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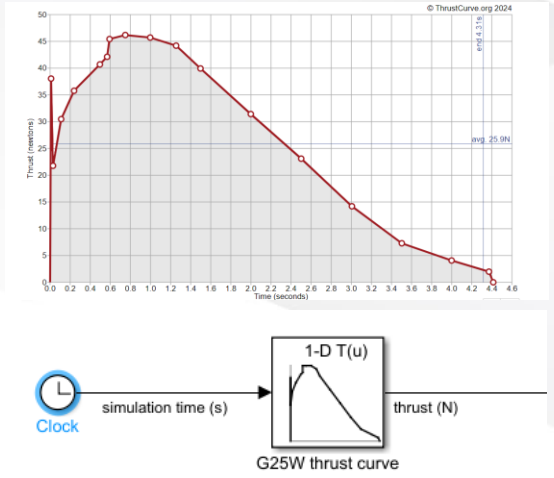
Sensor Fusion Toolbox for Rocket Motion

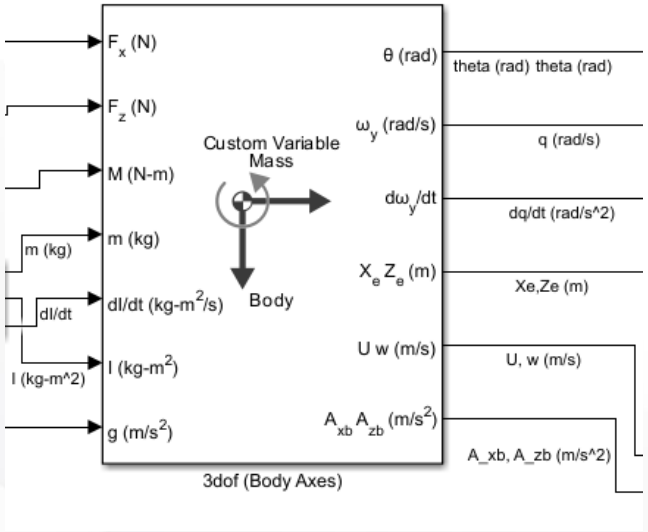
Luke Aagaard, Kian Jamal, Nathan Tardy, 4/11/2024

Data Generation

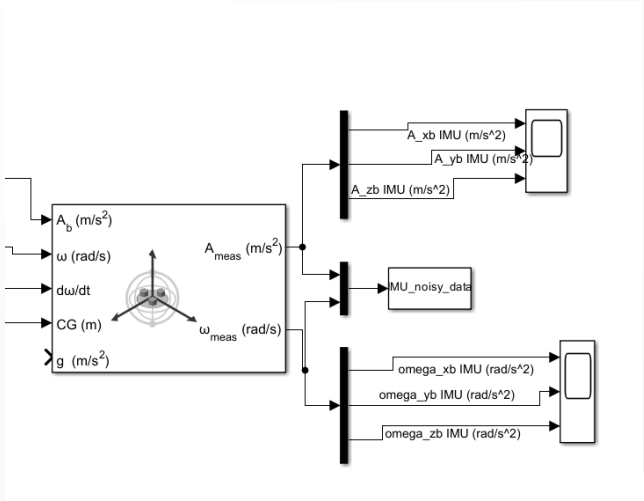
- Simulink model
  - 1-D lookup table outputs Aerotech G25W Thrust curve using simulation time (thrust curve data taken from thrustcurve.org).
  - Three-axis Inertial Measurement Unit data simulation outputs simulated noisy accelerometer and gyroscope data
  - 3DOF block applies the equations of motion (EOM)



1-D lookup table.



3DOF EOM block.



Three-axis IMU simulation block.

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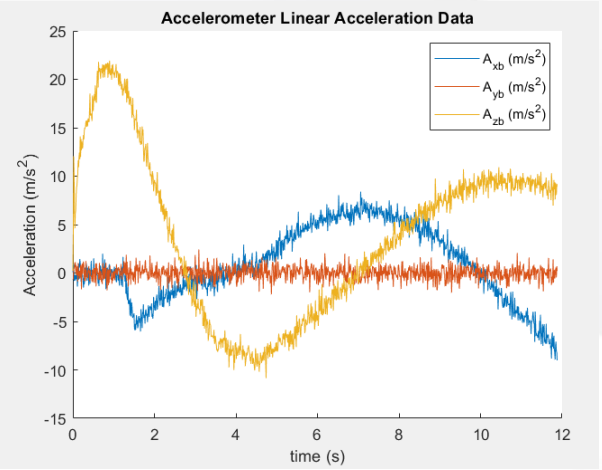
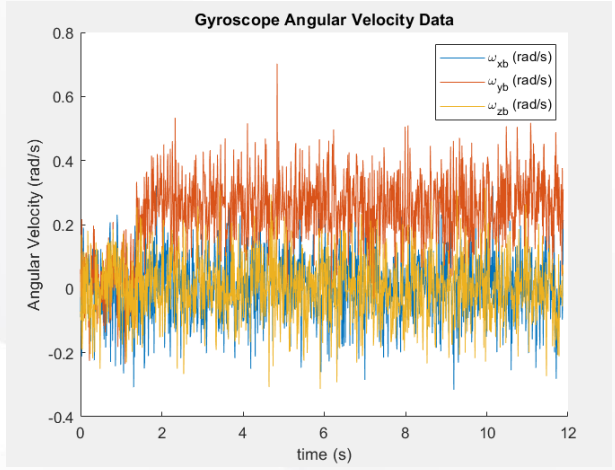
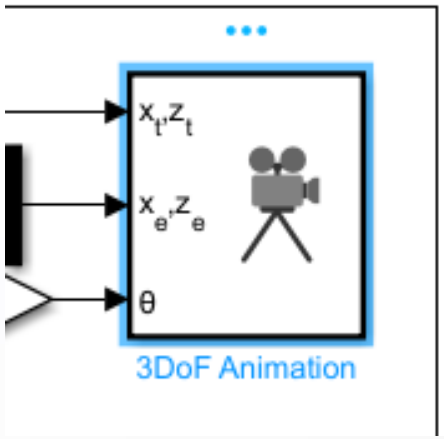
Data Generation

- Simulink model
- MATLAB

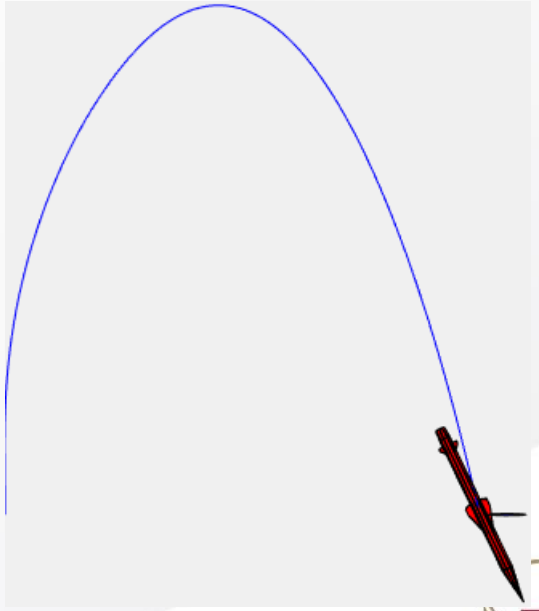
```
% Luke Aagaard
% AEE 3150 Team Project
% March 28, 2024
clc; clear; close all; format compact;
Simulation_Time = 13; %s
sim('RocketLander_version3.mdl',Simulation_Time)
AccelerationData = load('IMU_noisy_data.mat')
AccelerationData = struct2array(AccelerationData)
AccelerationData = AccelerationData';
```







3DoF animation block graphic



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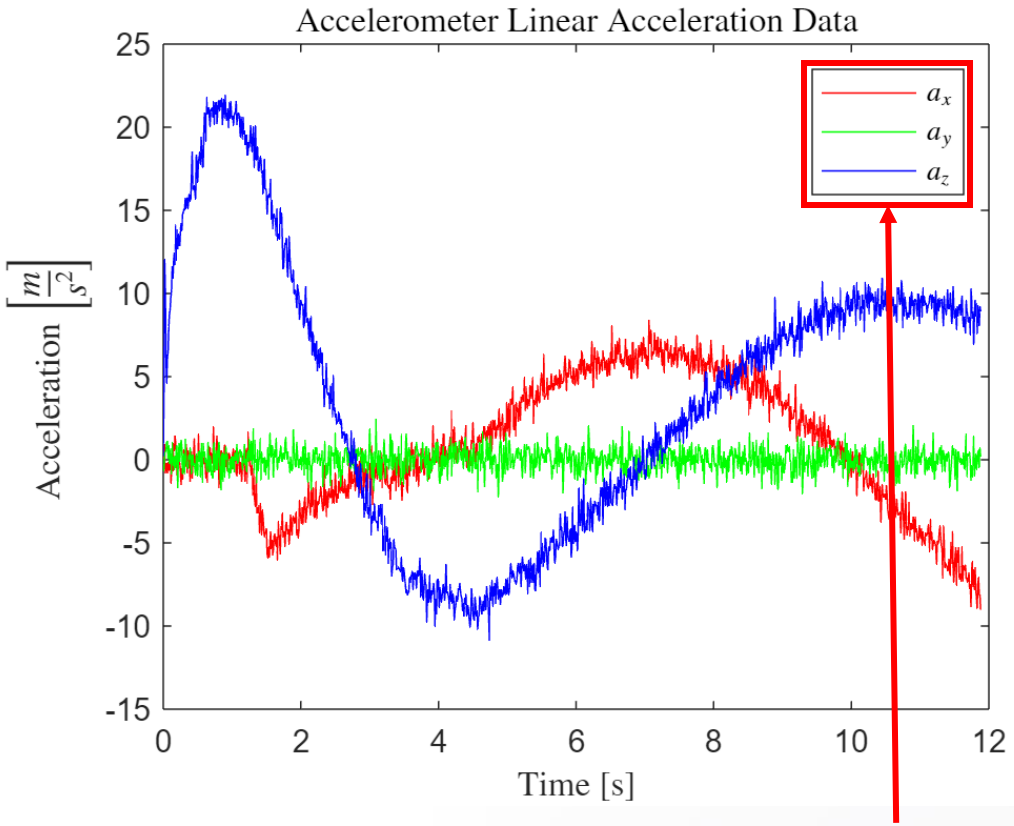
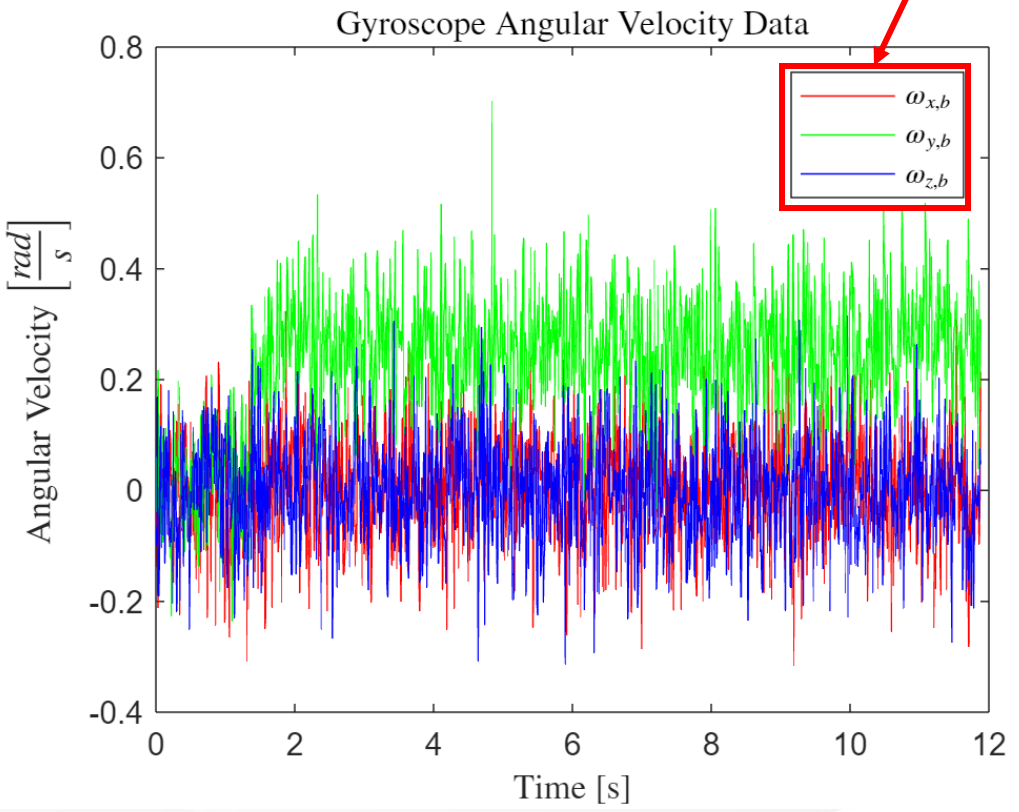
Data Processing

- Input: raw (noisy) data from virtual sensors



Linear acceleration along body axes

Angular velocity along body axes



- Only really 1 non-zero component due to nature of the motion
- No yaw
- No roll

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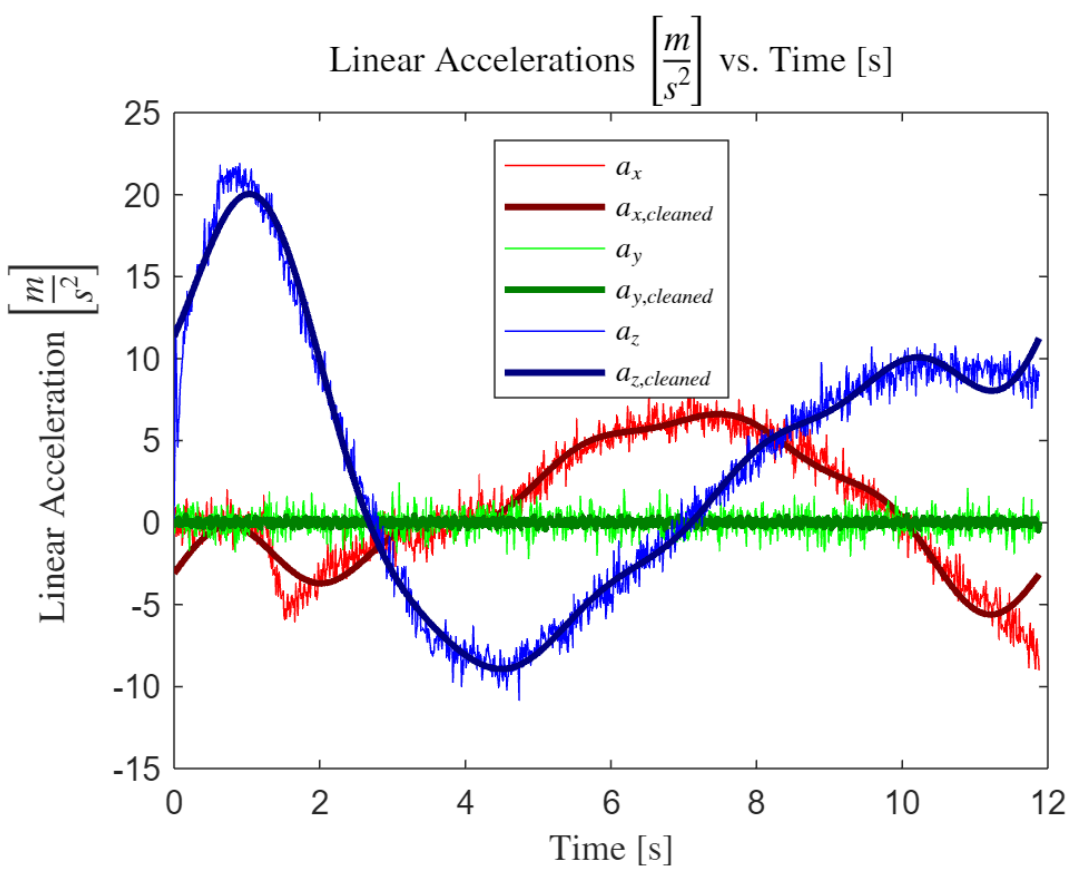
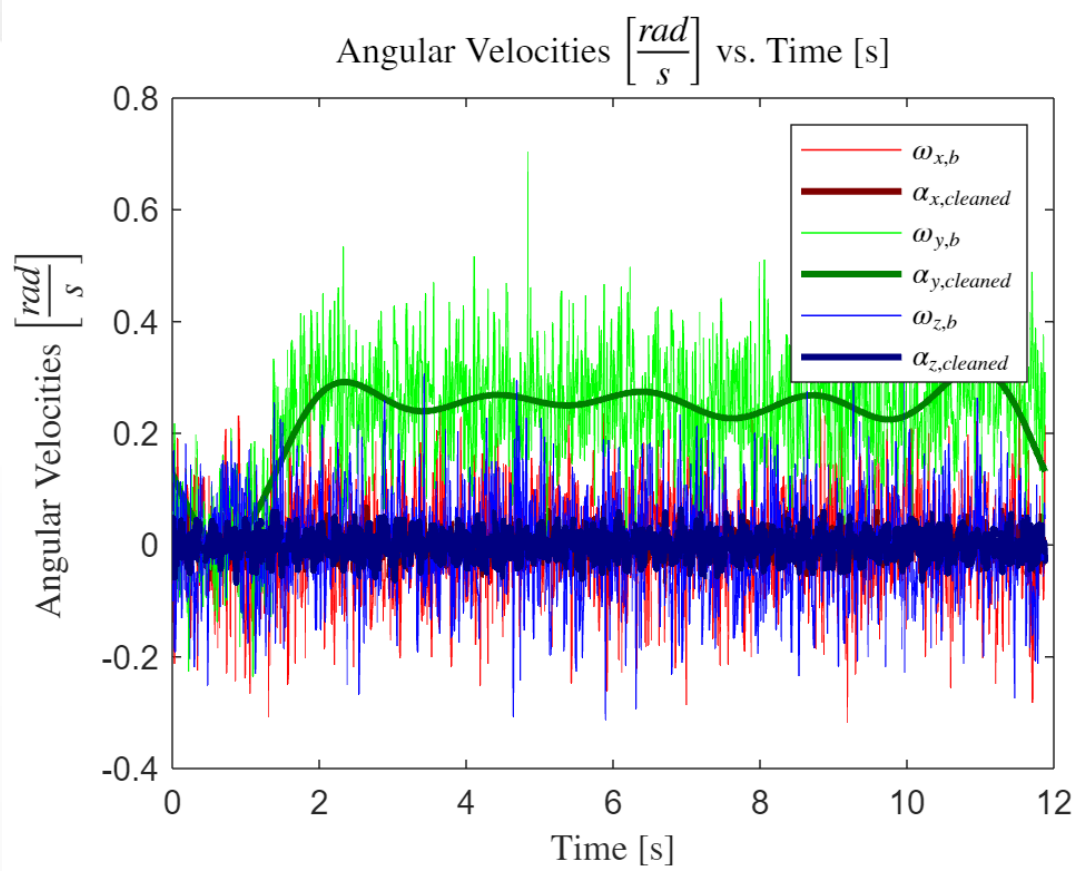
Data Processing

- Method: FFT on noisy data (HW 4)

```
FFT = fft(AccelerationData(:,col), N); % fft of noisy signal
PSD = FFT.*conj(FFT)/N; % PSD
choice = 0; % decide whether to keep certain percentage of frequencies or cer
switch choice
    case 0
        percentage_to_keep = 2/100; % percentage of greatest amplitude freque
        indices = PSD>=min(maxk(PSD, floor(percentage_to_keep*length(PSD))));
    case 1
        number_to_keep = 11;
        indices = PSD>=min(maxk(PSD, number_to_keep));
end
FFT_cleaned = FFT.*indices;
data_cleaned = ifft(FFT_cleaned);
cleaned_Acceleration_Data = [cleaned_Acceleration_Data data_cleaned];
```

Data Processing





- Thin lines: noisy signal
- Thick lines: cleaned signal (n = 11)

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