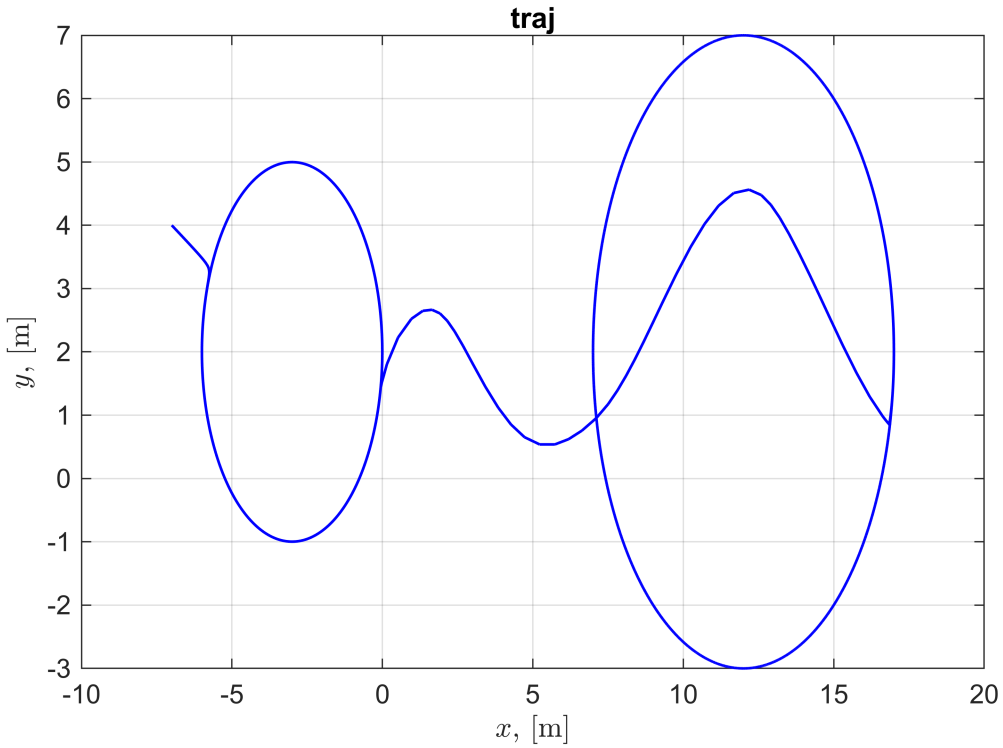
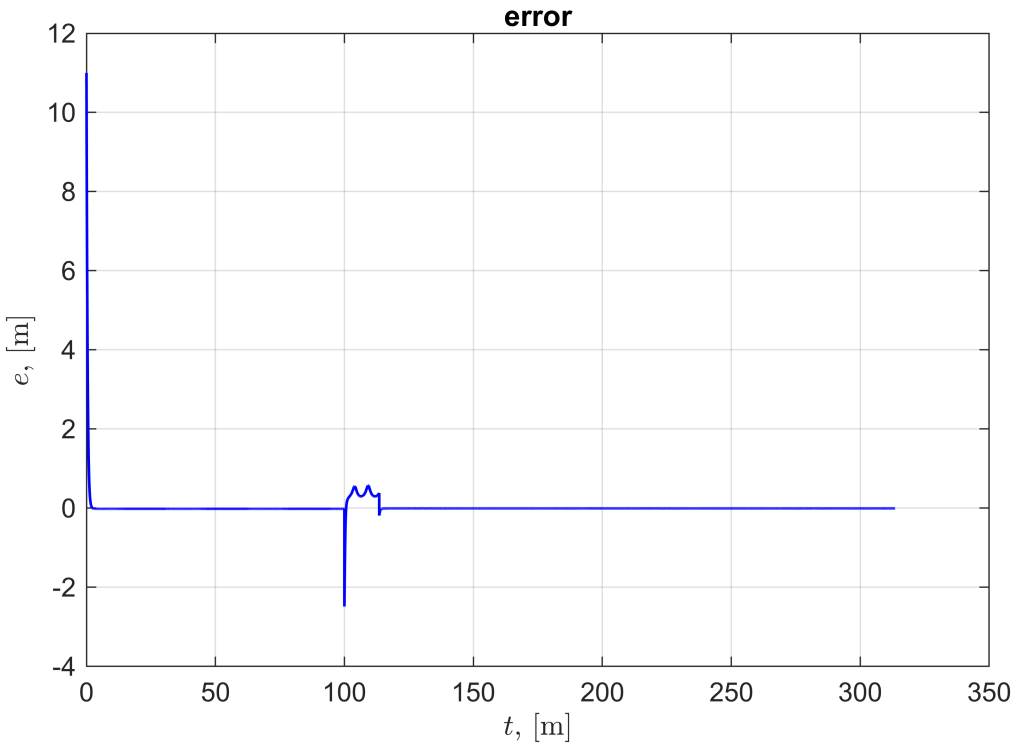
LAB 3 Trajectory Control

First task

```
% Given
x0 = -7;
y0 = 4;
alpha0 = 3*pi/4;
m = 2.8; % in kg

% for traj
R1 = 3;
xc1 = -3;
yc1 = 2;
R3 = 5;
xc3 = 12;
yc3 = 2;

kq=3;
ke=3;

% if vs_switcher==1
% elseif vs_switcher==2
% elseif vs_switcher==3
% end

vs_switcher = 1;

vs_des = 2.5;
s_sw = [100 113.5];
Tdes=s_sw(2)+200;
warning('off');
mdlName = "first_task.slx";
sim_control = sim(mdlName,'SrcWorkspace','current');
t = sim_control.tout;
x = sim_control.simout(:,1);
y = sim_control.simout(:,2);
e = sim_control.simout(:,3);
figure('Position',[0 0 1500 1000],'units','normalized');
plot(x, y, ...
    'linewidth', 1,'Color','b'); grid on; hold on
xlabel('$x$, [m]','Interpreter','latex');
ylabel('$y$, [m]','Interpreter','latex');
title("traj")
```




```
figure('Position',[0 0 1500 1000],'units','normalized');
plot(t, e, ...
    'linewidth', 1,'Color','b'); grid on; hold on
title("error")
% ylim([-0.1,0.1])
xlabel('$t$, [m]','Interpreter','latex');
ylabel('$e$, [m]','Interpreter','latex');
```

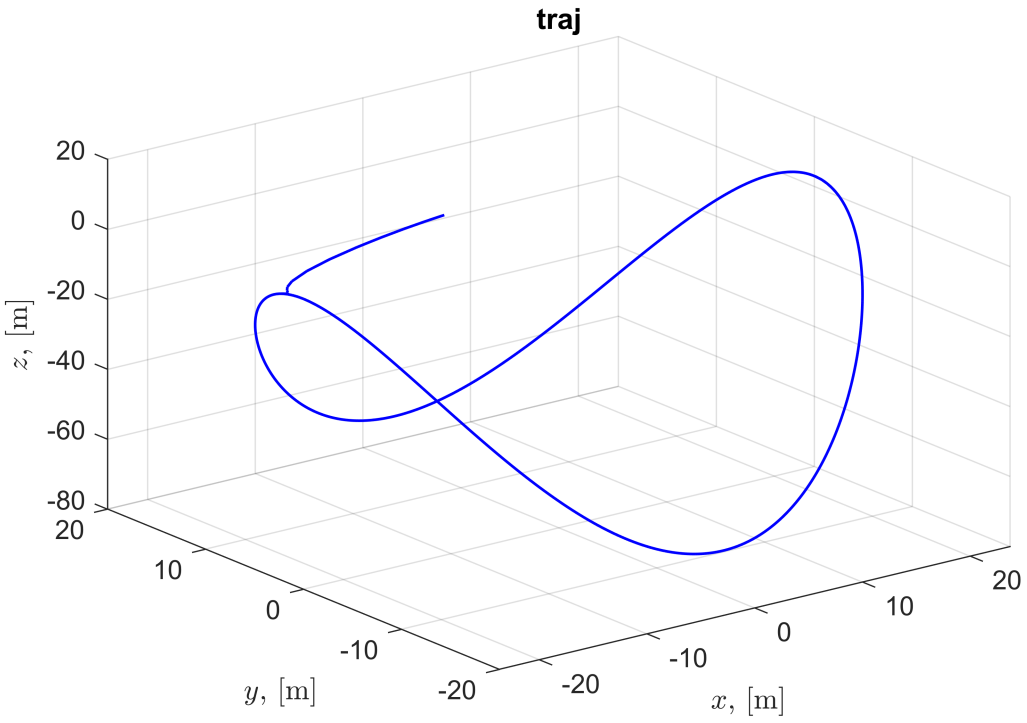


Second task

	m	J	Initial position $(x_0 \quad y_0 \quad z_0)$	Initial orientation n	Desired orientation n_d	$\varphi_i(x,y,z)$
5	2.8	3	$(-7 \quad 4 \quad 10)$	$(1 \quad 1 \quad 0)$	$(1/\sqrt{3} \quad 1/\sqrt{3} \quad 1/\sqrt{3})$	$\varphi_1(x,y,z) = 0.4x^2 + 0.8y^2 - 225 = 0$ $\varphi_2(x,y,z) = z + 0.25y^2 - 3 = 0$

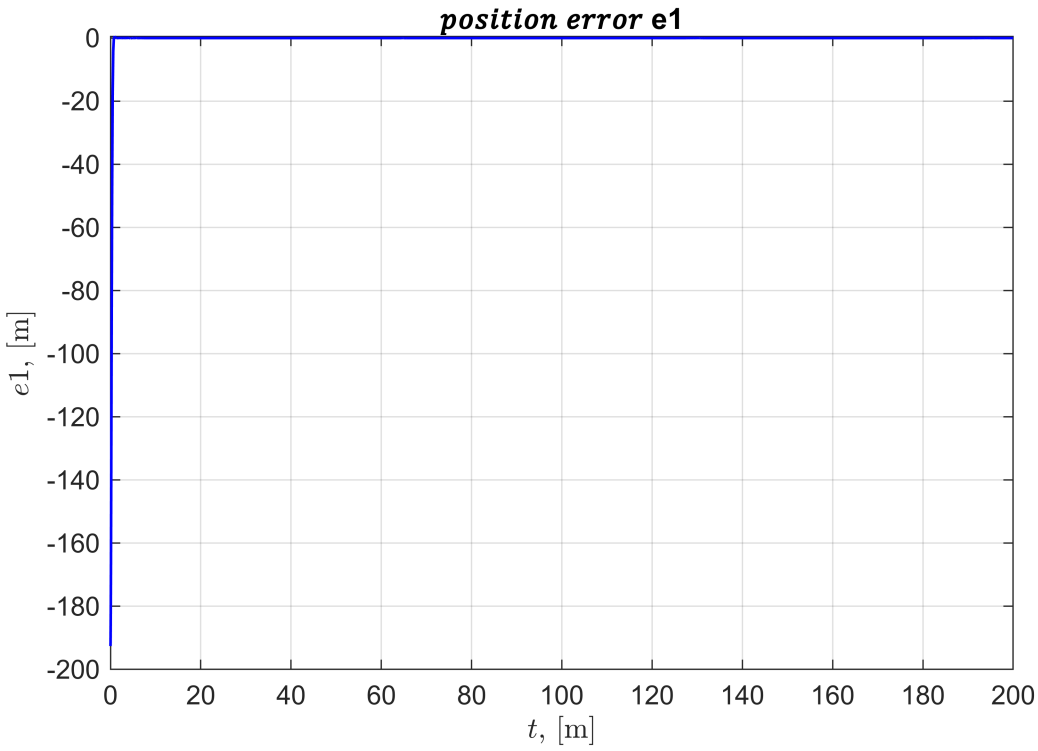
```
% Given
m=2.8;
j=3;
x0=-7;
y0=4;
z0=10;
q0=[x0;y0;z0];
n=[1 1 0];
nd=[1/sqrt(3) 1/sqrt(3) 1/sqrt(3)];
vs_des = 2.5;
ks=1;
k1e1=15;
k2e1=4;
k1e2=7;
k2e2=10;
kr=2;
kw=5;
Tdes=200;
warning('off');
```

```
mdlName = "second_task.slx";
sim_control = sim(mdlName,'SrcWorkspace','current');
t = sim_control.tout;
x = squeeze(sim_control.simout(1,1,:));
y = squeeze(sim_control.simout(1,2,:));
z = squeeze(sim_control.simout(1,3,:));
e1 = squeeze(sim_control.simout(1,4,:));
e2 = squeeze(sim_control.simout(1,5,:));
e_vs = squeeze(sim_control.simout(1,6,:));
n_x= squeeze(sim_control.simout(1,7,:));
n_y= squeeze(sim_control.simout(1,8,:));
n_z= squeeze(sim_control.simout(1,9,:));
e_ang_x= squeeze(sim_control.simout(1,10,:));
e_ang_y= squeeze(sim_control.simout(1,11,:));
e_ang_z= squeeze(sim_control.simout(1,12,:));
figure('Position',[0 0 1500 1000],'units','normalized');
plot3(x, y, z, ...
    'linewidth', 1,'Color','b'); grid on; hold on
xlabel('$x$, [m]','Interpreter','latex');
ylabel('$y$, [m]','Interpreter','latex');
zlabel('$z$, [m]','Interpreter','latex');
title("traj")
```

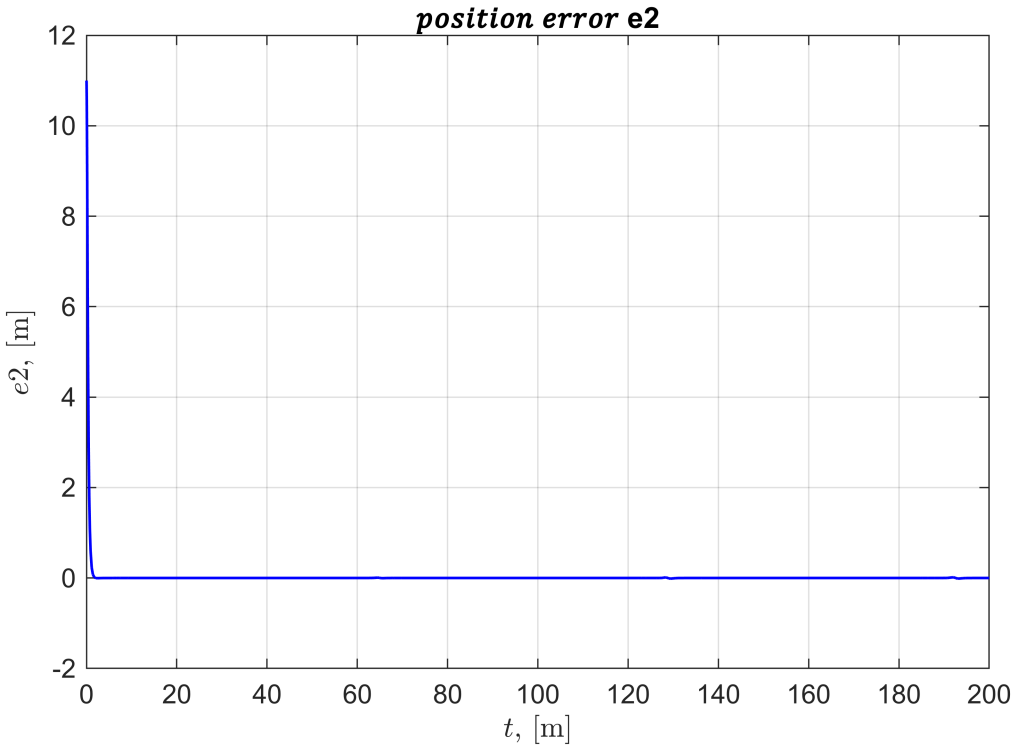



```
figure('Position',[0 0 1500 1000],'units','normalized');
plot(t, e1, ...
    'linewidth', 1,'Color','b'); grid on; hold on
xlabel('$t$, [m]','Interpreter','latex');
ylabel('$e1$, [m]','Interpreter','latex');
```

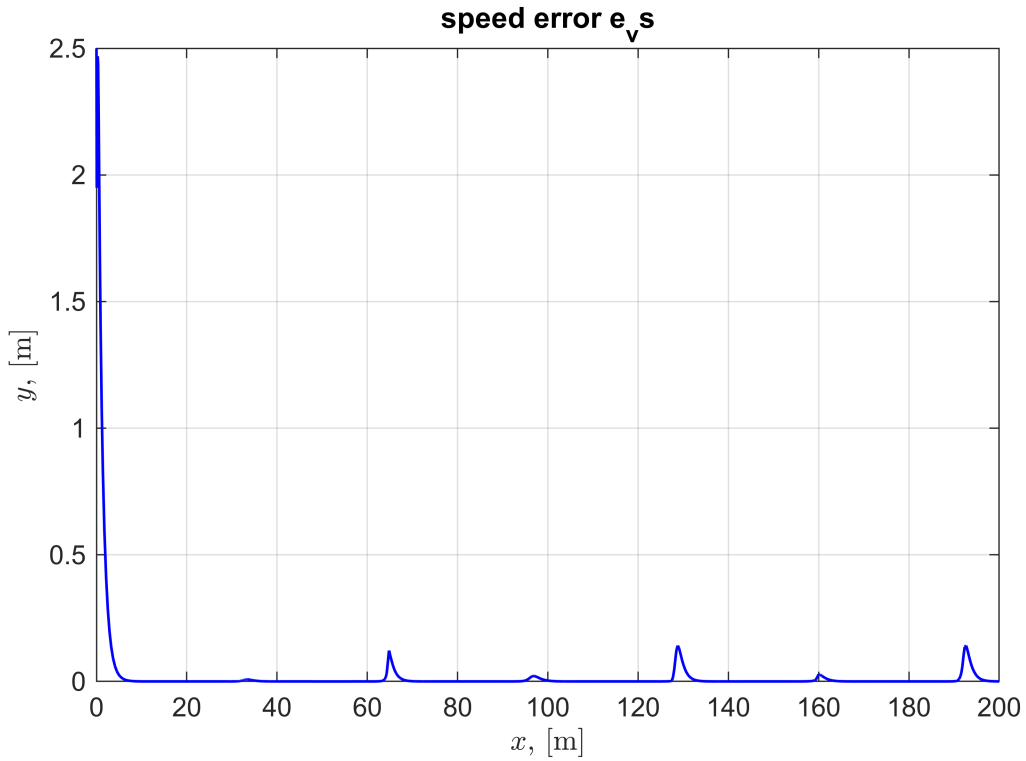
```
title("������ ����  e1")
```



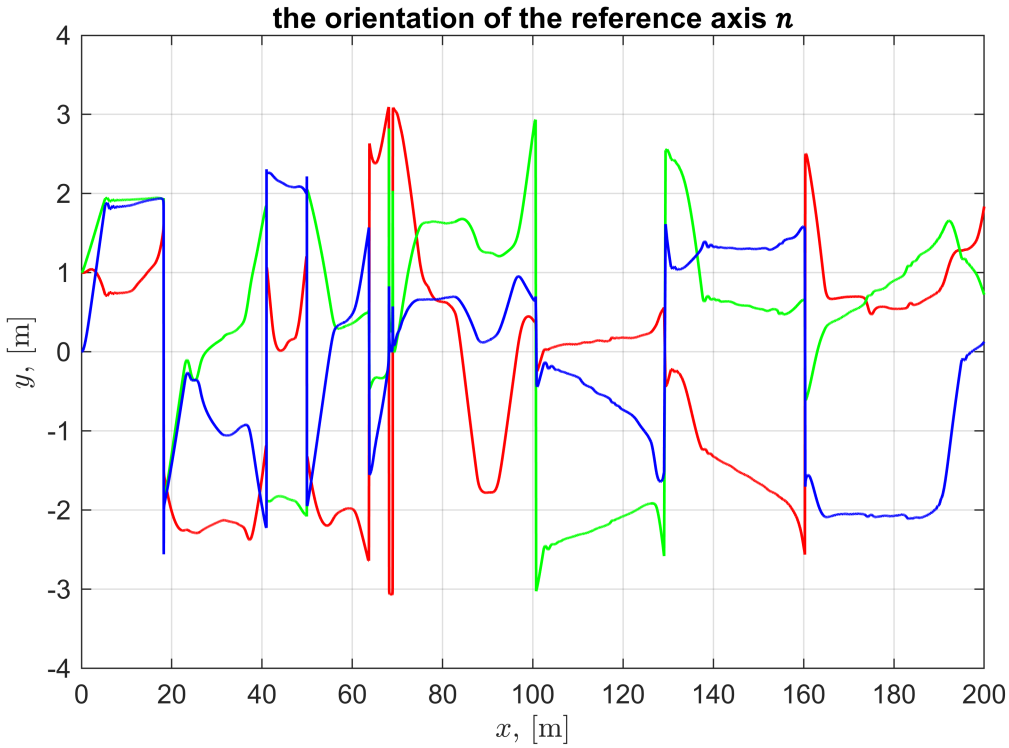

```
figure('Position',[0 0 1500 1000],'units','normalized');
plot(t, e2, ...
    'linewidth', 1,'Color','b'); grid on; hold on
xlabel('$t$, [m]','Interpreter','latex');
ylabel('$e2$, [m]','Interpreter','latex');
title("������ ����  e2")
```



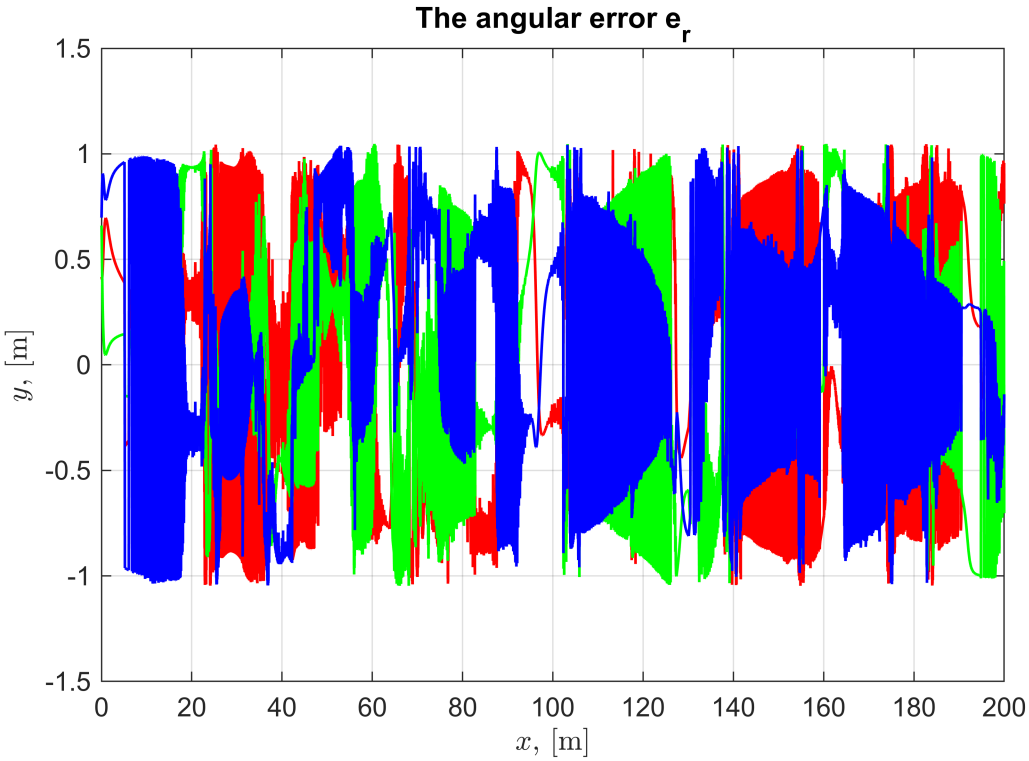

```
figure('Position',[0 0 1500 1000],'units','normalized');
plot(t, e_vs, ...
    'linewidth', 1,'Color','b'); grid on; hold on
xlabel('$x$, [m]','Interpreter','latex');
ylabel('$y$, [m]','Interpreter','latex');
title("speed error e_vs")
```




```
figure('Position',[0 0 1500 1000],'units','normalized');
plot(t, n_x, ...
    'linewidth', 1,'Color','r'); grid on; hold on
plot(t, n_y, ...
    'linewidth', 1,'Color','g');
plot(t, n_z, ...
    'linewidth', 1,'Color','b');
xlabel('$x$, [m]','Interpreter','latex');
ylabel('$y$, [m]','Interpreter','latex');
title("the orientation of the reference axis ")
```



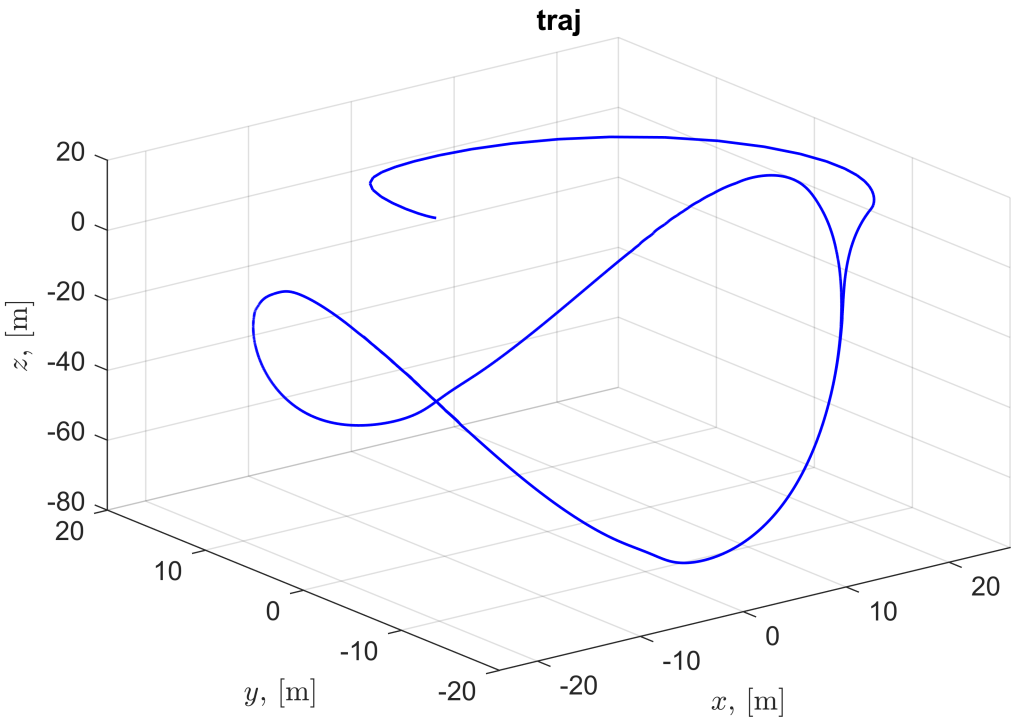

```
figure('Position',[0 0 1500 1000],'units','normalized');
plot(t, e_ang_x, ...
    'linewidth', 1,'Color','r'); grid on; hold on
plot(t, e_ang_y, ...
    'linewidth', 1,'Color','g');
plot(t, e_ang_z, ...
    'linewidth', 1,'Color','b');
xlabel('$x$, [m]','Interpreter','latex');
ylabel('$y$, [m]','Interpreter','latex');
title("The angular error e_r")
```



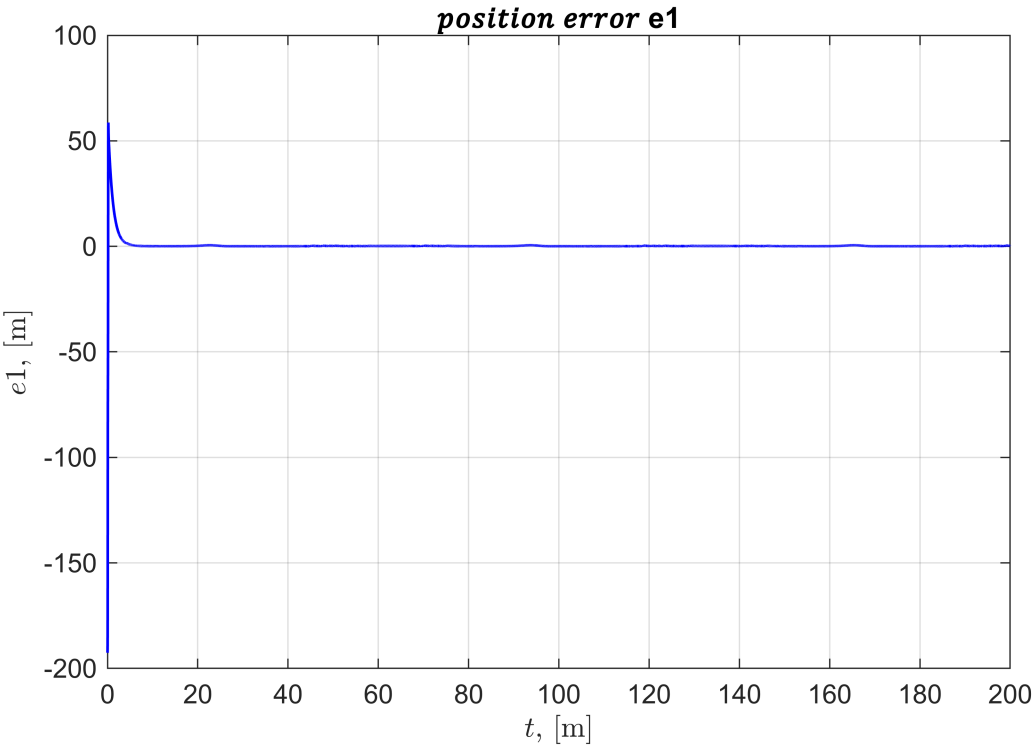
Task 3

```
% Given
m=2.8;
j=3;
x0=-7;
y0=4;
z0=10;
q0=[x0;y0;z0];
n=[1 1 0];
nd=[1/sqrt(3) 1/sqrt(3) 1/sqrt(3)];
vs_des = 2.5;
Tdes=200;
k_phi=diag([1 1 1]);
k_w=3;
K= diag([1 1 1 10 10 10]);
warning('off');
mdlName = "third_task.slx";
sim_control = sim(mdlName,'SrcWorkspace','current');
t = sim_control.tout;
x = squeeze(sim_control.simout(1,1,:));
y = squeeze(sim_control.simout(2,1,:));
z = squeeze(sim_control.simout(3,1,:));
e1 = squeeze(sim_control.simout(4,1,:));
e2 = squeeze(sim_control.simout(5,1,:));
e_vs = squeeze(sim_control.simout(6,1,:));
n_x= squeeze(sim_control.simout(7,1,:));
```

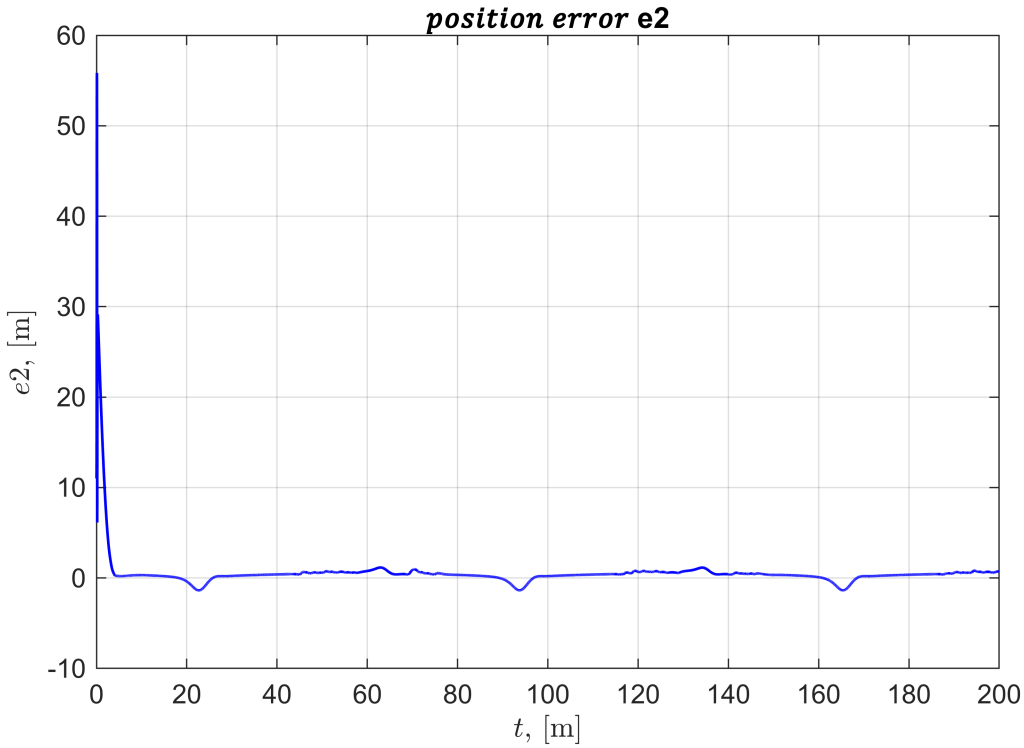
```
n_y= squeeze(sim_control.simout(8,1,:));
n_z= squeeze(sim_control.simout(9,1,:));
figure('Position',[0 0 1500 1000],'units','normalized');
plot3(x, y, z, ...
    'linewidth', 1,'Color','b'); grid on; hold on
xlabel('$x$, [m]','Interpreter','latex');
ylabel('$y$, [m]','Interpreter','latex');
zlabel('$z$, [m]','Interpreter','latex');
title("traj")
```



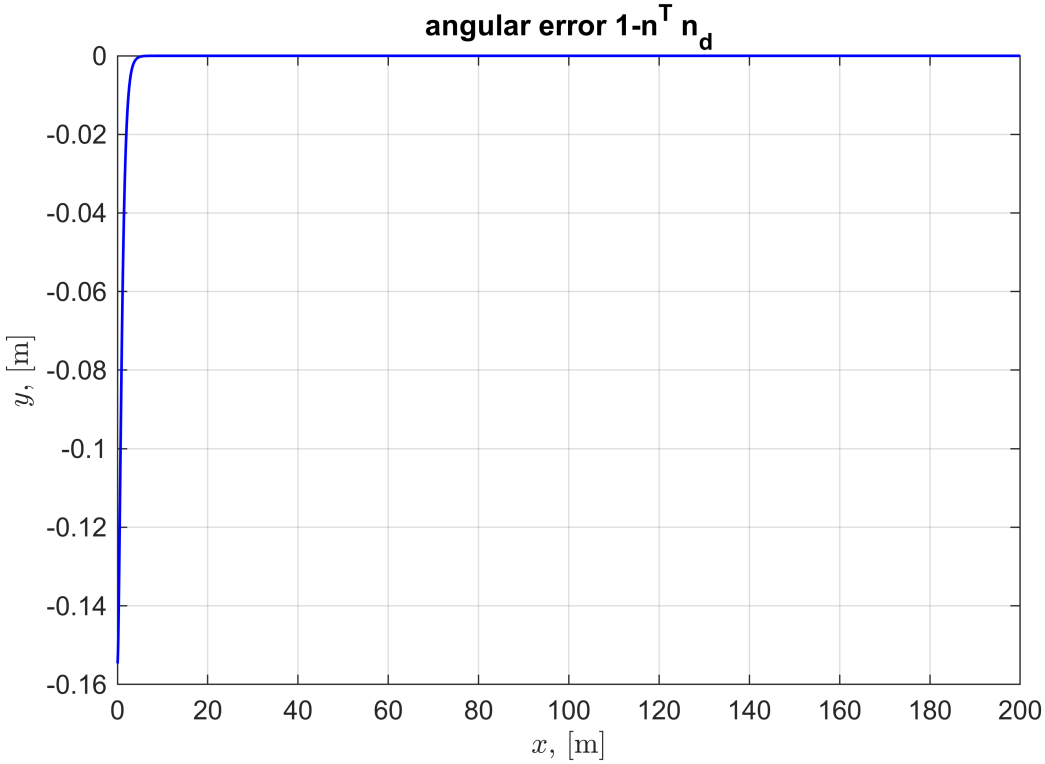

```
figure('Position',[0 0 1500 1000],'units','normalized');
plot(t, e1, ...
    'linewidth', 1,'Color','b'); grid on; hold on
xlabel('$t$, [m]','Interpreter','latex');
ylabel('$e1$, [m]','Interpreter','latex');
title("□□□□□□□□ □□□□□ e1")
```



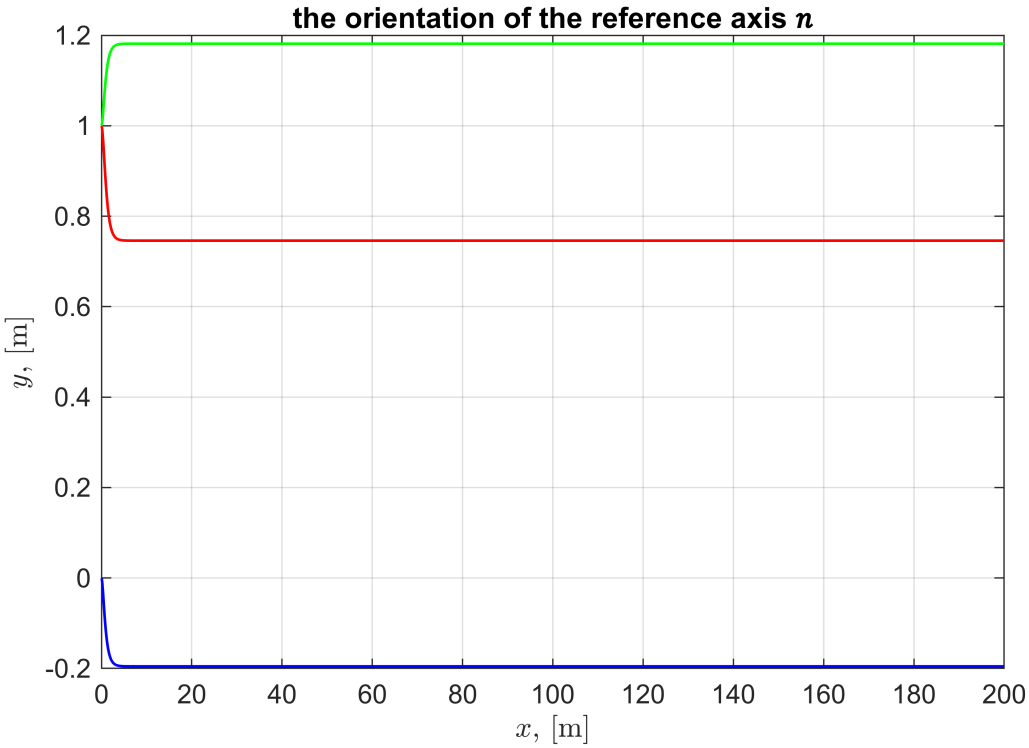

```
figure('Position',[0 0 1500 1000],'units','normalized');
plot(t, e2, ...
    'linewidth', 1,'Color','b'); grid on; hold on
xlabel('$t$, [m]','Interpreter','latex');
ylabel('$e2$, [m]','Interpreter','latex');
title("□□□□□□□□ □□□□□ e2")
```




```
figure('Position',[0 0 1500 1000],'units','normalized');
plot(t, e_vs, ...
    'linewidth', 1,'Color','b'); grid on; hold on
xlabel('$x$, [m]','Interpreter','latex');
ylabel('$y$, [m]','Interpreter','latex');
title("angular error 1-n^T n_d")
```




```
figure('Position',[0 0 1500 1000],'units','normalized');
plot(t, n_x, ...
    'linewidth', 1,'Color','r'); grid on; hold on
plot(t, n_y, ...
    'linewidth', 1,'Color','g');
plot(t, n_z, ...
    'linewidth', 1,'Color','b');
xlabel('$x$, [m]','Interpreter','latex');
ylabel('$y$, [m]','Interpreter','latex');
title("the orientation of the reference axis ")
```


the orientation of the reference axis n
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
y, [m]
0
20
40
60
80
100
120
140
160
180
200
x, [m]