

# Development of an accelerometer-based positional classification system

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## Background

- Over 1/3 of hospitalized older adults are discharged from the hospital with a major new functional disability in performing activities of daily living
- Recent studies support that activity measured by wearable devices predicts readmission risk, length of stay, and disability in hospitalized patients

## Problem

Consumer and research grade devices do not offer movement classification flexibility within specialized populations

## Aim

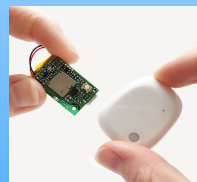
To develop software and techniques to classify laying, reclining, sitting, standing, and walking in a hospitalized population

## Technology

- 2 commercial accelerometers – MbiEnt MetaMotionR - worn on the chest and thigh
- Data captured via a custom iOS application
- Post-processing of data to determine accuracy of algorithm

## Initial Training Data

- 15 healthy older adults (55 and older) & 15 healthy adults (18-55)
- 10 minutes of activity collected
- Subjects directed through each position, maintaining each for 1 minute, twice



MbiEnt  
MetaMotionR

## Algorithm Development

- 3-axis accelerometer data buffered into short time windows with magnitude- and variance-based features extracted (trimmed-mean position and standard deviation of position)
- Implemented Random Forest classifier to automatically discriminate between positions using cross-validation techniques

## Initial Results

- Algorithm overall 95% accurate at classifying positions for healthy older adults in a lab setting

Geriatric LOSO: 95% correct

Truth \ Response	Laying	Reclining	Sitting	Standing	Walking
Laying	84.7	14.6	0.7	0	0
Reclining	3.6	95.1	1.3	0	0
Sitting	0.2	2.2	96.5	1.1	0
Standing	0	0	0.2	99.1	0.7
Walking	0	0	0	0.6	99.4

## Next Steps

- Continued data collection in hospitalized adults and older adults
- Finalize app development

\*References available on request

## Preliminary Hospitalized Results

- Testing in hospitalized adults did not match training data
- Unlike training data, test data did not have three distinct laying/reclining/sitting classes
- Ex: “laying” label often referred to someone at an incline when training data set assumed laying was at 180° (flat) even considering this incline was at a smaller angle than originally classified as “reclining”
- Ex2: “reclining” training data set did not reflect wide variety of real-world reclining angles
- Modifications in response to mismatch:
  - Collapsed laying/reclining into one class
  - Additional training data set sampled reclining at 15°, 30°, 45°, 60°

Subject 05: 84.4% correct					Subject 05: 96.7%				
Truth \ Response	Laying/Reclining	Sitting	Standing	Walking	Truth \ Response	Laying/Reclining	Sitting	Standing	Walking
Laying/Reclining	63.2	36.8	0	0	Laying/Reclining	92.1	7.9	0	0
Sitting	0	100	0	0	Sitting	0	100	0	0
Standing	0	0	100	0	Standing	0	0	100	0
Walking	0	0	0	100	Walking	0	0	0	100

A) Hospitalized confusion matrix based on initial training set

B) Confusing matrix demonstrating improved accuracy with updated algorithm



Signal Analysis Solutions