

Exercise 2 *Motion of Differential-Drive and Omni-Drive Robot*

2.1 Kinematic Model of Differential-Drive Robot / Omni-Drive Robot

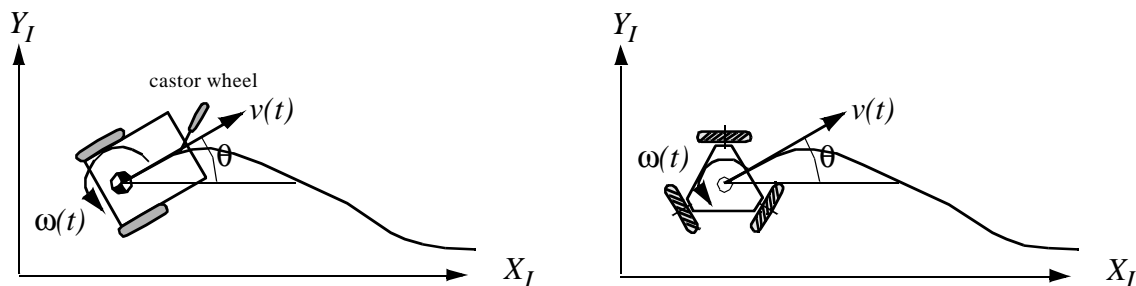


Fig 2.1 Typical configuration of a differential-drive and omni-drive robot

A differential drive robot is moving in the plane by controlling the rotational speed of the two fixed standard wheels. The wheel diameter is given by r and the distance between the origin of the robot and the wheels is l . The center of rotation of the castor wheel is at a distance l_c with an offset d of the wheel contact point and a wheel of the diameter r_c . The wheels of the omni-drive are arranged symmetrically. The small wheels of the omni-drive are arranged at 90° .

1. Establish the kinematics of the two robots: $\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix}^T = f(\phi_1, \phi_2, l, r, l_c, d, r_c \dots)$

2.1.1 Odometry of differential drive robot

1. Starting from the equation developed in 1.1 for the differential drive robot, find the relation between the movement of the wheels (ϕ_1, ϕ_2) and the development of the position (x, y) and orientation θ of the robots in the plane.
2. What is the influence of the sampling time Δt on the precision of the position 'estimate'?
How are the speeds of the two wheels (ϕ_1, ϕ_2) related with the rotation ω and heading speed v of the robot?

2.2 Preparation for the experiment on the Khepera robot

Two experiments on motion control will be done on the Khepera during the next exercise. First you have to test your odometry model running an open-loop motion controller (line and circle segments) and verify if the position is estimated correctly. Second, the feed-back controller presented in the course will be used for more precise motion. The controller will be implemented in Matlab with a fixed sampling time Δt .

From Matlab you will have direct access to the Khepera to read the encoder values and set the wheel speeds.

1. Establish a way to generate the line and circle segments of a trajectory
2. Set up all the required relations for feedback control of the Khepera robot.
3. How will you implement it in Matlab?

