ECSE 421 - Embedded Systems
Lab 1: Introduction to Arduino

Lab report

E1: Working with an RGB LED

- Task 1: https://youtu.be/IWVSsp3V-w0
- Task 2: https://youtu.be/x0hucU5MPDg

E2: Using the Rotary Encoder, the Buzzer, and the Microphone

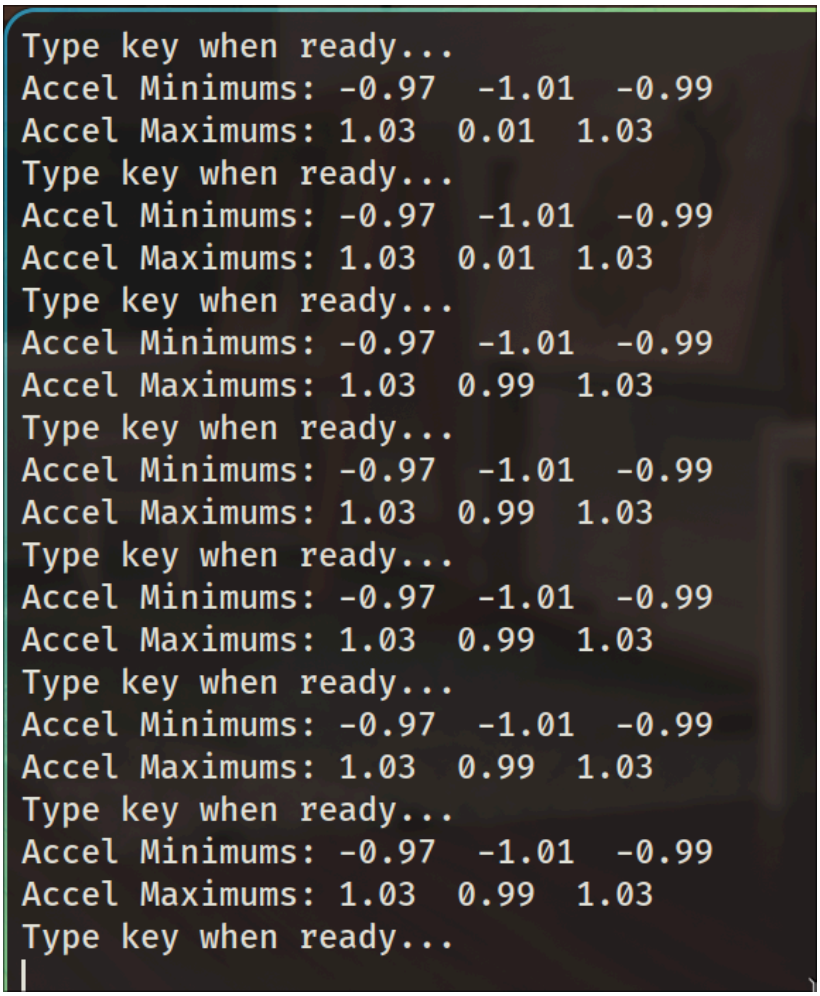
- Task 1: https://youtu.be/peAg8UWSv0M
- Task 2: https://youtu.be/VdPK57QqK2Y
- Task 3: https://youtu.be/k4wH3oI6L9Q
    - *Question*: How does the sensitivity change?
        - A: Since the buzzer produce the same amount of energy and that the new module is made for "small sound", the sensitivity is higher for lower frequency sound, but lower for high frequency sound.
- *Question*: What is the smallest value of change in voltage that the analog inputs can report? Explain your reasoning.
    - Answer: The smallest value of change in voltage that the analog input can report via calculation is: 5V / 1024 = 4.88 mV
        - 5V is the VCC of the analog sensor
        - 1024 or 10 bits is the dynamic range of the analog input

E3: The Weather

- Task 1: https://youtu.be/Zl3ULql3bLo
- Task 2: https://youtu.be/4_xUNbF7CC8

E4: You Are a Pilot

- Task 1: https://youtu.be/S2MtO_DzwnI + all answers to the questions
- Task 2: Please check the attached MATLAB live script! (`Plane.mlx`)
    - Calibration results:



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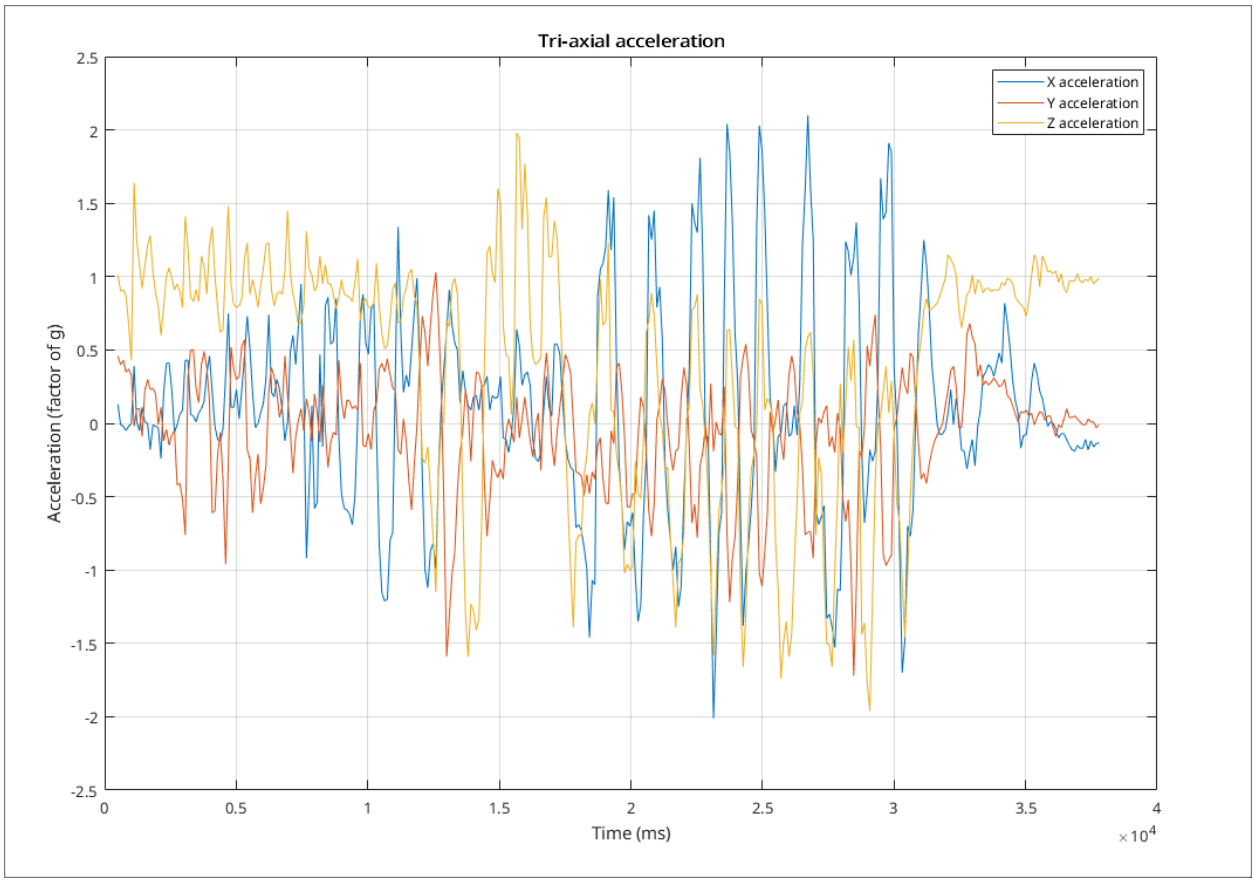
- Plot these data using any tool of your choice (Excel, Python, MATLAB, etc.).



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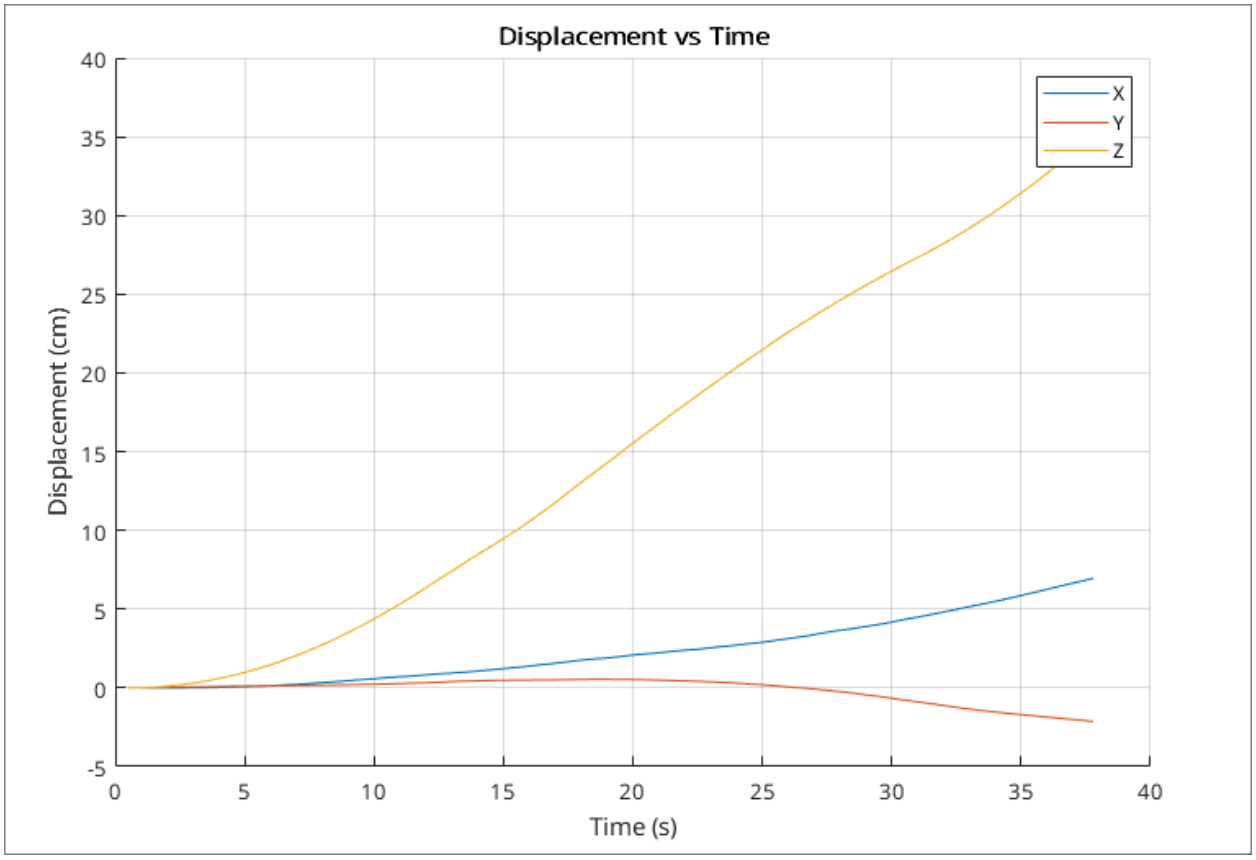
- Use these values to estimate the displacement of the accelerometer and plot displacement on a separate graph.



- Regarding the calculation for the distance, I used `cumtrapz` function to obtain the vectorized cumulative sum of the velocity and displacement over time:

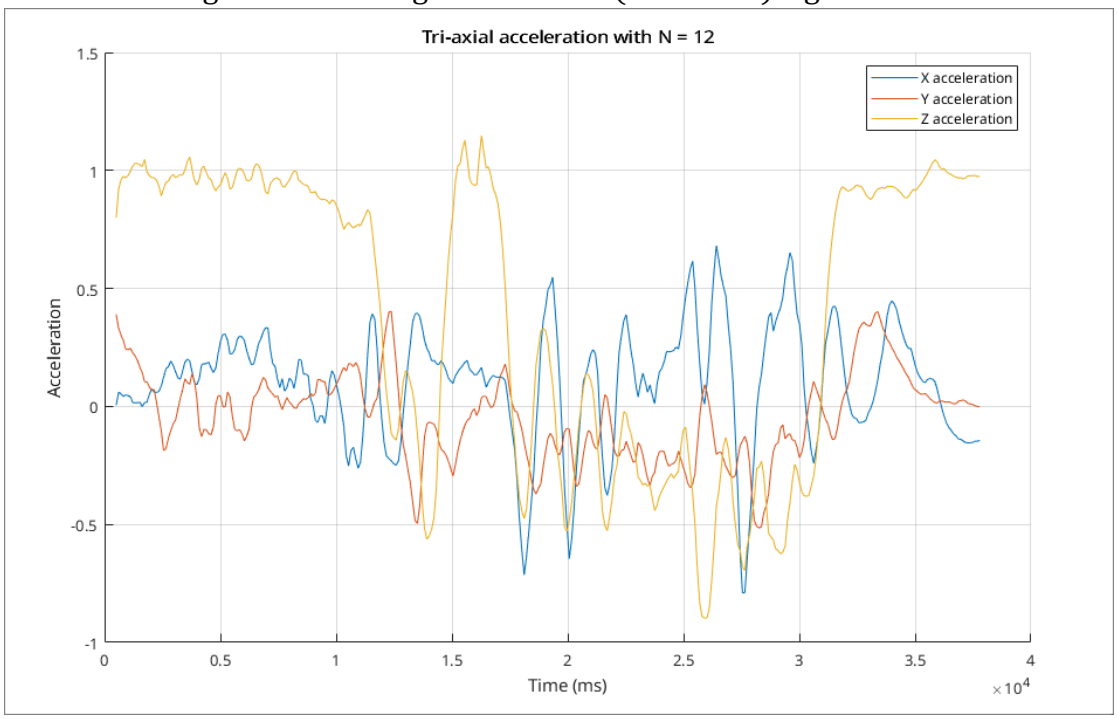
Use these values to estimate the displacement of the accelerometer and plot displacement on a separate graph.

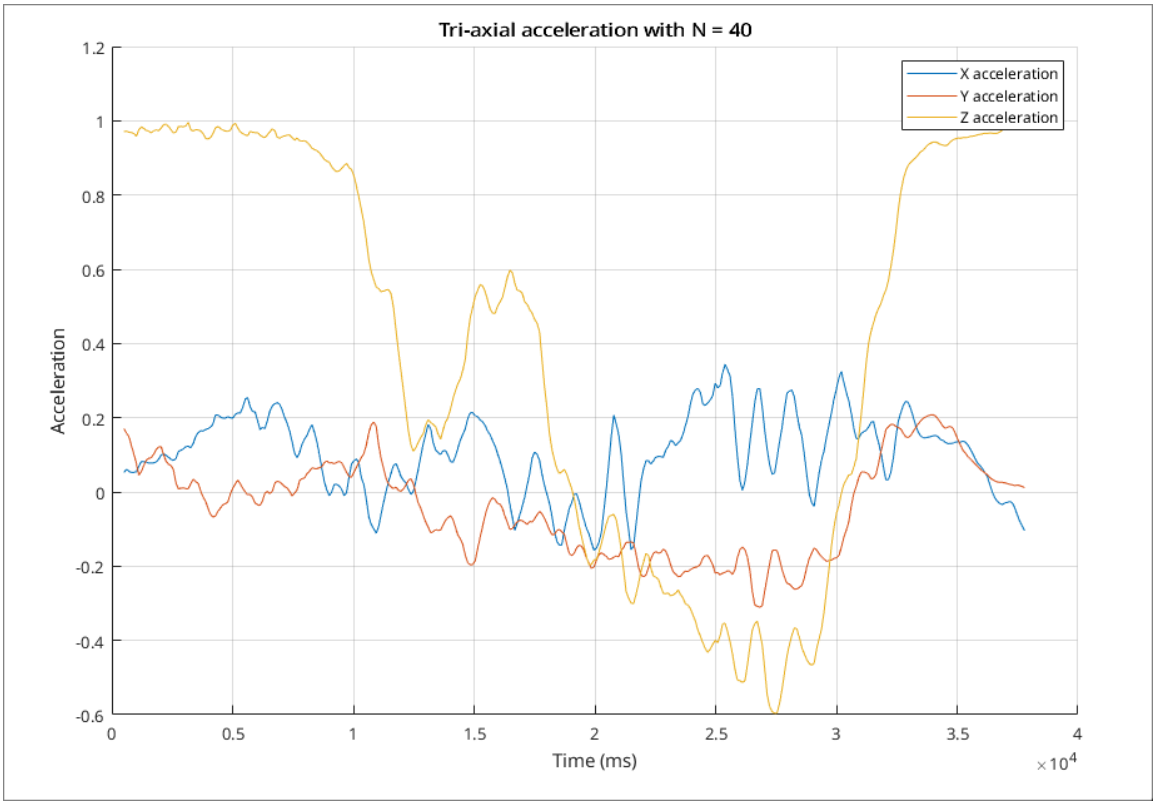
```
% X-axis
v_x = cumtrapz(t, x); % Integrate acceleration to get velocity
d_x = cumtrapz(t, v_x); % Integrate velocity to get displacement

% Y-axis
v_y = cumtrapz(t, y);
d_y = cumtrapz(t, v_y);

% Z-axis
v_z = cumtrapz(t, z);
d_z = cumtrapz(t, v_z);
```

- Task 3:
    - Choose a suitable value of N and write a moving average filter. Run your data through it. Plot this against the raw (unfiltered) signal.





    - What are the benefits/drawbacks of having a high N compared to a low N?
        - *Answer*:
            - **Benefit**: high N's graph provides a clearer trend of data for the larger interested window of data over low N's graph, i.e., it provides a good estimation for the data for quick analysis.
            - **Drawback**: high N's graph sacrifices details and potentially crucial data points (such as peaks or abnormal activity) compared to low N's graph.
- Task 4: https://youtu.be/e8MrLkbN0rY
- Task 5: https://youtu.be/hrKThGT9JlI