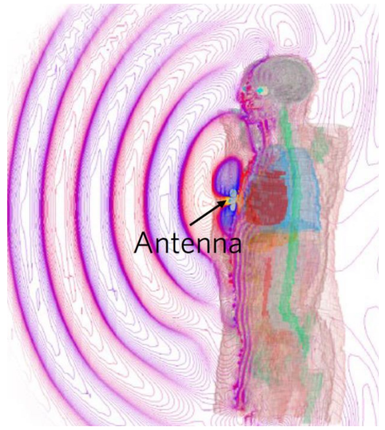


Detecting Respiratory Distress in Patients with Advanced ADRD Using Radio Sensors

Edwin C. Kan*, Veerawat Phongtankuel and Jamuna Krishnan

Weill Cornell Medicine; Electrical and Computer Engineering, Cornell

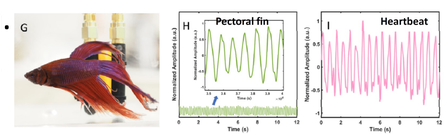
PennAITech AD/ADRD Focus Pilot Core

Background and Motivation

- **Respiratory distress** can lead to distress, suffering and poor outcomes for patients with ADRD[1-4].
- Research shows that up to 80% of ADRD patients experience some degree of respiratory distress[1].
- Patients with advanced ADRD **cannot self report short of breath** accurately[5].
- No agreed definition of respiratory distress now in clinical settings
- In clinical practice, validated scales that measure distress are implemented in an unstandardized and intermittent manner → **under detection** and **under treatment.**
- **Continuous monitoring** is critical to capture the episodes of respiratory distress.
- Present sensors for continuous monitoring are either cumbersome or inaccurate.

Radio Near-Field Sensors[7-11]

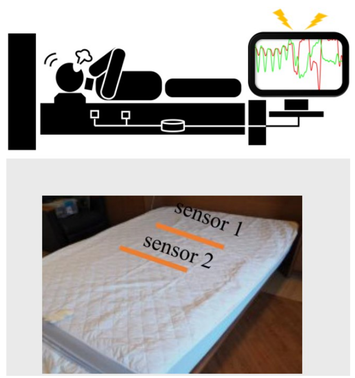
- Non-invasive and convenient (no skin contact required).
- Measure **internal** cardiopulmonary organ and muscle contraction directly.
- Collect **rich** and **direct** content of heart beats, respiration, blood pressure, etc.
- **High sensitivity**: various pulses and even a 2-g betta fish.
- Multiplexing.
- Inexpensive.



ADRD Patient Monitoring

Bed Integration

Radio sensor placed under bed sheets and mattress covers. Covert to users and adaptable to positional variations.

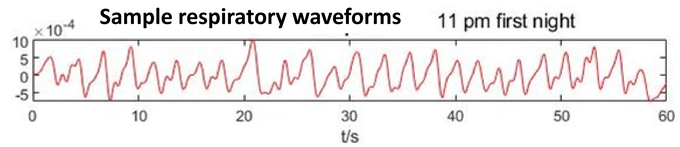


Recruitment

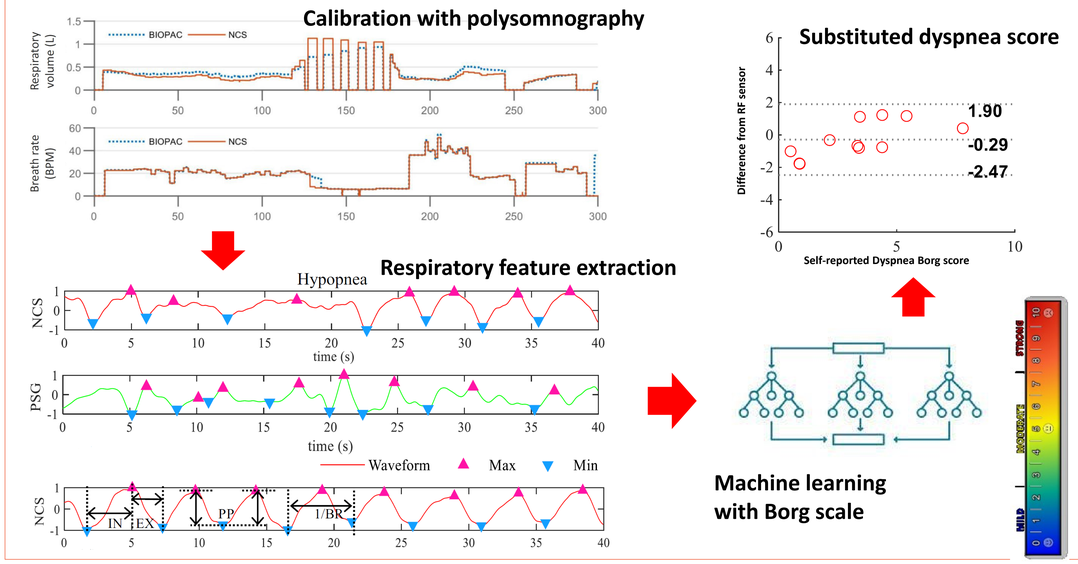
- ADRD patients at the Center on Aging at Weill Cornell.
- Patients with a CDR-SB score ≥ 16
- The patient's legal representative will be consented.
- Patients will not be restricted to bed.

Analysis

- 48 hours of data collected from the bed radio sensor.
- Concurrent video recording to detect respiratory distress.
- Two clinicians review the video to annotate events and calculate RDOS[5] scores.



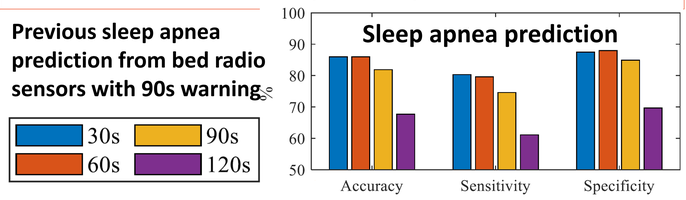
Correlated Respiratory Scores to Substitute Dyspnea Scale



Aims

Aim 1: To assess the acceptability and **feasibility** of radio sensors to continuously capture cardiopulmonary features in advanced ADRD patients. Evaluate sensor data quality. Interview caregivers for concerns.

Aim 2: To develop ML-based algorithms for autonomous detection and **prediction** of respiratory distress by continuous radio sensor recording. Benchmark with RDOS[5] scores and visible respiratory distress.



ML Methods

- Feature-based classification by decision trees with white-box supervised ML.
- Waveform-based classification by CNN and GAN with unsupervised learning.

Impacts

- To improve how respiratory distress is detected in ADRD patients.
- Earlier detection of respiratory distress can lead to timely treatment of respiratory distress to improve patient outcomes.

PennAITech through National Institute on Aging grant P30AG073105.