SERDP and ESTCP Initiatives on Environmental Munitions Response

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Strategic Environmental Research
and Development Program

Environmental Security Technology
Certification Program

Agenda

- Who We Are

- The Terrestrial UXO Problem
  - ♦ We are mostly finished with this

- The Underwater UXO Problem

DoD's Environmental Technology Programs

Science and Technology

Demonstration/Validation

- DoD, DOE, EPA Partnership
  - ♦ Fundamental research to impact real world environmental management
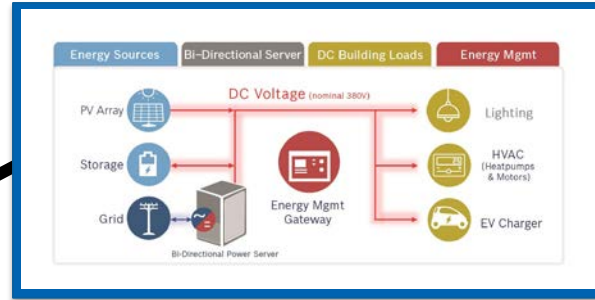 - ♦ Advanced technology development to address near-term needs

- Demonstrate Innovative Cost-Effective Environmental and Energy Technologies
- Promote Implementation
  - ♦ Direct Technology Insertion
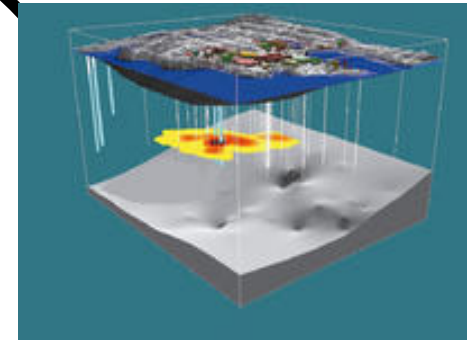 - ♦ Partner with End User and Regulator

Program Area Management Structure

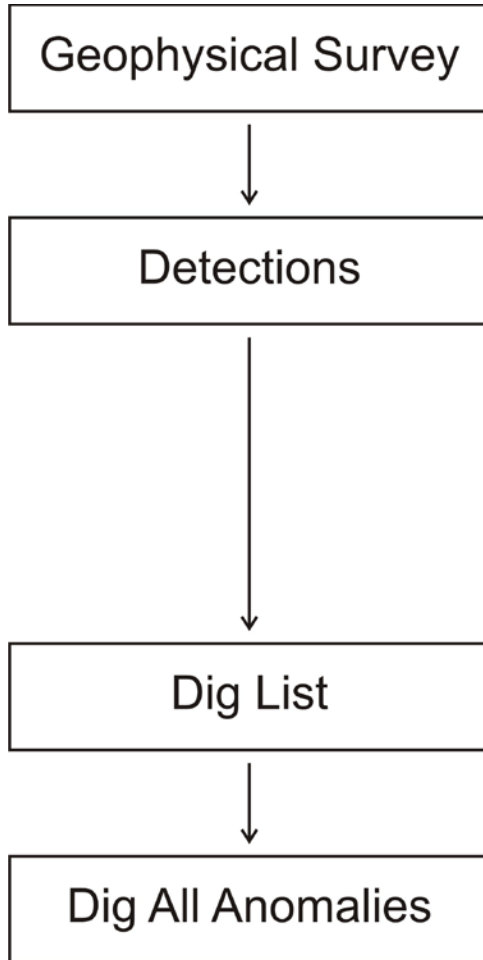**Weapons Systems & Platforms**

Environmental Restoration

Energy & Water (ESTCP only)

Resource Conservation & Resiliency

Munitions Response

Traditional Munitions Response Is An Inefficient Process

Geophysical Survey

↓

Detections

↓

Dig List

↓

Dig All Anomalies

- Costs are dominated by digging scrap
  - Often <1% are UXO
  - Example: Camp Butner, NC
    - 146 UXO out of >500,000 digs
    - Only 0.03% are UXO!

- ~$13B Cost to Complete

Defense Science Board 2003

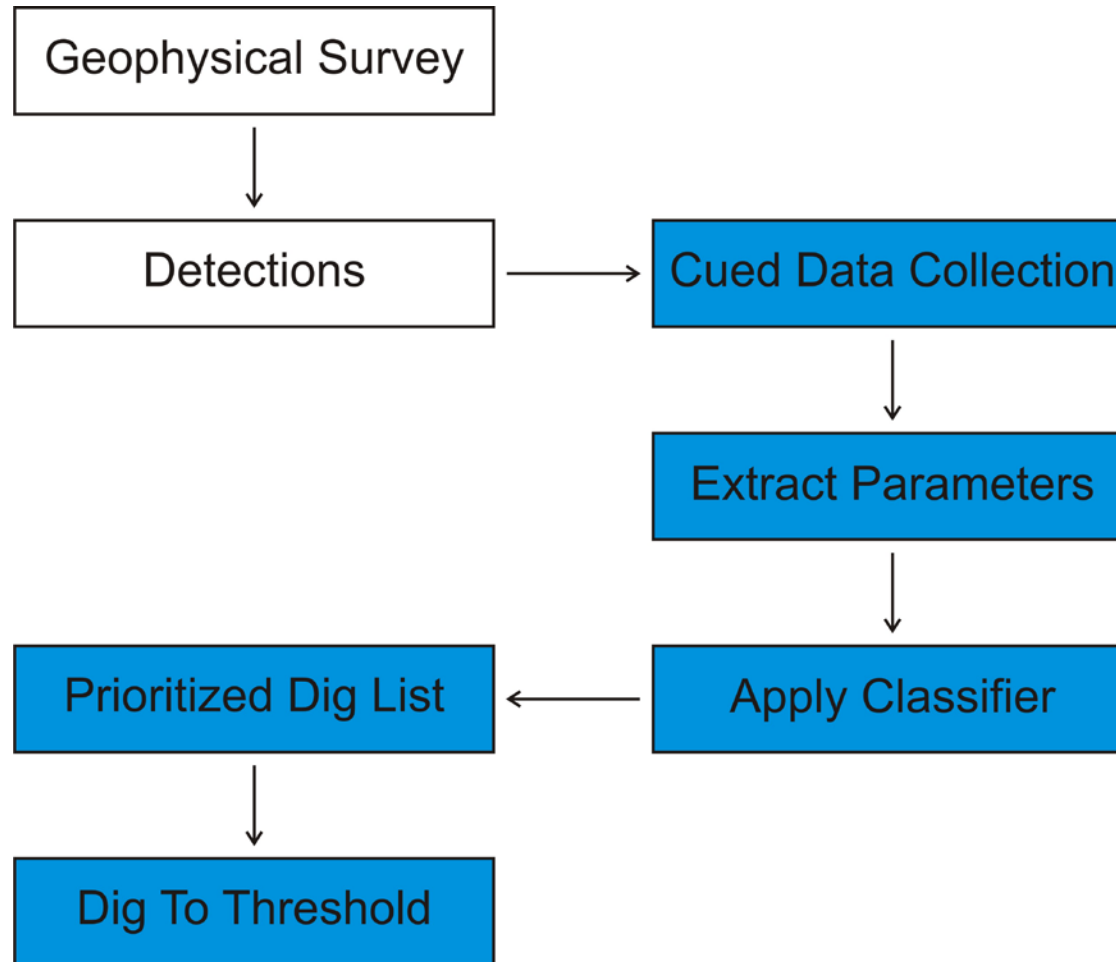(Bar chart: % of Total Costs vs. Site Assessment, Survey and Mapping, Vegetation Removal, Scrap Metal Removal, UXO Removal)
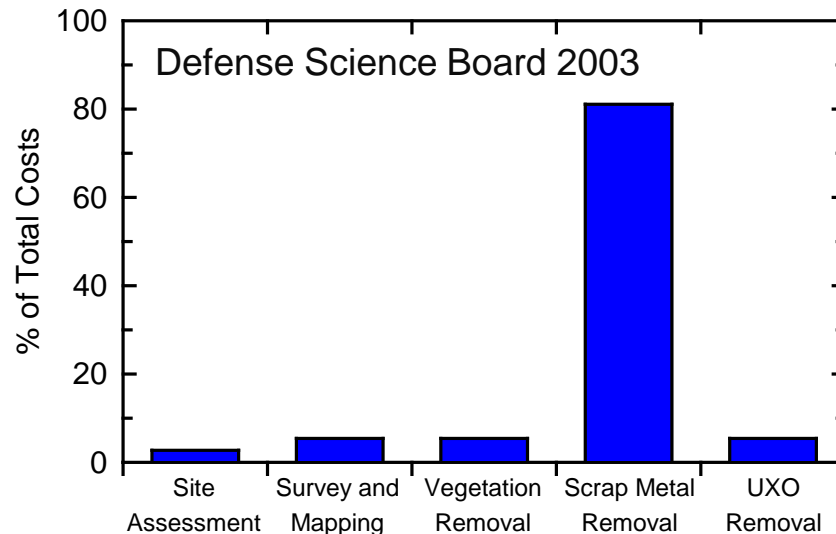
There Is Also an Environmental Cost

- Many sites can not tolerate the destruction resulting from 200 to 300 digs per acre
  - ♦ wilderness areas
  - ♦ marshland
  - ♦ recreation areas
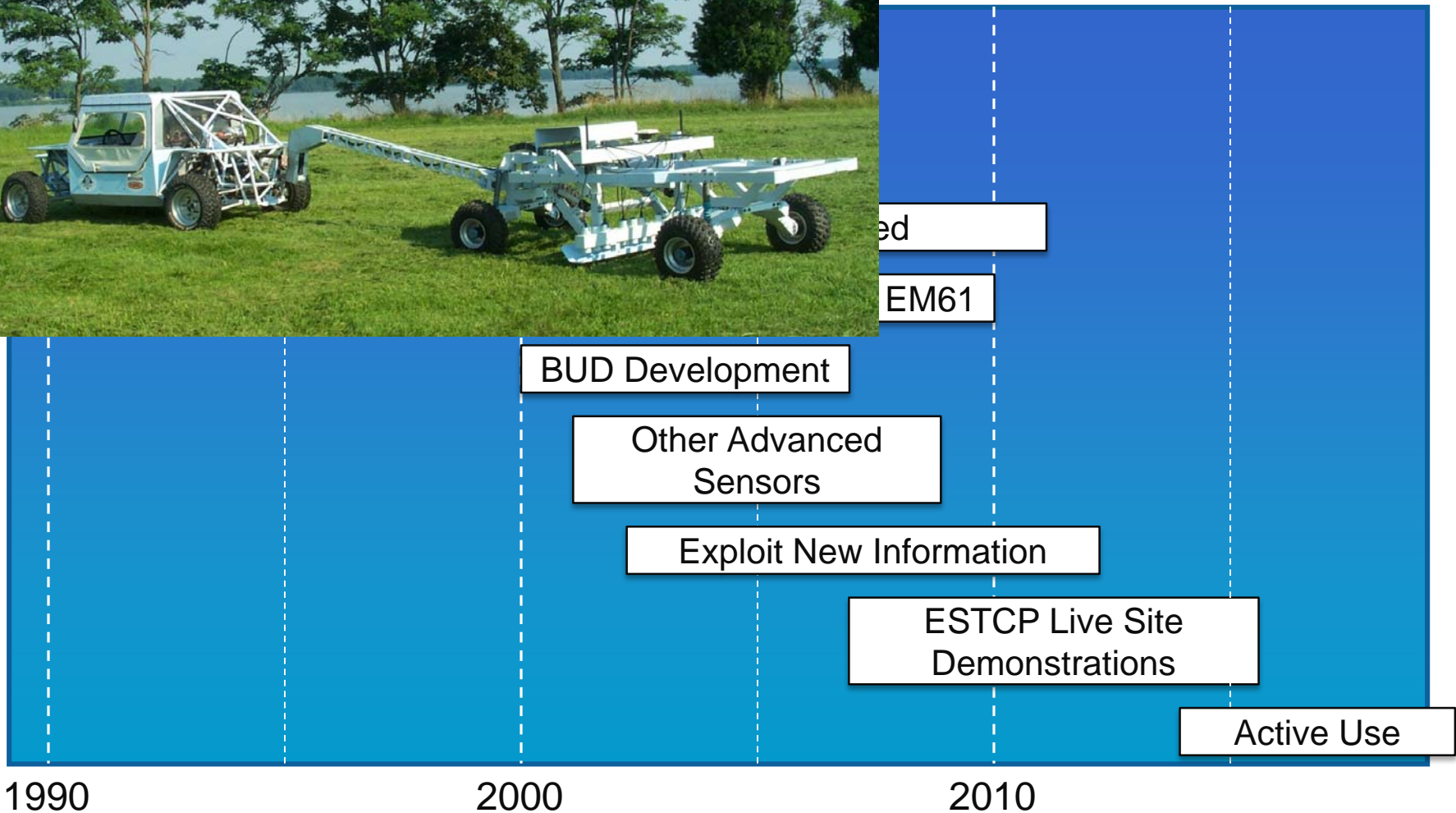 - ♦ other sensitive habitat areas

Classification Approach

```
┌──────────────────────┐
│  Geophysical Survey  │
└──────────────────────┘
           │
           ▼
┌──────────────────────┐         ┌──────────────────────┐
│      Detections      │────────▶│  Cued Data Collection │
└──────────────────────┘         └──────────────────────┘
                                            │
                                            ▼
                                 ┌──────────────────────┐
                                 │   Extract Parameters  │
                                 └──────────────────────┘
                                            │
                                            ▼
┌──────────────────────┐         ┌──────────────────────┐
│  Prioritized Dig List │◀───────│    Apply Classifier   │
└──────────────────────┘         └──────────────────────┘
           │
           ▼
┌──────────────────────┐
│    Dig To Threshold  │
└──────────────────────┘
```

How Do We Classify Munitions?

Visually, we use physical attributes such as size & shape

Because we cannot see buried objects, we must rely on attributes determined from geophysical data

Terrestrial Munitions Response

...ed

EM61

BUD Development

Other Advanced Sensors

Exploit New Information

ESTCP Live Site Demonstrations

Active Use

1990   2000   2010

Electromagnetic Induction Sensors

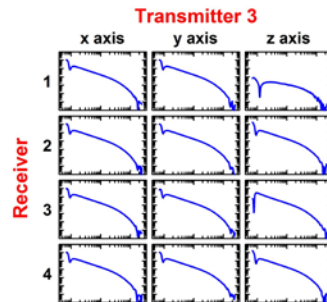Typical Electromagnetic Induction Sensor
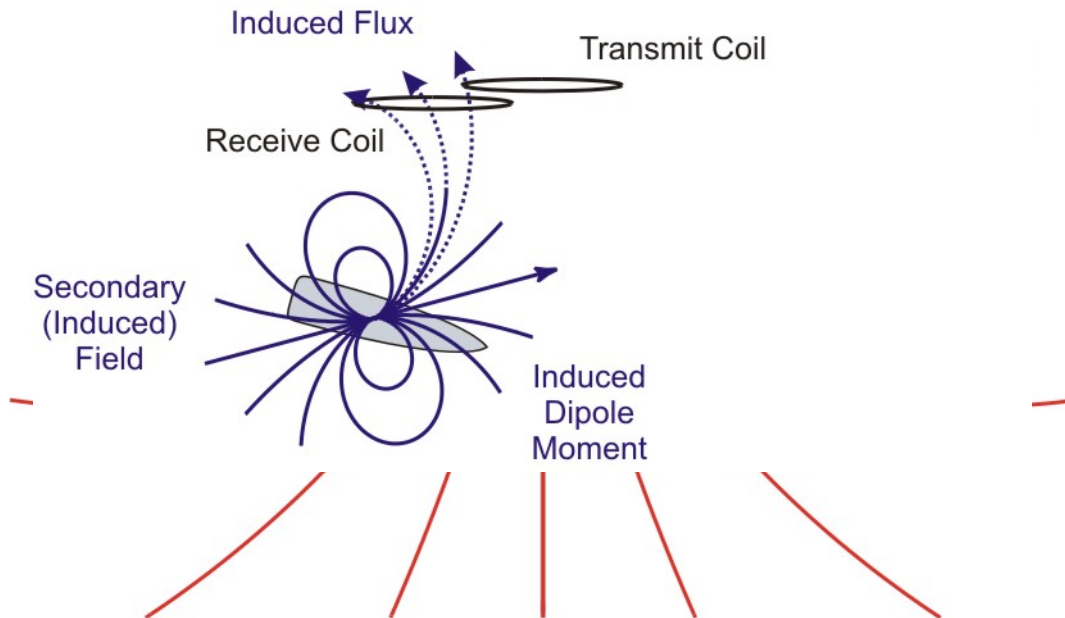
Excitation Pulse

Induced Target Response

Sense Induced Field

Polarizabilities Do Not Change with Burial Depth or Orientation
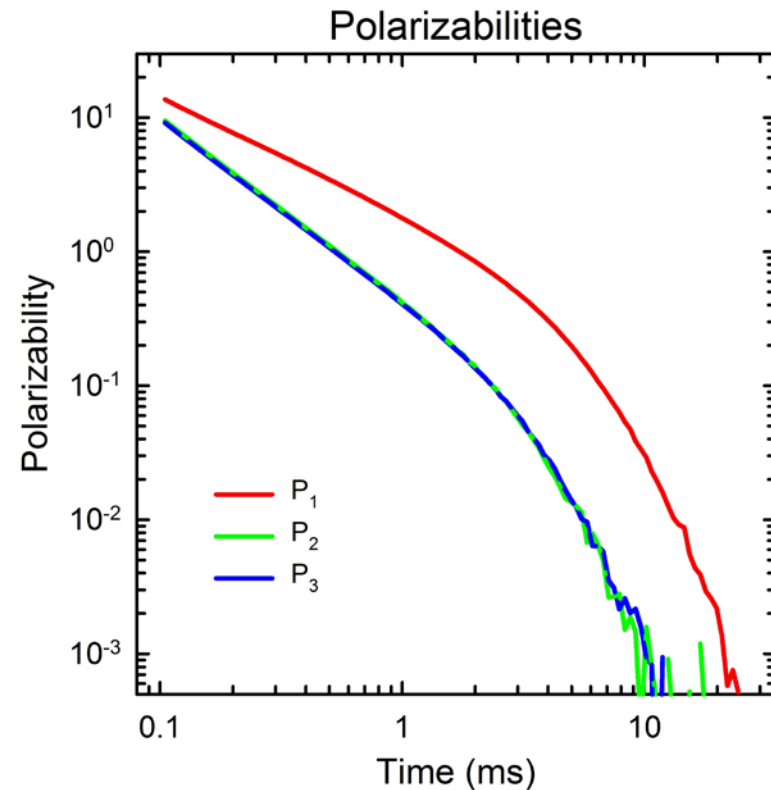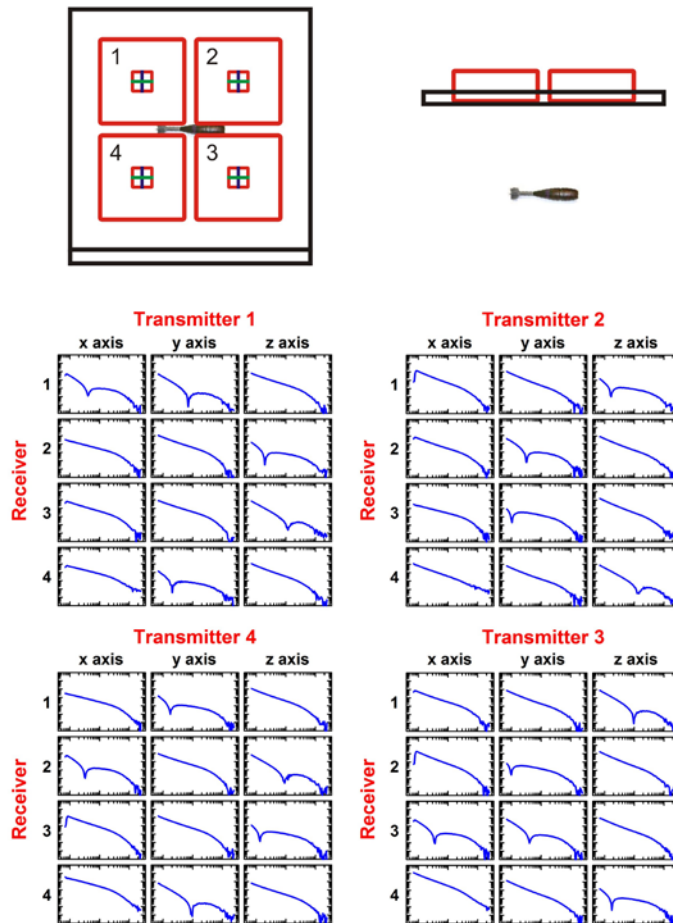
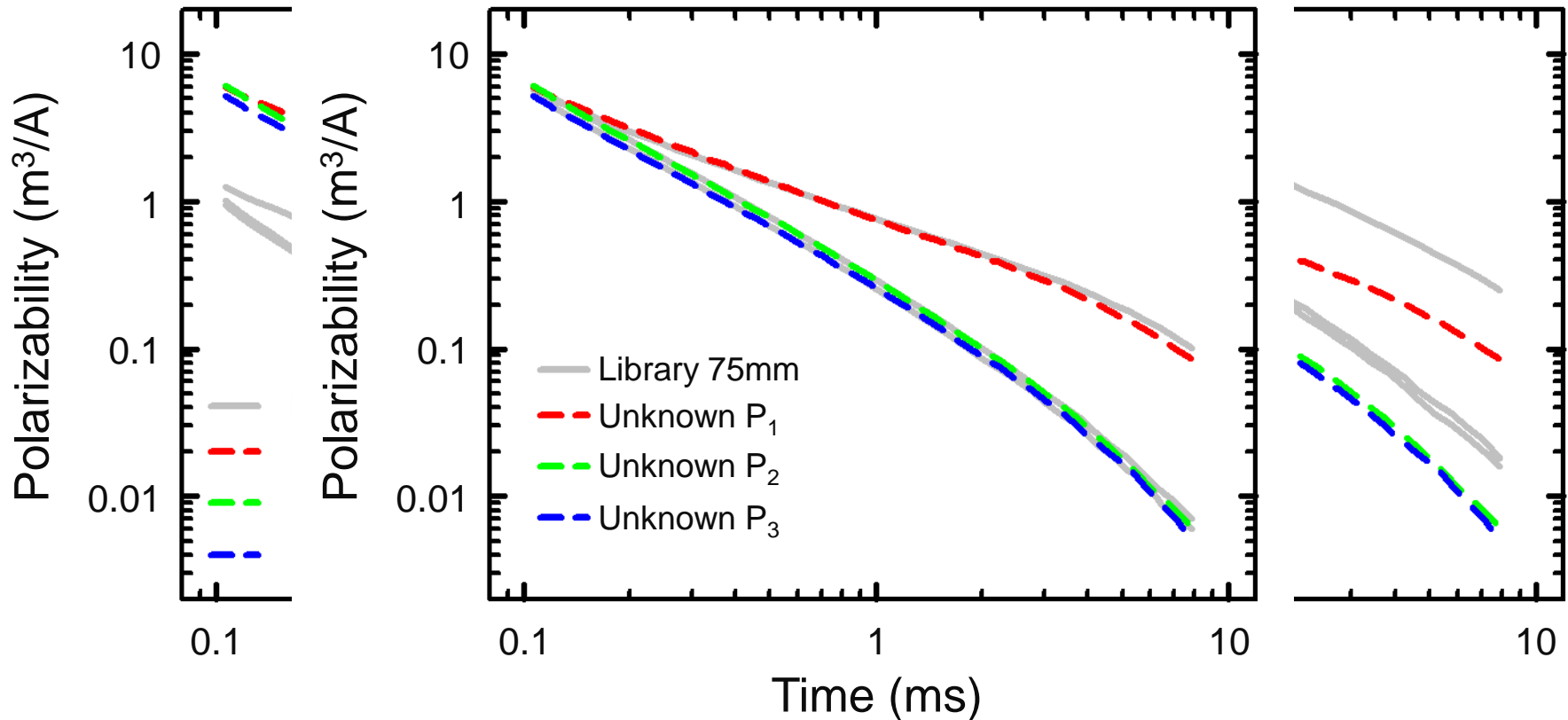# Polarizabilities Do Not Change with Burial Depth or Orientation
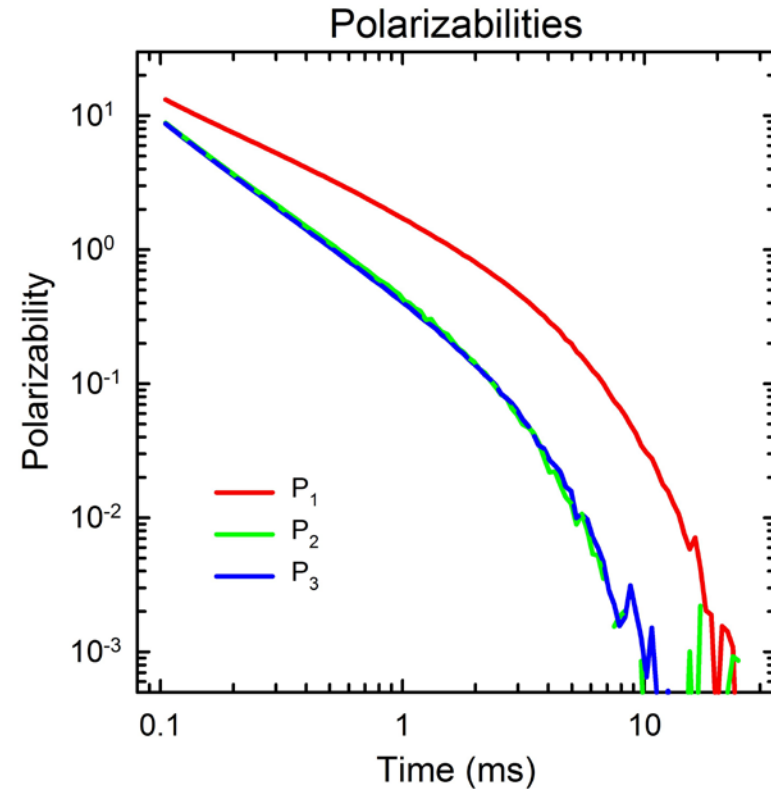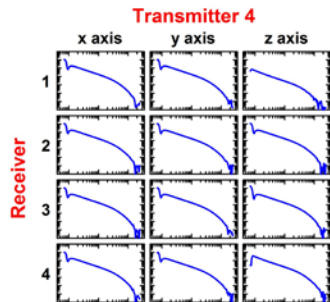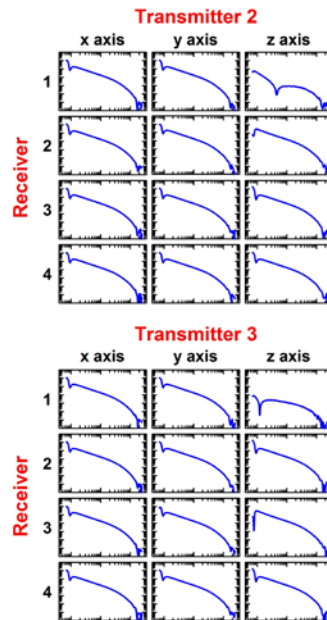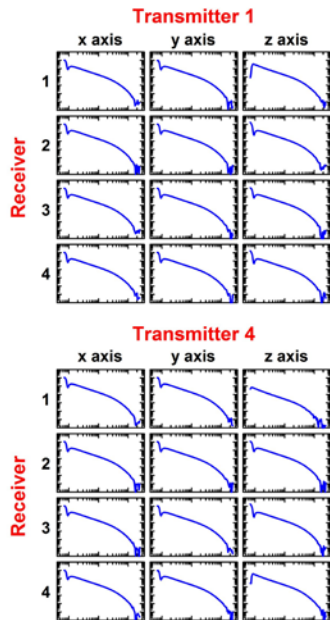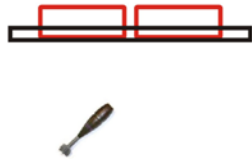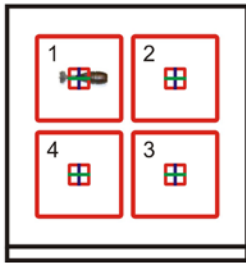
Target Features from EMI Data

- Intrinsic responses (polarizabilities) along target's principal axis directions fully characterize EMI signal
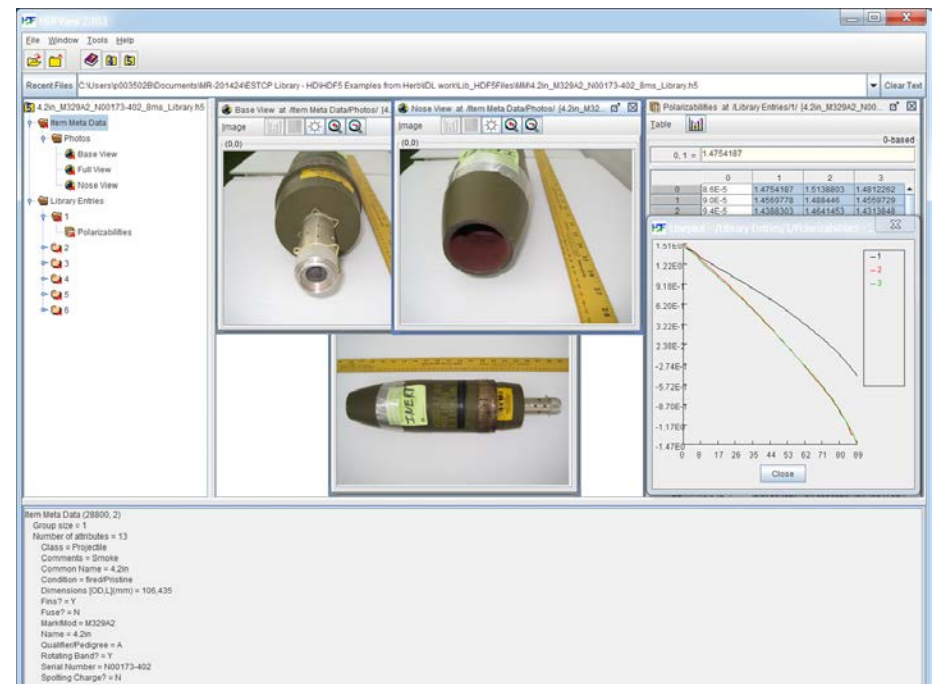 - ♦ Requires illumination of target and observation of response from all directions
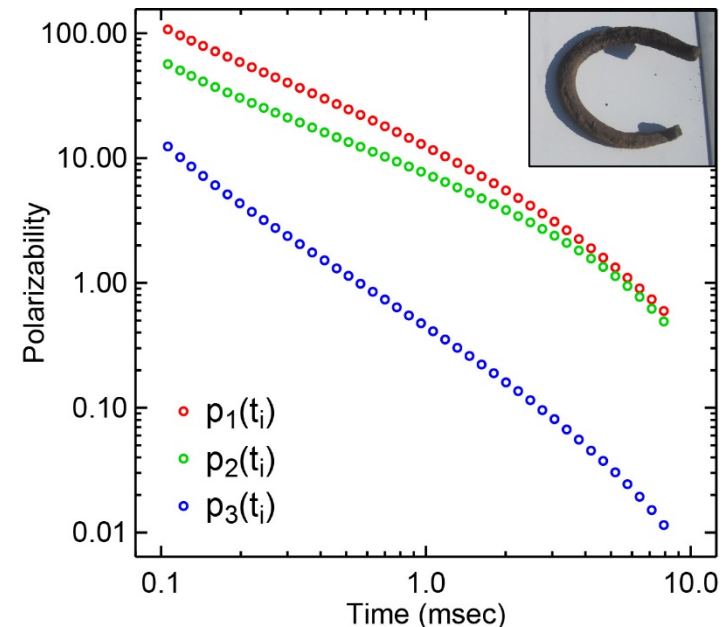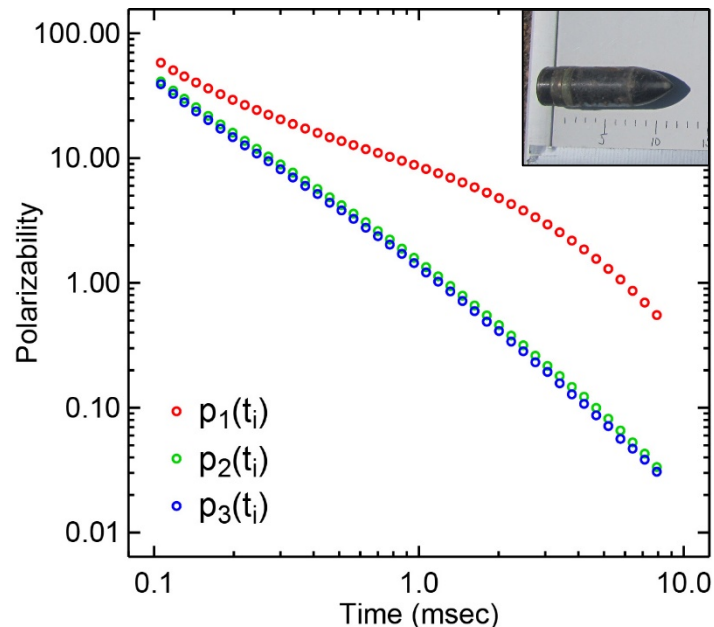
How Do You Get Classified as a TOI #1
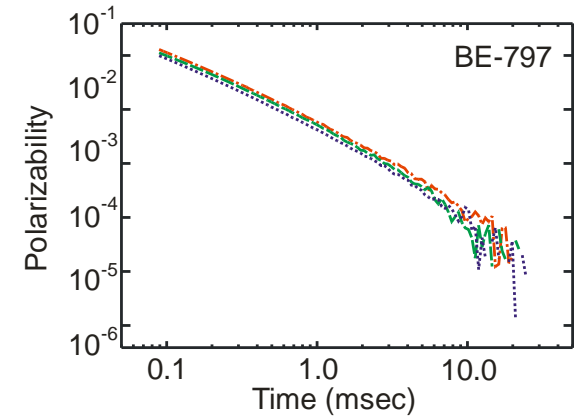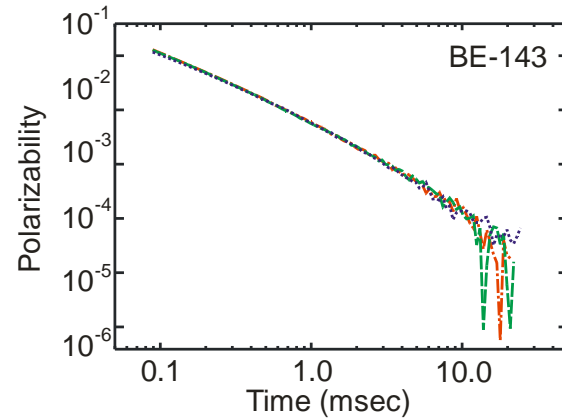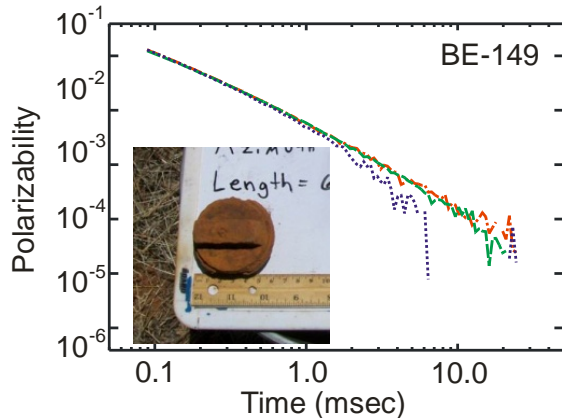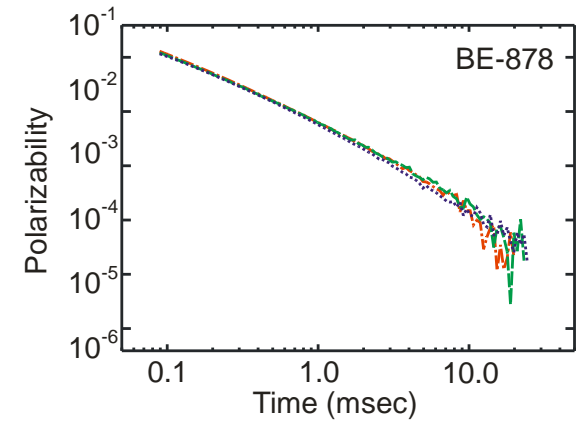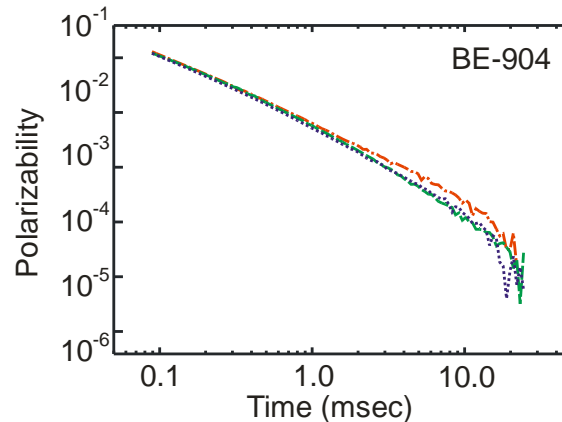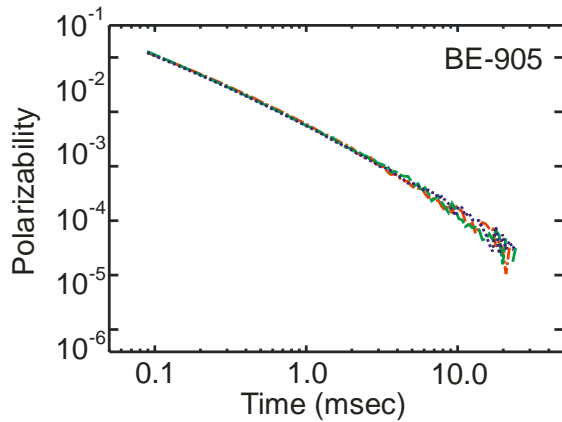
Match a Munition in the Library

Munitions Library

- Assembled through ESTCP funding
- Hosted by DDESB
- Managed by USACE

- ~50 munitions classes
- hundreds of individual signatures
- SOP developed to add additional items

How Do You Get Classified as a TOI #2

Be Part of a Cluster of Similar Items That Turn Out to Be TOI


6 of 25 in cluster

Technology is Proven and Ready to Go

- ESTCP has sponsored 26 demonstrations of the technology
  - ♦ 100% correct classification of munitions
  - ♦ up to 90% correct classification of clutter

- Interstate Technology Regulatory Council accepts the technology (http://www.itrcweb.org/gcmr-2/)

- DoD EDQW has published quality guidance

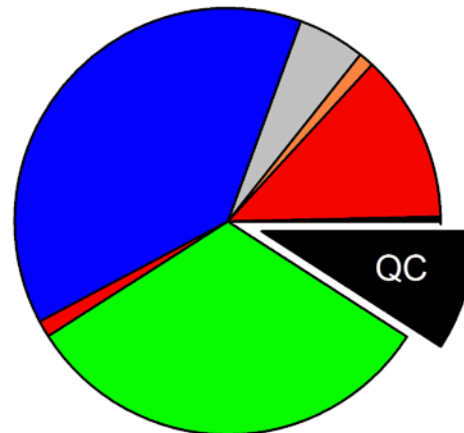- DoD has established an accreditation program for contractors

Potential Savings on a 100-acre Remediation
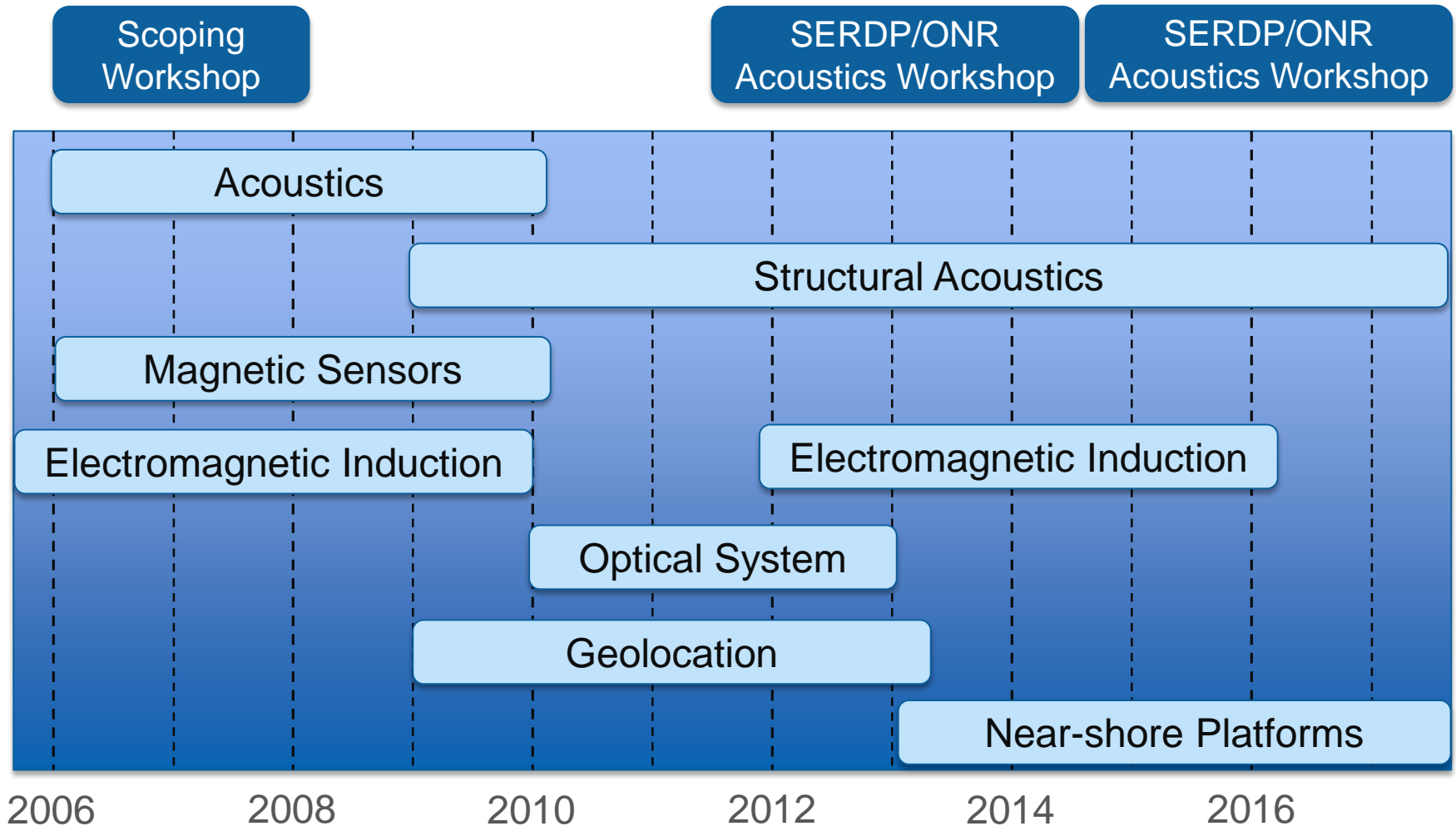

Current Practice
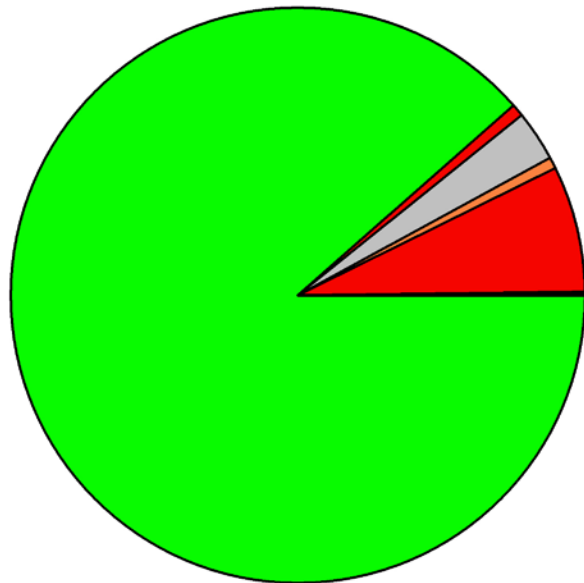
80% Reduction of Clutter

45% Savings

Legend:
- Mob/Demob
- Surface Sweep
- IVS & Seeds
- Detection Survey
- Cued Data
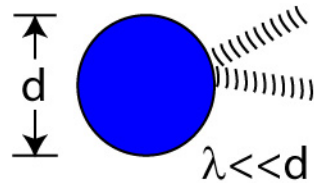- Dig UXO & Seeds
- Dig Clutter

Major Topics Related to Munitions Underwater

- Underwater Sensors and Analysis
  - ♦ Geophysical Sensors (magnetometers & EMI sensors)
  - ♦ Acoustic Sensors (imaging & low frequency (acoustic color or structural acoustics))

- Underwater Enabling Technologies
  - ♦ underwater munitions mobility (modeling and supporting experiments)
  - ♦ platforms
  - ♦ remediation technologies
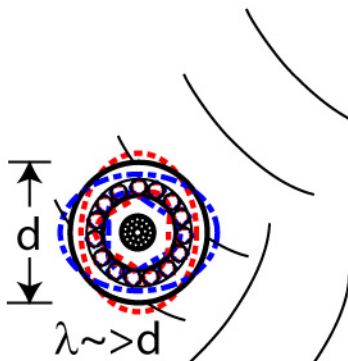
Detection and Classification Underwater

| | Scoping Workshop | | | | SERDP/ONR Acoustics Workshop | SERDP/ONR Acoustics Workshop |

- Acoustics
- Structural Acoustics
- Magnetic Sensors
- Electromagnetic Induction
- Electromagnetic Induction
- Optical System
- Geolocation
- Near-shore Platforms

2006 2008 2010 2012 2014 2016

Structural Acoustics

$\lambda << d$

Acoustic scattering "specular" in nature used to form image of the external shape of the target.
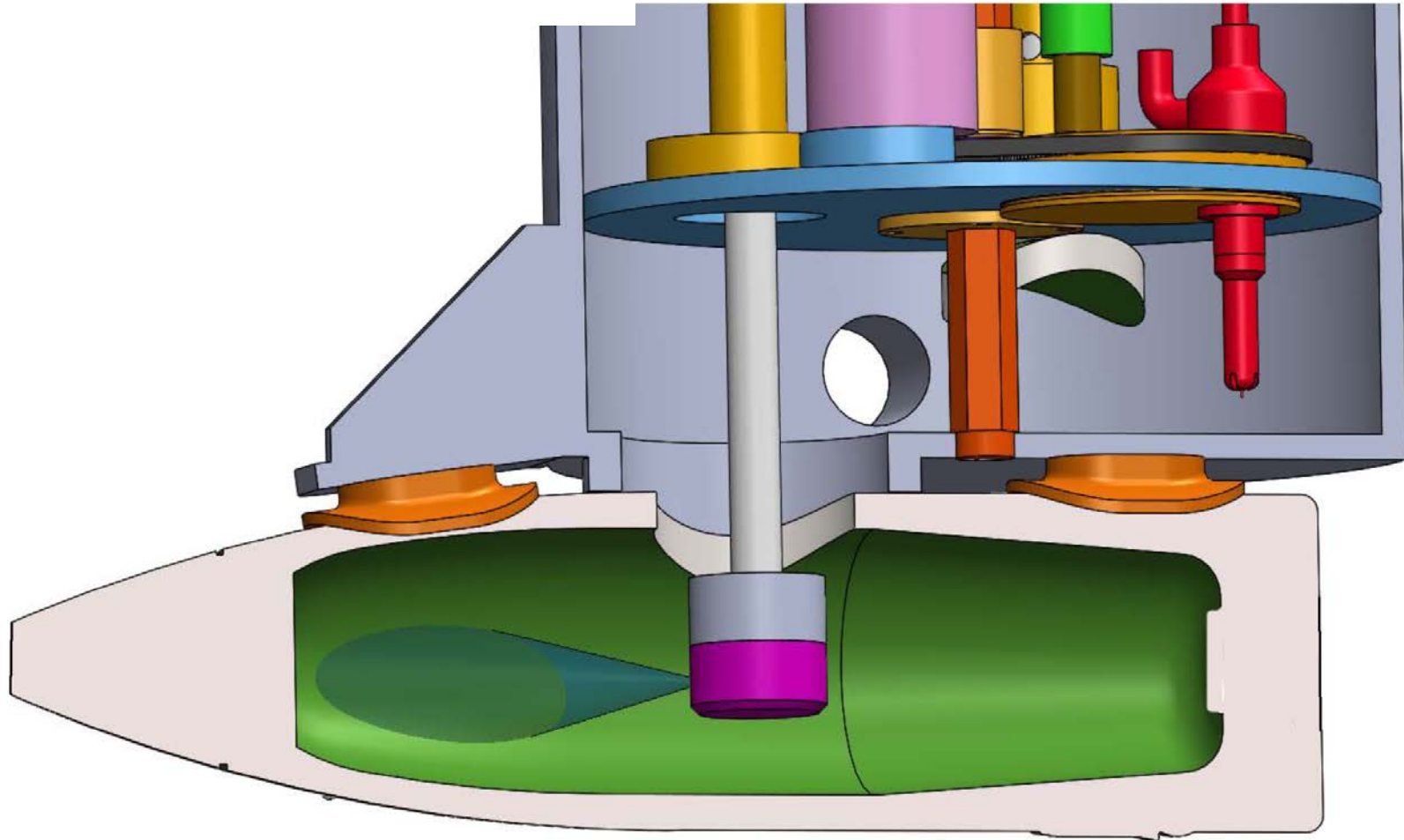
$\lambda \sim > d$

Acoustic scattering related to vibrational dynamics of the object both whole-body and internal structure. Resulting time-frequency features used to "fingerprint" target.

Acoustic Imaging Regime

Structural Acoustic Regime

Naval Research Lab
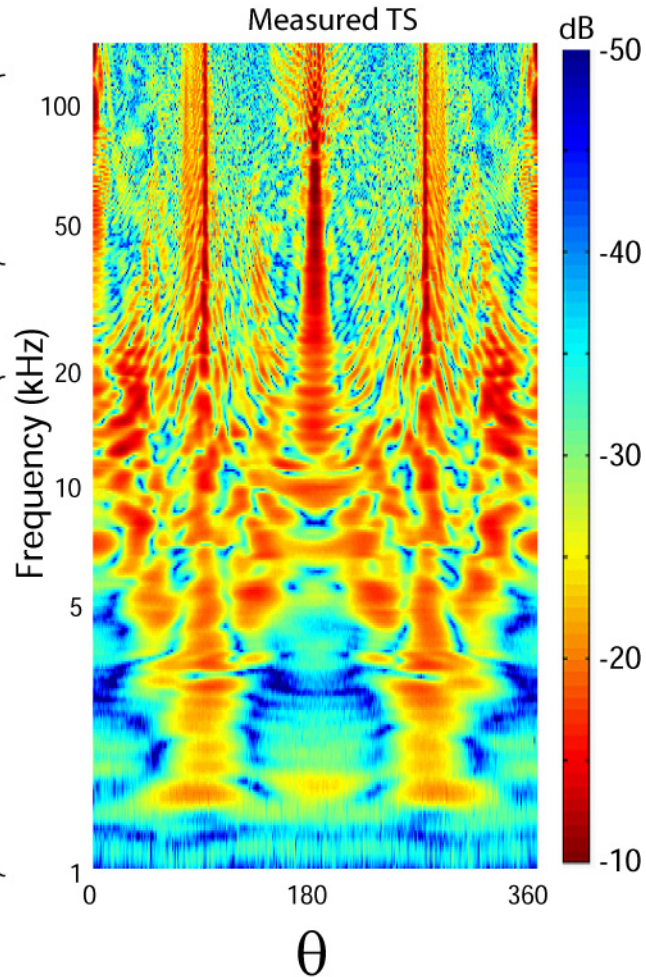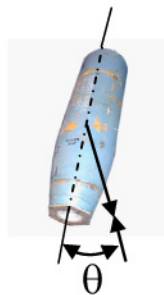
ERDC Blast Barge

Cut and Capture Remediation System

November 27 – 29, 2018
Washington Hilton Hotel

http://www.symposium.serdp-estcp.org

For More Information

serdp-estcp.org

Program-Areas > Munitions-Response
Or

Search – Project Name / Number / Key Word