acquisition Modes

- Library bundle to process DoD HDF5 Library sources during processing.
- Ultimate transparency;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Benefits to UX-Analyze in the Cloud

- Unprecedented management efficiencies;
- Ultimate transparency;
- Optimum collaboration for contractor, government buyer, and regulator;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Approved Sensors and Acquisition Modes

- Library bundle to process DoD HDF5 Library sources during processing.
- Ultimate transparency;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.

Benefits of using UX-Analyze for AGC

- Prioritized dig list;
- Detailed, digital record of decision process;
- Detailed quality control measures;
- Measured and derived attributes for all buried metal items;
- Millions of dollars saved in reduced excavations.

Approved Sensors and Acquisition Modes

- Library bundle to process DoD HDF5 Library sources during processing.
- Ultimate transparency;
- Cloud computing speeds;
- Automatic version control;
- Project auditing;
- State-of-the-art security;
- No local software installations.