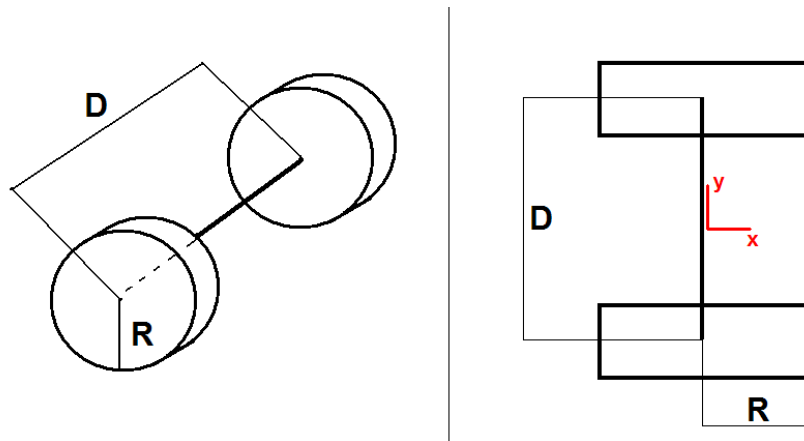


Assignment 5

Introduction to Robotics
Instructor: Michael Wolf & Jeremy Ma

SHOW YOUR WORK.

Odometry: Estimating the position of a robot by counting wheel rotations or “encoder ticks” is a method of position estimation known as “odometry”. Here, we’ll investigate some of the principals that go into this approach. Consider a robot that looks like the following diagram:



The left view is an isometric view and the right view is an overhead view of the same robot. The origin of the robot is indicated by the crosshair (midway between the two wheels, and slightly above the ground).

1. **Forward Motion:** Recall that “forward motion” was the part odometry that determines where a robot ends up after executing a certain set of known commands. Consider the robot in the above diagram. Let $D = 10\text{cm}$, $R = 5\text{cm}$. Answer the following questions:

***Note:** Be sure to convert your degrees to radians when using the equations derived in class.

- If both the right and left wheels were commanded to rotate 267° , how far forward would the robot have traveled (in cm) ?
- For a robot making a left turn, where does it end up if it only commands the right wheel to turn 54° ?

2. **Inverse Motion:** Recall that “inverse motion” was the part of odometry that determines what signals need to be sent to the wheels/motors in order to get the robot to a desired state. Consider the robot in the above diagram. Let $D = 10\text{cm}$, $R = 5\text{cm}$. Answer the following questions

***Note:** Be sure to convert your degrees to radians when using the equations in class.

- If I wanted to move the robot origin forward by 100cm , by how many degrees should I rotate each wheel by?
- If I wanted the robot to make a 90° **left** turn by doing a “pivot” - type turn (i.e. only moving the right wheel), how many degrees should the right wheel turn by?
- If I wanted the robot to make a 90° **right** turn by doing a “pivot” - type turn (i.e. only moving the left wheel), how many degrees should the left wheel turn by?
- Repeat questions (b) and (c) but this time for an “in-place” type turn.