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Professor V.P. Nguyen

CS 528

19 April 2024

Assignment 3 Analysis

1. 21 samples of up, down, left, and right gestures can be found in the submitted code. Each gesture is organized by gesture type in the folder “gesture\_data”. **An explanation of how to run my code may be found in the README.md file located in the “main” folder.**
2. For parts a and b, the x, y, and z axes are combined using the root square mean as suggested by the professor in class. All plots can be found in the gesture\_plots/plots folders
   1. Accelerometer data

A graph showing a line of a graph

Description automatically generated with medium confidenceA graph of a graph

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A graph showing a line

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A graph showing a line of blue color

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* 1. Gyroscope data

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* 1. Spectrogram data

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* 1. Analysis

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When analyzing the plot of the acceleration data, it is important to remember that the data plotted is a summary of the x, y, and z axes using their root squared mean. In the case of this up gesture, most change in acceleration was recorded on the y and z axes. This can be verified by looking at the csv file of moments of the gesture captured. By analyzing this graph, the motion began at around 1.0 seconds and ended at around 3.5 seconds. The graph is symmetrical, which makes sense as the gesture is symmetrical in nature as the hand moves up, pauses briefly, and then comes back down to a neutral position. Again, since the plotted data is squared, it will all be positive despite the direction being opposite at the beginning and end of the gesture. There is a spike in acceleration from 1.0 to 1.5 seconds as the hand is rising as the acceleration in the y axes increases. There is a significant drop as the hand approaches a 45º angle and a spike again as a 90º angle is approached again. Acceleration decreases again almost to the level of a neutral gesture at around 2.2 seconds as the hand pauses briefly, and then the pattern occurs again in the opposite order as the hand moves down back to neutral.

A similar story can be seen from the spectrogram. Through analyzing this graph, the motion began at around one second and ended around 3.3-3.5 seconds. This is shown through the increased magnitude of the frequencies of the rotation in the y axis during this time frame. By further analyzing the frequencies of the rotation in the y axis, there are spikes in activity around 1.5-2.3 seconds and 2.4-3.0 seconds, which correlates with the hand first moving up and then back down.

A graph showing a line

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When analyzing the plot of the acceleration data, it is important to remember that the data plotted is a summary of the x, y, and z axes using their root squared mean. In the case of this up gesture, most change in acceleration was recorded on the y and z axes. This can be verified by looking at the csv file of moments of the gesture captured. By analyzing this graph, the motion began at around 1.2 seconds and ended at around 3.5 seconds. The graph is symmetrical, which makes sense as the gesture is symmetrical in nature as the hand moves down, pauses briefly, and then comes back up to a neutral position. Again, since the plotted data is squared, it will all be positive and symmetrical despite the direction being opposite at the beginning and end of the gesture. There is a sudden decrease in acceleration from 1.2 to 1.6 seconds as the hand is lowering as the acceleration in the y axes decreases (increases in the negative direction). There is a significant increase in acceleration as the hand approaches a 45º angle and the **magnitude** in the acceleration in the y and z directions becomes greater again. (Again, recall that the data plotted is squared, so as the acceleration becomes increasingly negative, the root mean square will increase). Acceleration decreases again almost at around 2.0-2.5 seconds as the hand pauses briefly, and then the pattern occurs again in the opposite order as the hand moves down back to neutral.

A similar story can be seen from the spectrogram. Through analyzing this graph, the motion began at around one second and ended around 3.5 seconds. This is shown through the increased magnitude of the frequencies of the rotation in the y axis during this time frame. By further analyzing the frequencies of the rotation in the y axis, there are spikes in activity around 1.5-2.0 seconds and 2.5-3.0 seconds, which correlates with the hand first moving up and then back down. There is another spoke around 3.3-3.5 seconds which may be from the hand adjusting or noise.

A graph showing a line of blue color

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With the left gesture plot, it is more difficult to tell where the gesture starts and stops however by analyzing the plot and the spectrogram together, it can be determined that the gesture lasted from 1.0 to around 3.0 seconds. During this time, the measured acceleration seems to go experience random spikes. This could be because as the MPU was being rotated around the z axis, the axis that was experiencing acceleration was changing between the x and y axis.

For the left gesture, the movement is much clearer in the spectrogram for the z axis. By analyzing the spectrogram, it becomes obvious that much of the motion took place between 1.5-2.0 seconds and 2.2-2.5 seconds. This conclusion can be made by seeing that there are increased magnitudes of frequencies of movements at a larger range of frequencies compared to other times throughout the movement.

A graph with blue lines

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Description automatically generated

As with the plot for the left gesture, it is not entirely clear when the gesture begins and ends. By looking at the spectrogram, it is possible to tell that the motion took place from around 0.8-3.1 seconds. Again, during this time the measured acceleration seems to go experience random spikes. This could be because as the MPU was being rotated around the z axis, the axis that was experiencing acceleration was changing between the x and y axis.

For the left gesture, the movement is much clearer in the spectrogram for the z axis. Most motion around the z axis took place between 1.5-2.0 seconds and 2.2-3.2 seconds. This conclusion can be made by seeing that there are increased magnitudes of frequencies of movements at a larger range of frequencies compared to other times throughout the movement.