Efficient and Secure Cloud Computing for UXO Classification and Project Management

MR-201713
Dean Keiswetter
Acorn Science and Innovation, LLC
In-Progress Review Meeting
2/21/2018
MR-201713: Cloud Computing for UXO Classification

Performers: AcornSi and Geosoft, Inc.

Technology Focus
• Detection, Classification and Remediation of Military Munitions

Demonstration Site
• Former Lowry Bombing and Gunnery Range

Demonstration Objectives
• Develop and demonstrate Cloud based data analysis and classification capabilities
• Classification performance that matches PC-based UX-Analyze

Project Progress and Results
• Cloud-based Workflow
• Cloud-based Architecture
• UX-Analyze Web Server

Implementation Outlook
• Excellent
• Rick Grabowski offered Corps of Engineers support
“A new ESTCP project begun 2017 is bringing advanced UXO classification to the cloud. *This exciting project* is expected to deliver enhanced data and project security, speed of processing and analysis, auditability, and many other benefits. Year one developments included data handling schemes, system architecture, user experience interfaces, interactive linking, and EM inversions.”
Project Team

- Dean Keiswetter, Ph.D.
- Tom Furuya
- Bruce Barrow, Ph.D.

- Nick Valleau
- Hossein Madjidi
- Sameh Mora
- Melany Bailette
- Tara Marshall
- Darren Mortimer
- Rina Hartmann
- QA testers (2)
Problem Statement

This project addresses the detection, classification, and remediation of military munitions.

- It is highly relevant and important, given the 2017 DoD Policy that declares Advanced Geophysical Classification technologies the default technology for MMR responses.

The current approach is to utilize PC-based, UX-Analyze software. Limitations of PC-based solutions include:

- compartmentalized security
- compartmentalized collaboration and communication
- compartmentalized version control, activity logging, and auditing
- local IT requirements
- local and limited processing speed
Problem Statement (over simplified)

**PC-based Analysis**

...process local, provide snapshots of progress

Contractor

My government system can’t view the data…

Government Buyers

Have they validated the sensor yet?

State/Fed Regulator

Why am I not updated?

State/Fed Regulator

Buyers
Technical Objective

Our objective is to develop and demonstrate an effective, efficient, and secure cloud computing technology for classifying buried metal as UXO or not, based on the analysis of multi-coil electromagnetic induction (EMI) data.

Cloud Computing Characteristics

- On-demand self service
- Ubiquitous network access
- Location-independent
- Rapid elasticity
- Pay per use
Technical Approach

Leverage commercial cloud infrastructure and platforms with UX-Analyze work flows, processes, and solvers

Cloud Technology
- Strong security policies and backup procedures
- Data is encrypted and safe while at rest or in transit
- Efficient data transfer and storage containers

UX-Analyze
- Mature solvers and classification logic
- Efficient user workflows and processing schemes
- Proven track record
- Strong user base
Technical Approach

UX-Analyze is a suite of advanced software tools developed by Acorn SI and Geosoft over many years with funding from ESTCP.

Over 350 individuals (45 firms) have participated in 2-day, data-analysis workshops.

Multiple commercial firms have successfully used UX-Analyze during AGC-DAGCAP accreditation demonstrations.
Technical Approach

UX-Analyze: Workflow & QC

- High level bundles to guide data analysis
- Institutionalized QC measures and products
  - Sensor function tests
  - Instrument verification strips (IVS)
  - Check every sensor stream for quality
  - Background location validation
  - Background measurements
Technical Approach

Cloud-based analysis
# Technical Progress

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<td>UX-Analyze Web Server</td>
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<td>2c</td>
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Technical Progress

UXA Data Architecture

Survey Instrument
- Instrument Dump Files
  - Survey Data

Contractor Geophysicist Personal Computer
- UXA Desktop OM Database & Project Storage
  - Survey Data
  - Maps

Microsoft Azure Cloud
- UXA Cloud Project Storage & Azure Blob and Table
  - Survey Data
  - Maps
  - Graphs
  - Reports
  - Audit Logs
  - User Profiles & Permissions

Contractor
- Project Data Archive
  - ZIP
Technical Progress

UXA Cloud Applications

UXA Cloud Web Client
All Users

Microsoft Azure
UXA Cloud System
UXA Cloud Web Application
UXA Processing Server
Oasis montaj Cloud Storage
Microsoft Azure Table and Blob
Microsoft Azure Platforms
Microsoft Azure Infrastructure

UX-Analyzer
Contract Geophysicist
Oasis montaj Database & Storage
Technical Progress

Summary of accomplishment to date...

Data Transfer GX: from Desktop OM to Cloud
Graphical Look and Feel (cards, forms, etc.)
System behavior and user notifications during events
Workflow for Cued Data (Classify and Rank)
Graphical displays for a variety of cards
Linking tool between data displays
User Interactive Capability
Inversions + OM math (size and decay calculations)
Technical Progress

Selected Project Details of selected project:
• project name
• project creation date
• project description
• project members

Double click to enter project.
OR Single click project name to enter project.
Technical Progress

Navigation, appears after clicking icon
Information messages appear on cards with no data.

Process Classify and Rank

Classify and Rank view
Technical Progress

Classify and Rank Bundler

Invert for Sources Settings
Technical Progress

Invert for Sources Settings

Applies changes made.
Technical Progress

Classify and Rank Bundler re-appears

Clicking Run, runs process in the cloud.
An info message box appears for 10 seconds.

Blue badge appears.

Classify and Rank icon is disabled for the selected Type and Geo ID that is running in the cloud.

Clicking on Activities icon opens a panel.
Technical Progress

Activities Panel

Progress of process running in the cloud.
A success message box appears for 10 seconds.

Green badge appears.
Technical Progress

Activities Panel

Log of activities for project Spencer.

Clicking View brings the user to that view with the Type and Geo ID selected.
Technical Progress
Technical Progress

Parallel batch jobs...

Application package (inversion DLL, instructions, IO Azure)

Procure the Application pool (collection of virtual machines)
Technical Progress

Parallel batch jobs...example run

1000 cued data collections
20 VM’s procured, each processed 50 measurements
Execution time < 9 minutes
We proposed an initial system shakedown test, followed by the analysis of a complete, canned data set; processing the data in the same sequence as it was collected.

The data of opportunity are TBD and will be selected in consultation with the Program Office. The data recently collected the Former Lowry Bombing and Gunnery Range by Parsons may be a strong candidate.

The planned demonstration is one year out.
How will the service be consumed – high-level vision

- **Implementation of UX-Analyze Cloud Service**
  
  *Managed Service* by Geosoft (initially)
  
  - Provisioned cloud service, security, software and storage
  - Infrastructure/framework & System configuration
  - UX-Analyze deployment
  - Project decommissioning

  *Administered Service* by project prime contractor
  
  - Manages user and project permissions
  - UX-Analyze - data processing and analysis
  - Overall project management
  - Archiving and project completion
How will the service be consumed – high-level vision

- Subscription/Project fees
  - Provided as a service per project - rather than purchasing computers, software, IT services etc.
  - Service fees based primarily on:
    - Project size
    - Project duration and scope
    - Number and type of users
    - Extendable if project is modified or expanded
### Action Items

#### MR-201713  In Progress
Efficient and Secure Cloud Computing for UXO Classification and Project Management
Dean Keiswetter | Acorn Science and Innovation, Inc.

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<tr>
<th>Task Details</th>
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<tr>
<td>January 2018 Quarterly Progress Report</td>
<td>1/15/2018</td>
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<tr>
<td>Revision - Plan: Cloud based Workflow - report describing the planned workflow (v2)</td>
<td>2/6/2018</td>
<td>Overdue 14 days</td>
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<tr>
<td>Revision - Plan: Cloud Structure Architecture - report detailing the architecture and final approach for cloud processing (v2)</td>
<td>2/6/2018</td>
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<td>Security Services</td>
<td>3/28/2018</td>
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<tr>
<td>Reporting Services</td>
<td>8/28/2018</td>
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Technology Transfer

- Technology transfer is a critical part of this project.

- The primary technology transfer component of this specific effort is our report detailing the UX-Analyze Cloud and the direct, hands-on participation of a contractor, a Corps of Engineers geophysicist, and a State regulator in the final demonstration.
Technology Transfer

Upon successful completion of this program, we will solicit funding to aggressively pursue a number of technology transfer approaches targeting multiple audiences.

Suitable technology transfer approaches will likely include:
- Training workshops, live or via webinar
- Presentations at key conferences
- Web-based tools (see example at link)
- Technology fact sheets