Interactive Visualization of Parkinson's Disease Walking Data

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Introduction

- The DigiPsych Lab works on various projects that use predictive ML models to identify diagnostic features that change with medication.
- Pittman et al (2019) used walking data from a cell phone app to predict if a patient has Parkinson's or not.
- Currently, they are working on using walking data to predict medication status.

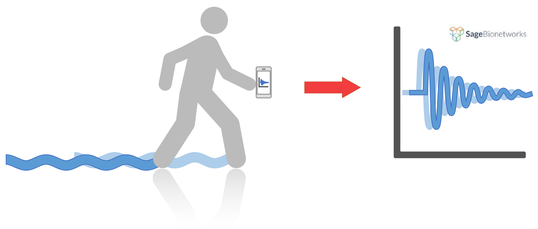
PROJECT ECHO

Parkinson's Disease (PD)

- PD is a neuro-degenerative disease that affects movement.
- PD cannot be diagnosed *via* blood test or scan, and has no known cure.
- The four classic symptoms of the disease are tremors, rigidity in the wrist and elbow joints, lack or slowness of movement, and an unstable posture.
- Current treatment options are limited and can only slow the progression of the disease.

The mPower Project

1. Walking data is collected from patients through the **Sage Bionetworks mPower app**. Raw data is generally **sinusoidal (wave-like)** in nature due to natural walking movements.

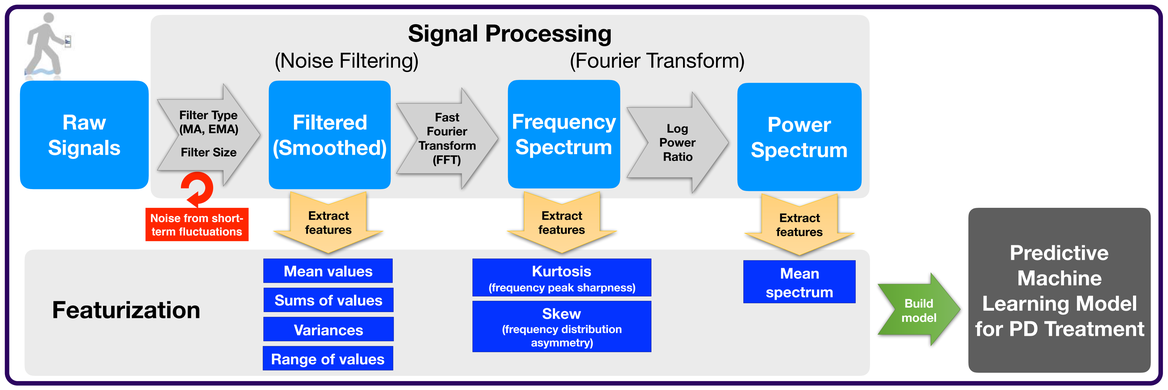


2. Waveforms are processed using various methods, such as **smoothing** and **Fourier transforms**, in order to reduce data into simpler representations for comparison.

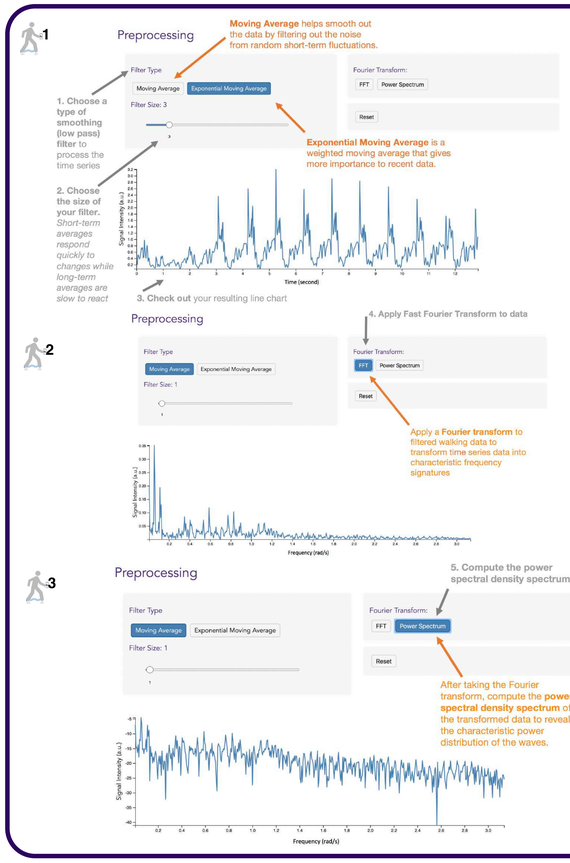
Reduced motor coordination will produce irregular waveforms in walking data. Medication for PD drastically improves patient condition. **We hypothesize that the waveforms produced by PD patients after ingesting medication will differ measurably from waveforms produced prior to medication.**

Visualization Design

FLOWCHART



Signal Processing



GOAL

Visualize the effect of various **signal processing steps** on the raw time-series data used to train the ML model.

This will determine which methods best preserve meaningful features in the data and show more informative plots.

Acknowledgments

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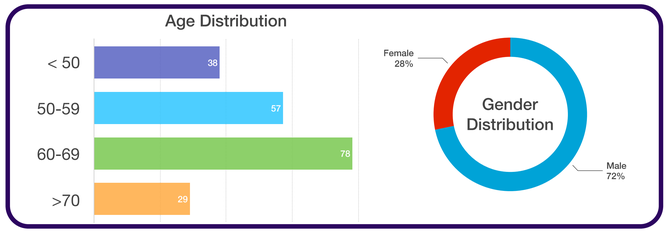
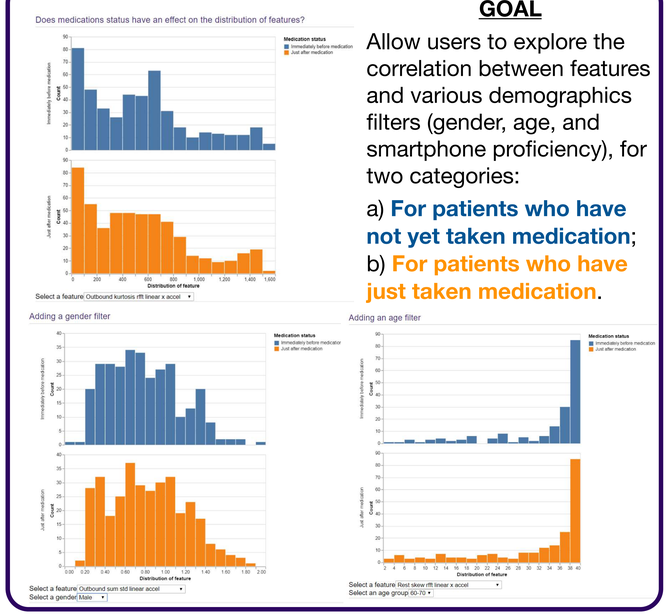
Featurization

DEMOGRAPHICS



VISUALIZATION OF FEATURES



GOAL

Allow users to explore the correlation between features and various demographics filters (gender, age, and smartphone proficiency), for two categories:

a) **For patients who have not yet taken medication**;
b) **For patients who have just taken medication**.

Conclusions

- Most feature distributions appear very similar for the two categories of medication status
- Demographic variables such as age and gender generally do not improve separation of features for the two categories of medication status
- Potential cause: Signal processing leads to loss of useful information which could predict medication status. Indeed, when we change how the accelerometer and device motion data are averaged, there are large-scale changes to the power spectrum which is used to derive the features.

References

Pittman, Benjamin, Reza Hosseini Ghomi, and Dong Si. "Parkinson's Disease Classification of mPower Walking Activity Participants." *2018 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*. IEEE, 2018.

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