Dev Shah (G36372072)

Robotic Systems Project

Aim:

In this project, I aimed to design and implement a quadrotor control system using MATLAB. To achieve the objectives, I began by developing a mathematical model of the quadrotor dynamics, based on the principles of aerodynamics and Newtonian mechanics. Then I used this model to develop control algorithms for the various flight modes, including proportional, integral, and derivative (PID) controllers. Finally, I implemented the control system in MATLAB and tested its performance using simulations.

Methodology:

1. Defined constants such as the mass of the quadrotor, length of the quadrotor arm, acceleration due to gravity, and Moment of Inertia.

2. Defined drone body coordinates.

3. Declared initial parameters of the quadrotor [x, y, z, phi, theta, psi, x_dot, y_dot, z_dot, p, q, r]

4. Defined and tuned PID gain for motion control.

5. Created Rotation matrix function for the body to the inertial frame.

6. Created Rotation matrix function for finding Euler angle velocities [phi_dot, theta_dot, psi_dot]

7. Created Equations of motion function for finding Linear Acceleration [x_dot_dot, y_dot_dot, z_dot_dot], Euler angle velocities [phi_dot, theta_dot, psi_dot], Body angle accelerations [p_dot, q_dot, r_dot].

8. Creating a simulation environment to display the movement of the quadrotor in the X, Y, Z plane.

9. Creating graph plots to see the change in phi, theta, psi, X, Y, and Z_dot parameters of the quadrotor.

10. Creating a controller which calculates the error using the difference between desired values and the current values of [phi, theta, psi, z_dot]. Creates a PID controller to control the Thrust and Torques values using these error values.

11. Running the simulation.

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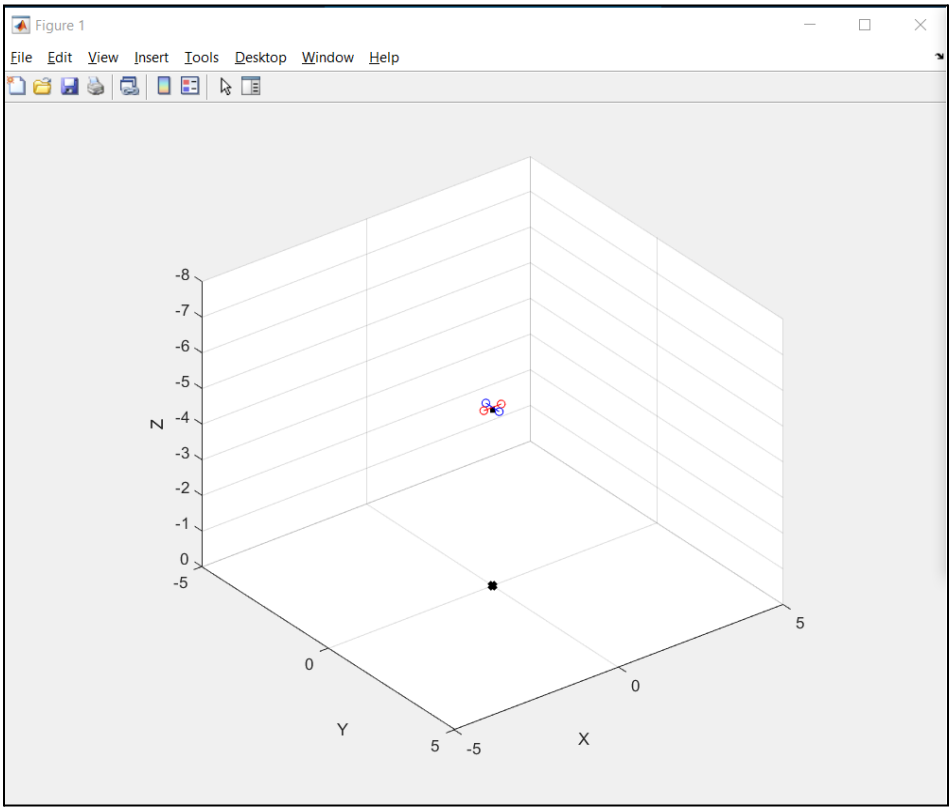
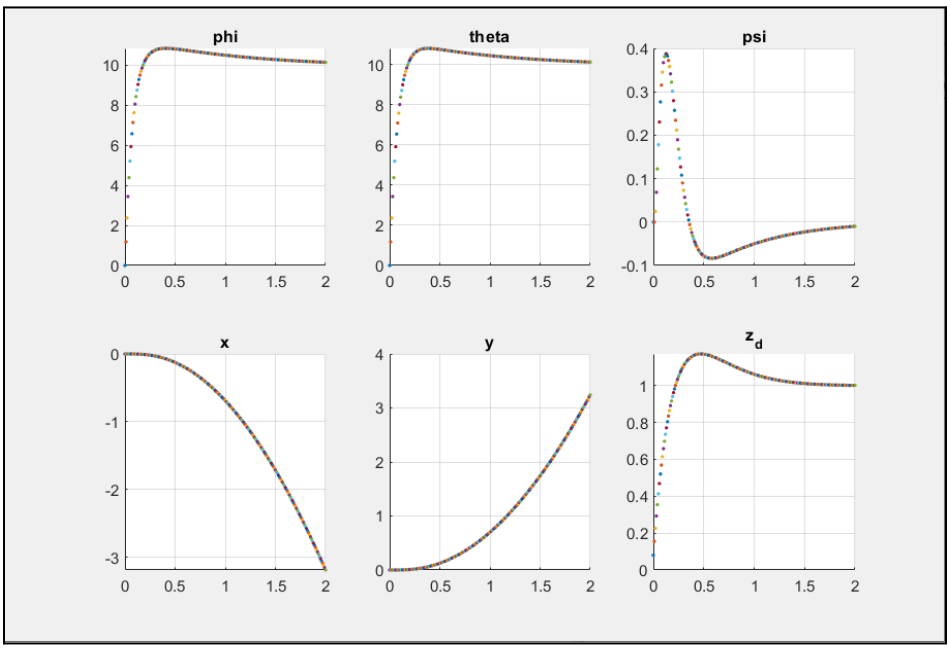
Output & Results:

To view the output of the MATLAB code - Running the “Main.m” file will run the Project and the simulation for the given control parameters. You may change control values for testing the control system.





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Conclusion:

Successfully created a quadrotor model which takes input as the desired Euler angles [phi, theta, psi] and z_dot and displays the motion of the quadrotor for these inputs. The controller works well for the given gain values.

References:

1. Quadrotor Dynamics and Control Rev 0.1 by Randal Beard (2008-05-05).
2. Quadcopter Dynamics, Simulation, and Control.
3. MATLAB Simulation of a Quadrotor UAV Dynamics and Control (Youtube- https://youtu.be/7F9cG64kRxI).
4. Quadrotor Controls (Youtube- https://youtu.be/tZ-l0-UBWzA).