Army Acoustics Needs
DARPA Air-Coupled Acoustic Micro Sensors Workshop

by

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# Army Acoustic Needs

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**Title and Subtitle:** Army Acoustic Needs

**Performing Organization:** Army Research Laboratory  
Adelphi, MD

**Abstract:** DARPA, Air-Coupled Acoustic Microsensors Workshop held on August 24 and 25, 1999 in Crystal City, VA., The original document contains color images.
Goals and Objectives
Battlefield Acoustics

- To research, explore, and develop innovative and state of the art signal processing techniques in acoustics and other passive sensor technologies.

- To apply these techniques to perform detection and classification of ground troops, ground vehicles, airborne vehicles, artillery and sniper.

- To transition real-time and robust algorithms to ongoing Army acoustic programs.

Army Battlefield Acoustics Research conducted at ARL, ARDEC and CRREL.
Acoustic Advantages

• Attractive technology for the Army
  – Passive
  – Non-line of sight (NLOS)
  – Low cost
  – Small and rugged
  – Provides 360° coverage
  – Target signatures are hard to suppress

• Capability includes target detection, bearing estimation, tracking, localization, classification and ID
  – Provides wake-up and cueing of optical sensors

Real-time capability due to advances in CPU and DSP technology
Army Applications

Detection, tracking and classification
- Ground vehicles
- Troop movements
- Fixed and rotary wing aircraft's

Surveillance and monitoring
- 360° field of view coverage
- Excellent “wake-up” and cueing sensor
- Tactical decision aid

Other Applications
- Infrasonic detection and localization
- Physiological monitoring of soldiers
- Detection and localization of gun fire (e.g., sniper), artillery / mortar fire, rocket launch, etc.
Issues

- **Noise Cancellation:**
  - Need to cancel out platform noise for acoustic sensors mounted onto idle or moving vehicles to allow detection and identification of surrounding targets.
  - Need to cancel out wind / flow noise from acoustic sensors positioned on the ground or on top moving vehicles.

- Lack of data from acoustic sensors mounted on top vehicles.
- Lack of research conducted in this topic
Current Army Needs

• Research Issues
  – Noise cancellation / Platform and Wind
  – Multi Target Recognition
  – Sensor fusion
  – MEMS Acoustic / Seismic

• Programs
  – MFS3 / FSV
  – DEMO III Robotics
  – Sniper Detection Systems
  – Unattended Ground Sensors
R&D Transition / Programs

- Transition R&D into future Army programs in support of RDECs and Battle Labs
  - Infrasonic research
  - Modeling of acoustic sensors
  - Anti-Personnel Landmine Alternatives (APLA)
  - Warrior Extended Battlespace Sensors (WEBS)
**Infrasonic Research**

- **Objective:** to develop state-of-the-art infrasonic sensors and signal processing algorithms to detect, classify, localize of impulsive signals below 20 Hz

- **Army applications**
  - Artillery and mortar firings
  - Missile and rocket launches

- **Other infrasonic signals of interest:**
  - Nuclear tests: 0.02 Hz - 4 Hz
  - Earthquakes: 0.125 mHz - 12.5 Hz
  - Volcanoes, meteors: 23 mHz - 0.29 Hz
  - Winds, tornadoes, etc.: 10mHz - 0.125 Hz

- Six 20 ft. porous hose lengths at each sensor
- Met sensors located with central microphone.
Infrasonic Detection

Space Shuttle Launch
4 Dec 98
From Blossom Point, MD

Date: 12/4/98 Time: 3:54:28

1200 km
1 hr delay

Direction of arrival

USA
Objective:

- **Database:** to centralize acoustic data archives from various programs & organizations, to expedite data access and to ease data maintenance

- **ATR Lab:** to expedite algorithm development & performance evaluation against various battlefield conditions
Large selection of trucks, tanks and helicopter signatures collected at different environment and time of year.

Server - Client environment will allow user to access data on-line.
Current Progress

- Experimenting with existing small, sensor systems capable of detecting personnel using acoustic / seismic / magnetic sensors.

FY00

- Research and evaluate personnel detection algorithms with low false alarm.
- Use fusion techniques between suite of orthogonal sensors to enhance detection and recognition
Warrior Extended Battlespace Sensors (WEBS)

A network of sensor nodes using multiple types of sensors can accurately locate and identify battlefield targets.

Small Passive Real Time Very Low Cost Non-line of sight 360° Coverage

Wide Range of targets

Acoustic Magnetic Day imager Passive RF Seismic Low cost IR Passive RF

Wide Range of Sensors

The vision: Small, expendable sensors
Upcoming Symposiums

Yearly event, established to share battlefield acoustic research knowledge between government, industry and universities.

**Battlefield Acoustic Symposium**  
Sept 13 - 15, 1999  
Johns Hopkins University, MD,  
*Security Clearances Required*

**National Symposium**  
Nov 16 - 19, 1999  
SPAWAR Systems Center, SC

**SPIE - The International Society for Optical Engineering**

**Sensor Technology for the Urban Battlefield**  
Orlando, FL  
April 24 - 28, 2000