

```

clear; clc;
% ---- Punto 1 ----
% ---- Punto a) Pose del robot en cada paso ----
% Parámetros iniciales
x = -1;
y = -5;
theta = 0; % en radianes

% Historial de pasos (de la imagen)
v = [1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0];
w = [0, pi/3, 0, pi/3, 0, pi/3, 0, pi/3, 0, pi/3, 0, pi/3];
dt = ones(1, 12);

% Inicializamos almacenamiento
poses = zeros(12, 3); % Cada fila: [x y theta]

% Cálculo de la pose paso a paso
for k = 1:12
    x = x + v(k) * cos(theta) * dt(k);
    y = y + v(k) * sin(theta) * dt(k);
    theta = theta + w(k) * dt(k);
    poses(k, :) = [x, y, theta];
end

% Mostrar tabla de resultados
T = table((1:12)', poses(:,1), poses(:,2), poses(:,3), ...
    'VariableNames', {'Paso', 'x', 'y', 'theta_rad'});
disp(T);

```

Paso	x	y	theta_rad
1	0	-5	0
2	0	-5	1.0472
3	0.5	-4.134	1.0472
4	0.5	-4.134	2.0944
5	3.3307e-16	-3.2679	2.0944
6	3.3307e-16	-3.2679	3.1416
7	-1	-3.2679	3.1416
8	-1	-3.2679	4.1888
9	-1.5	-4.134	4.1888
10	-1.5	-4.134	5.236
11	-1	-5	5.236
12	-1	-5	6.2832

```

% ---- Punto b) Pose final ----
pose_final = poses(end, :); % Última fila

fprintf('\nPose final del robot tras 12 pasos:\n');

```

Pose final del robot tras 12 pasos:

```

fprintf('x = %.3f m\ny = %.3f m\ntheta = %.3f rad (%.2f°)\n', ...

```

```
pose_final(1), pose_final(2), pose_final(3), rad2deg(pose_final(3)));
```

```
x = -1.000 m  
y = -5.000 m  
theta = 6.283 rad (360.00°)
```

```
% ---- Punto 2 ----
```

```
clear; clc;
```

```
% Parámetros del robot
```

```
radio_rueda = 0.1; % Radio de rueda (m)  
L_eje = 0.4; % Distancia entre ruedas (m)  
dt2 = 1.0; % Paso de tiempo (s)
```

```
% Datos extraídos de la tabla
```

```
omegaR = [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];
```

```
omegaL = [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];
```

```
N2 = length(omegaR); % 21 pasos
```

```
% Inicialización
```

```
vr = zeros(1, N2); % Velocidad lineal  
wr = zeros(1, N2); % Velocidad angular  
xr = zeros(1, N2 + 1); % Posición x  
yr = zeros(1, N2 + 1); % Posición y  
thetar = zeros(1, N2 + 1); % Orientación
```

```
% Pose inicial
```

```
xr(1) = 0; yr(1) = 0; thetar(1) = 0;
```

```
% Cálculo paso a paso
```

```
for k = 1:N2  
    vr(k) = (radio_rueda / 2) * (omegaR(k) + omegaL(k));  
    wr(k) = (radio_rueda / L_eje) * (omegaR(k) - omegaL(k));
```

```
% Integración de la pose
```

```
thetar(k+1) = thetar(k) + wr(k) * dt2;  
xr(k+1) = xr(k) + vr(k) * cos(thetar(k+1)) * dt2;  
yr(k+1) = yr(k) + vr(k) * sin(thetar(k+1)) * dt2;
```

```
end
```

```
vr_ext = [vr, NaN];  
wr_ext = [wr, NaN];
```

```

omegaR_ext = [omegaR, NaN];
omegaL_ext = [omegaL, NaN];
xr_ext     = xr'; % ya tiene 22 elementos
yr_ext     = yr';
theta_ext  = rad2deg(thetar');

T2 = table((0:N2)', ...
    vr_ext', ...
    wr_ext', ...
    omegaR_ext', ...
    omegaL_ext', ...
    xr_ext, yr_ext, theta_ext, ...
    'VariableNames', {'t_s', 'v_mps', 'w_rps', 'omega_R', 'omega_L', 'x_m', 'y_m',
    'theta_deg'});

% Mostrar la tabla
disp(T2);

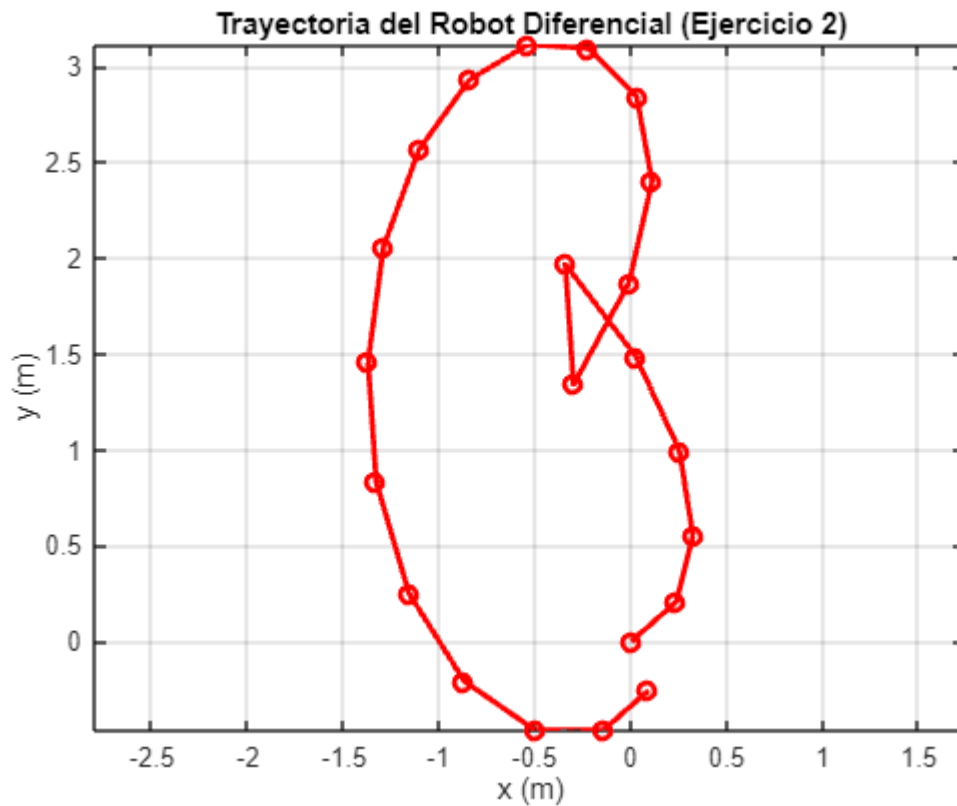
```

t_s	v_mps	w_rps	omega_R	omega_L	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

```

% Graficar trayectoria
figure;
plot(xr, yr, 'r-o', 'LineWidth', 2);
xlabel('x (m)');
ylabel('y (m)');
title('Trayectoria del Robot Diferencial (Ejercicio 2)');
grid on;
axis equal;

```



```
% ---- Punto 3 ----
% Punto 3 - Trayectoria circular
clear; clc;

% Parámetros del robot
r = 0.1;      % Radio de rueda (m)
L = 0.4;      % Distancia entre ruedas (m)
dt = 1.0;     % Paso de tiempo (s)
R = 20;       % Radio de la trayectoria deseada (m)
v = 1.0;      % Velocidad lineal del robot (m/s)

% Cálculo de w y velocidades angulares
w = v / R;
omegaR = (2*v + w*L) / (2*r);
omegaL = (2*v - w*L) / (2*r);

% Número de pasos de simulación
N = 126;

% Inicialización
xr = zeros(1, N+1);
yr = zeros(1, N+1);
thetar = zeros(1, N+1); % en radianes
vr = zeros(1, N);
wr = zeros(1, N);
```

```

omegaR_arr = omegaR * ones(1, N);
omegaL_arr = omegaL * ones(1, N);

% Simulación
for k = 1:N
    vr(k) = (r / 2) * (omegaR + omegaL);
    wr(k) = (r / L) * (omegaR - omegaL);

    thetar(k+1) = thetar(k) + wr(k)*dt;
    xr(k+1) = xr(k) + vr(k)*cos(thetar(k+1))*dt;
    yr(k+1) = yr(k) + vr(k)*sin(thetar(k+1))*dt;
end

% Tabla de datos
T3 = table((0:N-1)', vr', wr', ...
    omegaR_arr', omegaL_arr', ...
    xr(1:end-1)', yr(1:end-1)', rad2deg(thetar(1:end-1))', ...
    'VariableNames', {'t_s', 'v_mps', 'w_rps', ...
        'omega_R', 'omega_L', ...
        'x_m', 'y_m', 'theta_deg'});

disp(T3);

```

t_s	v_mps	w_rps	omega_R	omega_L	x_m	y_m	theta_deg
0	1	0.05	10.1	9.9	0	0	0
1	1	0.05	10.1	9.9	0.99875	0.049979	2.8648
2	1	0.05	10.1	9.9	1.9938	0.14981	5.7296
3	1	0.05	10.1	9.9	2.9825	0.29925	8.5944
4	1	0.05	10.1	9.9	3.9626	0.49792	11.459
5	1	0.05	10.1	9.9	4.9315	0.74532	14.324
6	1	0.05	10.1	9.9	5.8868	1.0408	17.189
7	1	0.05	10.1	9.9	6.8262	1.3837	20.054
8	1	0.05	10.1	9.9	7.7473	1.7732	22.918
9	1	0.05	10.1	9.9	8.6477	2.2081	25.783
10	1	0.05	10.1	9.9	9.5253	2.6876	28.648
11	1	0.05	10.1	9.9	10.378	3.2102	31.513
12	1	0.05	10.1	9.9	11.203	3.7749	34.377
13	1	0.05	10.1	9.9	11.999	4.3801	37.242
14	1	0.05	10.1	9.9	12.764	5.0243	40.107
15	1	0.05	10.1	9.9	13.496	5.7059	42.972
16	1	0.05	10.1	9.9	14.192	6.4233	45.837
17	1	0.05	10.1	9.9	14.852	7.1746	48.701
18	1	0.05	10.1	9.9	15.474	7.9579	51.566
19	1	0.05	10.1	9.9	16.056	8.7713	54.431
20	1	0.05	10.1	9.9	16.596	9.6128	57.296
21	1	0.05	10.1	9.9	17.094	10.48	60.161
22	1	0.05	10.1	9.9	17.547	11.371	63.025
23	1	0.05	10.1	9.9	17.956	12.284	65.89
24	1	0.05	10.1	9.9	18.318	13.216	68.755
25	1	0.05	10.1	9.9	18.633	14.165	71.62
26	1	0.05	10.1	9.9	18.901	15.129	74.485
27	1	0.05	10.1	9.9	19.12	16.104	77.349
28	1	0.05	10.1	9.9	19.29	17.09	80.214
29	1	0.05	10.1	9.9	19.41	18.083	83.079
30	1	0.05	10.1	9.9	19.481	19.08	85.944
31	1	0.05	10.1	9.9	19.502	20.08	88.808

32	1	0.05	10.1	9.9	19.473	21.079	91.673
33	1	0.05	10.1	9.9	19.394	22.076	94.538
34	1	0.05	10.1	9.9	19.265	23.068	97.403
35	1	0.05	10.1	9.9	19.086	24.052	100.27
36	1	0.05	10.1	9.9	18.859	25.026	103.13
37	1	0.05	10.1	9.9	18.584	25.987	106
38	1	0.05	10.1	9.9	18.26	26.933	108.86
39	1	0.05	10.1	9.9	17.89	27.862	111.73
40	1	0.05	10.1	9.9	17.474	28.772	114.59
41	1	0.05	10.1	9.9	17.013	29.659	117.46
42	1	0.05	10.1	9.9	16.508	30.522	120.32
43	1	0.05	10.1	9.9	15.961	31.359	123.19
44	1	0.05	10.1	9.9	15.372	32.168	126.05
45	1	0.05	10.1	9.9	14.744	32.946	128.92
46	1	0.05	10.1	9.9	14.078	33.691	131.78
47	1	0.05	10.1	9.9	13.375	34.403	134.65
48	1	0.05	10.1	9.9	12.638	35.078	137.51
49	1	0.05	10.1	9.9	11.868	35.716	140.37
50	1	0.05	10.1	9.9	11.066	36.315	143.24
51	1	0.05	10.1	9.9	10.236	36.872	146.1
52	1	0.05	10.1	9.9	9.3794	37.388	148.97
53	1	0.05	10.1	9.9	8.4979	37.86	151.83
54	1	0.05	10.1	9.9	7.5938	38.287	154.7
55	1	0.05	10.1	9.9	6.6695	38.669	157.56
56	1	0.05	10.1	9.9	5.7273	39.004	160.43
57	1	0.05	10.1	9.9	4.7695	39.291	163.29
58	1	0.05	10.1	9.9	3.7985	39.531	166.16
59	1	0.05	10.1	9.9	2.8168	39.721	169.02
60	1	0.05	10.1	9.9	1.8268	39.862	171.89
61	1	0.05	10.1	9.9	0.83101	39.954	174.75
62	1	0.05	10.1	9.9	-0.16813	39.995	177.62
63	1	0.05	10.1	9.9	-1.1681	39.987	180.48
64	1	0.05	10.1	9.9	-2.1664	39.928	183.35
65	1	0.05	10.1	9.9	-3.1605	39.82	186.21
66	1	0.05	10.1	9.9	-4.148	39.662	189.08
67	1	0.05	10.1	9.9	-5.1264	39.456	191.94
68	1	0.05	10.1	9.9	-6.0932	39.2	194.81
69	1	0.05	10.1	9.9	-7.046	38.896	197.67
70	1	0.05	10.1	9.9	-7.9824	38.546	200.54
71	1	0.05	10.1	9.9	-8.9002	38.149	203.4
72	1	0.05	10.1	9.9	-9.7969	37.706	206.26
73	1	0.05	10.1	9.9	-10.67	37.219	209.13
74	1	0.05	10.1	9.9	-11.519	36.689	211.99
75	1	0.05	10.1	9.9	-12.339	36.118	214.86
76	1	0.05	10.1	9.9	-13.13	35.506	217.72
77	1	0.05	10.1	9.9	-13.889	34.855	220.59
78	1	0.05	10.1	9.9	-14.615	34.168	223.45
79	1	0.05	10.1	9.9	-15.306	33.444	226.32
80	1	0.05	10.1	9.9	-15.96	32.688	229.18
81	1	0.05	10.1	9.9	-16.575	31.899	232.05
82	1	0.05	10.1	9.9	-17.15	31.081	234.91
83	1	0.05	10.1	9.9	-17.683	30.235	237.78
84	1	0.05	10.1	9.9	-18.173	29.363	240.64
85	1	0.05	10.1	9.9	-18.619	28.468	243.51
86	1	0.05	10.1	9.9	-19.02	27.552	246.37
87	1	0.05	10.1	9.9	-19.374	26.617	249.24
88	1	0.05	10.1	9.9	-19.682	25.665	252.1
89	1	0.05	10.1	9.9	-19.941	24.7	254.97
90	1	0.05	10.1	9.9	-20.152	23.722	257.83
91	1	0.05	10.1	9.9	-20.314	22.735	260.7
92	1	0.05	10.1	9.9	-20.426	21.742	263.56
93	1	0.05	10.1	9.9	-20.488	20.744	266.43
94	1	0.05	10.1	9.9	-20.5	19.744	269.29
95	1	0.05	10.1	9.9	-20.463	18.744	272.15

96	1	0.05	10.1	9.9	-20.375	17.748	275.02
97	1	0.05	10.1	9.9	-20.238	16.758	277.88
98	1	0.05	10.1	9.9	-20.052	15.775	280.75
99	1	0.05	10.1	9.9	-19.816	14.803	283.61
100	1	0.05	10.1	9.9	-19.533	13.844	286.48
101	1	0.05	10.1	9.9	-19.201	12.901	289.34
102	1	0.05	10.1	9.9	-18.823	11.975	292.21
103	1	0.05	10.1	9.9	-18.4	11.069	295.07
104	1	0.05	10.1	9.9	-17.931	10.186	297.94
105	1	0.05	10.1	9.9	-17.419	9.3268	300.8
106	1	0.05	10.1	9.9	-16.865	8.4945	303.67
107	1	0.05	10.1	9.9	-16.269	7.691	306.53
108	1	0.05	10.1	9.9	-15.635	6.9182	309.4
109	1	0.05	10.1	9.9	-14.962	6.1782	312.26
110	1	0.05	10.1	9.9	-14.254	5.4726	315.13
111	1	0.05	10.1	9.9	-13.51	4.8034	317.99
112	1	0.05	10.1	9.9	-12.735	4.1721	320.86
113	1	0.05	10.1	9.9	-11.929	3.5804	323.72
114	1	0.05	10.1	9.9	-11.094	3.0297	326.59
115	1	0.05	10.1	9.9	-10.233	2.5214	329.45
116	1	0.05	10.1	9.9	-9.3473	2.0568	332.32
117	1	0.05	10.1	9.9	-8.4397	1.6371	335.18
118	1	0.05	10.1	9.9	-7.5122	1.2632	338.05
119	1	0.05	10.1	9.9	-6.5672	0.93614	340.91
120	1	0.05	10.1	9.9	-5.6071	0.65672	343.77
121	1	0.05	10.1	9.9	-4.6341	0.42564	346.64
122	1	0.05	10.1	9.9	-3.6509	0.24348	349.5
123	1	0.05	10.1	9.9	-2.6597	0.11069	352.37
124	1	0.05	10.1	9.9	-1.6632	0.027599	355.23
125	1	0.05	10.1	9.9	-0.66372	-0.0055803	358.1

```

% Gráfica de trayectoria
figure;
plot(xr, yr, 'b-o', 'LineWidth', 2);
xlabel('x (m)');
ylabel('y (m)');
title('Trayectoria Circular del Robot Diferencial (Radio = 20 m)');
grid on;
axis equal;

```

