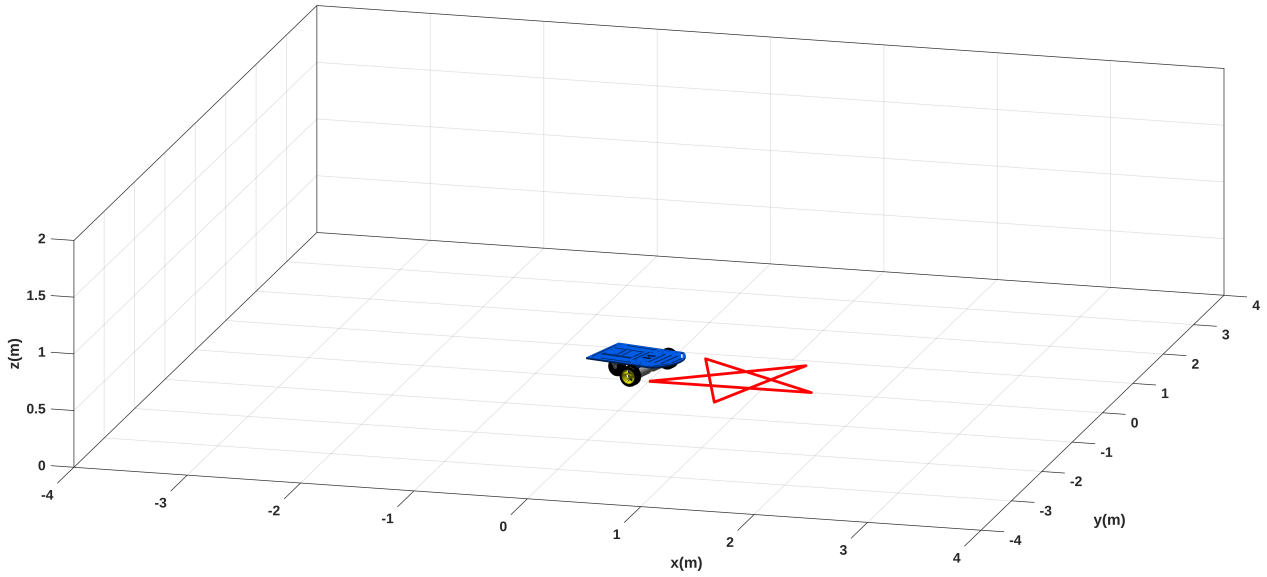
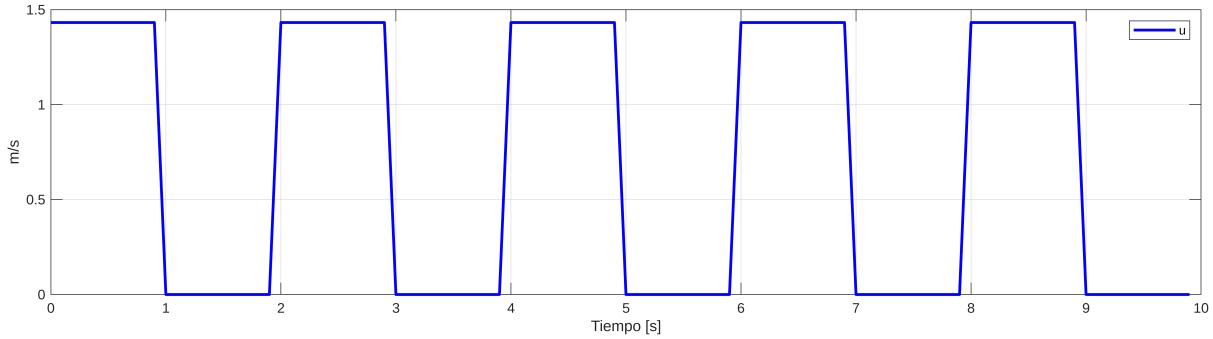
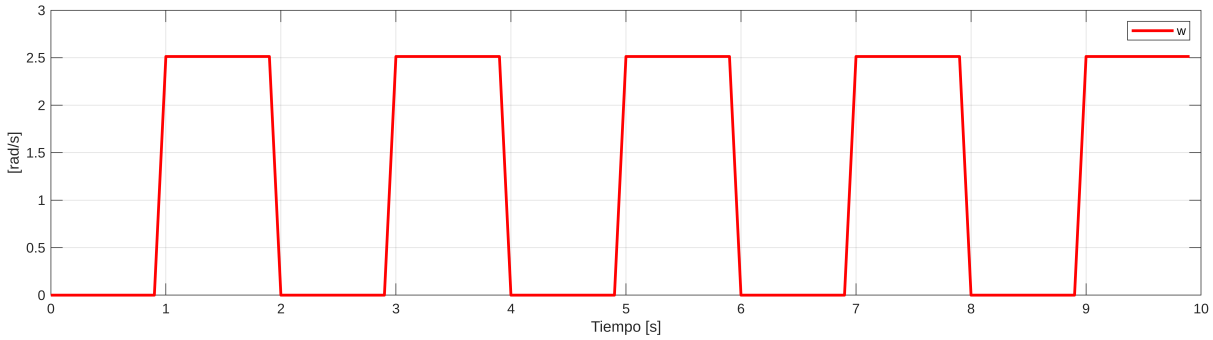
```
clear
close all
clc

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% TIEMPO %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

ts = 0.1;              % Tiempo de muestreo
num_steps = 10;        % 12 pasos de la tabla
samples_per_step = 1 / ts; % 10 muestras por paso
N = num_steps * samples_per_step; % Total de muestras = 120
tf = N * ts;           % Tiempo total
t = 0:ts:tf;           % Vector de tiempo

%%%%%%%%%%%%%%%%%%%%%%%%%% CONDICIONES INICIALES %%%%%%%%%%%%%%%%%%%%%%%%%%%%

x1 = zeros(1, N+1);
y1 = zeros(1, N+1);
phi = zeros(1, N+1);

x1(1) = 0;
y1(1) = 0;
phi(1) = 0;

hx = zeros(1, N+1);
hy = zeros(1, N+1);
hx(1) = x1(1);
hy(1) = y1(1);

%%%%%%%%%%%%%%%%%%%%%%%% VELOCIDADES SEGÚN TABLA %%%%%%%%%%%%%%%%%%%%%%%%%%%%

v_table = [1.432 0 1.432 0 1.432 0 1.432 0 1.432 0];          % Velocidades
lineales (v)
w_table = [0 2.513 0 2.513 0 2.513 0 2.513 0 2.513]; % Velocidades angulares
(ω)

u = zeros(1, N);
w = zeros(1, N);

for i = 1:num_steps
    idx_start = (i-1)*samples_per_step + 1;
    idx_end = i*samples_per_step;
    u(idx_start:idx_end) = v_table(i);
    w(idx_start:idx_end) = w_table(i);
end

%%%%%%%%%%%%%%%%%%%%%%%%%%%% SIMULACIÓN %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

for k = 1:N
    phi(k+1) = phi(k) + w(k) * ts;
    xp1 = u(k) * cos(phi(k+1));
```

```
    yp1 = u(k) * sin(phi(k+1));
    x1(k+1) = x1(k) + xp1 * ts;
    y1(k+1) = y1(k) + yp1 * ts;
    hx(k+1) = x1(k+1);
    hy(k+1) = y1(k+1);
end

%%%%%%%%%%%%%%%%%%%%%%%%%%%% SIMULACIÓN 3D %%%%%%%%%%%%%%%%%%%%%%%%%%%%

scene = figure;
set(scene,'Color','white');
set(gca,'FontWeight','bold');
sizeScreen = get(0,'ScreenSize');
set(scene,'position',sizeScreen);
camlight('headlight');
axis equal;
grid on;
box on;
xlabel('x(m)'); ylabel('y(m)'); zlabel('z(m)');
view([15 15]);
axis([-4 4 -4 4 0 2]);  % Ajusta según resultado

scale = 4;
MobileRobot_5;
H1 = MobilePlot_4(x1(1), y1(1), phi(1), scale); hold on;
H2 = plot3(hx(1), hy(1), 0, 'r', 'lineWidth', 2);

step = 1;
for k = 1:step:N
    delete(H1);
    delete(H2);
    H1 = MobilePlot_4(x1(k), y1(k), phi(k), scale);
    H2 = plot3(hx(1:k), hy(1:k), zeros(1,k), 'r', 'lineWidth', 2);
    pause(ts);
end
```

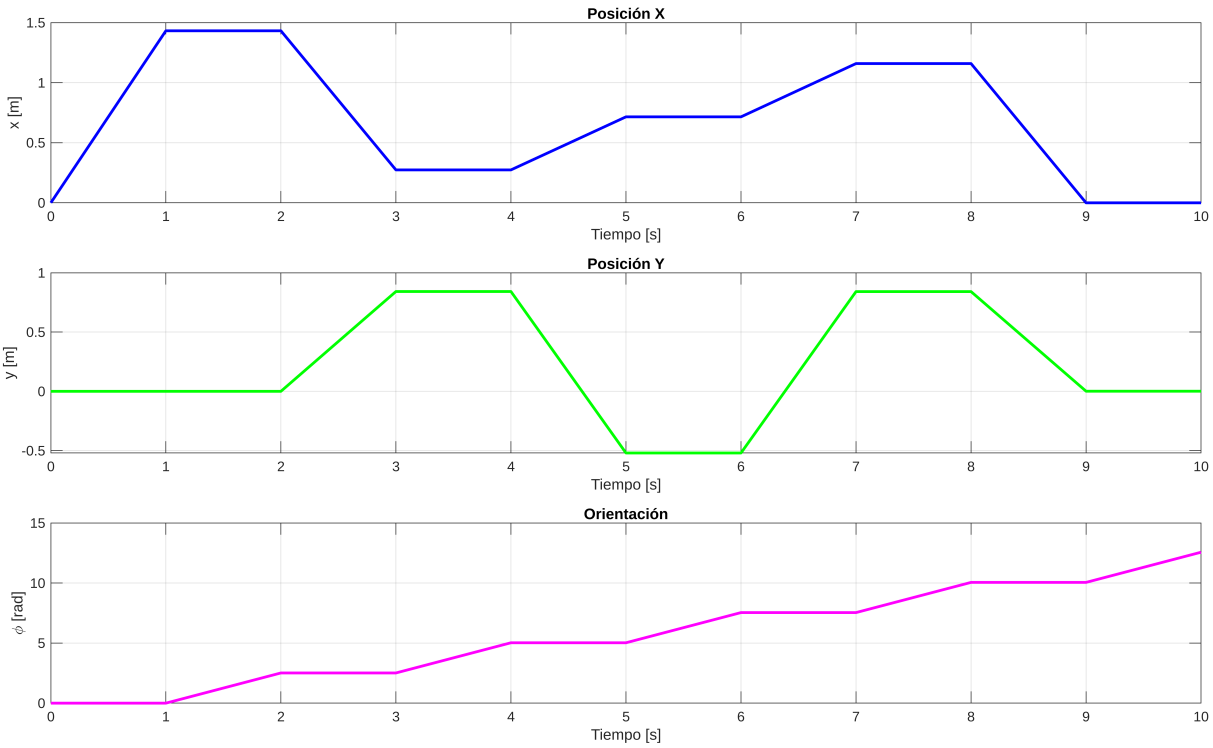



```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% Graficas %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

graph = figure;
set(graph, 'position', sizeScreen);

subplot(211)
plot(t(1:N), u, 'b', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('m/s')
legend('u')

subplot(212)
plot(t(1:N), w, 'r', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('[rad/s]')
legend('w')
```

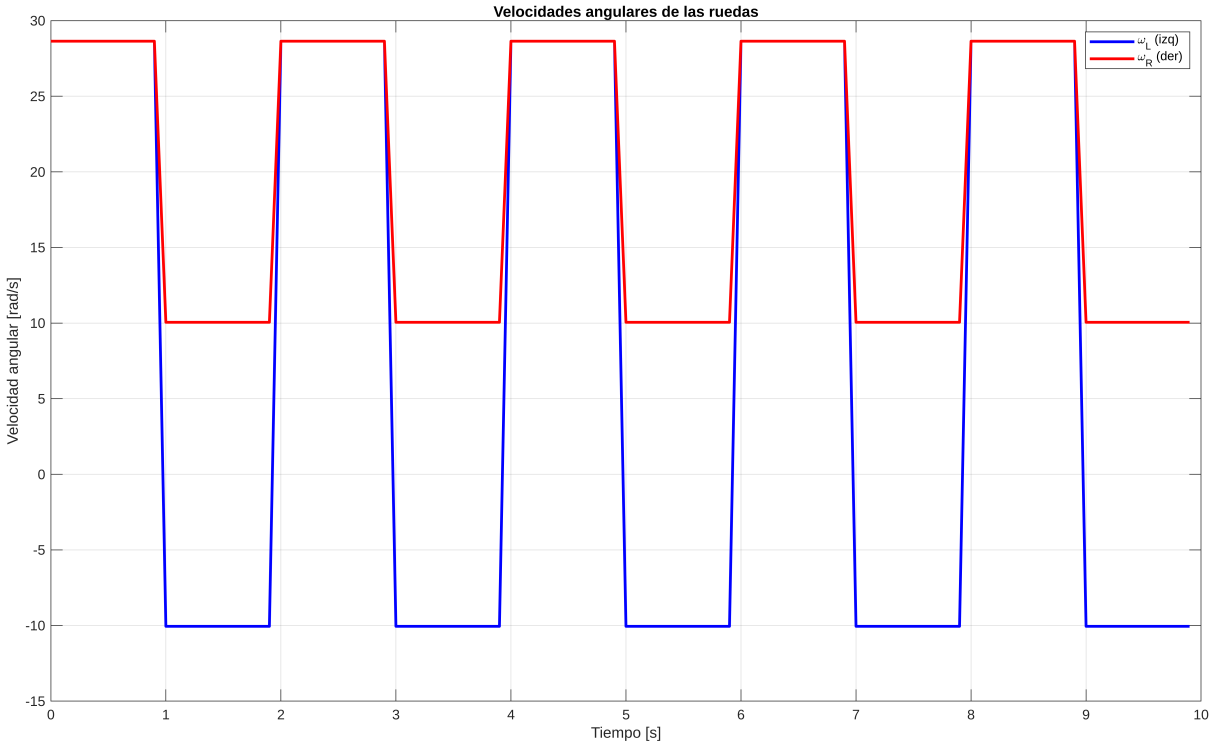





```
%%%%%%%%%%%%%%%%%%%%%% GRAFICAR POSE %%%%%%%%%%%%%%%%%%%%

pose_graph = figure;
set(pose_graph, 'position', sizeScreen);

subplot(311)
plot(t(1:N+1), x1, 'b', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('x [m]')
title('Posición X');

subplot(312)
plot(t(1:N+1), y1, 'g', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('y [m]')
title('Posición Y');

subplot(313)
plot(t(1:N+1), phi, 'm', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('\phi [rad]')
title('Orientación');
```




```
%%%%%%%%%%%%%%%%%% CÁLCULO DE VELOCIDADES ANGULARES DE RUEDAS %%%%%%%%%%%%%%%%%%

r = 0.05; % Radio de ruedas
L = 0.4;  % Distancia entre ruedas

wl = (2*u - w*L) / (2*r);
wr = (2*u + w*L) / (2*r);

wheel_graph = figure;
set(wheel_graph, 'position', sizeScreen);
plot(t(1:N), wl, 'b', 'LineWidth', 2), hold on
plot(t(1:N), wr, 'r', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('Velocidad angular [rad/s]')
legend('\omega_L (izq)', '\omega_R (der)')
title('Velocidades angulares de las ruedas')
```




```
%%%%%%%%%%%%%%%%%%%%%%%%% POSE CADA SEGUNDO (a) %%%%%%%%%%%%%%%%%%%%%%%%%

indices_pasos = 1:samples_per_step:(N+1-samples_per_step);  % Exactamente 12
pasos

poses_cada_segundo = table((0:num_steps-1)', ...
    x1(indices_pasos)', ...
    y1(indices_pasos)', ...
    phi(indices_pasos)', ...
    'VariableNames', {'Tiempo_s', 'X_m', 'Y_m', 'Theta_rad'});

disp('POSE DEL ROBOT CADA SEGUNDO:')
```

```
POSE DEL ROBOT CADA SEGUNDO:
```

```
disp(poses_cada_segundo)
```

Tiempo_s	X_m	Y_m	Theta_rad
0	0	0	0
1	1.432	0	0
2	1.432	0	2.513
3	0.27372	0.84203	2.513
4	0.27372	0.84203	5.026
5	0.71548	-0.52013	5.026
6	0.71548	-0.52013	7.539
7	1.1591	0.84142	7.539

```
        8            1.1591       0.84142     10.052
        9       -0.00031834    0.00098158     10.052
```

```
f_tabla = figure;
%%%%%%%%%%%%%%%%%%%%%%%%%% MOSTRAR TABLA COMO TEXTO (a) %%%%%%%%%%%%%%%%%%%%%%
%%%%%

% Crear la tabla como texto simple
pose_text = sprintf(' PASO |    X (m)   |    Y (m)   |  Theta (rad)\n');
pose_text = [pose_text, sprintf('----------------------------------------
\n')];

for i = 1:num_steps
    pose_text = [pose_text, sprintf('  %2d   |  %8.3f |  %8.3f |  %8.3f\n',
...
        i, x1(indices_pasos(i)), y1(indices_pasos(i)),
phi(indices_pasos(i)))];
end


%%%%%%%%%%%%%%%%%%%%%%%%% POSE FINAL (b) %%%%%%%%%%%%%%%%%%%%%%%%%

fprintf('\nPOSE FINAL DEL ROBOT (tras 12 pasos):\n');
```

```
POSE FINAL DEL ROBOT (tras 12 pasos):
```

```
fprintf('x = %.4f m\ny = %.4f m\nphi = %.4f rad\n', x1(end), y1(end),
phi(end));
```

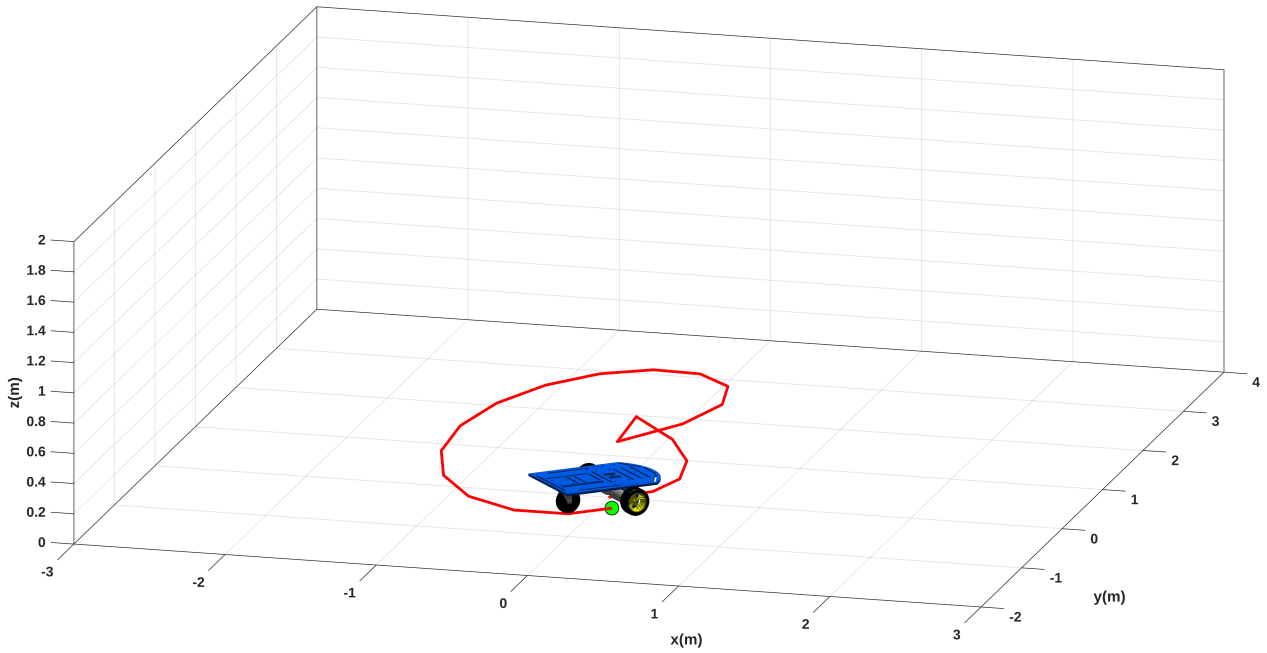
```
x = -0.0003 m
y = 0.0010 m
phi = 12.5650 rad
```

n

```
%%%%%%%%%%%%%%%%%%%%%%% PARÁMETROS DEL ROBOT %%%%%%%%%%%%%%%%%%%%%%%

r = 0.1;   % Radio de las ruedas (m)
L = 0.4;   % Distancia entre ruedas (m)
ts = 1.0;  % Tiempo por paso (s)

% Entradas de velocidades angulares por rueda (ωR y ωL)
wR = [4.582, 4.773, 5.291, 5.960, 6.490, -1.168, -1.364, 5.960, 5.291,
4.773, ...
      4.582, 4.773, 5.291, 5.960, 6.490, 6.686, 6.490, 5.960, 5.291, 4.773,
4.582];
wL = [1.701, 2.353, 3.676, 4.856, 5.618, 13.735, 13.472, 4.856, 3.676,
2.353, ...
      1.701, 2.353, 3.676, 4.856, 5.618, 5.881, 5.618, 4.856, 3.676, 2.353,
1.701];
```

```
N = length(wR);  % 21 muestras

% Inicialización de vectores de pose
x = zeros(1, N+1);      % Posición en x
y = zeros(1, N+1);      % Posición en y
theta = zeros(1, N+1);  % Orientación en radianes

% Pose inicial
x(1) = 0;
y(1) = 0;
theta(1) = 0;

%%%%%%%%%%%%%%%%%%% CÁLCULO DE VELOCIDADES Y POSE %%%%%%%%%%%%%%%%%%%

v = (r/2) * (wR + wL);        % Velocidad lineal v(k)
w = (r/L) * (wR - wL);        % Velocidad angular w(k)

for k = 1:N
    theta(k+1) = theta(k) + w(k) * ts;
    x(k+1) = x(k) + v(k) * cos(theta(k+1)) * ts;
    y(k+1) = y(k) + v(k) * sin(theta(k+1)) * ts;
end

%%%%%%%%%%%%%%%%%%%%%%%%%%%% SIMULACIÓN 3D %%%%%%%%%%%%%%%%%%%%%%%%%%%%
x1 = x;
y1 = y;
phi = theta;
hx = x;
hy = y;

scene = figure;
set(scene,'Color','white');
set(gca,'FontWeight','bold');
sizeScreen = get(0,'ScreenSize');
set(scene,'position',sizeScreen);
camlight('headlight');
axis equal;
grid on;
box on;
xlabel('x(m)'); ylabel('y(m)'); zlabel('z(m)');
view([15 15]);
axis([-3 3 -2 4 0 2]);  % Ajusta según resultado

scale = 4;
MobileRobot_5;
H1 = MobilePlot_4(x1(1), y1(1), phi(1), scale); hold on;
H2 = plot3(hx(1), hy(1), 0, 'r', 'lineWidth', 2);
plot3(x(end), y(end), 0, 'ko', 'MarkerFaceColor', 'g', 'MarkerSize', 10);  %
punto final
```

```
step = 1;
for k = 1:step:N+1
    delete(H1);
    delete(H2);
    H1 = MobilePlot_4(x1(k), y1(k), phi(k), scale);
    H2 = plot3(hx(1:k), hy(1:k), zeros(1,k), 'r', 'lineWidth', 2);
    pause(ts);
end
```



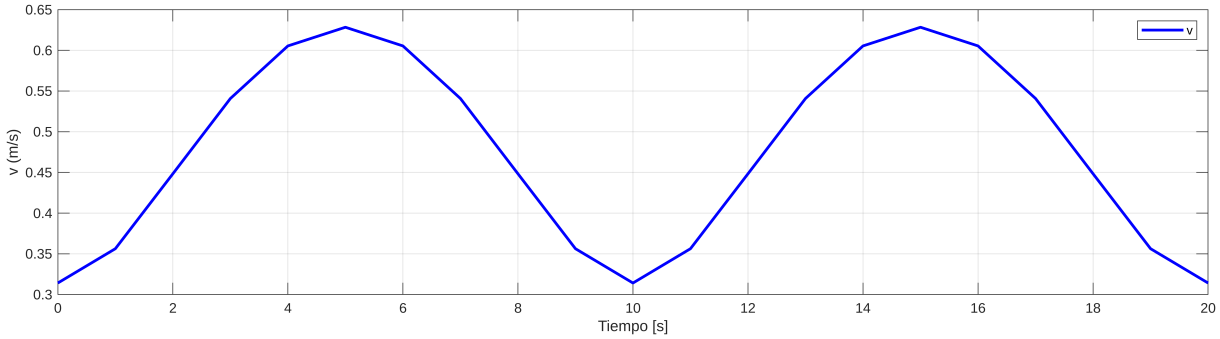

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% TABLA %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

tiempo = (0:N)';                              % Ahora de 0 a 21
theta_out = rad2deg(theta(:));                % Convertir orientación a grados
v_full = [v, NaN];                            % Añadir NaN al final
w_full = [w, NaN];
wR_full = [wR, NaN];
wL_full = [wL, NaN];

tabla = table( ...
    tiempo, v_full(:), w_full(:), wR_full(:), wL_full(:), ...
    x(:), y(:), theta_out, ...
    'VariableNames', {'t_s', 'v_m_s', 'w_rad_s', 'wR_rad_s', 'wL_rad_s',
'x_m', 'y_m', 'theta_deg'});

disp('TABLA DE POSE FINAL DESPUÉS DE CADA VELOCIDAD:')
```

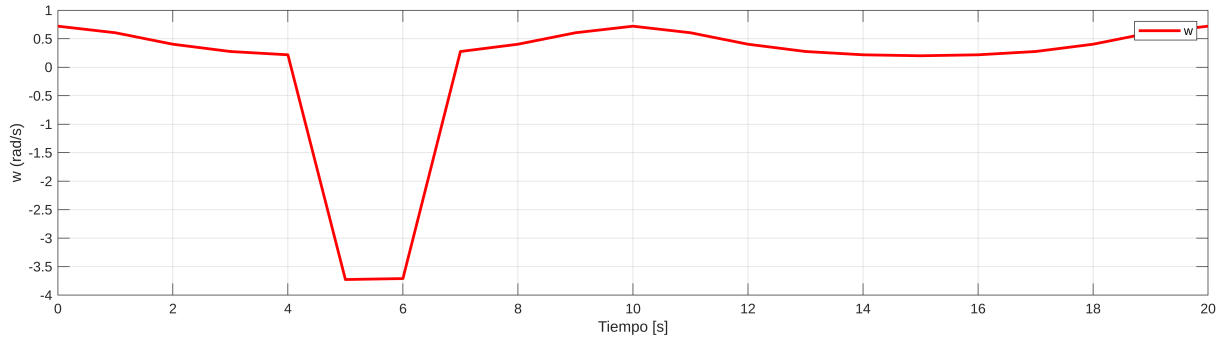
TABLA DE POSE FINAL DESPUÉS DE CADA VELOCIDAD:

```
disp(tabla)
```

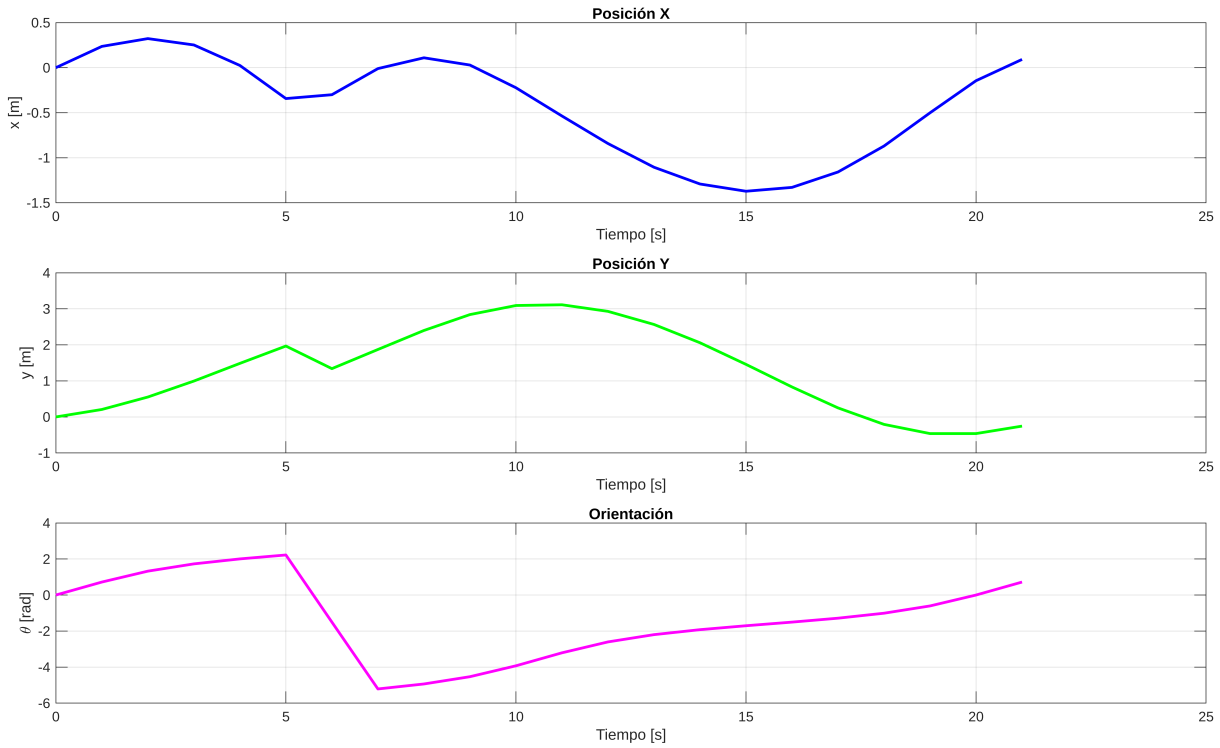
t_s	v_m_s	w_rad_s	wR_rad_s	wL_rad_s	x_m	y_m	theta_deg
0	0.31415	0.72025	4.582	1.701	0	0	0
1	0.3563	0.605	4.773	2.353	0.23613	0.2072	41.267
2	0.44835	0.40375	5.291	3.676	0.32274	0.55282	75.931
3	0.5408	0.276	5.96	4.856	0.2521	0.99557	99.064
4	0.6054	0.218	6.49	5.618	0.024596	1.4862	114.88
5	0.62835	-3.7257	-1.168	13.735	-0.34284	1.9673	127.37
6	0.6054	-3.709	-1.364	13.472	-0.30012	1.3404	-86.101
7	0.5408	0.276	5.96	4.856	-0.010216	1.8719	-298.61
8	0.44835	0.40375	5.291	3.676	0.10958	2.3993	-282.8
9	0.3563	0.605	4.773	2.353	0.029136	2.8403	-259.66
10	0.31415	0.72025	4.582	1.701	-0.2228	3.0923	-225
11	0.3563	0.605	4.773	2.353	-0.53629	3.1127	-183.73
12	0.44835	0.40375	5.291	3.676	-0.84192	2.9296	-149.07
13	0.5408	0.276	5.96	4.856	-1.105	2.5666	-125.94
14	0.6054	0.218	6.49	5.618	-1.2911	2.0588	-110.12
15	0.62835	0.20125	6.686	5.881	-1.3715	1.4588	-97.632
16	0.6054	0.218	6.49	5.618	-1.3288	0.83187	-86.101
17	0.5408	0.276	5.96	4.856	-1.158	0.25107	-73.611
18	0.44835	0.40375	5.291	3.676	-0.86975	-0.20654	-57.797
19	0.3563	0.605	4.773	2.353	-0.50098	-0.46155	-34.664
20	0.31415	0.72025	4.582	1.701	-0.14468	-0.46155	-6.3611e-15
21	NaN	NaN	NaN	NaN	0.091444	-0.25434	41.267

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% GRAFICAS %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

sizeScreen = get(0, 'ScreenSize');
t = tiempo;

% --------- v(t) y w(t) ---------
graph = figure;
set(graph, 'position', sizeScreen);

subplot(211)
plot(t, v_full, 'b', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('v (m/s)')
legend('v')

subplot(212)
plot(t, w_full, 'r', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('w (rad/s)')
legend('w')
```

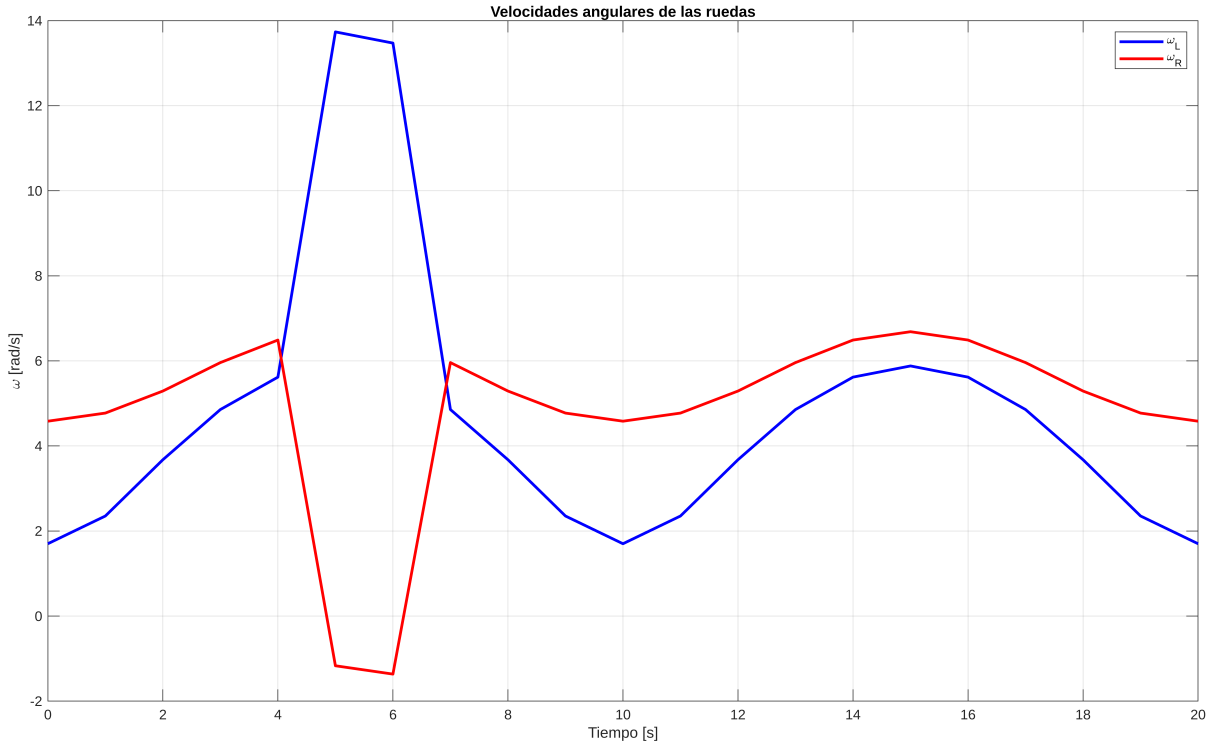





```
% --------- Pose del robot: x(t), y(t), theta(t) ---------
pose_graph = figure;
set(pose_graph, 'position', sizeScreen);

subplot(311)
plot(t, x, 'b', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('x [m]')
title('Posición X')

subplot(312)
plot(t, y, 'g', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('y [m]')
title('Posición Y')

subplot(313)
plot(t, theta, 'm', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('\theta [rad]')
title('Orientación')
```




```
% --------- Velocidades angulares de ruedas ---------
wheel_graph = figure;
set(wheel_graph, 'position', sizeScreen);

plot(t, wL_full, 'b', 'LineWidth', 2), hold on
plot(t, wR_full, 'r', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('\omega [rad/s]')
legend('\omega_L', '\omega_R')
title('Velocidades angulares de las ruedas')
```

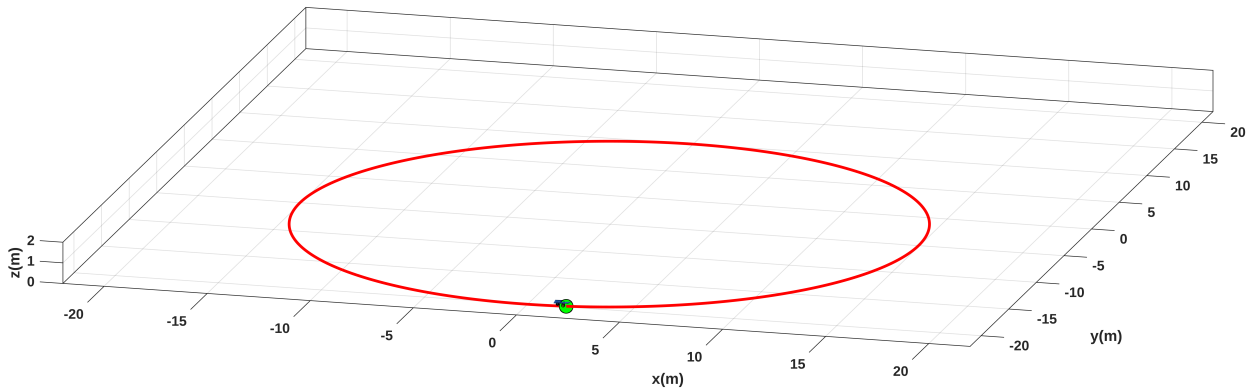


s

```
clear; clc;

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% TIEMPO %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

tf = 96;              % Tiempo de simulación en segundos
ts = 0.1;              % Tiempo de muestreo en segundos
t = 0:ts:tf;           % Vector de tiempo
N = length(t);         % Número de muestras

%%%%%%%%%%%%%%%%%%%%%%%% CONDICIONES INICIALES %%%%%%%%%%%%%%%%%%%%%%%%%%%%

x1 = zeros(1, N+1);    % Posición x del robot
y1 = zeros(1, N+1);    % Posición y del robot
phi = zeros(1, N+1);   % Orientación del robot en radianes

x1(1) = 0;             % Posición inicial x
y1(1) = -20;           % Posición inicial y
phi(1) = 0;            % Orientación inicial

%%%%%%%%%%%%%%%%%%%%%%%%%%%% PUNTO DE CONTROL %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

hx = zeros(1, N+1);    % Posición x del punto de control
```

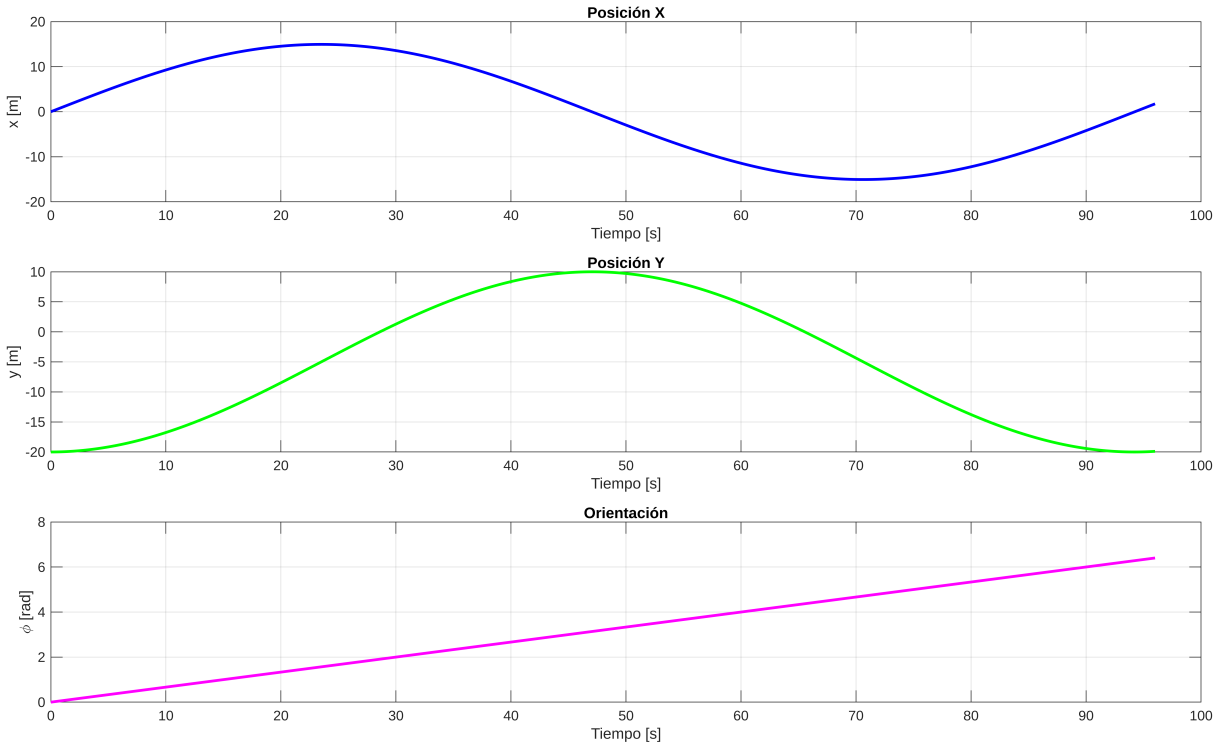
```
hy = zeros(1, N+1);    % Posición y del punto de control
hx(1) = x1(1);
hy(1) = y1(1);

%%%%%%%%%%%%%%%%%%%%%% VELOCIDADES DE REFERENCIA %%%%%%%%%%%%%%%%%%%%%%%%%

u = 1 * ones(1, N);       % Velocidad lineal de referencia
w = ones(1, N) / 15;      % Velocidad angular de referencia

%%%%%%%%%%%%%%%%%%%%%%%% BUCLE DE SIMULACION %%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%

for k = 1:N
    phi(k+1) = phi(k) + w(k) * ts;  % Integración de orientación

    % Modelo cinemático diferencial
    xp1 = u(k) * cos(phi(k+1));
    yp1 = u(k) * sin(phi(k+1));

    x1(k+1) = x1(k) + xp1 * ts;
    y1(k+1) = y1(k) + yp1 * ts;

    hx(k+1) = x1(k+1);
    hy(k+1) = y1(k+1);
end

%%%%%%%%%%%%%%%%%%%%%%%%%%%% SIMULACIÓN 3D %%%%%%%%%%%%%%%%%%%%%%%%%%%%%

scene = figure;
set(scene,'Color','white');
set(gca,'FontWeight','bold');
sizeScreen = get(0,'ScreenSize');
set(scene,'position',sizeScreen);
camlight('headlight');
axis equal;
grid on;
box on;
xlabel('x(m)'); ylabel('y(m)'); zlabel('z(m)');
view([15 15]);
axis([-22 22 -22 22 0 2]); % Ajustado a la trayectoria circular

scale = 4;
MobileRobot_5;
H1 = MobilePlot_4(x1(1), y1(1), phi(1), scale); hold on;
H2 = plot3(hx(1), hy(1), 0, 'r', 'lineWidth', 2);
plot3(x1(end), y1(end), 0, 'ko', 'MarkerFaceColor', 'g', 'MarkerSize', 10);
% Punto final

step = 1;
for k = 1:step:N
```

```
    delete(H1);
    delete(H2);
    H1 = MobilePlot_4(x1(k), y1(k), phi(k), scale);
    H2 = plot3(hx(1:k), hy(1:k), zeros(1,k), 'r', 'lineWidth', 2);
    pause(ts);
end
```

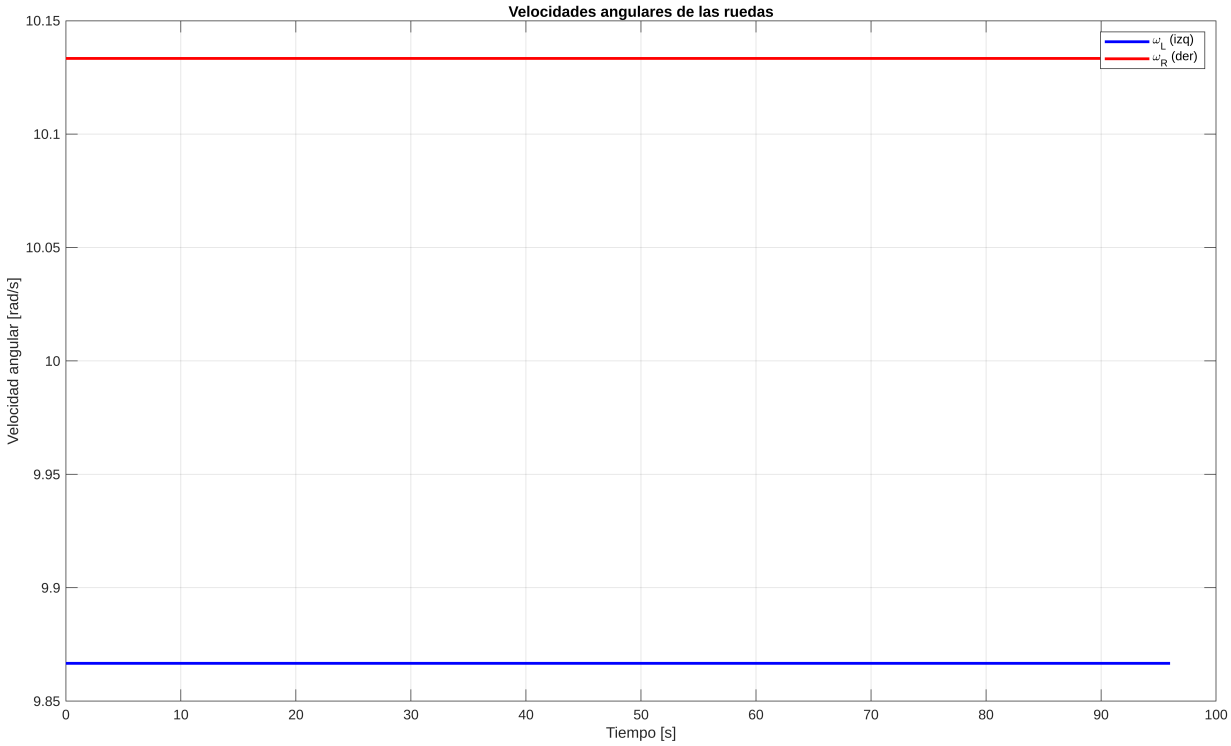



```
%%%%%%%%%%%%%%%%%%% CÁLCULO DE VELOCIDADES ANGULARES DE LAS RUEDAS %%%%%%%%%
%%%%%%%%

r = 0.1; % Radio de las ruedas (m)
L = 0.4; % Distancia entre ruedas (m)

wl = zeros(1, N); % Velocidad angular de rueda izquierda
wr = zeros(1, N); % Velocidad angular de rueda derecha

for k = 1:N
    wl(k) = (2 * u(k) - w(k) * L) / (2 * r);
    wr(k) = (2 * u(k) + w(k) * L) / (2 * r);
end

%%%%%%%%%%%%%%%%%%% GRAFICAR POSE Y VELOCIDADES ANGULARES %%%%%%%%%%%%%%%%%%%

pose_graph = figure;
set(pose_graph, 'position', sizeScreen);
```

```
subplot(311)
plot(t, x1(1:N), 'b', 'LineWidth', 2), grid on
xlabel('Tiempo [s]'), ylabel('x [m]'), title('Posición X');

subplot(312)
plot(t, y1(1:N), 'g', 'LineWidth', 2), grid on
xlabel('Tiempo [s]'), ylabel('y [m]'), title('Posición Y');

subplot(313)
plot(t, phi(1:N), 'm', 'LineWidth', 2), grid on
xlabel('Tiempo [s]'), ylabel('\phi [rad]'), title('Orientación');
```




```
wheel_graph = figure;
set(wheel_graph, 'position', sizeScreen);
plot(t, wl, 'b', 'LineWidth', 2), hold on
plot(t, wr, 'r', 'LineWidth', 2), grid on
xlabel('Tiempo [s]')
ylabel('Velocidad angular [rad/s]')
legend('\omega_L (izq)', '\omega_R (der)')
title('Velocidades angulares de las ruedas')
```




```
%%%%%%%%%%%%%%%%%% TABLA MUESTREADA CADA 5 SEGUNDOS %%%%%%%%%%%%%%%%%%

muestreo_intervalo = 5;                                % Intervalo de muestreo
en segundos
indices_muestreados = 1 : muestreo_intervalo/ts : N; % Cada 5 segundos
tiempos_muestreados = t(indices_muestreados)';         % Tiempo en segundos
wr_muestreados = wr(indices_muestreados)';             % ω_R muestreado
wl_muestreados = wl(indices_muestreados)';             % ω_L muestreado

tabla_muestreo = table(tiempos_muestreados, wr_muestreados, wl_muestreados,
...
    'VariableNames', {'Tiempo_s', 'omega_R_rad_s', 'omega_L_rad_s'});

disp('Tabla de velocidades angulares muestreadas cada 5 segundos:')
```

```
Tabla de velocidades angulares muestreadas cada 5 segundos:
```

```
disp(tabla_muestreo)
```

Tiempo_s	omega_R_rad_s	omega_L_rad_s
0	10.133	9.8667
5	10.133	9.8667
10	10.133	9.8667
15	10.133	9.8667
20	10.133	9.8667

```
25          10.133          9.8667
30          10.133          9.8667
35          10.133          9.8667
40          10.133          9.8667
45          10.133          9.8667
50          10.133          9.8667
55          10.133          9.8667
60          10.133          9.8667
65          10.133          9.8667
70          10.133          9.8667
75          10.133          9.8667
80          10.133          9.8667
85          10.133          9.8667
90          10.133          9.8667
95          10.133          9.8667
```