R101/R102 演習 4-1

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知的システム工学科システム制御コース

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1　回転速度の計算

演習 3-1 で導出した $\dot{\phi_R}$, $\dot{\phi_L}$ の式を次に示す。

$$\dot{\phi_R} = \frac{2v + dw}{2r} \tag{1.1}$$

$$\dot{\phi_L} = \frac{2v - dw}{2r} \tag{1.2}$$

ここで v, w は半径 R, 周期 T より、

$$v = \frac{2\pi}{T} \times R \tag{1.3}$$

$$w = \frac{2\pi}{T} \tag{1.4}$$

演習の説明文より、$R = 1.0$, $T = 10.0$ であるから、それぞれ値を代入して計算すると、

$$\dot{\phi_R} = \frac{2 \times (\frac{\pi}{5}) + d \times (\frac{\pi}{5})}{0.05} \tag{1.5}$$

$$\dot{\phi_L} = \frac{2 \times (\frac{\pi}{5}) - d \times (\frac{\pi}{5})}{0.05} \tag{1.6}$$

したがって、$\dot{\phi_R} = 11.13$, $\dot{\phi_L} = 14.00$ である。

2　回転のシミュレーション

2.1　ソースコード

2.1.1　パラメータ

Listing 2.1: mobile __ robot __ params.m

```
1
2 % mobile_robot_params.m
3 % Configuration parameters for mobile robot simulation
4
5 % Robot physical parameters - fixed, not intended to be changed
6 params.wheel_radius = 0.05;  % radius of wheel [m]
```

```
params.wheel_distance = 0.23;  % distance between wheels [m]
params.body_length = 0.3;     % length of robot body [m]
params.body_width = 0.3;      % width of robot body [m]

% Simulation parameters
params.sim_time = 40;         % simulation time [s]
params.ode_max_step = 1e-1;  % maximum step size for ODE solver

% Animation parameters
params.draw_mode = 1;         % 0: update existing plot, 1: create new plot
    ↪ each frame
params.ani_sample = 100;      % animation sampling rate (higher = slower
    ↪ animation)
params.field_size = 3;        % size of the field for visualization [m]

% Motion parameters - different exercises
% Exercise 1: Constant wheel velocities
ex1.left_wheel_vel = 1.0;   % left wheel angular velocity [rad/s]
ex1.right_wheel_vel = 1.0;  % right wheel angular velocity [rad/s]

% Exercise 2: Circular motion
ex2.period = 10;            % period [s]
ex2.radius = 1.0;           % radius of rotation [m]

% Exercise 3: Figure-8 motion
ex3.period = 20;            % period for half of figure-8 [s]
ex3.radius = 1.0;           % radius of rotation [m]

% Exercise 4: Square path
ex4.period = 10;            % period for each segment [s]
ex4.side_length = 2.0;      % length of one side of square [m]

% Motion type selection (1, 2, 3, or 4)
% Change this value to select different motion types:
% 1: Constant Wheel Velocities
% 2: Circular Motion
% 3: Figure-8 Motion
% 4: Square Path
params.motion_type = 2;

% Combine all exercise parameters
params.ex1 = ex1;
params.ex2 = ex2;
params.ex3 = ex3;
params.ex4 = ex4;
```

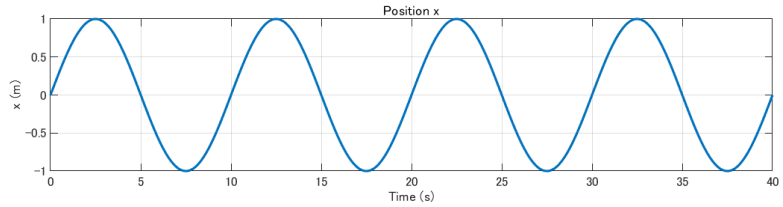
2.1.2 シミュレーション

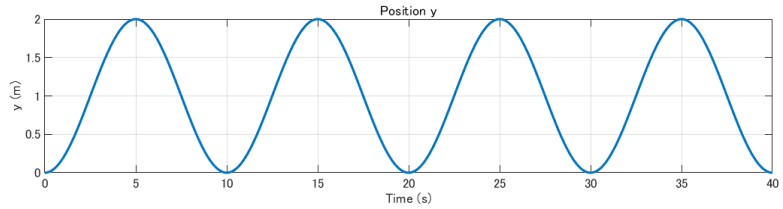
Listing 2.2: exe__mobile__robot__sim.m

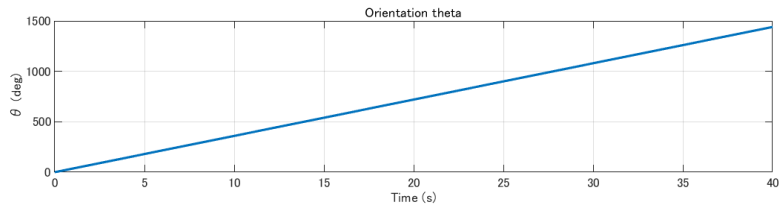
```
1
2  % exe_mobile_robot_sim.m
3  % Main simulation file for mobile robot using RobotDataCollector
4
5  clear;
6  close all;
7
8  % Load parameters
9  mobile_robot_params;
10
11 % Initial state [x, y, theta]
12 initial_state = [0.0; 0.0; 0.0];
13
14 % Configure ODE options
15 opts = odeset('MaxStep', params.ode_max_step, 'RelTol', 1e-4, 'AbsTol', 1e
       ↪ -6);
16
17 % Display selected motion type
18 motion_types = {'Constant Wheel Velocities', 'Circular Motion', ...
19                 'Figure-8 Motion', 'Square Path'};
20 fprintf('Running simulation with motion type %d: %s\n', params.motion_type,
       ↪ motion_types{params.motion_type});
21
22 % Run simulation
23 tic;
24 [t, x] = ode45(@(t, x) dynamics_mobile_robot(t, x, params), [0 params.
       ↪ sim_time], initial_state, opts);
25 sim_time = toc;
26 fprintf('Simulation completed in %.2f seconds\n', sim_time);
27
28 % Process results using RobotDataCollector
29 collector = RobotDataCollector();
30 collector.process(t, x, params);
31
32 % Save results
33 collector.save('robot_simulation_result.mat');
34
35 % Make sure we don't have old animation windows lingering
36 close(findobj('Type', 'figure', 'Name', 'Mobile Robot Animation'));
37
38 % Plot basic trajectories
39 collector.plotBasicTrajectories();
40
```

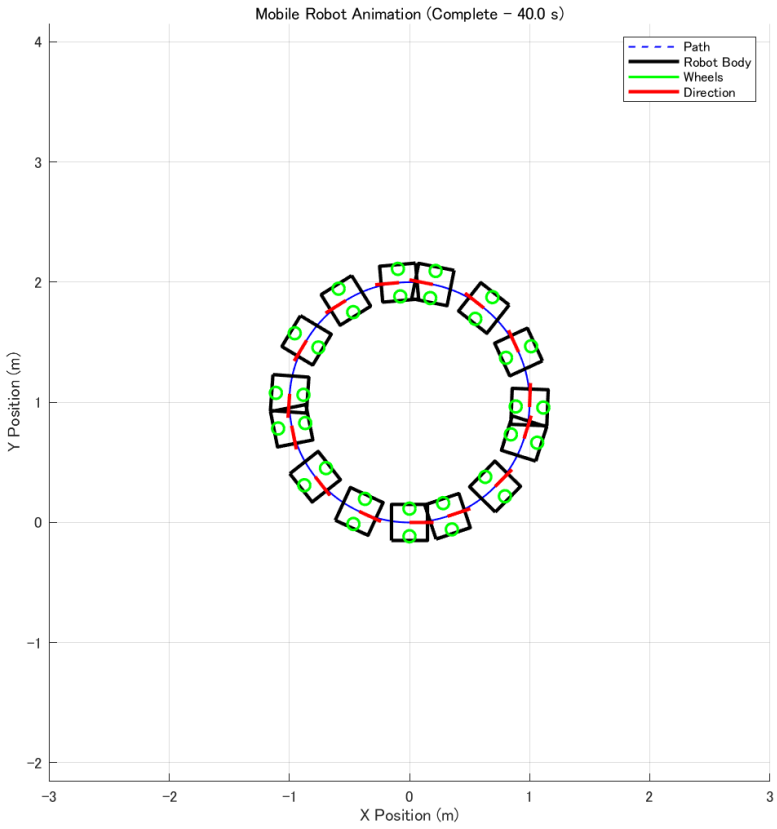
```
% Optional: Plot detailed analysis
% collector.plotDetailedAnalysis();

% Run animation using the new integrated method
collector.animateRobot();
```

3　シミュレーション結果









4　参考文献

[1] テキスト（第 4 章まで）