Pison Report:

Highlights: https://github.com/gerardoRO/Pison

- 6 gestures identified with K Means clustering
- XGBoost Classifier returns an F1 score of 84% in the classification.

1. Data Exploration

Goal: Investigate underlying patterns and potential issues with the data.

- Dataset has some big jumps in time that separate the body positionings, so first I looked at the IMU data in these groups to see if there were clear groupings of gestures.
- The IMU data also seems to be all over the place in terms of scaling, this could be due to new gestures present or due to noisiness in the data.
- The accelerometer data also seems to have some strong underlying oscillations, that perhaps can highlight repetitions of gestures, so we can use this to segregate gestures.

2. Dataset Generation

Goal: Generate a NxM table with N number of samples ideally corresponding to a gesture. I decided to use the accelerometer underlying oscillations and peaks to segregate our datasets into samples. I worked with a fixed value of height and distance chosen, but I later on explore how changing these parameters affects our gesture classification.

3. Data Augmentation

Goal: Generate the M properties of the table described above to classify gestures effectively.

- I applied Singular Spectrum Analysis to the oscillatory signals (accelereometer, sensor data) and fourier analysis to the same signals
- Also decided to estimate the power of the SSA components and the Fourier spectra, as well as the time component of IMU data. For the time components I also estimated the mean and standard deviation.

4. Clustering

Goal: Generate labels for the N samples that are reliable groupings of gestures.

Visualizing the K Means results, we can see an increase in silhouette score at around 6-8 gestures, and an elbow like behavior around 6-7 for the inertia score.
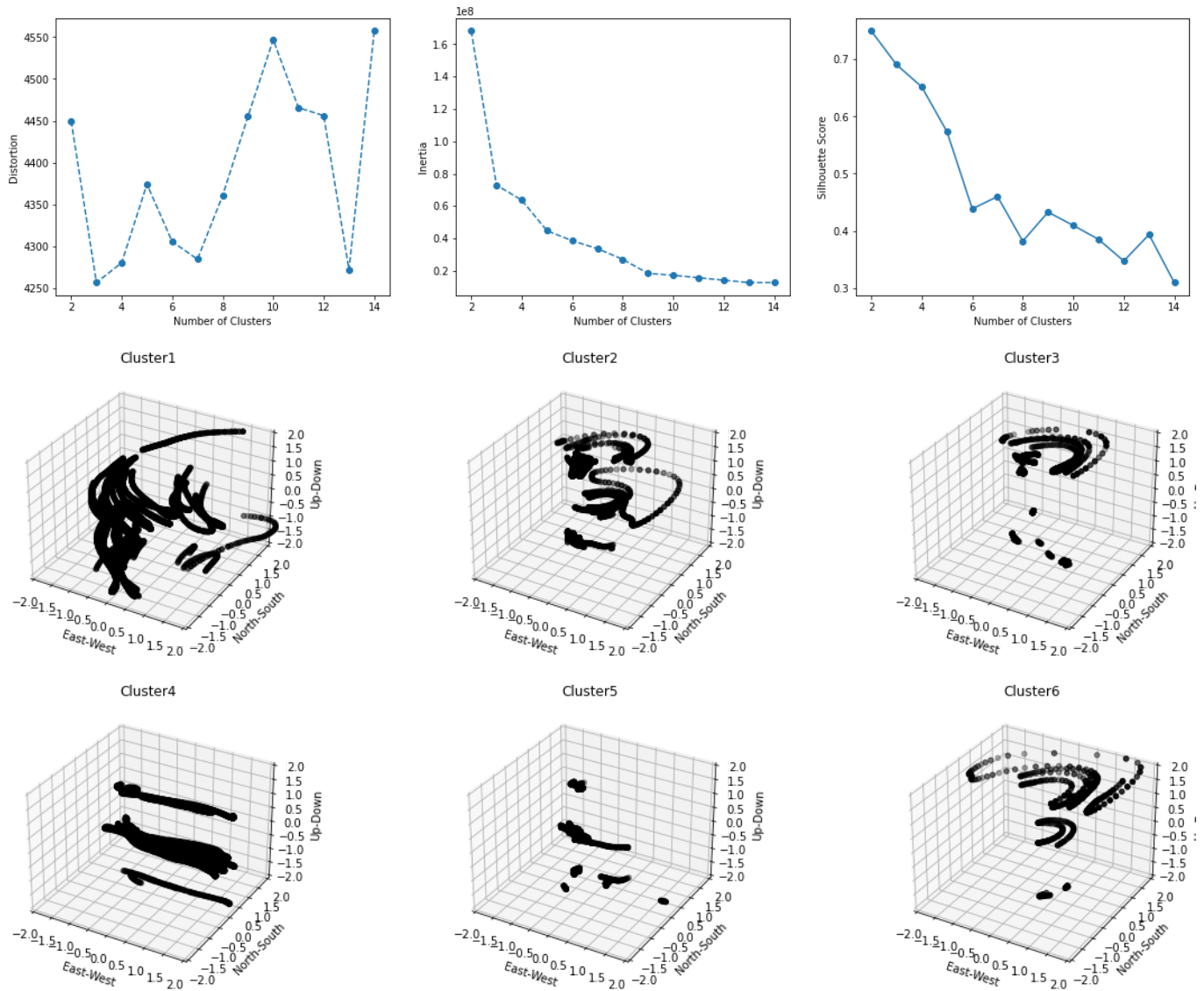
We see that when I segregated with a peak of 10 and a distance of 200, and 6 gestures, we get some consistent gesture motions. With linear motion, rotational motion, and some more diverse motion.

5. Classification
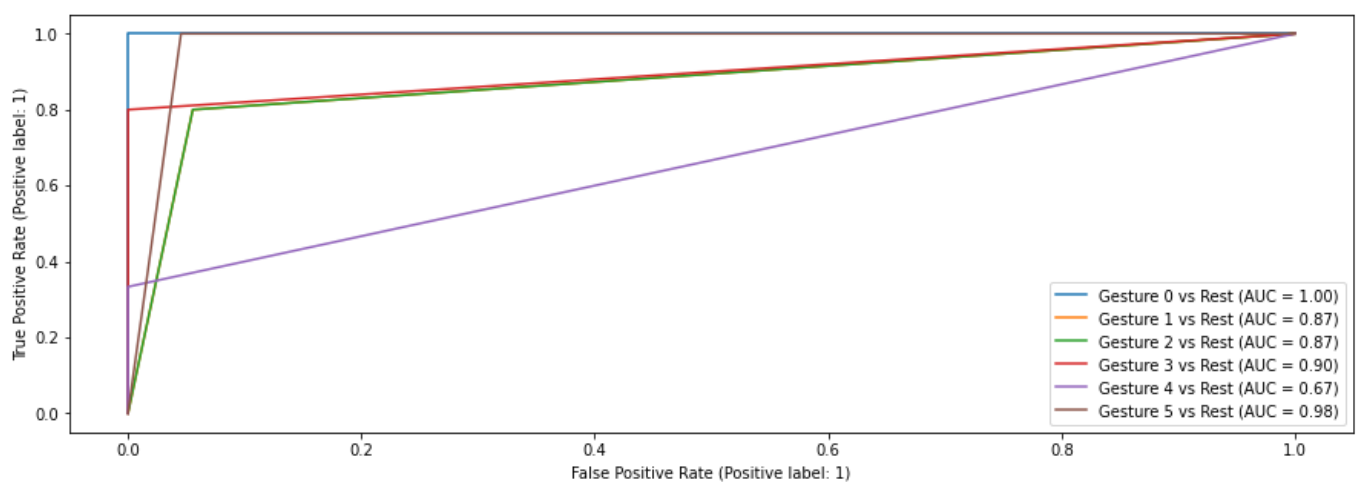
For more in depth results, look here, but we get a roc_score of 99%, and a f1 score of 84%. Not only that, but looking at the gestures predictions we have a varied predictions and the labels are not correlated with body movement label.