

MACHINE LEARNING

Submission Assignment 02

von

Benjamin Ellmer
(S2210455012)



Mobile Computing Master
FH Hagenberg

November 23, 2023

1. Data Preprocessing

1.1. Preprocessing - Missing values

Are there any missing values which need to be taken care of?

No, I did not find a sample that has missing values. This was done by counting the number of values that are not nan for each sample. Then I counted the number of nan values for the first values.

This means if the sample has 100 not nan values I took the first 100 values and counted the number of nan values. If the number of nan values in the first 100 values is 0, then there is no missing data in the sample.

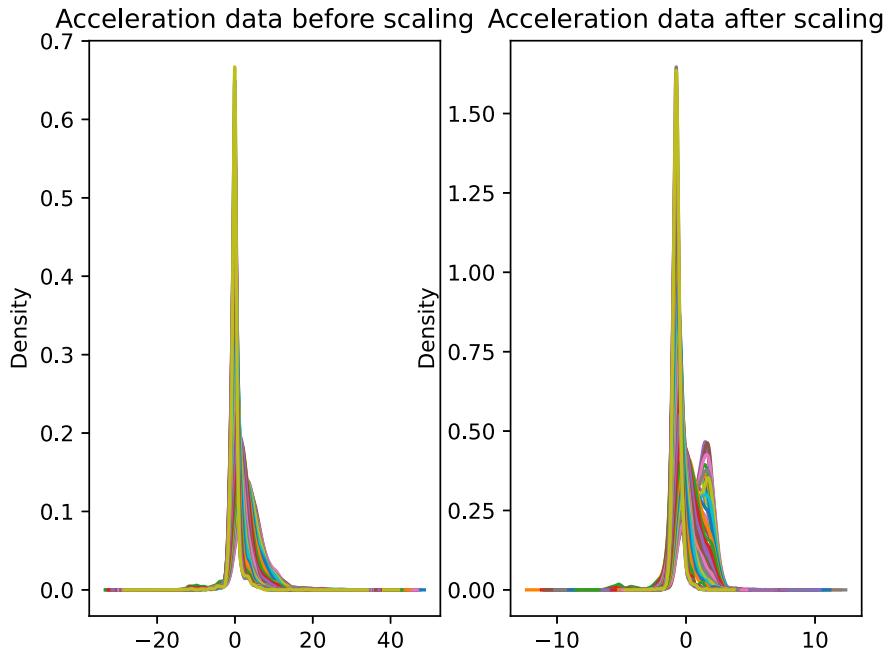
1.2. Preprocessing - Feature Reduction

To get an equal amount of acceleration values I interpolated the gesture data and took an equal amount of values for each sample. According to the description the sensor was recording with 100Hz and the max frequency that makes sense is 20Hz, this means 84.6 ($423/5$) values should be sufficient.

Therefore, I visualized the comparison of the interpolated data for each gesture and using 50, 100 and 200 values compared to the original data. As a result I decided to continue to work with only 50 values, because I think it still shows the mandatory information. The comparisons can be seen in Appendix Interpolations 3.1.

1.3. Preprocessing - Normalization

I decided to normalize the data using scaling. Figure 1 shows the distribution of the data before and after normalization. The normalization was done, because it helps the models to work with the data.



1.4. Preprocessing - Filtering

I decided to use filter to reduce the noise in the data, as suggested in the exercise hints. I tried the suggested filters (running mean, running median and savgol filter).

In my opinion the savgol filter preserves the trends of the gestures best, therefore I continued with the data that was filtered using the savgol filter. The comparisons can be seen in Appendix Filters 3.2. Regarding the windowsize I tried some sizes and ended up with 8, but I think including these plots here would be too much.

1.5. Preprocessing - Feature Addition

In the last exercise we already saw, that there is a correlation between the length of a sample and the gesture type. But, by processing the samples to get samples with equal lengths, we lost this information. Therefore, I added it manually as an extra feature, describing the original length of the recording.

2. Feature Extraction

Yes I think it makes sense to derive more features besides the acceleration values, or at least try and look if there might be ones that make sense. I chose to extract the following features.

Based on the x-axis data (preprocessed):

- raw values
- min
- max
- mean
- median
- standard deviation
- innerquartile range
- median absolute deviation
- number of maximas
- number of minimas
- zero crossing rate
- median crossing rate
- frequency power
- frequency angle
- autocorrelation

Based on the 1st derivative of the x-axis data:

- raw values
- min
- max
- mean
- median
- standard deviation
- innerquartile range
- median absolute deviation
- autocorrelation

Based on the 2nd derivative of the x-axis data:

- raw values
- min
- max
- mean
- median
- standard deviation
- innerquartile range
- median absolute deviation
- autocorrelation

Based on the wavelet transformation of the x-axis data:

- raw values
- min
- max
- mean
- median
- standard deviation
- innerquartile range
- median absolute deviation
- autocorrelation

Afterwards I evaluated the features and chose the most promising ones, as described in This will be described in depth in the next assignment.

2.1. Raw x-axis data

2.2. 1st derivative of x-axis data

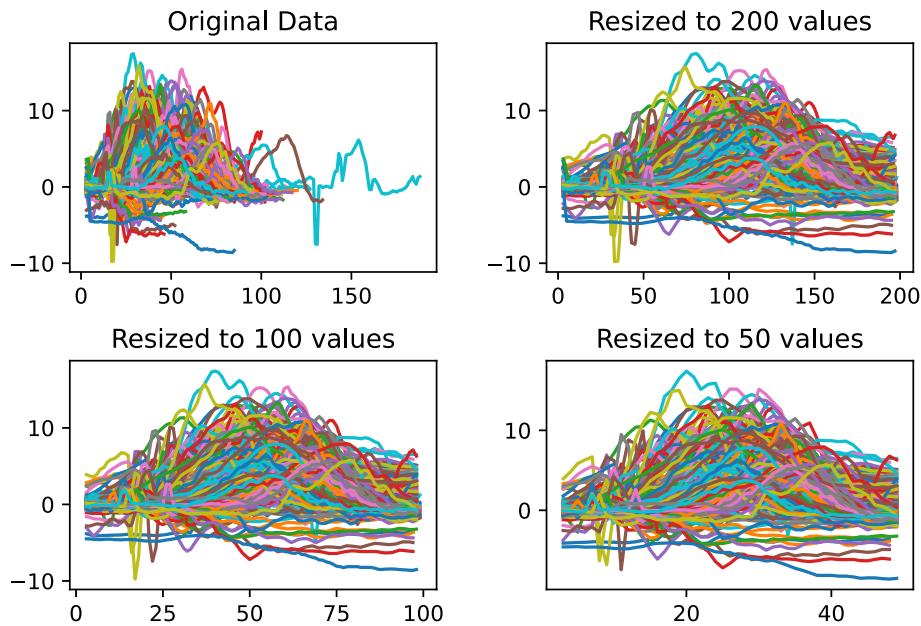
2.3. 2nd derivative of x-axis data

2.4. Wavelet transformation of x-axis data

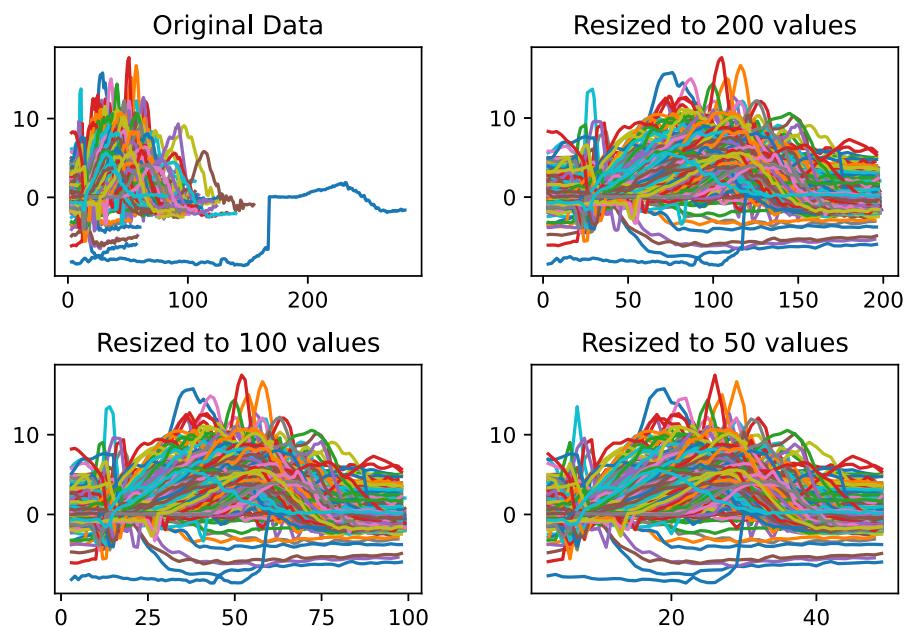
3. Appendix

3.1. Appendix Interpolations

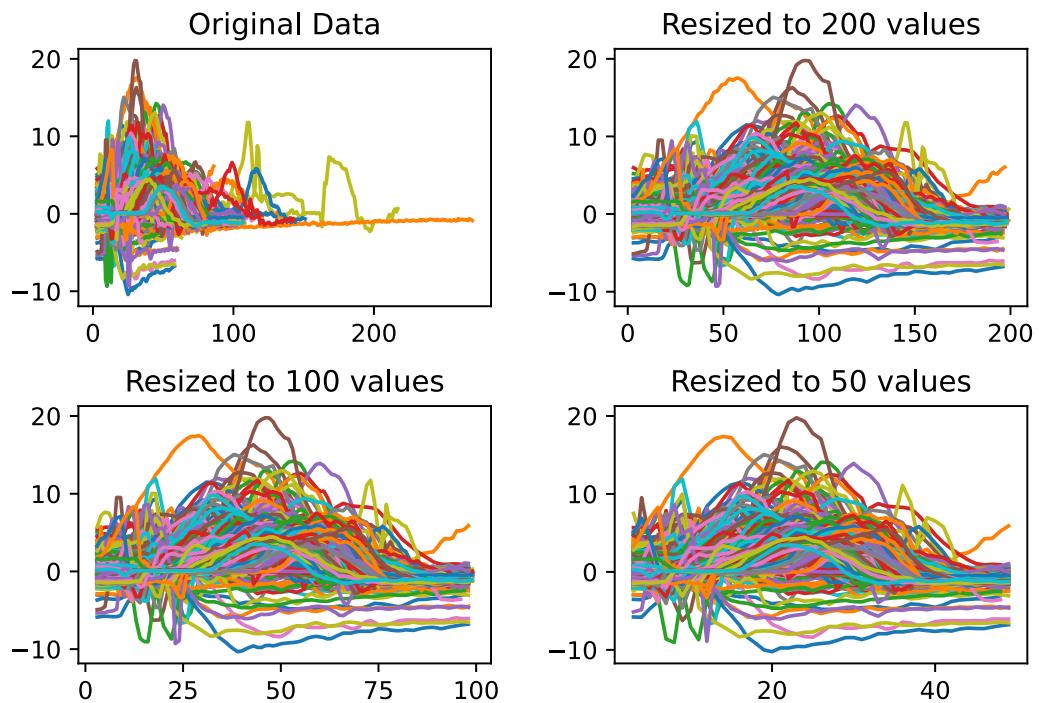
left gesture interpolation and resizing comparison



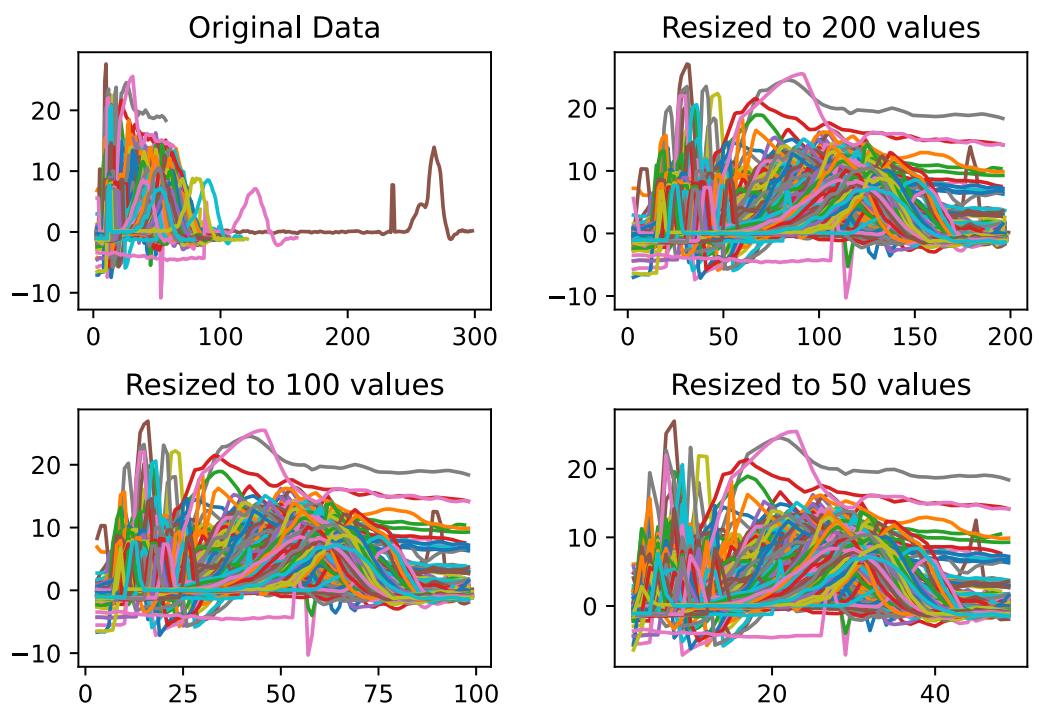
right gesture interpolation and resizing comparison



up gesture interpolation and resizing comparison



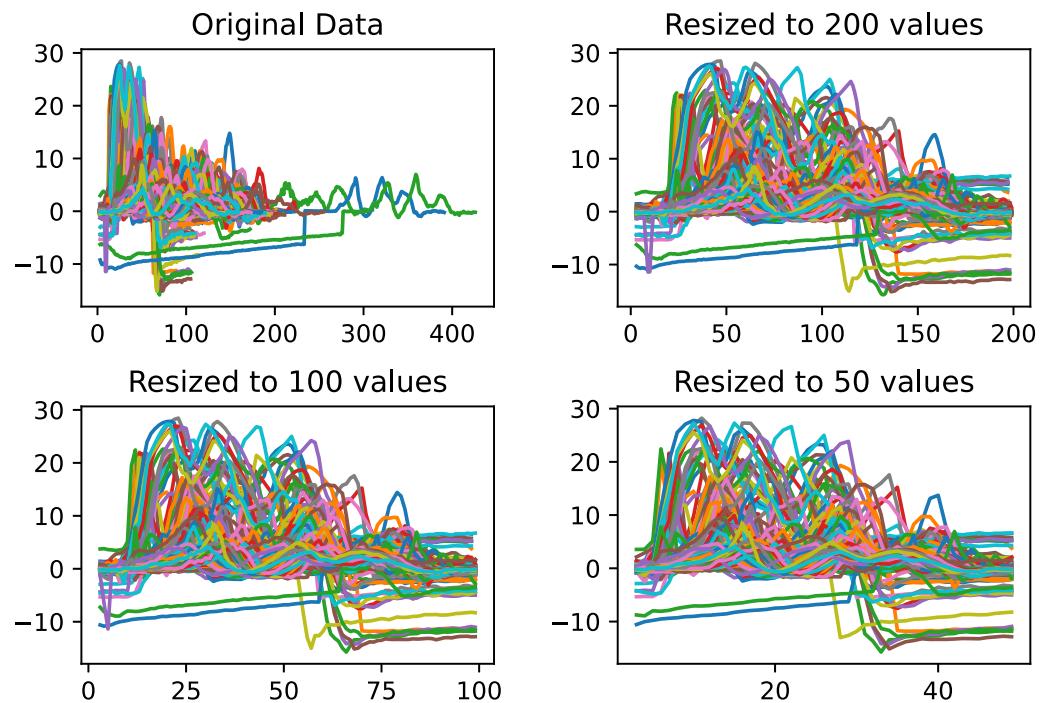
down gesture interpolation and resizing comparison



square gesture interpolation and resizing comparison



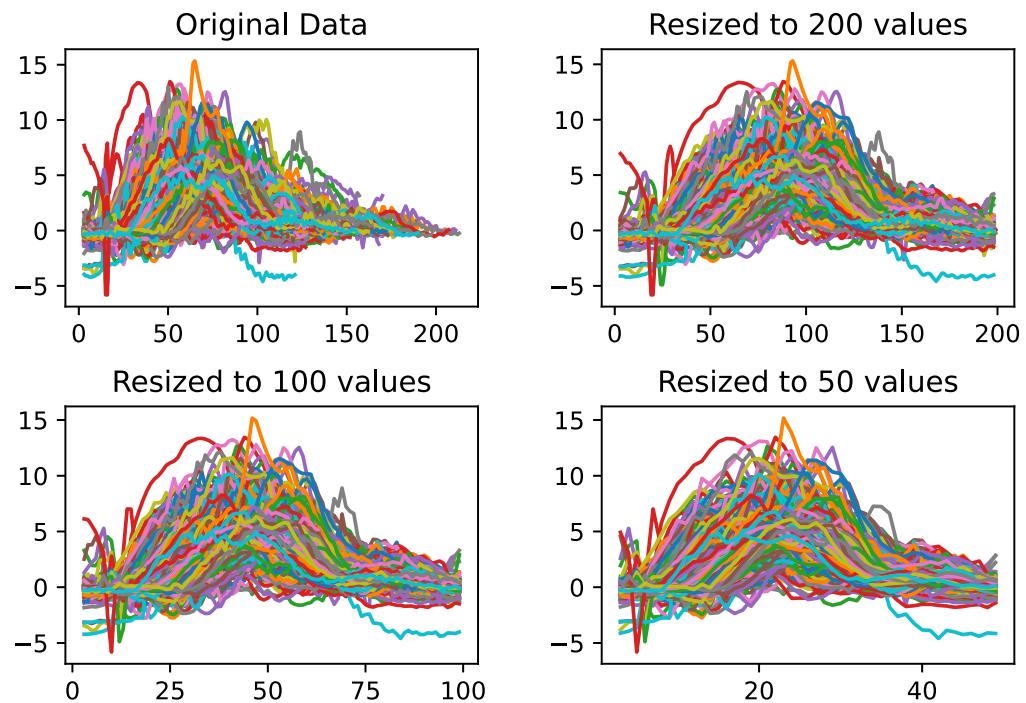
triangle gesture interpolation and resizing comparison



circleCw gesture interpolation and resizing comparison

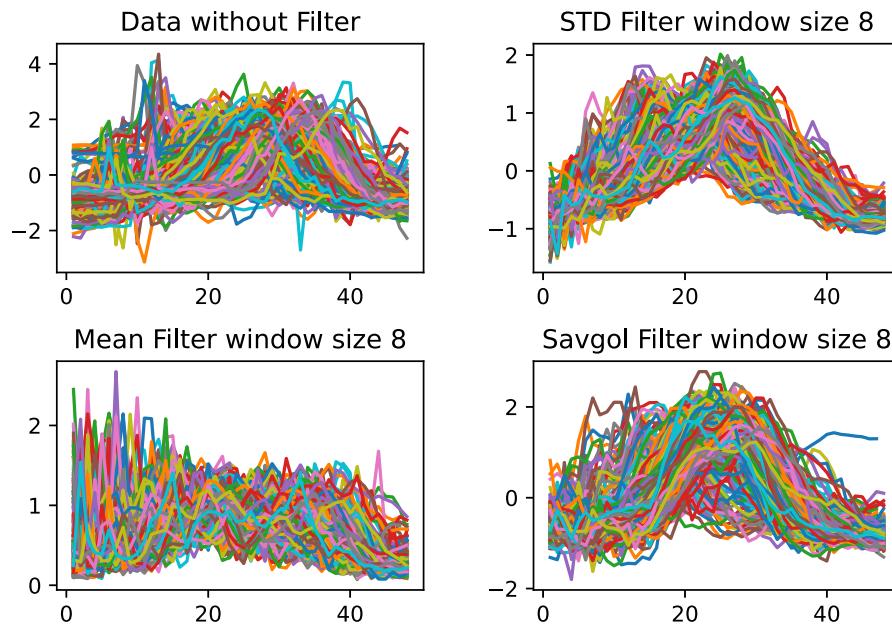


circleCcw gesture interpolation and resizing comparison

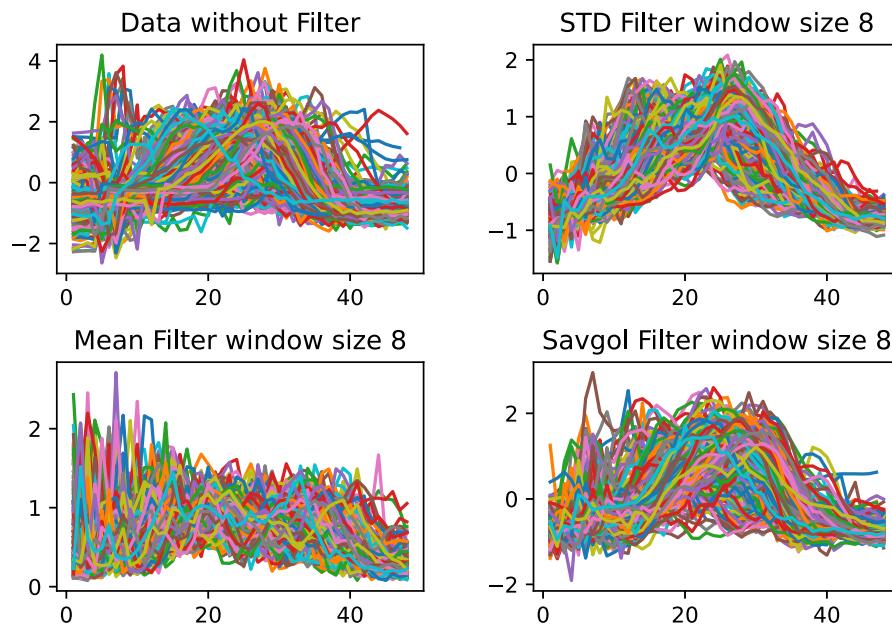


3.2. Appendix Filtering

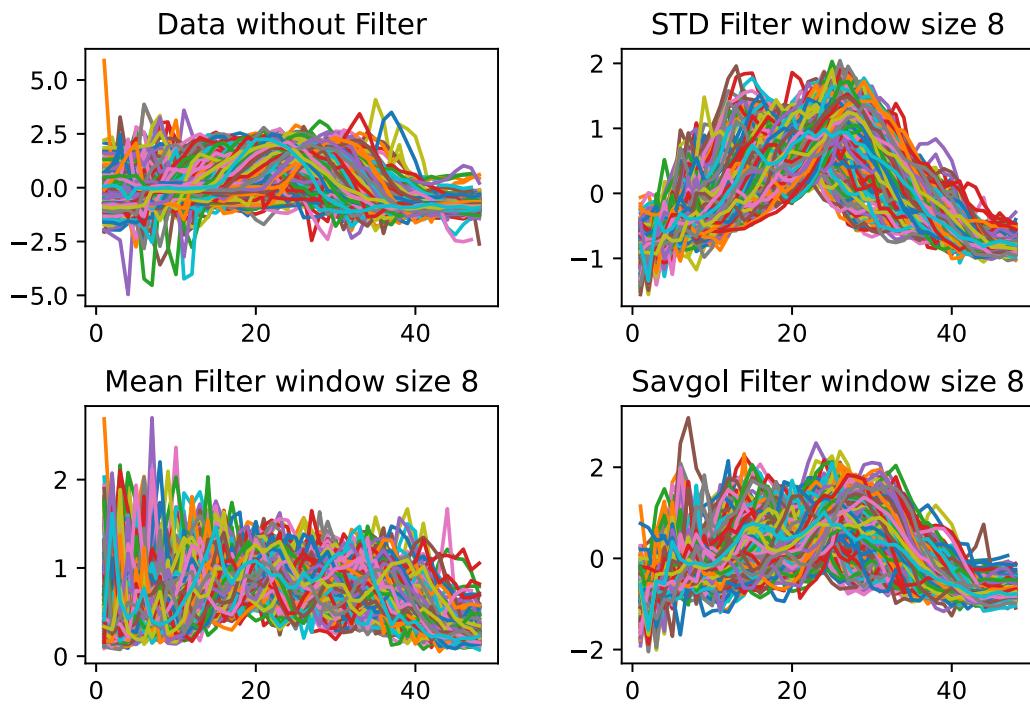
left gesture Filter comparison



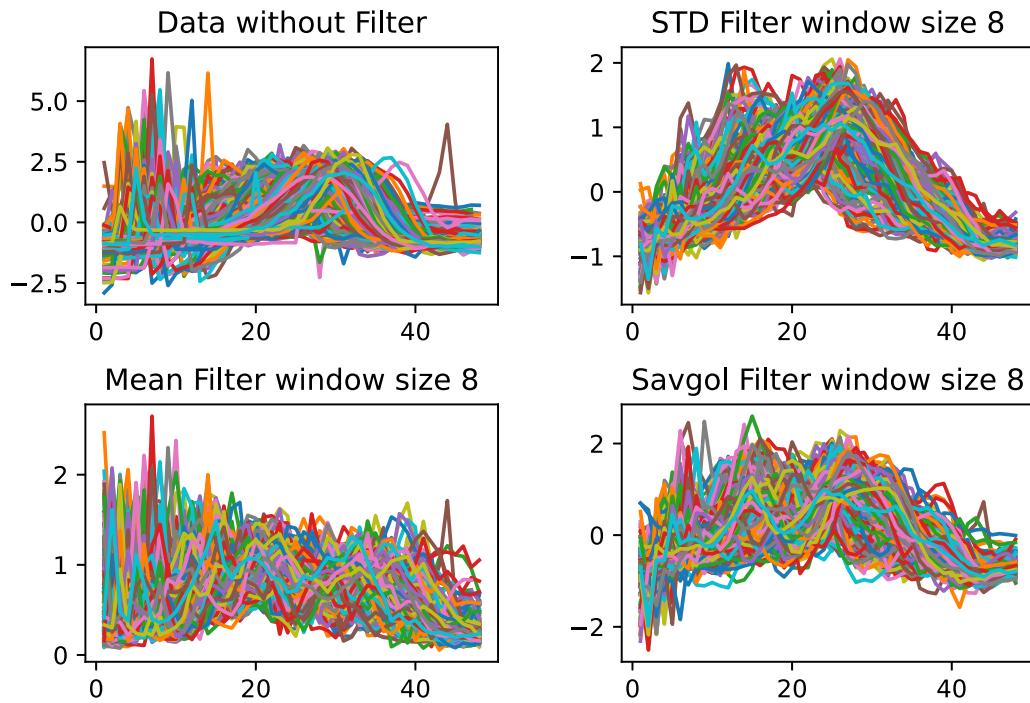
right gesture Filter comparison



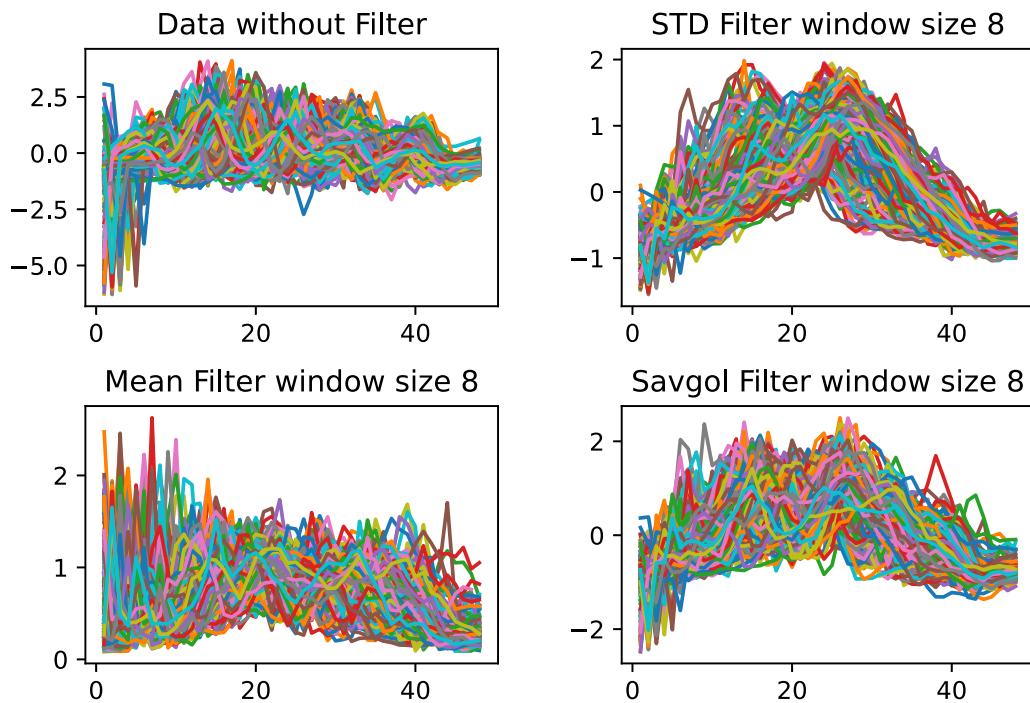
up gesture Filter comparison



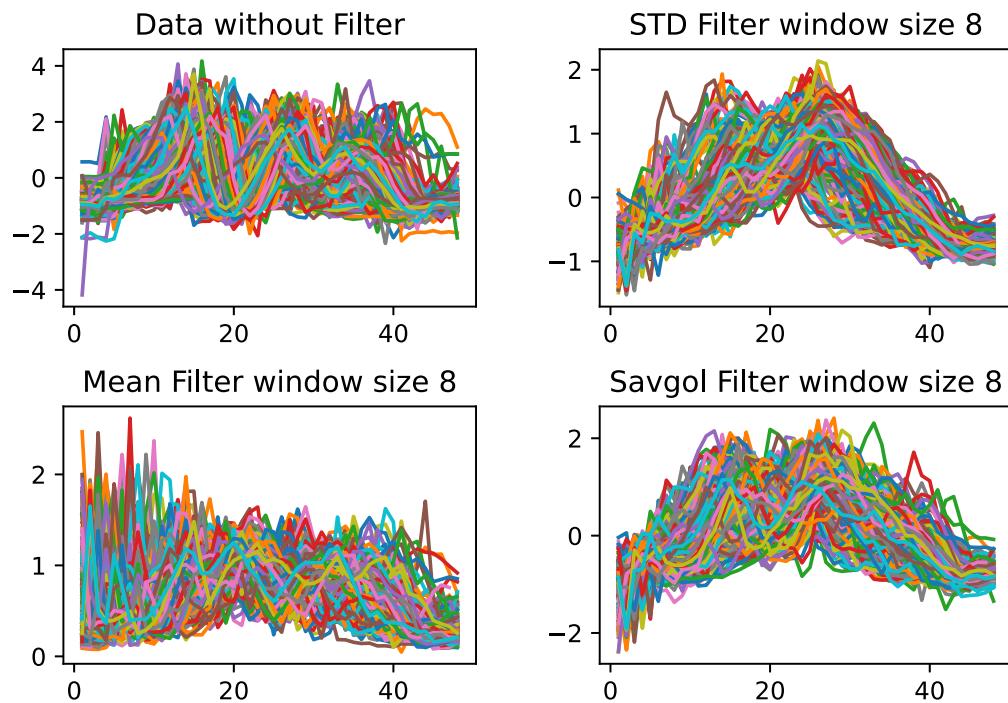
down gesture Filter comparison



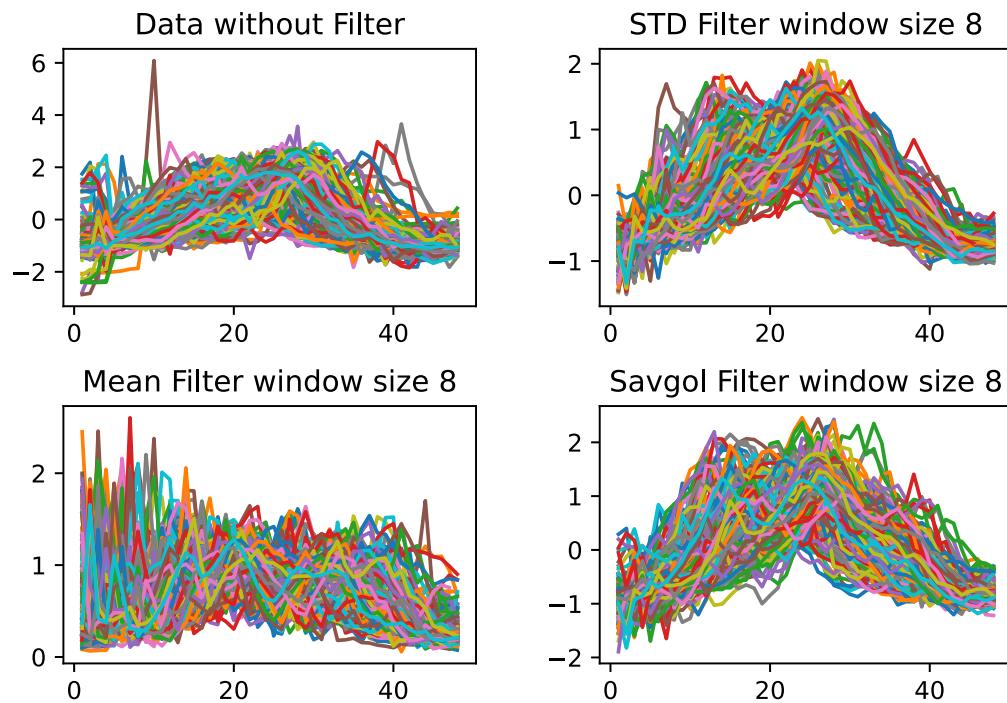
square gesture Filter comparison



triangle gesture Filter comparison



circleCw gesture Filter comparison



circleCcw gesture Filter comparison

