

RECOLIFT: AN ANDROID WEAR FITNESS TRACKER FOR STRENGTH TRAINING

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MOTIVATION

How do you marry interests in lifting, mobile, and DSP?

A few thoughts:

- 1.5 million Apple Watches sold in two weeks
- Almost 1 million Android Wear devices sold in 2014
- Apple, Google creating health APIs
- Few strength-training devices on market

Pictured: Dan Green, jtsstrength.com



THE END GOAL

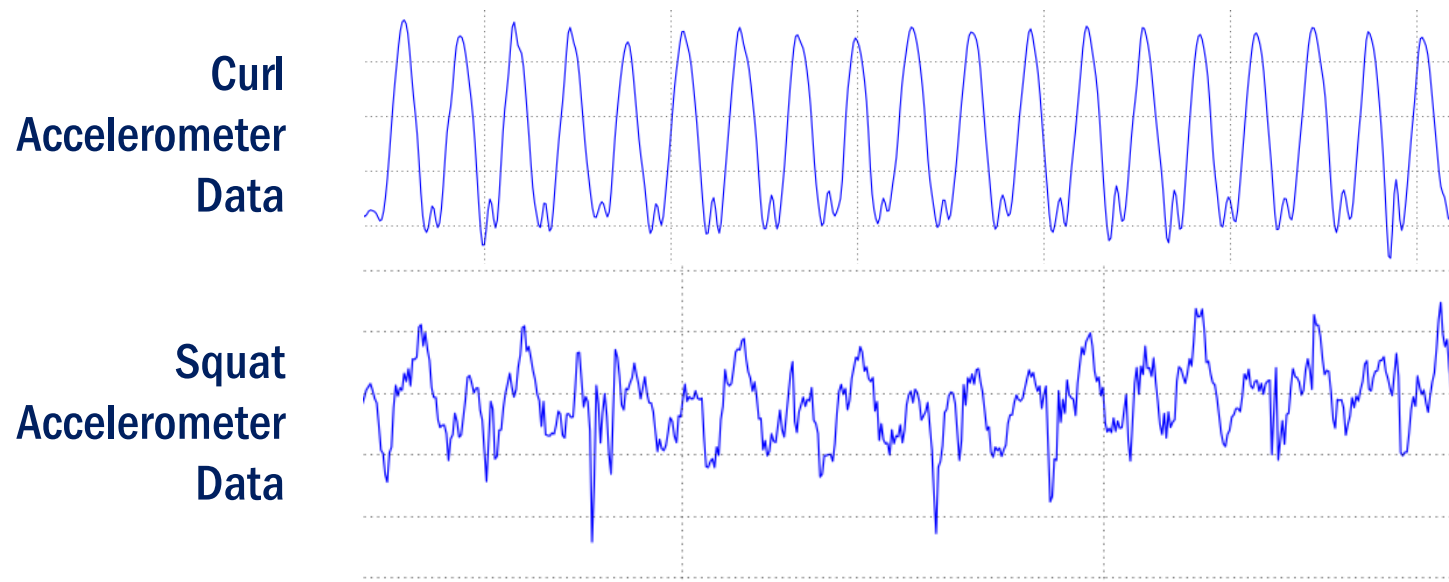
To create an application which:

- *Tracks lift types, sets, and reps*
- *Requires no user input*
- *Uses off-the-shelf hardware*

Pictured: Sony Smartwatch, <http://www-static.se-mc.com>

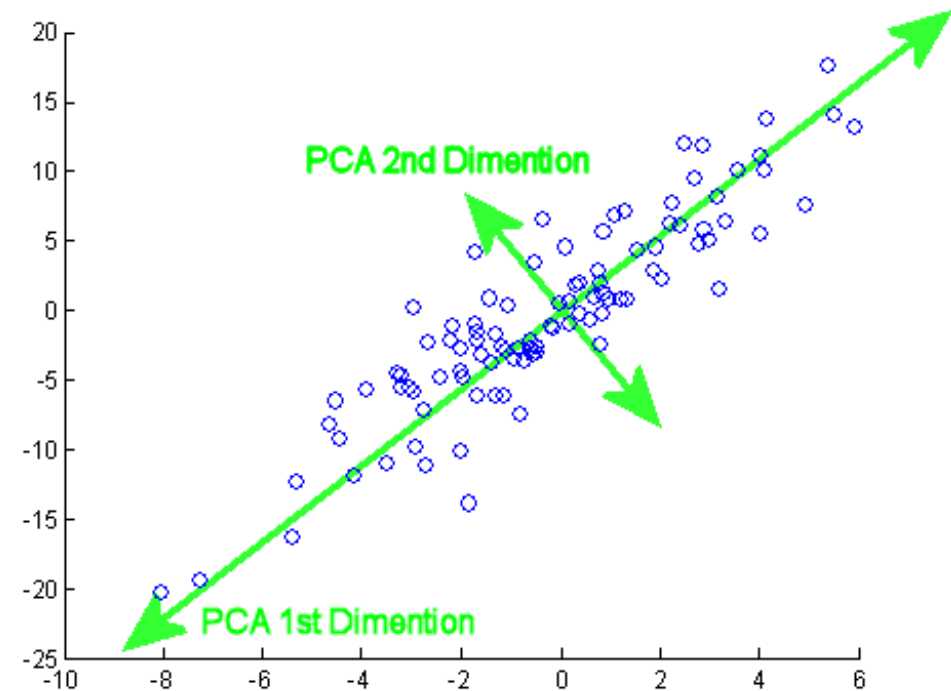
CHALLENGES

- **Segmenting** exercise from non-exercise
- **Recognizing** which lift is being performed
- **Counting** repetitions with a noisy signal



PREPROCESSING

- **Resample**
 - 25Hz Zero Order Hold
- **Low pass filter**
 - 12Hz 5th Order Butterworth
- **Compute new signals**
 - Magnitude
 - Projection onto PCA axis

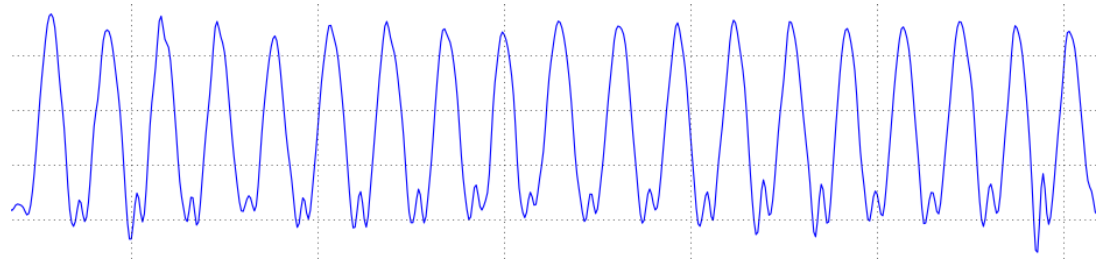


Pictured: PCA example, weigend.com

SEGMENTATION - FUNDAMENTALS

- Primary intuition
 - Exercise is *periodic*
 - Non-exercise is *aperiodic*

Curl
Accelerometer
Data

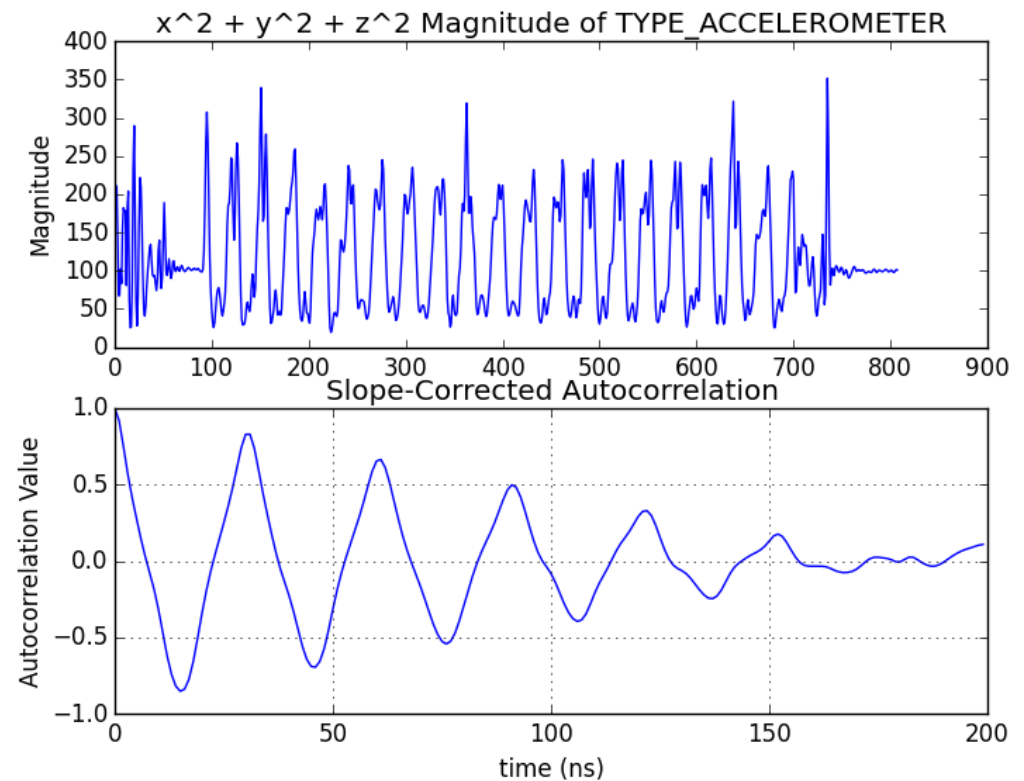


Idling
Accelerometer
Data

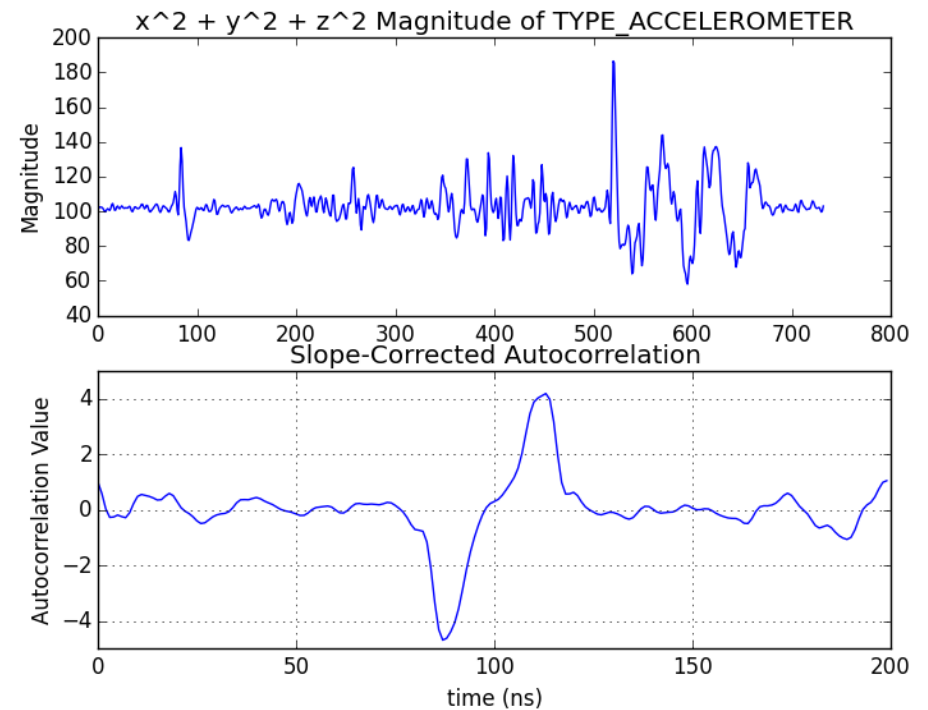
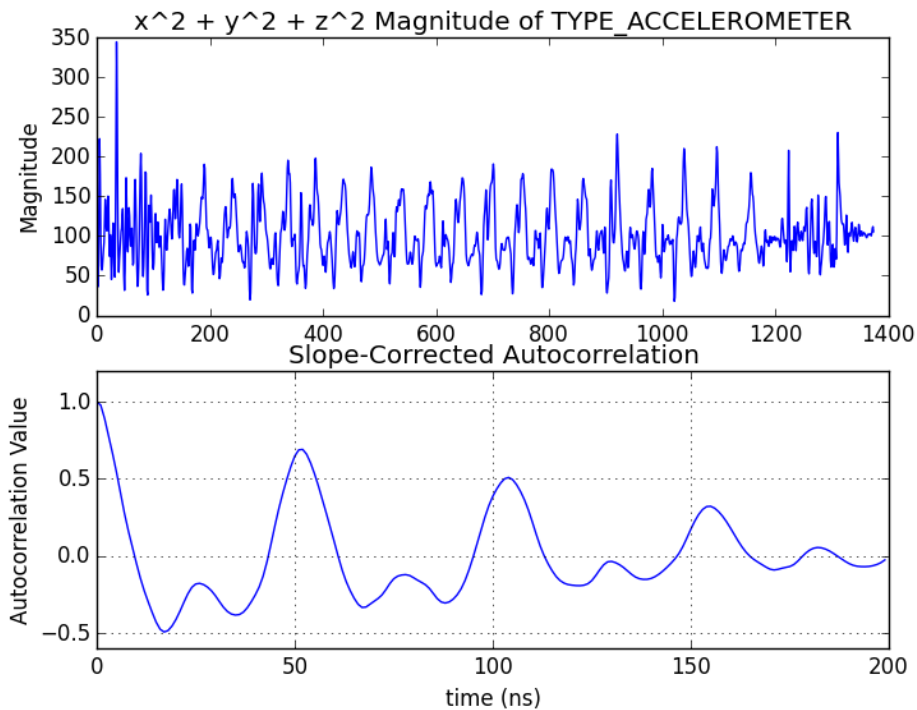


SEGMENTATION - PROCESS

- Compute signal autocorrelation
- Extract features
- Classify with SVM
 - Majority vote

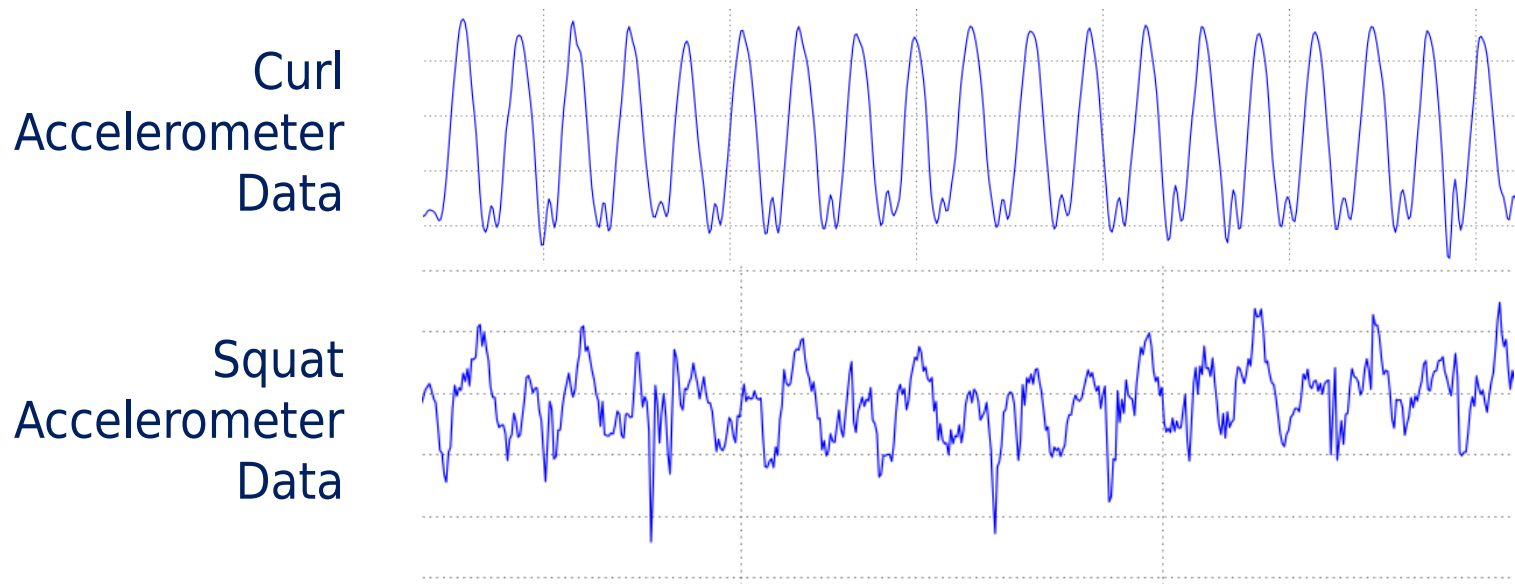


SEGMENTATION - AUTOCORRELATION



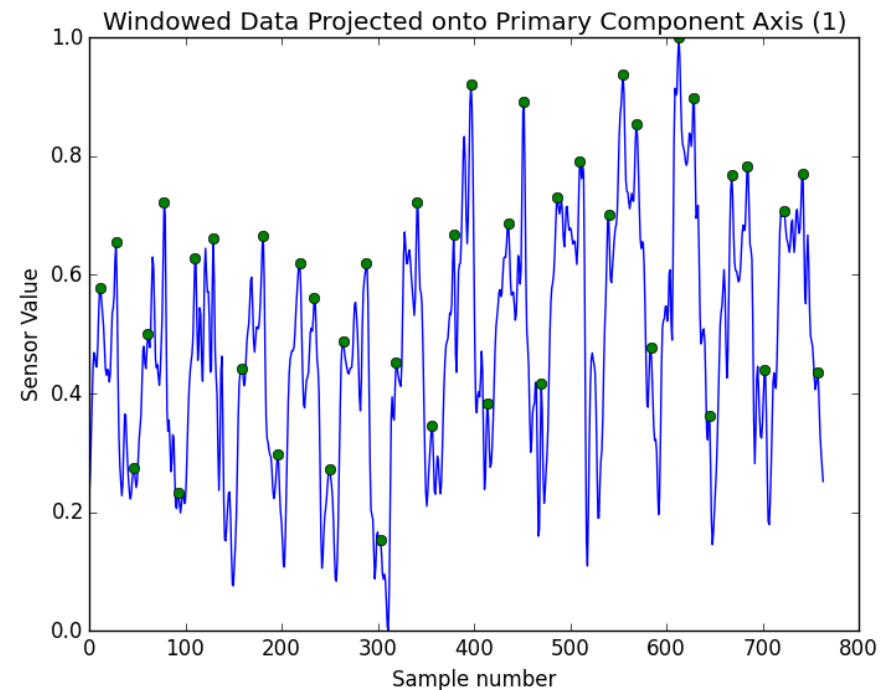
RECOGNITION

- Extract features
 - Autocorrelation
 - Mean, Standard Deviation, etc
- Classify with SVM



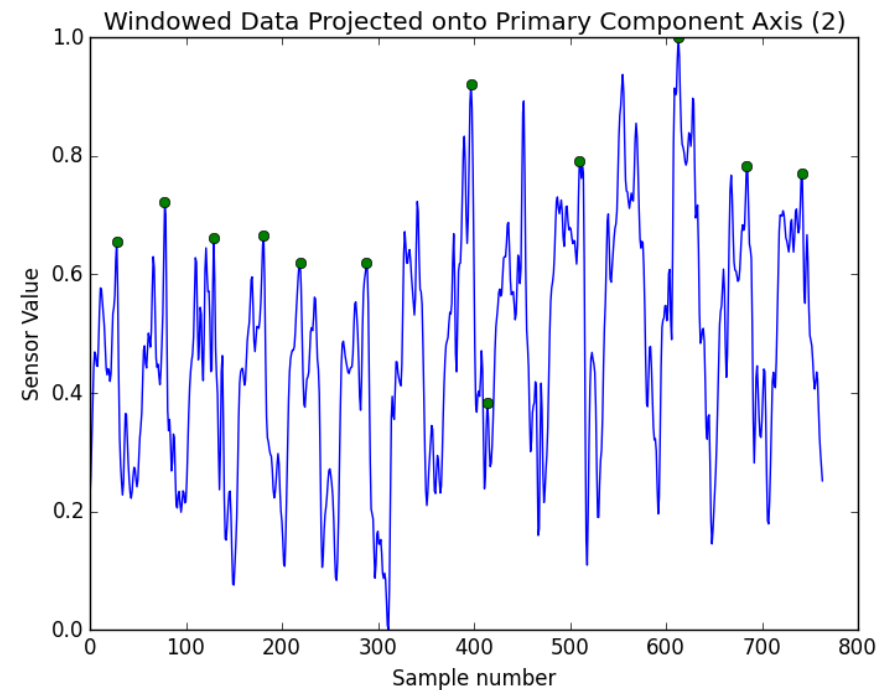
COUNTING – ALGORITHM (1)

- Find all local maxima
 - Constrained to some minimum period between peaks



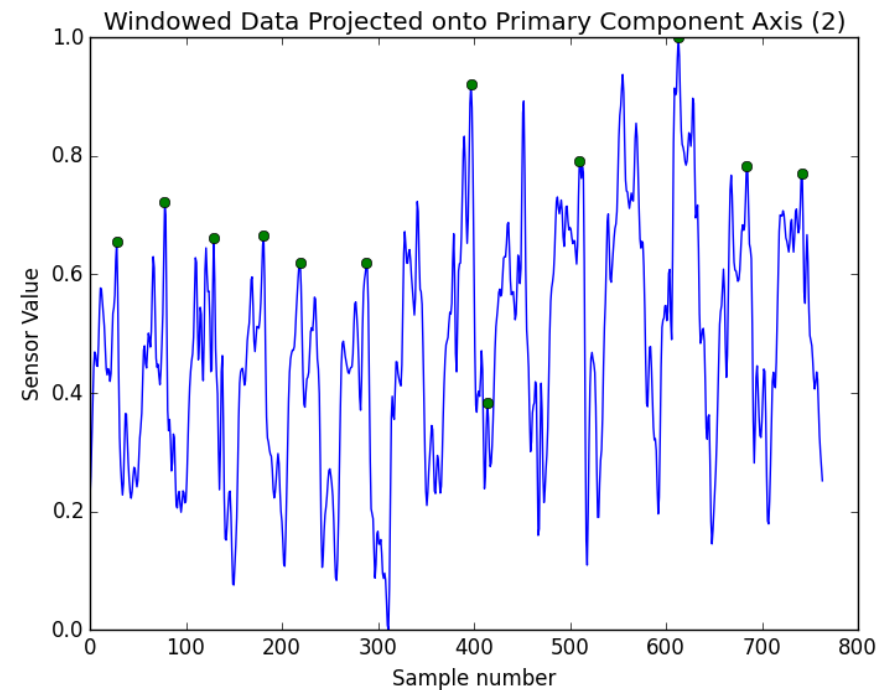
COUNTING – ALGORITHM (2)

- Perform autocorrelation around each peak
 - Determine local period
 - Cull any peaks that occur too close



COUNTING – ALGORITHM (3)

- Find peak at 40th percentile
 - Cull all peaks less than 50% of that peak





RESULTS

Battery Drain: ~10% per hour

Accuracy: Need more training data

Current supported lifts:

- Bench Press
- Overhead Press
- Squat
- Preacher Curl
- Pendlay Row

Soon:

- Deadlift
- Lat Pulldown
- Shoulder Fly