**ENPM809T - Autonomous Robots**
**Homework 1**
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**https://github.com/ShonBC/ENPM_809T_Autonomous_Robots/tree/master/Homework_1**

**Python Code:**

```
import numpy as np
import matplotlib.pyplot as plt

def PlotIMUData(imu_angle, increment):

    # Generate x-axis data
    x = np.linspace(1, imu_angle.size, imu_angle.size)

    # Raw IMU Data Plotting
    fig = plt.figure()
    ax = fig.add_subplot(111)
    # plt.plot(x, imu_angle, 'k')
    ax.plot(x, imu_angle, color='red', linewidth=.5, label='IMU_Data')

    # Moving Average Plotting
    mavg = np.array(MovingAvg(imu_angle, increment))
    std_dev = np.std(mavg)
    mean_data = mavg.mean()
    x1 = np.linspace(1, imu_angle.size, mavg.size)
    ax.plot(x1, mavg, color='blue', linewidth=.5, label=f'Moving Average [{increment}]')
    ax.text(1,1,
        f'Mean: {mean_data}, \nStandard Deviation: {std_dev}',
        style='italic')

    ax.legend(loc='best')
    ax.set(title='IMU Data History',
        ylabel='IMU Angle Reading [Degrees]',
        xlabel='Data Entry Number')

    plt.show()

def MovingAvg(imu_angle, increment = 10):

    avg_list = []
    ang_list = []
    for i in range(len(imu_angle)):
        ang_list.append(imu_angle[i])
        if len(ang_list) >= increment:
            avg_list.append(sum(ang_list) / increment)
            ang_list = []

    return avg_list
```

```
if __name__ == '__main__':

        # Load imu angular data in the 5th column of the data file
        imu_angle = np.loadtxt('Homework_1/imudata.txt', usecols= 4)

        PlotIMUData(imu_angle, 2)
        PlotIMUData(imu_angle, 4)
        PlotIMUData(imu_angle, 8)
        PlotIMUData(imu_angle, 16)
        PlotIMUData(imu_angle, 64)
        PlotIMUData(imu_angle, 128)
```

## Matplotlib Plots:

The raw imu data collected had a lot of noise. We used the moving average as a low pass filter and compared the results across six different window sizes (2, 4, 8, 16, 64, 128). As the window size increased, the high frequency noise was filtered and the data curves began to smoothen out. Smaller window sizes did not filter out enough noise whereas a window size that was too large filtered out too much. The optimal window size for this application was approximately between 16 and 64.

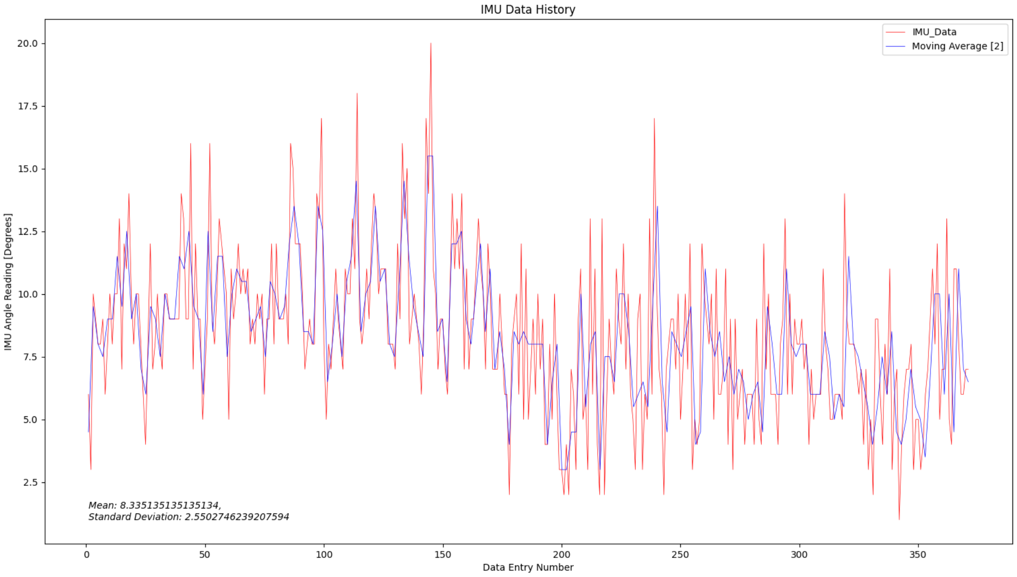

Figure 1: RAW IMU Data with Moving Average using a window of 2

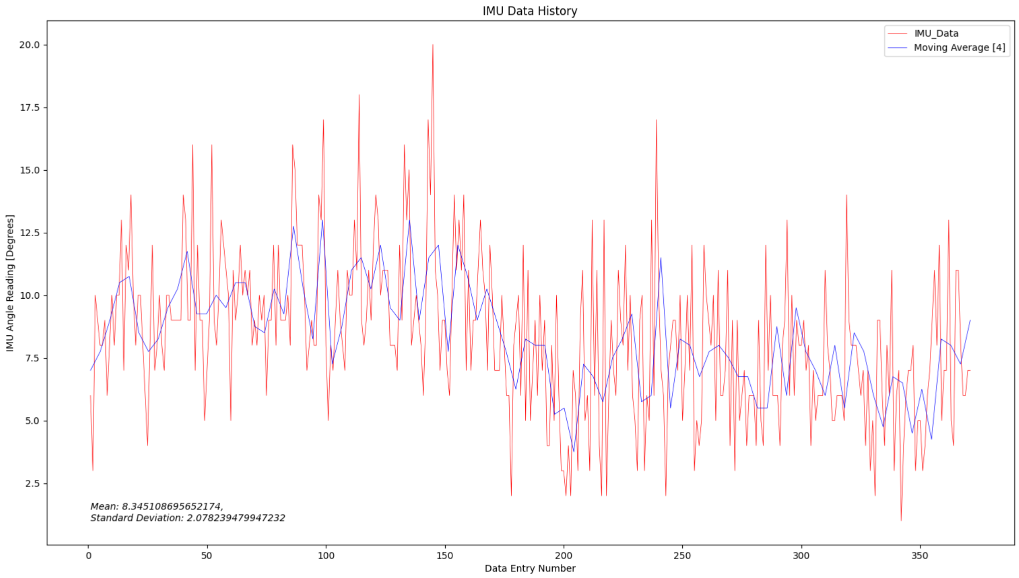

Figure 2: RAW IMU Data with Moving Average using a window of 4

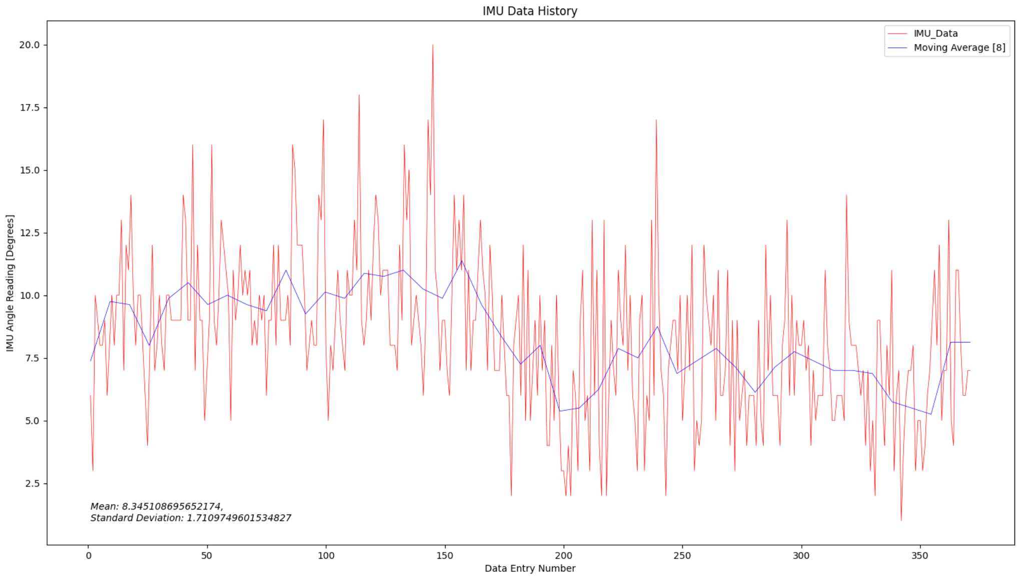

Figure 3: RAW IMU Data with Moving Average using a window of 8

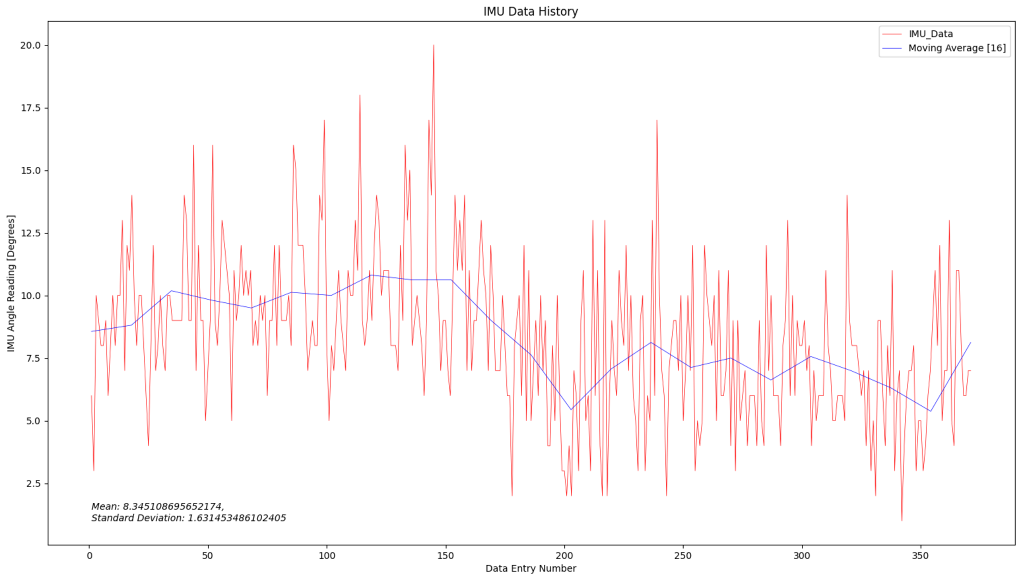

Figure 4: RAW IMU Data with Moving Average using a window of 16

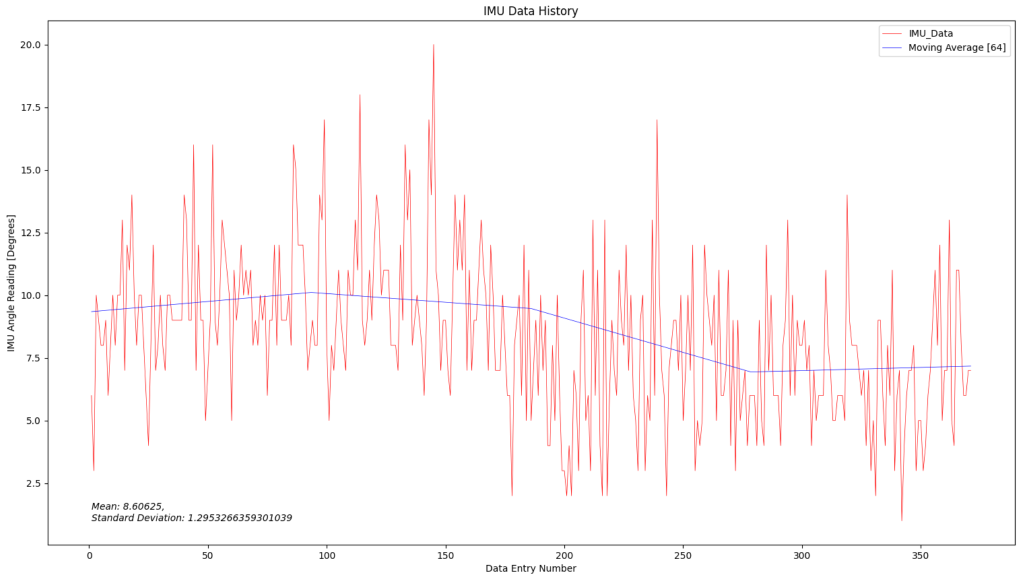

Figure 5: RAW IMU Data with Moving Average using a window of 64

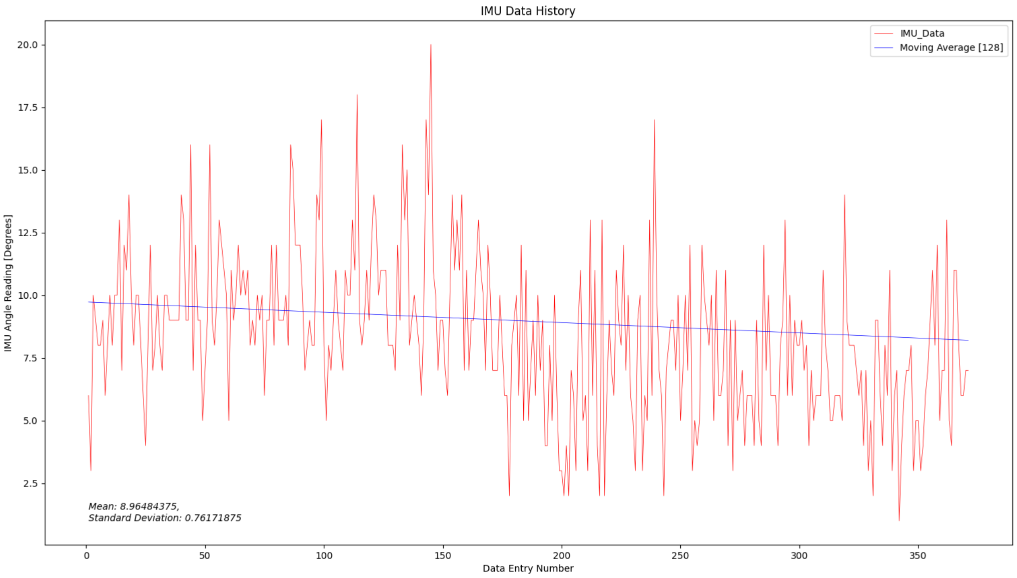

Figure 6: RAW IMU Data with Moving Average using a window of 128