Table of Contents

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```
%Section - 01
%Aero 421 HW5: 5/23/25
```

Workspace Prep

```
%warning off
format long      %Allows for more accurate decimals
close all;       %Clears all
clear all;       %Clears Workspace
clc;             %Clears Command Window
```

Setup

```
J = diag([1200,2000,2800]);
K = -5.65;

% Spacecraft Orbit Properties (given)
global mu
mu = 398600; % km^3/s^2
h = 53335.2; % km^2/s
e = 0; % none
Omega = 0*pi/180; % radians
inc = 98.43*pi/180; % radians
omega = 0*pi/180; % radians
nu = 0*pi/180; % radians

a = h^2/mu/(1 - e^2);
orbital_period = 2*pi*sqrt(a^3/mu);

% Torque free scenario (Given)
T = [0;0;0];

% Set/Compute initial conditions
% intial orbital position and velocity
[r_ECI_0, v_ECI_0] = coes2rvd(a,e,rad2deg(inc),0,omega,nu,mu);

% Compute inital F_LVLH basis vectors in F_ECI components based on F_LVLH
% definition

rV = r_ECI_0; %Position Vector km
```

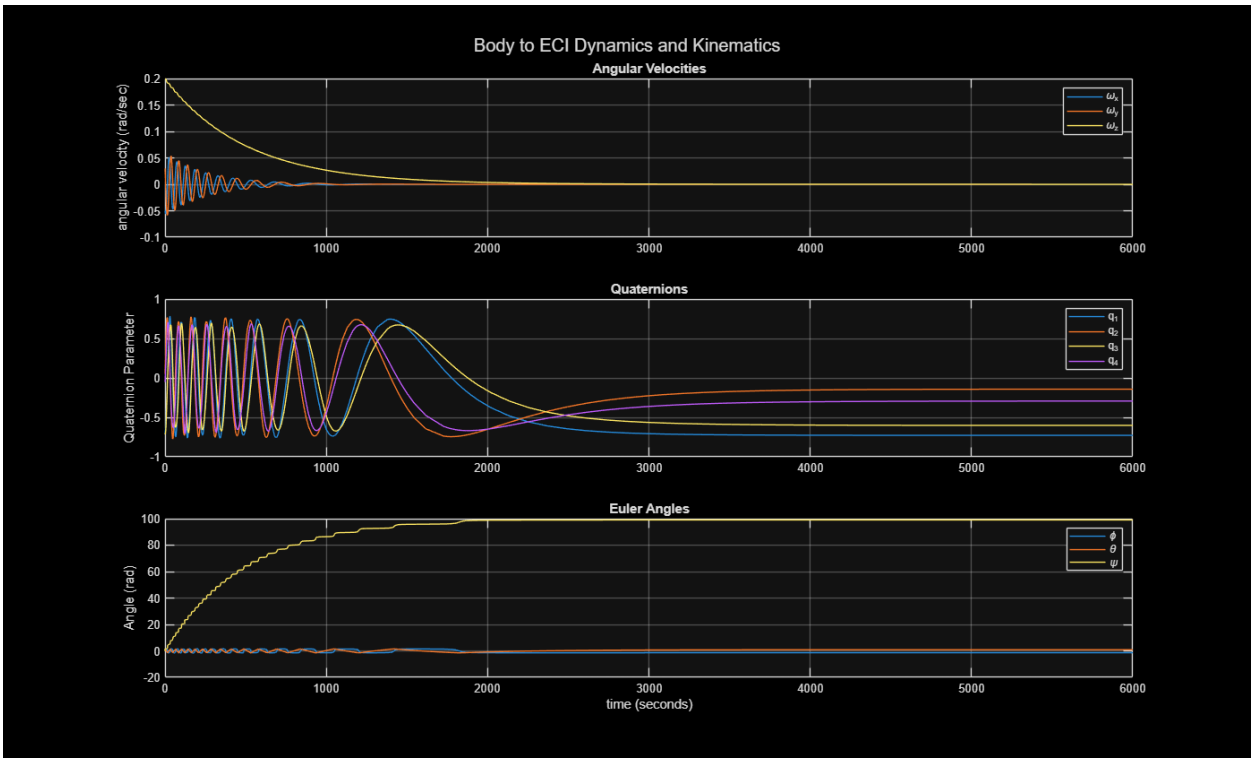
```
vV = v_ECI_0; %Vel Vector km/s

%Converting to F'LVLH

Zlvlh = -(rV/norm(rV));
Ylvlh = -(cross(rV,vV)/norm(cross(rV,vV)));
Xlvlh = cross(Ylvlh,Zlvlh);

%Creating Matrix with new vectors

Clvlh_eci = [Xlvlh, Ylvlh, Zlvlh]';
disp(num2str(Clvlh_eci))
C_b_ECI_0 = Clvlh_eci;

% Initial Euler angles relating F_body and F_LVLH (given)
phi_0 = 0;
theta_0 = 0;
psi_0 = 0;
E_b_LVLH_0 = [phi_0; theta_0; psi_0];

% Initial Quaternion relating F_body and F_LVLH (given)
q_b_LVLH_0 = [0; 0; 0; 1];

% Compute initial C_LVLH_ECI_0, C_b_LHVL_0, and C_b_ECI_0 rotaiton matrices

% Initial Euler angles relating body to ECI
% E_b_ECI_0 = C2EulerAngles(C_b_ECI_0);
E_b_ECI_0 = rotm2eul(C_b_ECI_0);

% Initial quaternion relating body to E
q_b_ECI_0 = -rotm2quat(C_b_ECI_0);

% Initial body rates of spacecraft (given)
w_b_ECI_0 = [-0.05; 0.03; 0.2];

tspan = orbital_period;

out = sim("ADCS_FP5_RJF_Linear.slx");
```

```
 0     -0.1466      0.9892
 0      0.9892      0.1466
-1           0           0
```

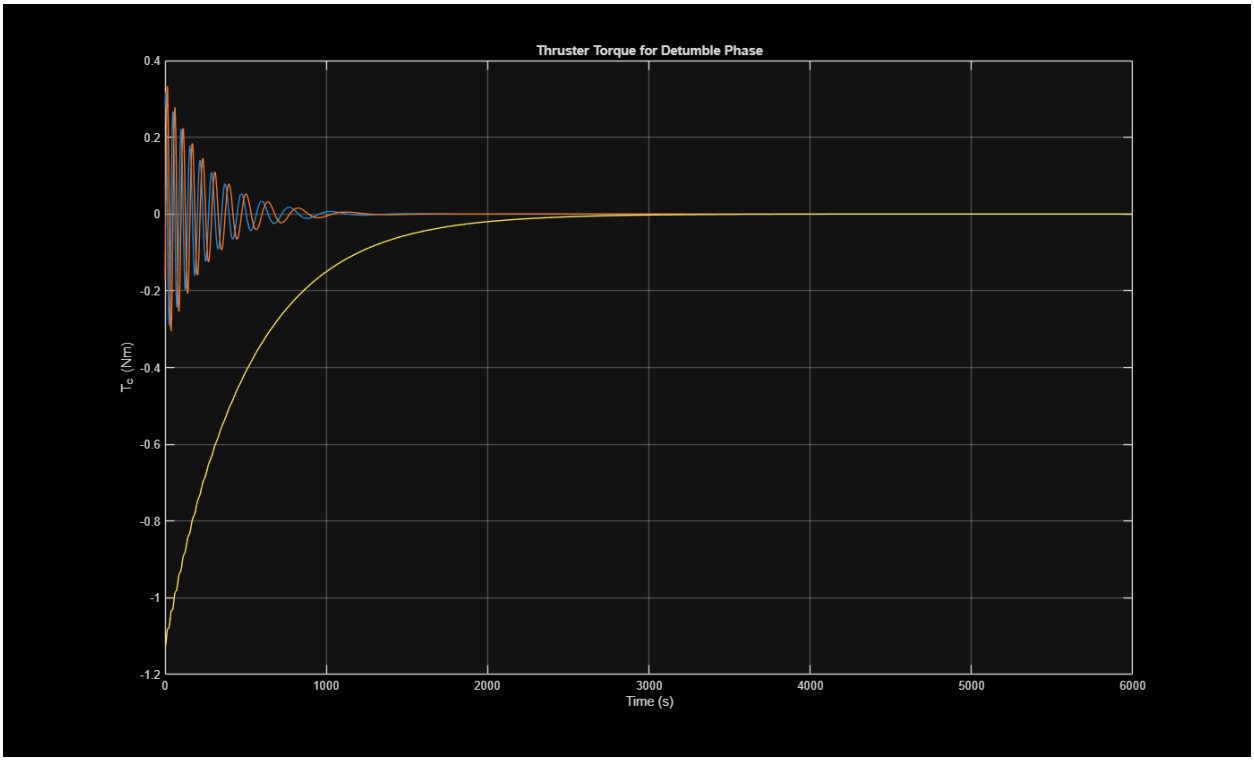
Plot Results

```
figure('Name','Detumble Phase Dynamics')
subplot(3,1,1)
plot(out.w_b_ECI(:,1), out.w_b_ECI(:,2:4))
title('Angular Velocities')
ylabel('angular velocity (rad/sec)')
legend('\omega_x','\omega_y','\omega_z')
grid on
```

```
subplot(3,1,2)
plot(out.tout, out.q_b_ECI(:,2:5))
title('Quaternions')
ylabel('Quaternion Parameter')
legend('q_1','q_2','q_3','q_4')
grid on

subplot(3,1,3)
plot(out.tout, out.E_b_ECI(:,2:4))
title('Euler Angles')
xlabel('time (seconds)')
ylabel('Angle (rad)')
legend('\phi','\theta','\psi')
grid on

sgtitle('Body to ECI Dynamics and Kinematics')
```




```
Tc = squeeze(out.T.signals.values);

figure('Name','Thruster Torque for Detumble Phase')
plot(out.tout,Tc)
xlabel('Time (s)')
ylabel('T_c (Nm)')
grid on
title('Thruster Torque for Detumble Phase')
```



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