EVALUATING EMG SIGNALS FOR A BASELINE SIGNAL

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PURPOSE

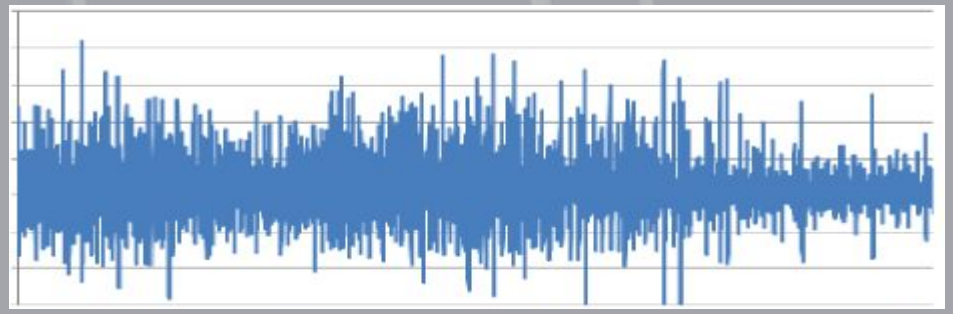
Checking an EMG signal population for establishing a benchmark baseline signal for hand grip gestures.

Application: Document progression of muscle rehabilitation.

BACKGROUND

ELECTROMYOGRAPHY (EMG):

- Electrical activity by skeletal muscles
- Measured in microvolts (activation units a.u.)
- Amplitude = contraction force

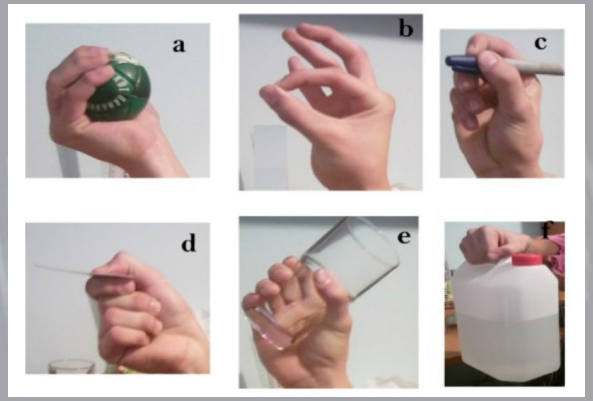


HYPOTHESIS

The population observed is a representative sample of a greater population, and is reliable for calculating a baseline.

DATA

MATERIALS



- Recorded @ 500Hz for 6 sec
- 2 sites:
  - Flexor carpi ulnaris
  - Extensor carpi radialis longus/brevis
- 6 grips:
  - Spherical, tip, palmar, lateral, cylindrical, hook

LIBRARIES

MATERIALS

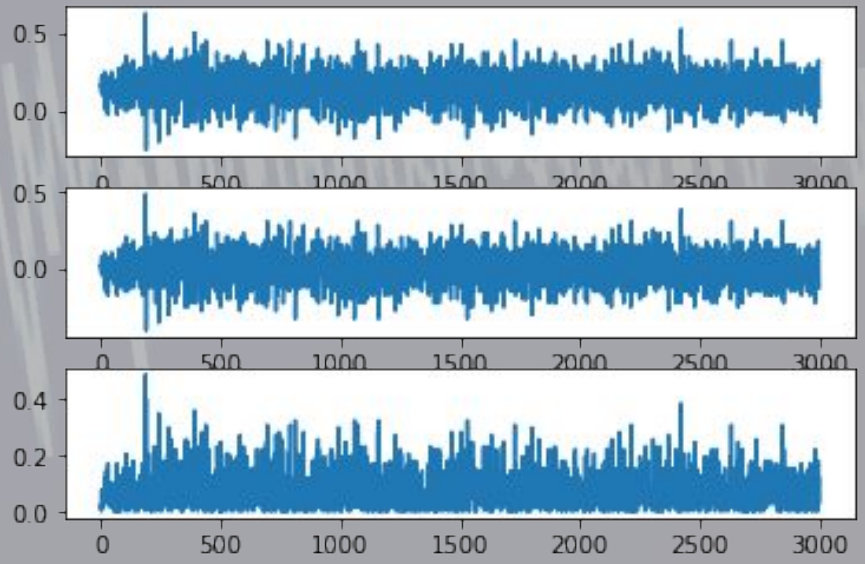
Data Wrangling/EDA/Stats

- pandas
- numpy
- scipy
- matplotlib

DATA WRANGLING

EXPERIMENTAL DESIGN

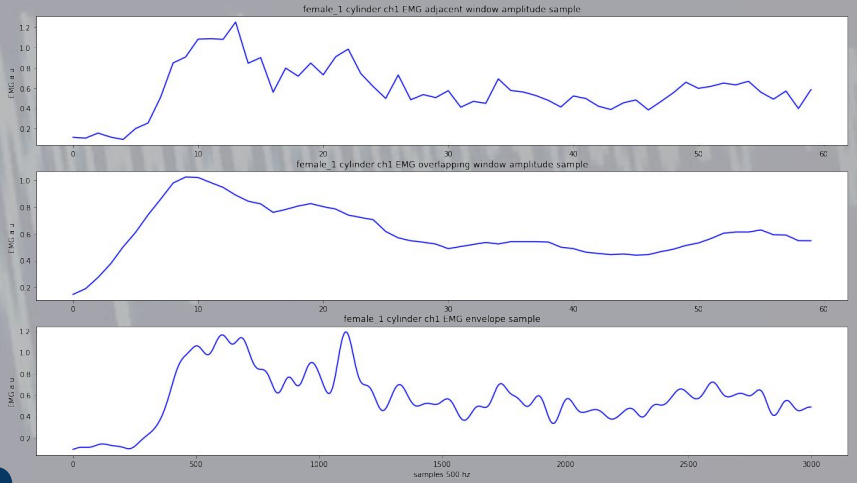
- Arrange as dataframe
- Correct centrality
  - Subtract mean
- Rectify signal
  - Absolute value



FEATURE EXTRACTION

EXPERIMENTAL DESIGN

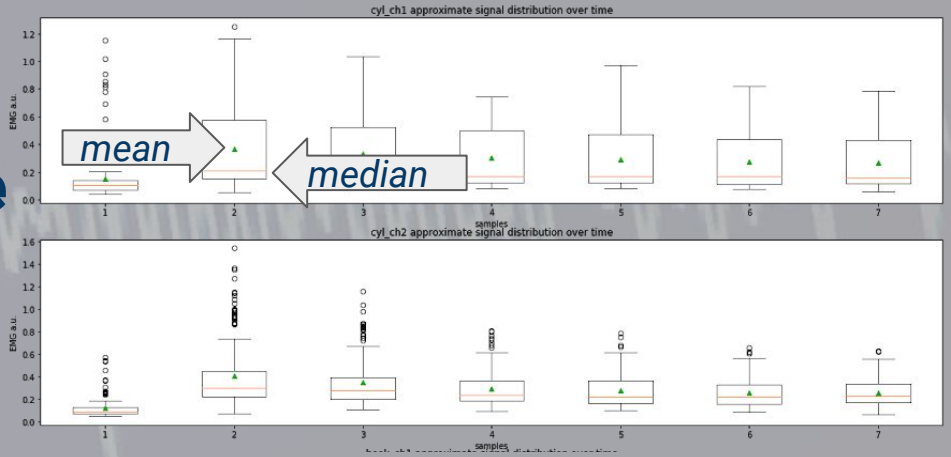
- Windowed samples*
  - Mean of adjacent 50
  - *Final choice for testing
- Overlapping samples
  - Mean of 345, overlap 300
- Signal envelope



BASELINE CALCULATION

EXPERIMENTAL DESIGN

- Windowed samples
  - Variability of envelope
  - 50x sample reduction
- Mean of signals
  - More variability than median



HYPOTHESIS TESTING

EXPERIMENTAL DESIGN

- ***Criteria 1***
  - **Signals by grip-channel are different.**
- ***Criteria 2***
  - **Signals for subjects w/in grip-channel are <u>not</u> different.**

CRITERIA 1: Signals by Grip-Channel

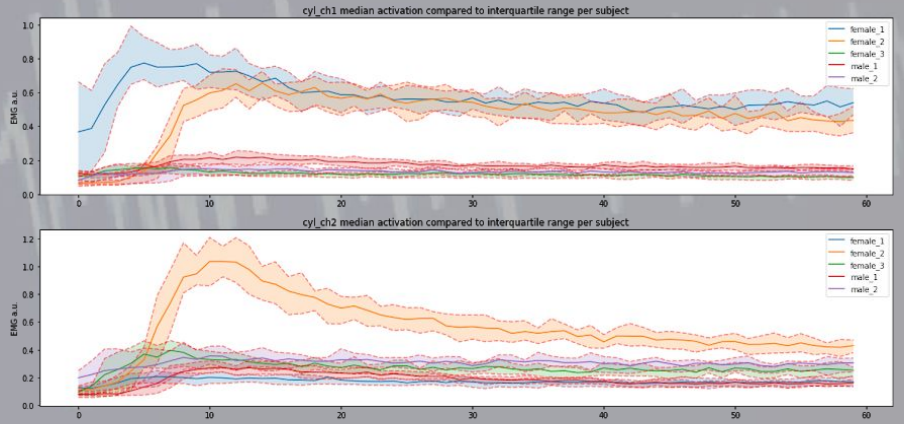
EXPERIMENTAL DESIGN

- Kruskal Wallis H-test
  - Not normal distribution
  - Non-parametric
- 2 populations
  - 6 grips / channel
  - 2 channels = 2 tests

CRITERIA 2: Signals by Subject W/IN Grip-Channel

EXPERIMENTAL DESIGN

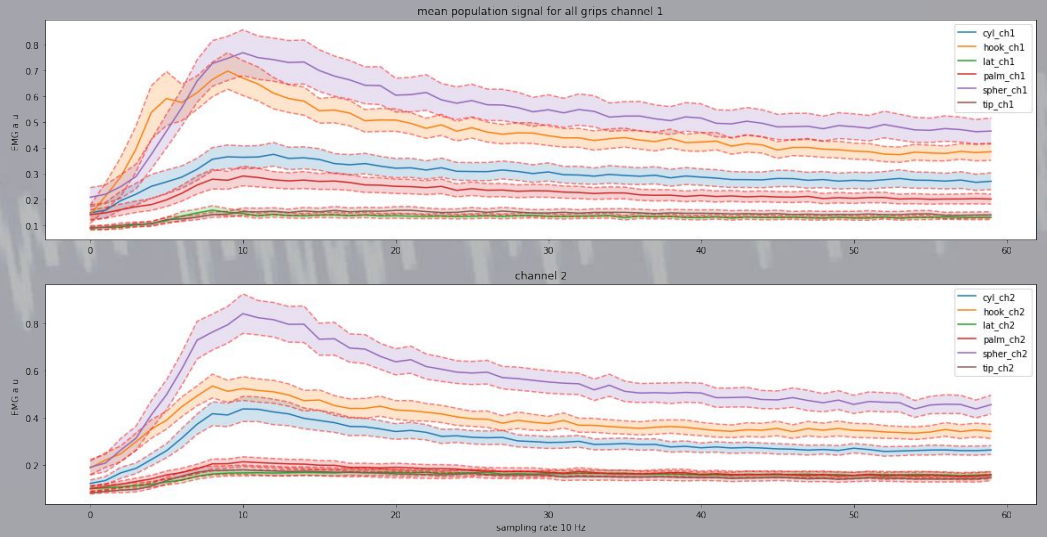
- Kruskal Wallis H-test
  - Normal distribution
  - Mismatch stand. dev.
- 12 populations
  - 5 subjects / grip-channel
  - 12 grip-channel = 12 tests



BASELINE CALCULATION

RESULTS

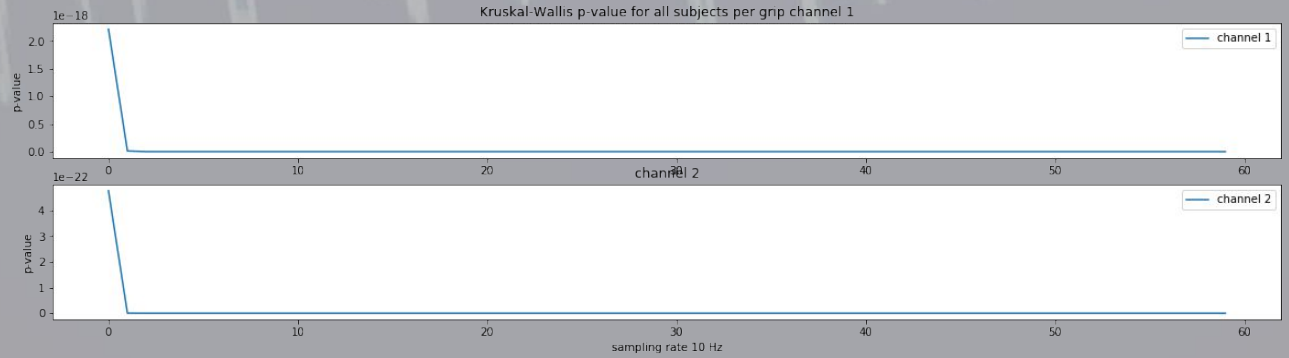
- **Stabilize w/in 0.2 a.u.**
- **Distinct by grip**
- **Practical?**



CRITERIA 1

RESULTS

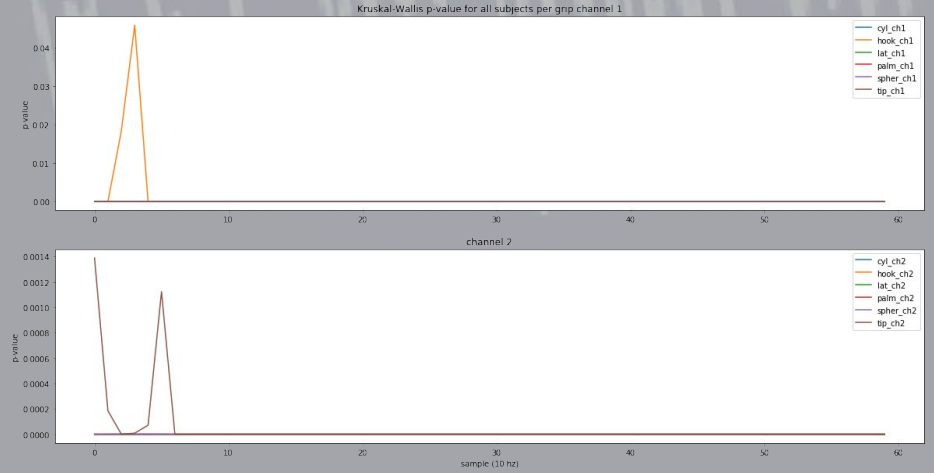
- **Reject Null Hypothesis**
- **Signals by grip-channel are different**



CRITERIA 2

RESULTS

- **Reject Null Hypothesis**
- **Signals by subject w/in grip-channel are different**



IMPLICATIONS

CONCLUSION

- Baseline still possible
- Population not representative
  - Grips distinct, but subjects dissimilar
- Not practical with dataset
  - More features
  - More data