1. Introduction

The goal of this assignment is to design and implement a robot moving using the differential drive. The purpose of this practical is to compare and contrast different distance measurements as well as different Dynamic Potential Fields techniques capable of overcoming the Local Minimum Problem.

1. Overview.

The robot exists in a two-dimensional space and has sensors in its front part. The length and the amount of sensors are specified by the user or given arbitrarily by the program at the beginning of the execution. The size of the robot can also be chosen or given randomly.

The robot uses the potential field provided by the specification, where the goal power is quadratic (i. e. the goal power grows drastically as the robot gets near it or gets very small when the distance between the robot and the goal increases). The supplied User Graphical Interface has been used in this practical.

1. Part 1.

The provided robot has been used as a prototype. Since a lot of useful methods have already been provided, it seemed easier to create a new robot as a subclass of the existing PotentialFieldsRobot. The new Robot, CarriageRobot, uses the superclass in a lot of situations, but has overridden and its own methods.

Since the implementation has clearly failed, this report will mostly discuss the ideas behind the new robot.

Differential drive is implemented through the speed difference of the two wheels of the robot. When both of the wheels rotate in the same direction with the same speed the robot moves forward on a straight line. If, for example, the left wheel rotates slower than the right one, then the robot turns left. In this practical the situation where wheels would rotate in different directions (which would allow the robot to turn around its centre) or one wheel would not rotate at all (which would allow the robot to turn around the static wheel) are not discussed.

One of the approaches that could work in the Free Space is to move the robot around the smallest possible circle until the robot faces the goal, and then moving it straight at the goal. That would seem most cost-efficient since the road to the goal would be almost straight. However, this might lead to the local minima problem in case where the Instantaneous Centre of Curvature for the maximum rotation rate coincides with the goal. Overall, this seems like a good approach to begin with.

Another approach is described in “Computational Principles of Mobile Robotics” by Dudek and Jenkin. The kinematics of the differential drive is described as follows: the rotation rate of both wheels will be the same, and this gives us enough information to find the Instantaneous Centre of the Curvature.

w(R + l/2)=Vr

w(R – l/2) = Vl

Hence R = l/2 \* (Vr + Vl)/(Vr - Vl)

And w = (Vr - Vl)/l.

Therefore, when given the current position of the robot and its heading, it is possible to calculate the Instantaneous Curvature Centre, which will have coordinates [x – R\*sin(heading); y + R\*cos(heading)].

This means that after time t + at, the position of the robot will be

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