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Homework 2

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```
pu = get(gcf,'PaperUnits');
pp = get(gcf,'PaperPosition');
set(gcf,'Units',pu,'Position',pp)
```

2a

```
clear variables; close all; clc;

v_e = [10 0 0]'; % units
R_i_e = rotx(deg2rad(13))*roty(deg2rad(15))*rotz(deg2rad(10));

v_i = R_i_e \ v_e % units
```

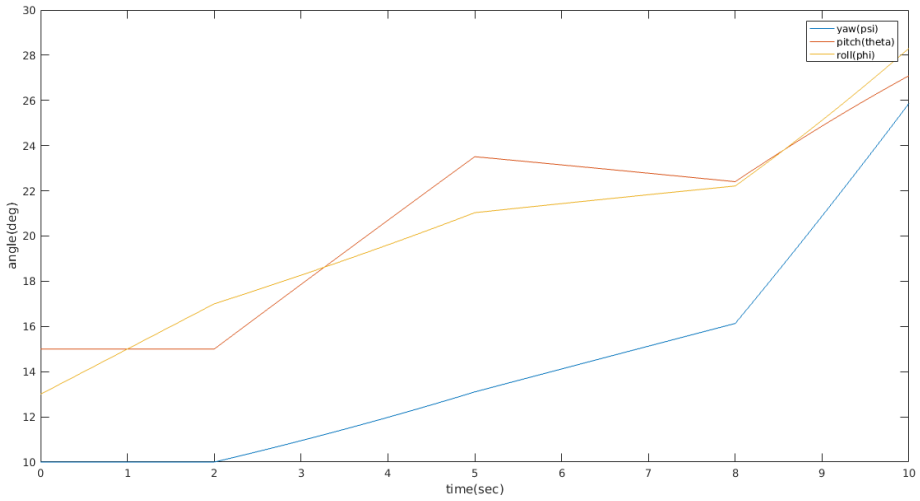
```
v_i =

    9.9998
   -0.0305
    0.0457
```

2b

```
function euler321_angles_dot = rotational_kinematics(t,
 euler321_angles, omega_iee)

psi_yaw = euler321_angles(1);
theta_pitch = euler321_angles(2);
phi_roll = euler321_angles(3);

H_321 = [-sin(theta_pitch) 0 1;
    sin(phi_roll)*cos(theta_pitch) cos(phi_roll) 0;
    cos(phi_roll)*cos(theta_pitch) -sin(phi_roll) 0];

euler321_angles_dot = H_321 \ omega_iee;
end
```

```
clear variables; close all; clc;

%initial conditions
euler321_angles_initial = [10; 15; 13] * pi/180; %radians
time_span = [0 2]; %seconds
omega_iee = [2; 0; 0;] *pi/180; %radians/second

%solve ODE
[t_sim, euler321_angles_sim] = ...
ode45(@(t, y)rotational_kinematics(t, y, omega_iee), time_span,
 euler321_angles_initial);

%initial conditions same as last ones
euler321_angles_initial = euler321_angles_sim(end, :); %rad
time_span = [2 5]; %s
omega_iee = [1; 3; 0;] * pi/180; %rad/s

%solve ODE
[t_sim_2, euler321_angles_sim_2] = ...
ode45(@(t, y)rotational_kinematics(t, y, omega_iee), time_span,
 euler321_angles_initial);

%initial conditions same as last ones
euler321_angles_initial = euler321_angles_sim_2(end, :); %rad
time_span = [5 8]; %s
omega_iee = [0; 0; 1;] * pi/180; %rad/s

%solve ODE
[t_sim_3, euler321_angles_sim_3] = ...
ode45(@(t, y)rotational_kinematics(t, y, omega_iee), time_span,
 euler321_angles_initial);
```

```
%initial conditions same as last ones
euler321_angles_initial = euler321_angles_sim_3(end, :); %rad
time_span = [8 10]; %s
omega_iee = [1; 4; 3;] * pi/180; %rad/s

%solve ODE
[t_sim_4, euler321_angles_sim_4] = ...
ode45(@(t, y)rotational_kinematics(t, y, omega_iee), time_span,
 euler321_angles_initial);

euler321_angles_degrees_1 = euler321_angles_sim * 180/pi;
euler321_angles_degrees_2 = euler321_angles_sim_2 * 180/pi;
euler321_angles_degrees_3 = euler321_angles_sim_3 * 180/pi;
euler321_angles_degrees_4 = euler321_angles_sim_4 * 180/pi;

time = [t_sim; t_sim_2; t_sim_3; t_sim_4;];
euler321_angles_degrees = [euler321_angles_degrees_1;
 euler321_angles_degrees_2; euler321_angles_degrees_3;
 euler321_angles_degrees_4;];

plot(time, euler321_angles_degrees)

xlabel('time(sec)')
ylabel ('angle(deg)')
legend ('yaw(psi)','pitch(theta)','roll(phi)')
```

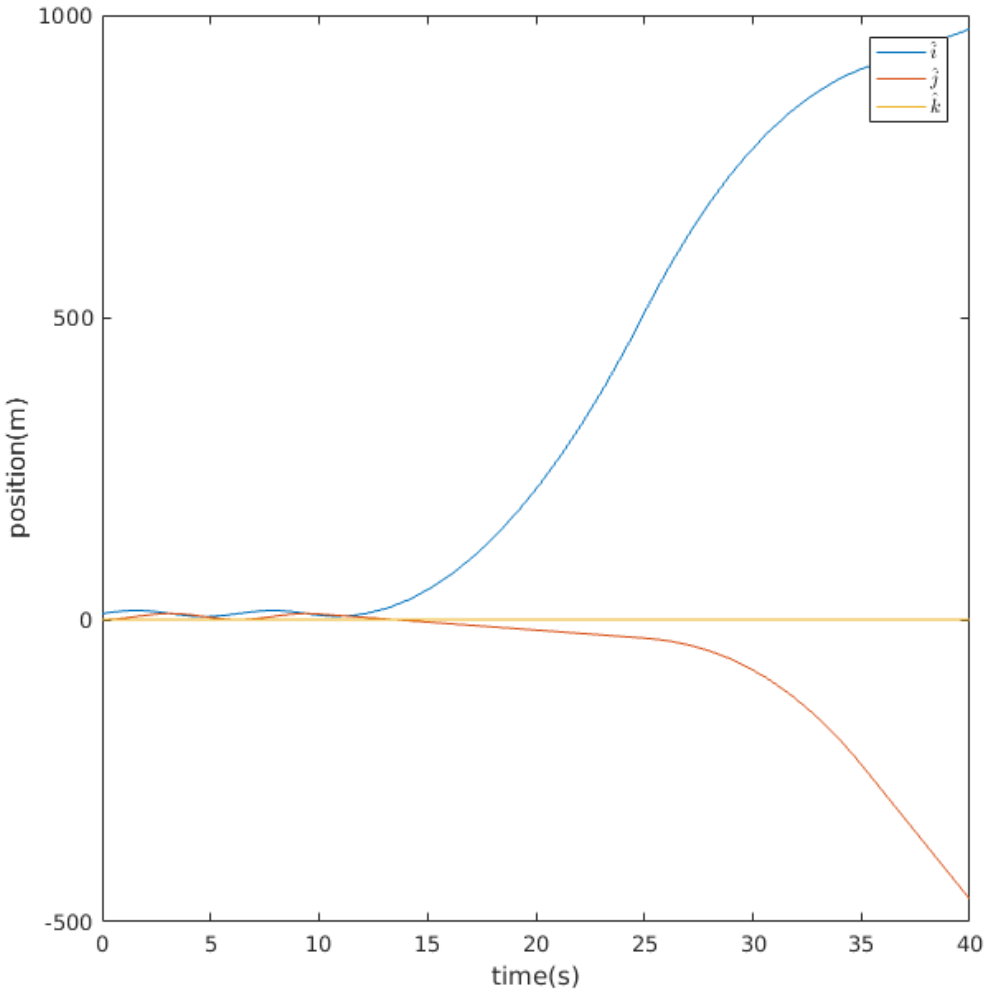


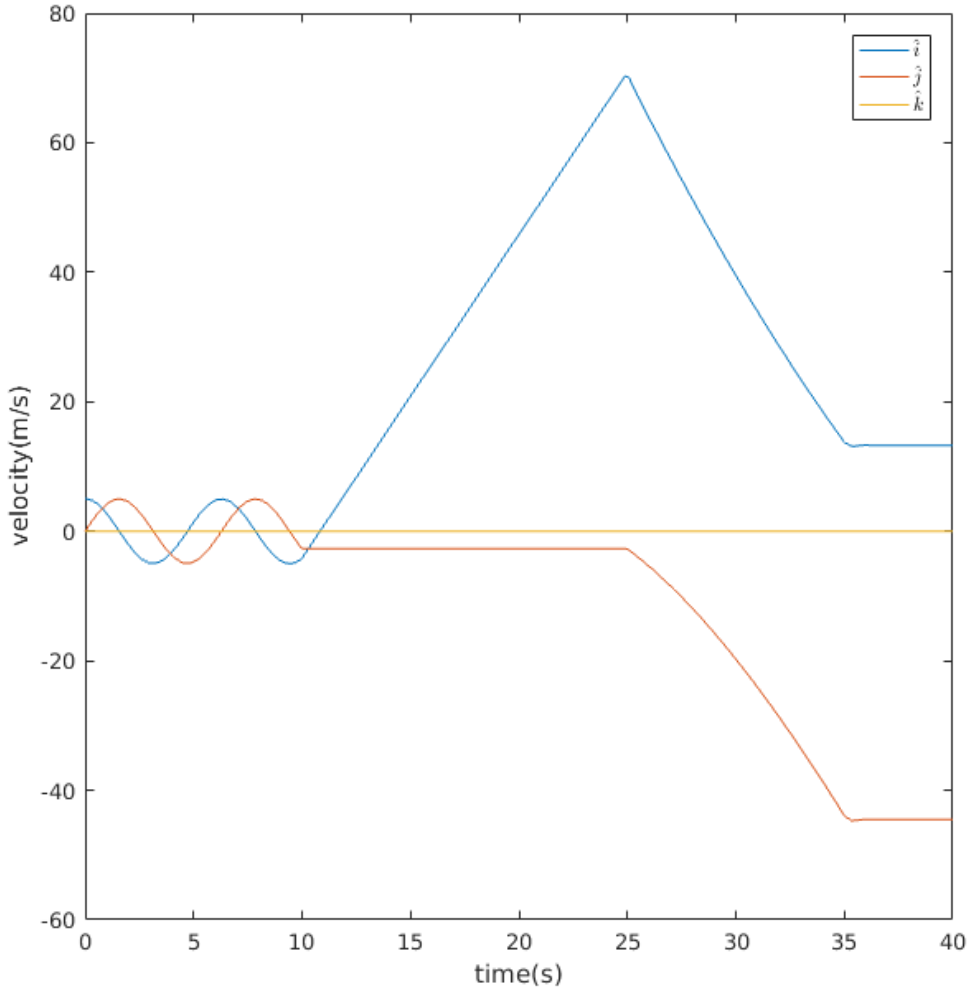
3a

```
clear variables; close all; clc;
% from the derivation on the paper, v_dot_i is a piecewise function of
 t.
v_dot_i = @(t) [hw2_a_t(t)*cos(hw2_psi(t)) -
 hw2_psi_dot(t)*hw2_v(t)*sin(hw2_psi(t));
            hw2_a_t(t)*sin(hw2_psi(t)) +
 hw2_psi_dot(t)*hw2_v(t)*cos(hw2_psi(t));
```

```
            0];
% in odefun and initial conditon y0,
% y(1:3, :) = p_i (position in m)
% y(4:6, :) = v_i (velocity in m/s)
odefun = @(t,y) [y(4:6, :); v_dot_i(t)];
y0 = [10 0 0 5 0 0]';
warning('off','all')
[t_sim, y_sim] = ode45(odefun, [0 40], y0);
warning('on','all')
figure();
plot(t_sim, y_sim(:, 1:3));
xlabel('time(s)')
ylabel('position(m)')
legend({'$\hat{i}$', '$\hat{j}$', '$\hat{k}$'},'Interpreter','latex')
figure();
plot(t_sim, y_sim(:, 4:6));
xlabel('time(s)')
ylabel('velocity(m/s)')
legend({'$\hat{i}$', '$\hat{j}$', '$\hat{k}$'},'Interpreter','latex')
position = y_sim(end, 1:3)' % m
velocity = y_sim(end, 4:6)' % m/s
```

```
position =

  977.1305
 -462.6104
         0


velocity =

   13.2583
  -44.5351
         0
```


1000
500
0
-500
position(m)
0
5
10
15
20
25
30
35
40
time(s)
$\hat{i}$
$\hat{j}$
$\hat{k}$



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