TEDCO
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Acoustic Physiological Monitoring

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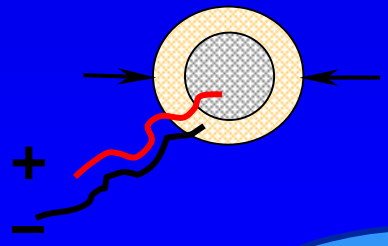
Acoustic Sensor Design

Sensor Design Characteristics

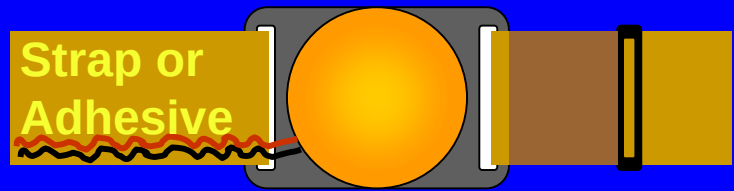
- Match impedance of sensor to body
- Body sounds transmit well into pad
- Airborne sounds rejected due to impedance mismatch
- Small, low-cost, and passive
- Solid-gel filled bladder with sensor



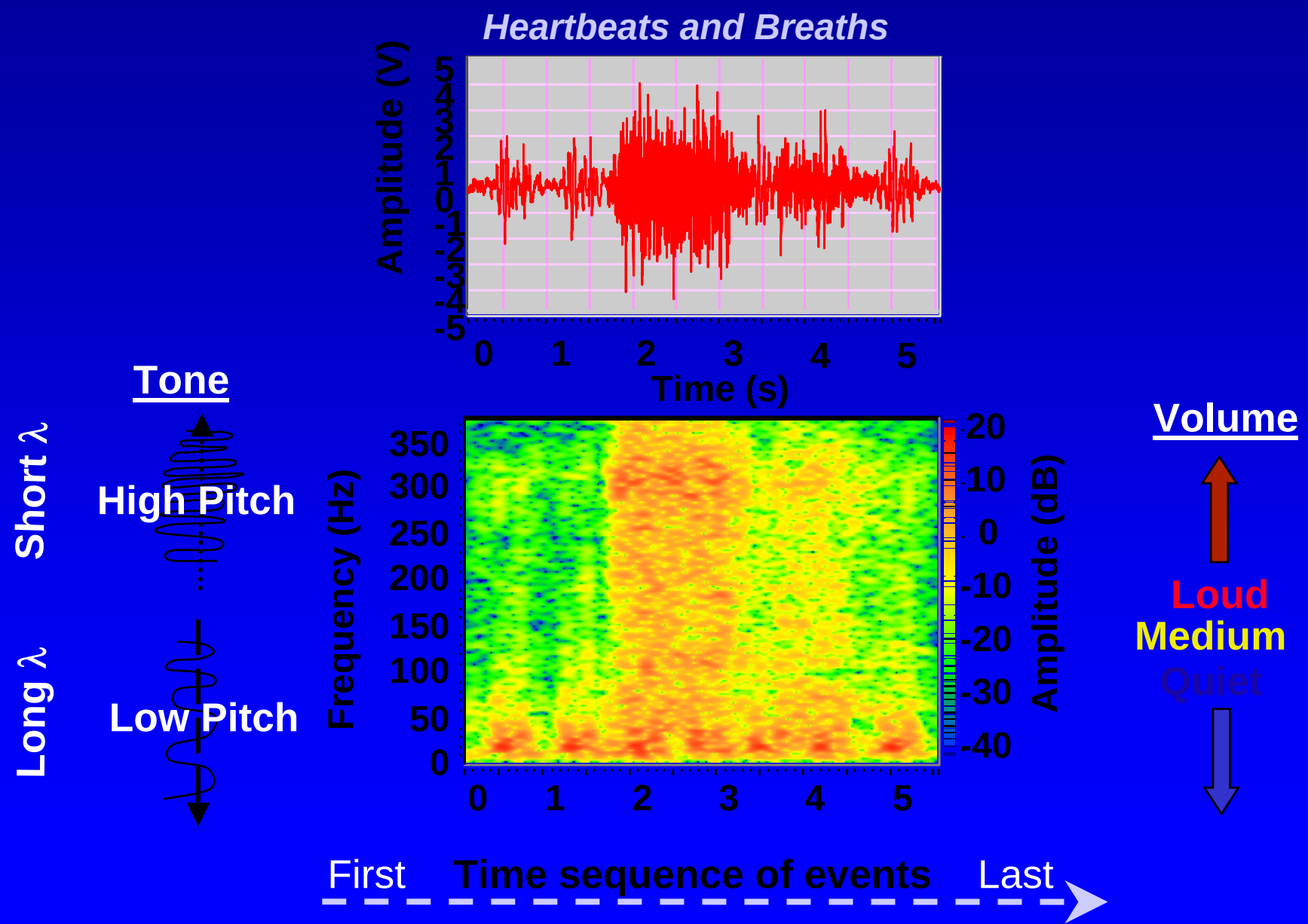
Detectable Physiology

- Heart rate, variability (IBI)
- Breath rate, volume, wheeze, fluids, coughing, gasp, vomit
- Blood pressure
- Walk, run, sleep, shiver, spasm
- Voice, vocalizations, moan
- Indicate food and liquid intake
- Gastrointestinal sounds
- Blunt/penetrating trauma, falls

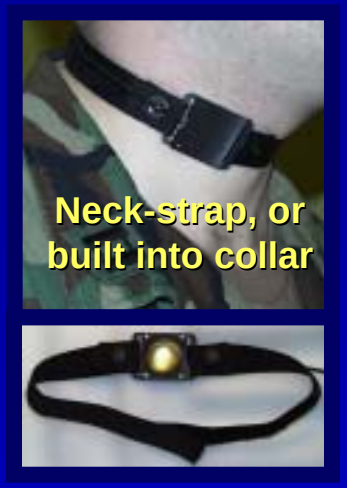
Wrist-watch or in sleeve cuff



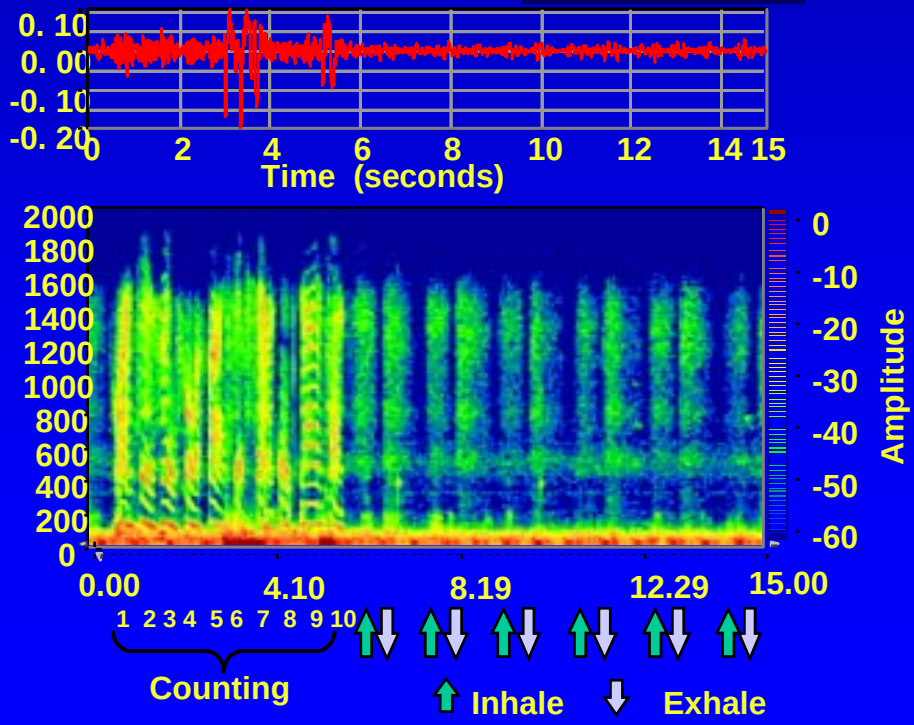
The **Spectrogram** is a visual depiction of how sound details change with time

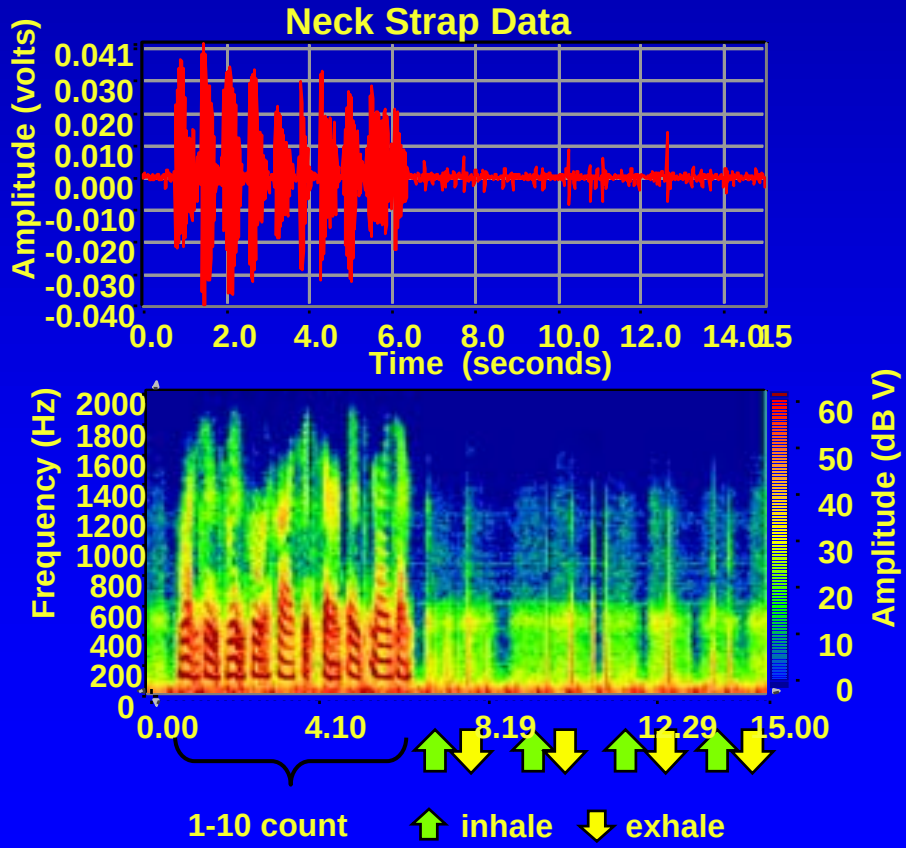


Use Multi-Sensor Fusion to Enhance Physiology



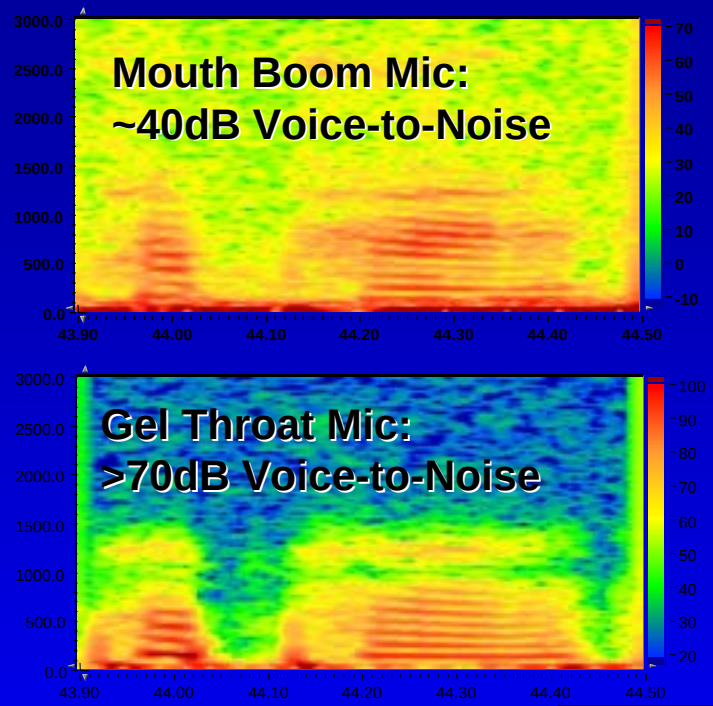
Helmet Data





Diverse physiology, different noise artifacts, covariant physiology

A Communication Sensor (with embedded physiology)

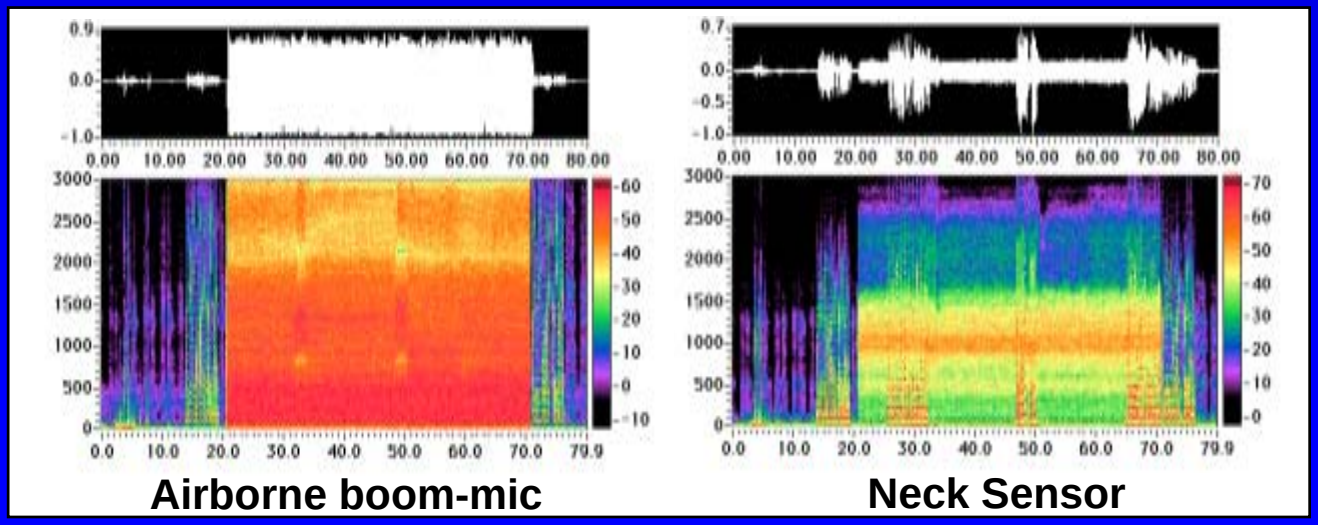


Better coupling for COMMS and voiced computer commands

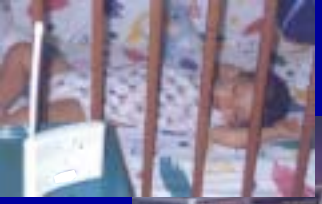
- >35 dB ambient noise rejection
- Excellent intelligibility at head and neck
- Evaluated Automatic Speech Recognition (ASR) in noise (Entropic HTK, Dragon)

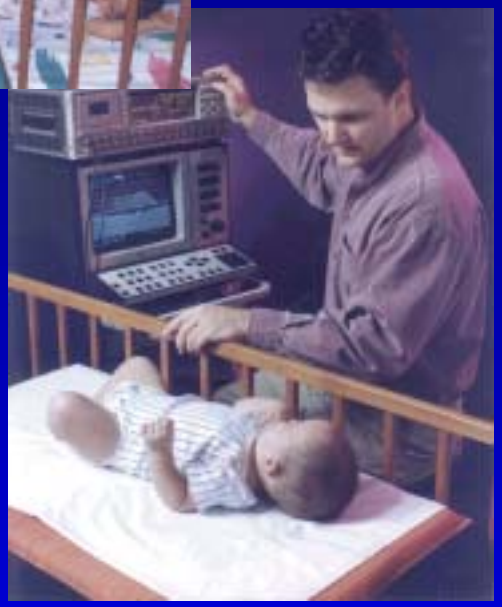
- 1-10 counts in 105dB noise
- Gel-coupled neck sensor detects voice
- Boom mic cannot

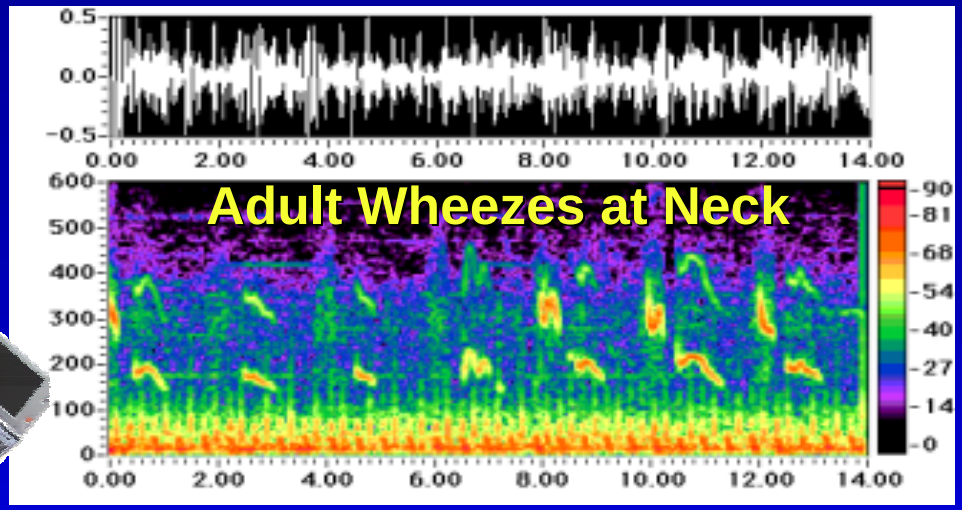
High Noise Environment

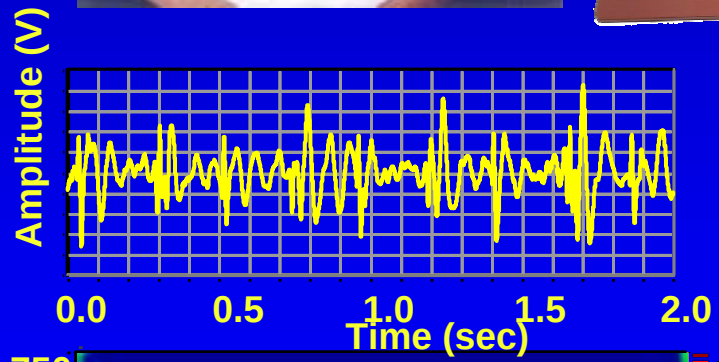


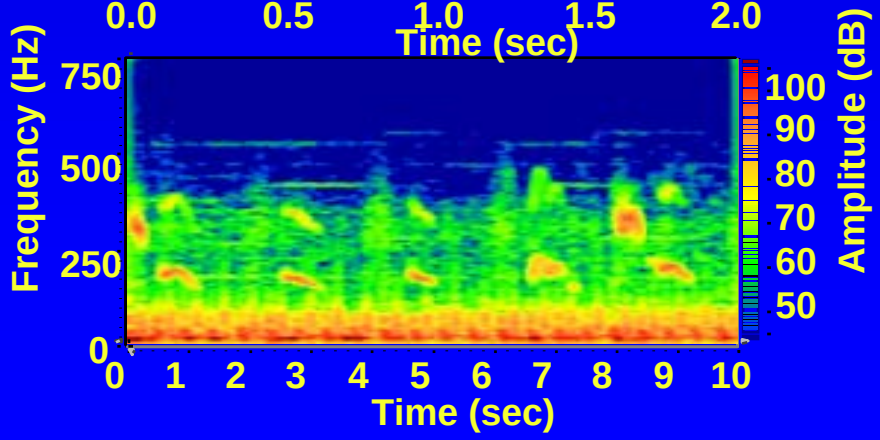
SIDS and Apnea Pad… Continuous Health Monitoring

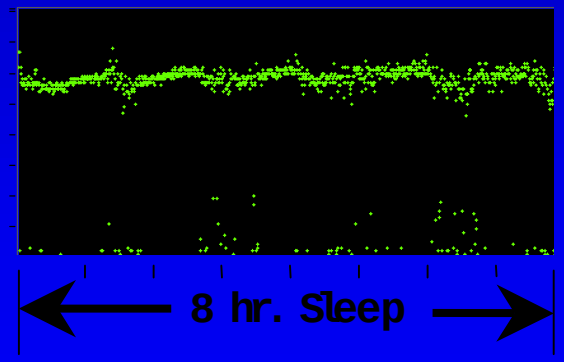






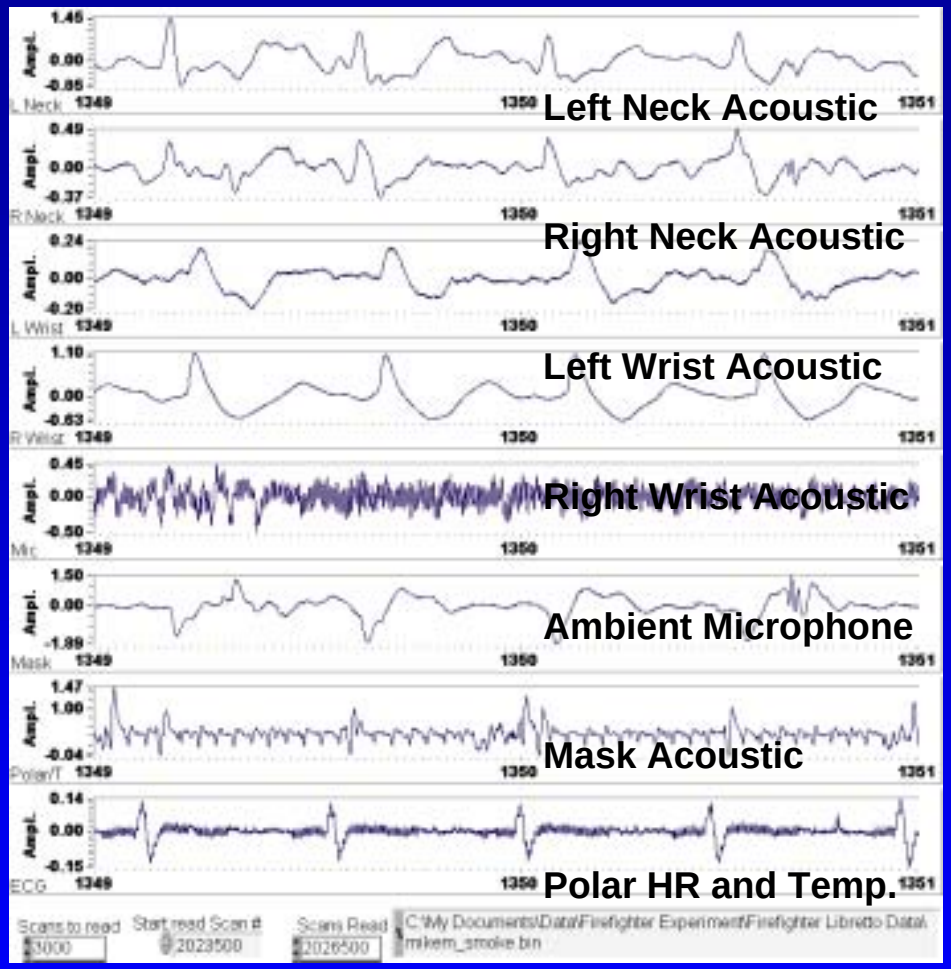


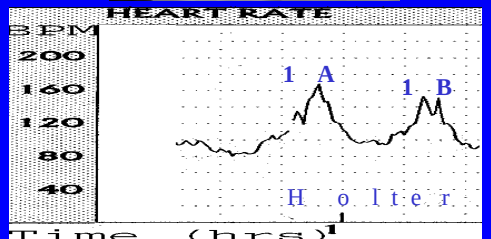


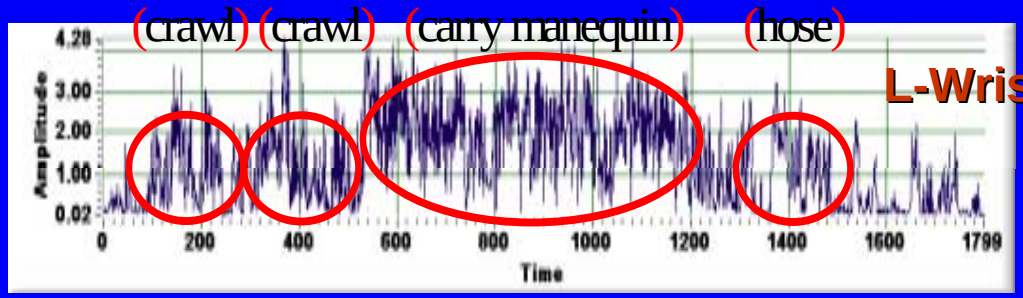


- Hospital
- Nursing home
- Homebound
- Outpatient
- Epileptic seizures
- Asthma
- Sleep monitoring, snoring, apnea
- Post-op recovery and pain remediation
- Activity monitoring, rehabilitation

Firefighter Experiment



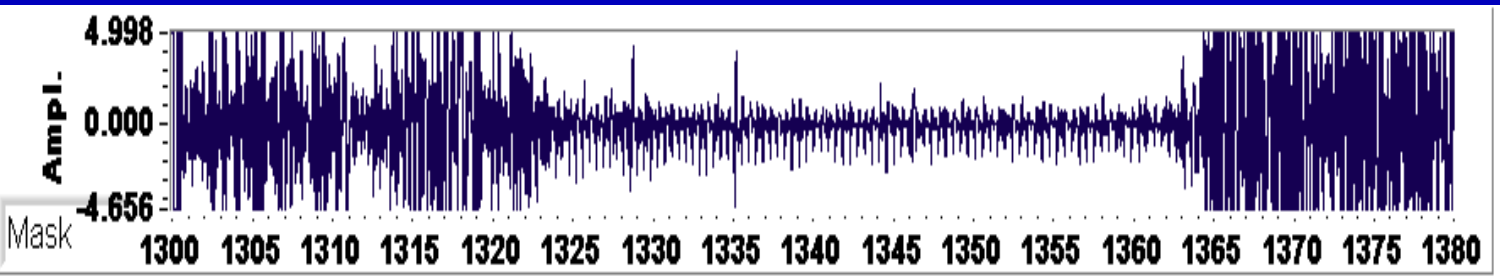


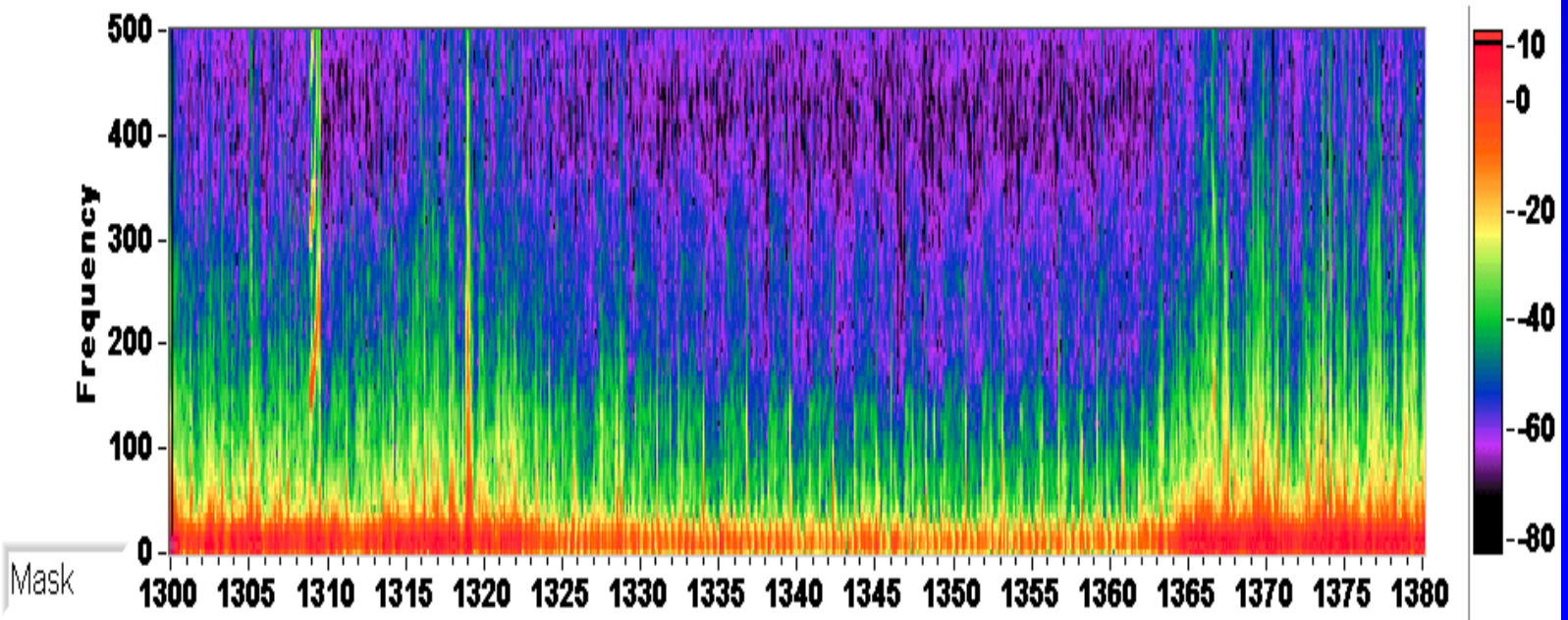


Simulated unconscious firefighter …very high SNR for low-level activity

Link from headband sensor to garment

Sensors and cables in garment

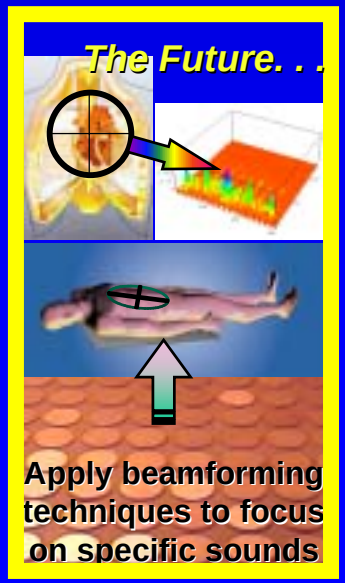




Other Commercial Applications

- Health & performance
- "Alive/Dead" indication
- COMMS & automatic speech recognition
- Biometric identification
- Long-term health history data
- Data for training and simulation
- Telemed (TX/RX, WWW, modem)
- Biofeedback, stress management, education
- Games and competition

- Body-worn activity, sleep, treatment
- Monitor operators of heavy machinery, aircraft, vehicles
- Sleep, heart attack, attention deficit
- Presence of person in prison, hospital, nursery beds
- Veterinarian



Acoustic Sensors Provide Situational Awareness

Acoustics can detect very diverse physiology

Gives a better understanding of the environment that may be effecting person's health or performance

Voice Communications

Voice Commands (ASR)

Physiological Monitor

Activity Monitor

For more information, go to:
http://www.arl.army.mil/acoustics
mscanlon@arl.army.mil
US Patents #5,515,865, #5,684,460, and #5,853,005