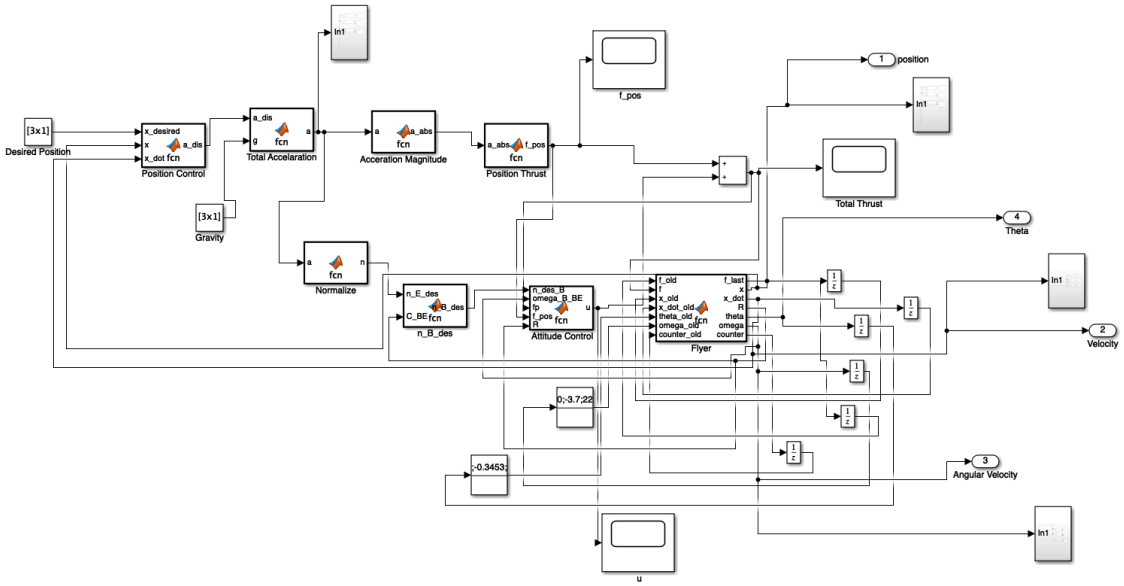
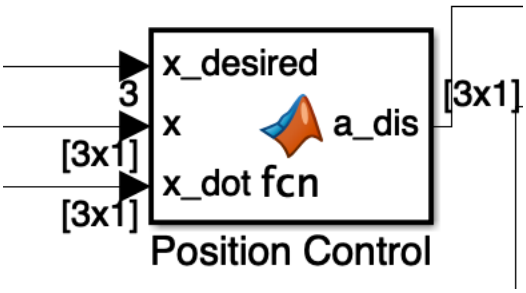
Debugging Report



The overall control loop is shown above. The blocks that need to be debugged are Position Control, Position Thrust, Attitude Control and Flyer.

Position control:
The position control block contains a PD controller that generates the desired acceleration required for the flyer to reach the desired position.



Inputs:
Desired Position (3 by 1 vector)
Current Position (3 by 1 vector)
Current Velocity (3 by 1 vector)

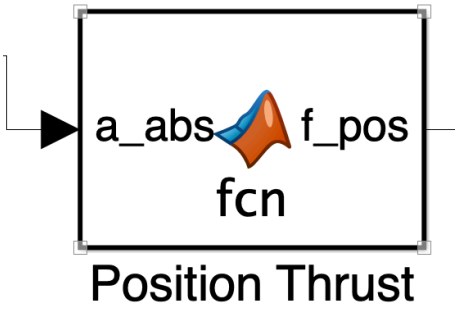
Outputs:
Desired acceleration (3 by 1 vector)

Debugging
Desired Position: [1:0:0]
Current Position: [0:0:0]

Current Velocity [-1:0:0]

Desired acceleration: [4.35:0:0]

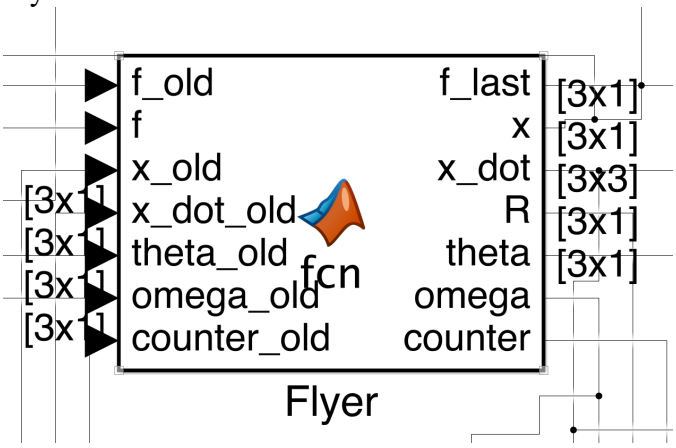
Position Thrust



The position thrust block takes in the magnitude of the required acceleration from the system, and outputs the thrust required for the position control.
Input:
magnitude of the required acceleration from the system (scalar)
Output:
Position thrust (scalar)

Unit test:
Set the desired acceleration $a_{des} = 0$, then the input to the position thrust $a_{abs} = g = 9.8m/s^2$.
Then $f_{pos} = 2.255N$, which is consistent with the hover solution.

Flyer



The block simulates the dynamics of the drone given a thrust input.
Inputs ("old" values are values from the last iteration):
Current thrust f
Old thrust f_{old}
Old position x_{old}
Old velocity $\dot{x}_{old}$

Old Euler angle θ_{old}
Old Angular velocity ω_{old}
Old Counter (for keeping track of the number of iterations)

Outputs:
Last thrust f_{last} (save the current thrust value for the next iteration)
Position x
Velocity $\dot{x}$
Euler angle θ
Angular velocity ω
Counter (for keeping track of the number of iterations)

Debugging:
The first step to check is the rotation matrix. The built-in function eul2rotm in MATLAB can produce a rotation matrix given an Euler angle. However, eul2rotm uses a different convention from the quadcopter model the Flyer block is based on: It is possible that the abnormal Euler Angle data is caused by the discrepancy.
Test: fixed thrust hover
Start:
Euler angle: [0;-0.3453;0] (hover state value)
Angular Velocity: [7.0;-3.7;22.4] (hover state value)
Thrust: 2.255 N
No drag force and torque

Results:

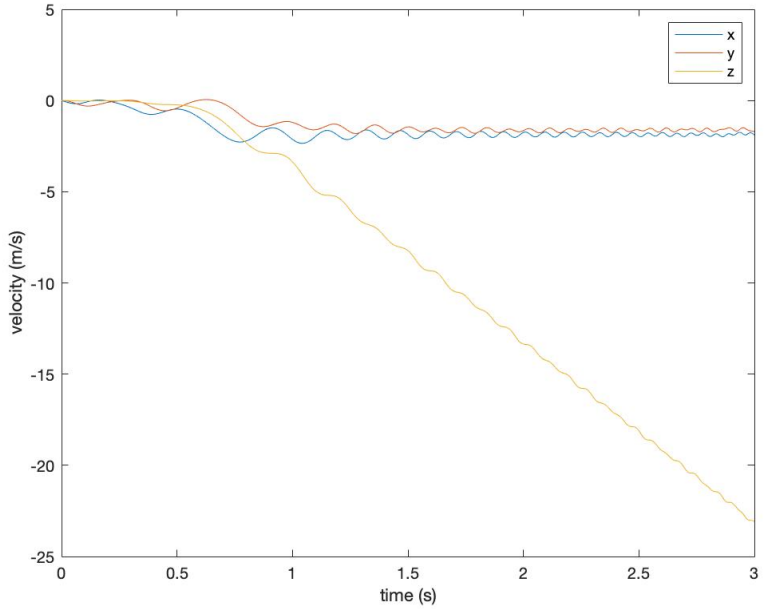


Figure 1: velocity

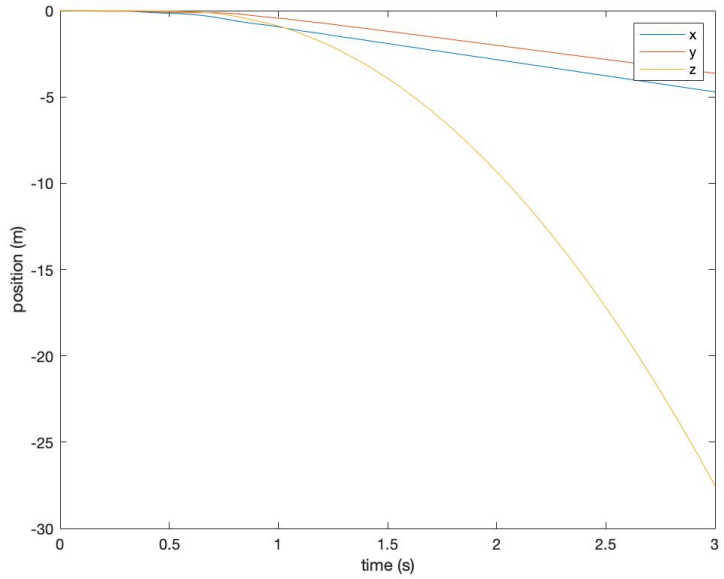


Figure 2: position

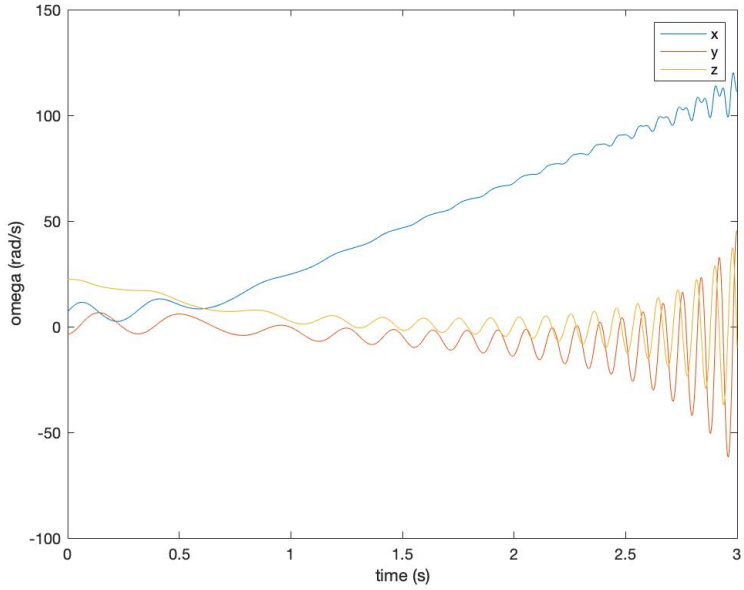


Figure 3: angular acceleration

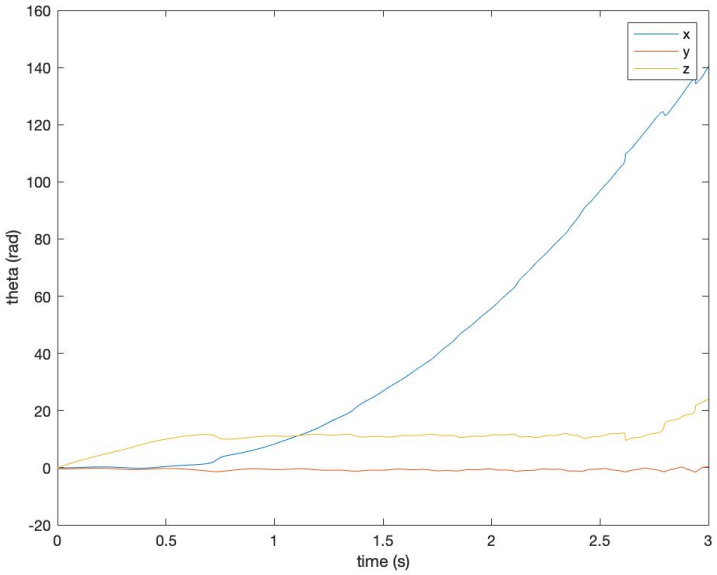


Figure 4: Euler angles