



SENSORS, SAFETY AND PERFORMANCE ANALYTICS

Maximizing the performance, health, and safety of individuals

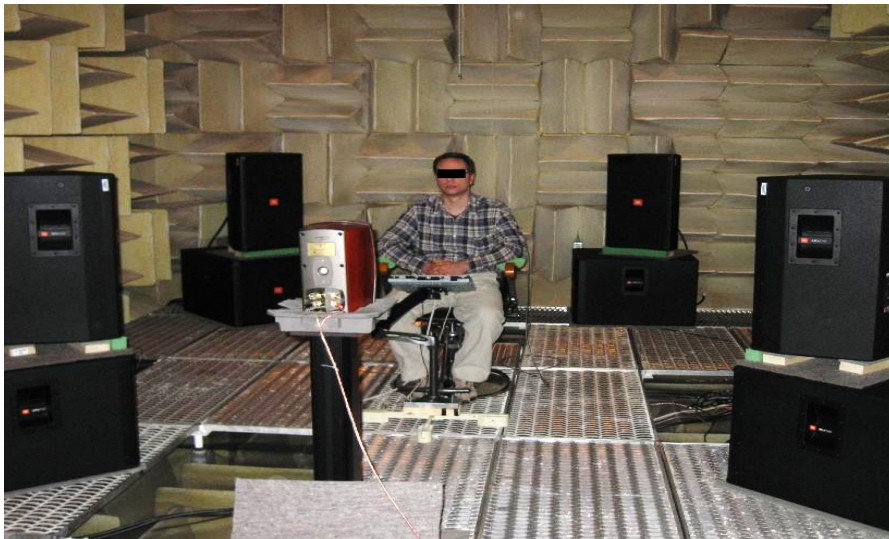
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Facility

Biodynamics Lab at UConn Health

- 8000 ft² state-of-the-art lab facility for biodynamic/ergonomics/audio research
- Rail-mounted and freestanding opto-electronic motion capture system and Vibration Exciters
- Anechoic Chamber: 28 x 19 x 17 ft³ and Audiometric Booth: 9 x 8 x 8 ft³
- Desktop Driving simulator with integrated sensor systems.
- State-of-the-art electronics building and testing equipment & 3D printers



Anechoic Chamber



- EMG/Heart Rate embedded car seat
- EDA embedded in steering wheel
- Camera



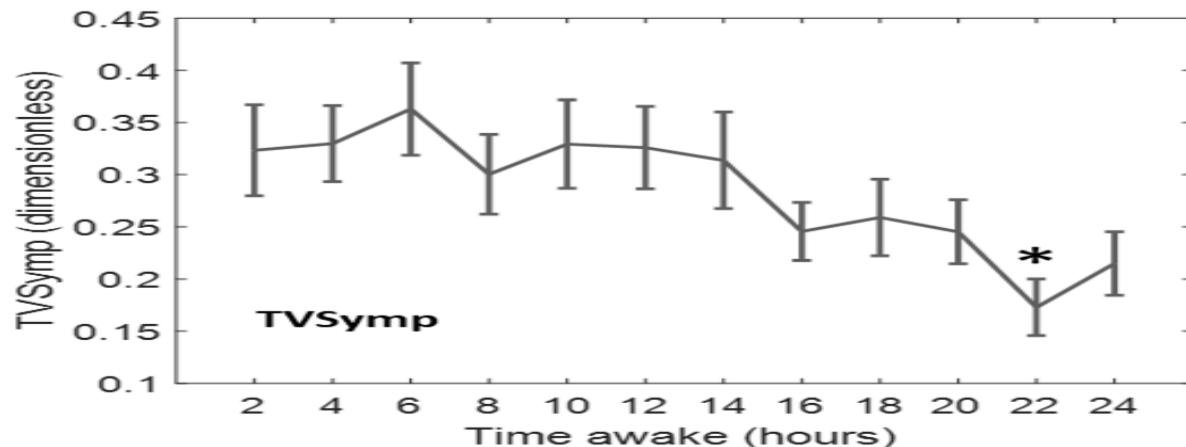
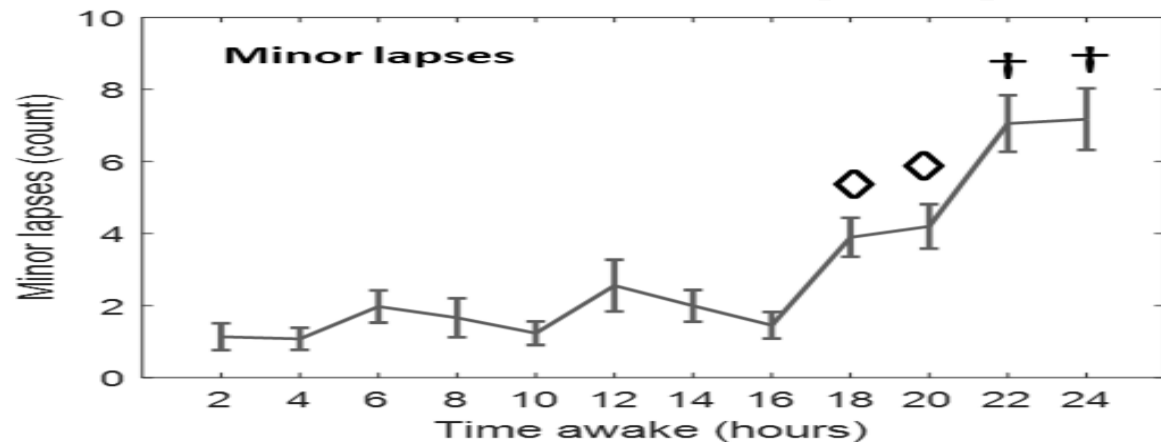


Technologies for Physiological Measurements in Water Immersion





Electrodermal Activity can Predict Performance Deterioration – 24 hr Sleep Deprivation (ship detection)



N = 20 subjects
Correlation = 0.9



Hearing Protector & Speech Intelligibility

Noise-Induced Hearing Loss

- Prolonged exposure to 85+ dB of constant noise can cause hearing loss
- Common Noise Levels
 - Heavy Traffic: 85 dB
 - Motorcycles: 95 dB
 - Sirens: 120 dB
- OSHA requires to protect all workers who are exposed to 85 dB of higher noise over 8 hours

Workers refuse to wear hearing protector

- Due to its impedance of communication
- Hearing protectors block alarming sounds as well.



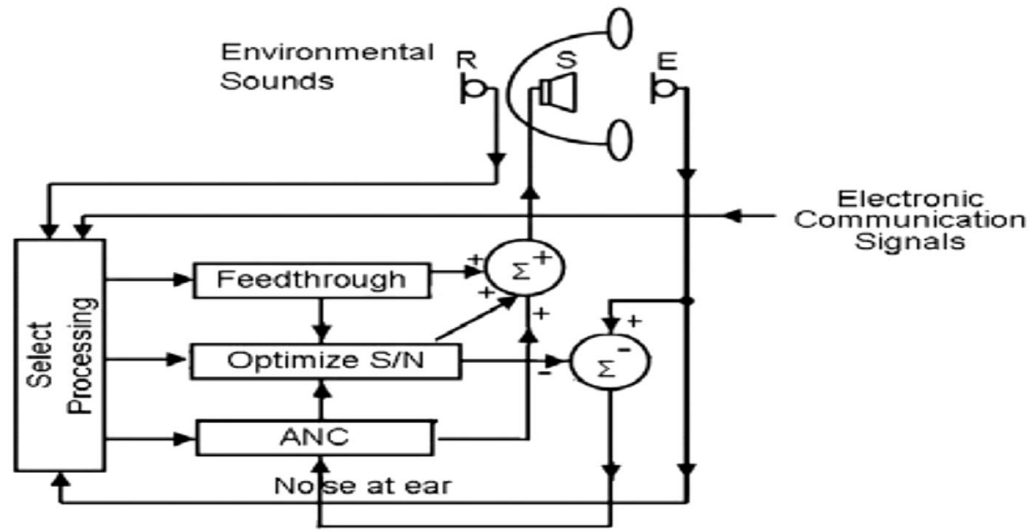
Research Goal

Hearing Protector with Separation of Speech and Alarming Sounds from Environmental Noise

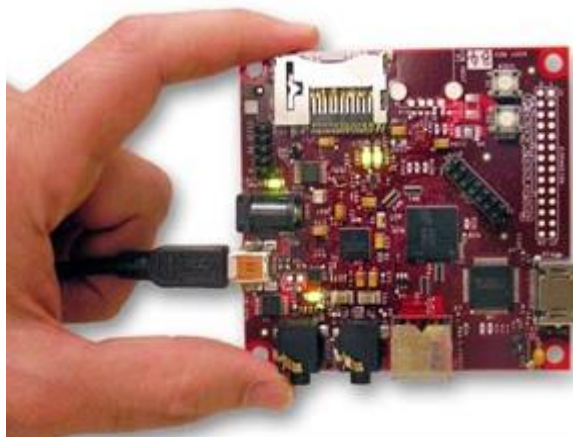


Hearing Protector & Speech Intelligibility

UConn's Sub-band Feed-forward ANR System

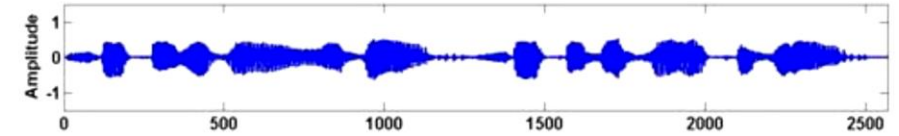


Hearing Protector

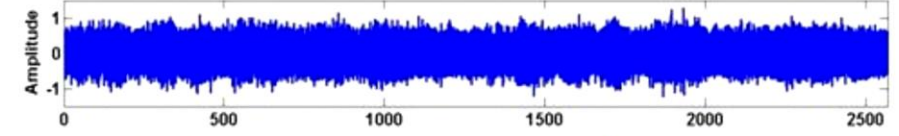


Algorithm was implemented on a
DSP evaluation board

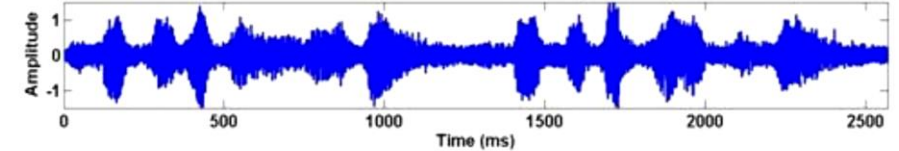
Original
Speech



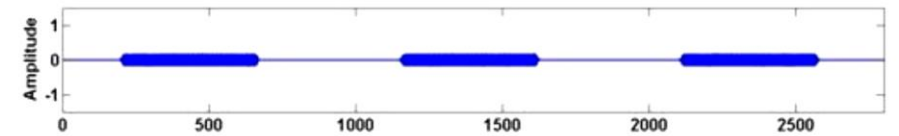
Noise+
Original



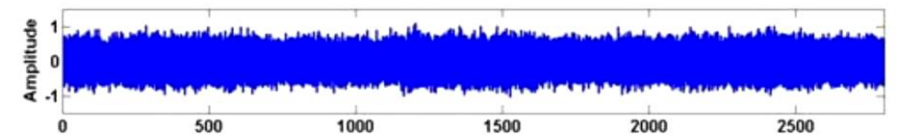
Recovered
Signal



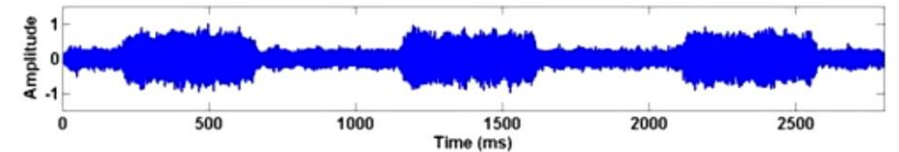
Original
Alarm



Noise +
Alarm



Recovered
Signal





Evaluating Data Analytics to Optimize Performance

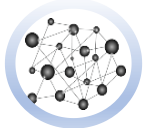
Research Direction: The overarching research theme is to utilize wearable technology for the early detection of injuries and to mitigate adverse events. This will be accomplished through both providing optimal movement strategies to improve their performance and developing novel wearable devices and clothing to reduce risk.

Injury Prediction or Detecting Injury Progression

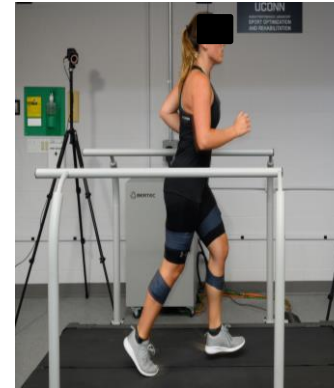
INPUT FEATURES



MACHINE LEARNING



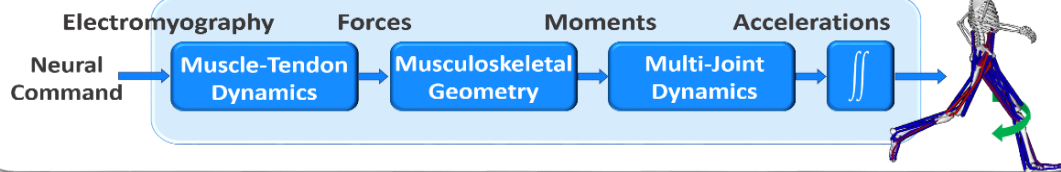
OUTPUT



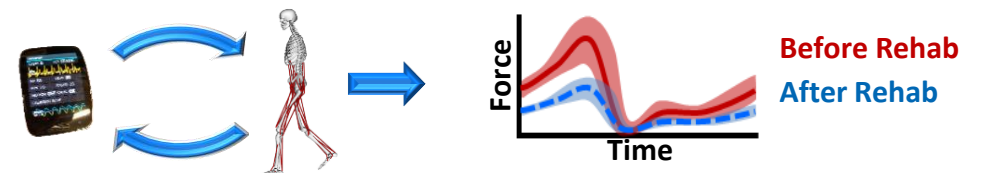
- 12 Vicon camera motion capture system.
- 2 In-ground Bertec force plates.
- Wireless surface electromyography system.
- Split-belt, dual force instrumented treadmill.
- Biodex isokinetic dynamometer.
- Diagnostic ultrasound.
- Volitional muscle activation system.

The Human Performance Laboratory is located in Gampel Pavilion on the University of Connecticut Storrs Campus (above).

Optimal Movement Strategy



Develop Intelligent Biofeedback Devices & Clothing



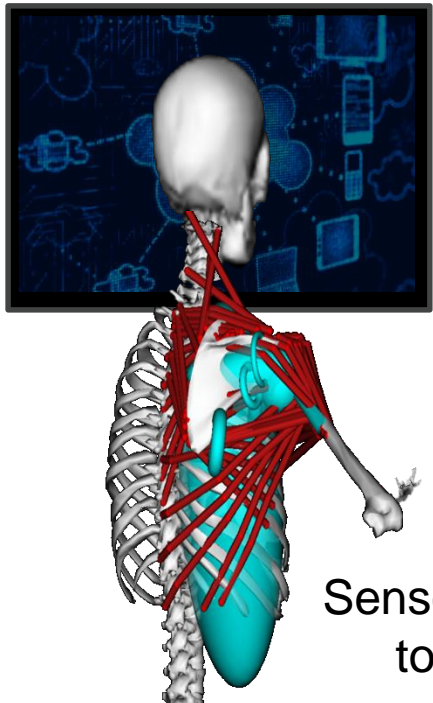


Self Adapting Chair and Stability Analysis

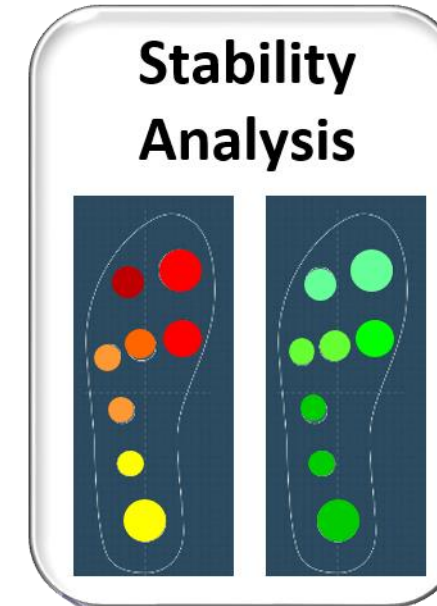
Currently, we are utilizing sensor data and computational modeling to detect movement abnormalities in individuals during high impact and velocity movements (i.e. walking, running, jumping).

We will apply this knowledge and technology to improve human ergonomics.

Objective: Integrate pressure sensors and accelerometer data to optimize seat ergonomics.



Sensor Data
Foot Pressure
Center of Pressure
Center of Mass acceleration
Muscle Activation



Sensor data will be used to provide real-time feedback to alter seat cushion pressure and adjustments.



Driving Studies

- Studied road markings and variable message signs to determine visibility under a variety of driving conditions
- Used a full-size driving simulator for analysis of multi-tasking and performance



CAUTION
ROAD WORK
AHEAD

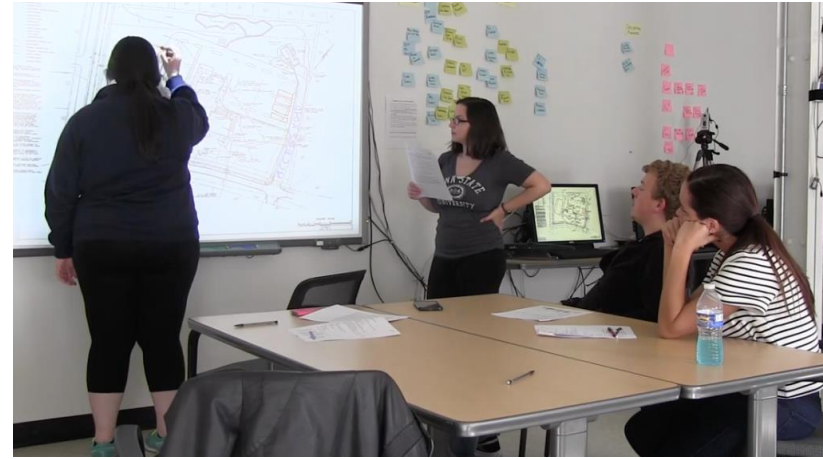
ROAD WORK
AHEAD

CAUTION



Team Dynamics and Communication

- Recorded team communication patterns in complex tasks
- Used structural models to measure the relationships between personality, emotional intelligence, and quantification of team communication as either moderators or mediators, as they relate to team performance





Human Factors and Accessibility

- Factory and workplace analysis studies, especially with undergraduate project teams from human factors course, cross-listed with psychology
- Accessibility studies – sidewalk measurement for wheelchairs
- Human Computer Interaction and Usability studies





**PERFORMANCE
ENHANCEMENT
ALGORITHMS**



**OPTIMIZING
MOVEMENT
AND EQUIPMENT
DESIGN**

**FUTURE
VISION**



**DEVELOP INNOVATIVE &
ADAPTIVE
BIOFEEDBACK
TECHNOLOGY**



**SYNERGISTIC &
COLLABORATIVE
PARTNERSHIP**