CSE 483: Mobile Robotics - Assignment 05

Due: **14th November 2016**, 2300 hrs

November 2, 2016

General Instructions

1. **Form teams of 2 people for this assignment.** In this assignment, you would immensely benefit from collaborations. Working alone is *discouraged.*
2. The assignments are to be done in MATLAB. For this assignment, the code provided does not use any specialized toolbox, so Octave should not be a problem. However, no guarantees are made on this front, and the evaluation shall be carried out on MATLAB R2015a.
3. Plagiarism is strictly prohibited.
4. Ensure that the plots included in the report are reproducible from the code that you submit.

Non-holonomic Trajectory Planning Using the Bernstein Basis Functions

This project involves writing code to generate a kinematically feasible trajectory for a differential drive robot in an obstacle-free environment. We will use the Bernstein basis method to plan smooth trajectories. As discussed in class, we shall adopt a 5th order Beizier curve to parameterize the trajectory.

Specifically, following the exposition in the two lectures on this method, formulate a linear system $Ax = b$ while imposing appropriate position, velocity, and intermediate-point constraints.

The implementation has to be validated in the following scenarios.

- Under-constrained
- Exactly-constrained
- Over-constrained

Problem setting

Consider a robot starting at $(x(t_0), y(t_0)) = (10, 10)$ and with a goal location $(x(t_f), y(t_f)) = (50, 50)$. Also, consider the velocity constraints $\dot{x}(t_0) = 0$, $\dot{y}(t_0) = 0$, $\dot{x}(t_f) = 0$, and $\dot{y}(t_f) = 0$. Further, let $t_0 = 0$, $t_f = 10$, and $t_c = 5$, and $(x(t_c), y(t_c)) = (25, 25)$. For constraints on $K = tan\theta$, consider $K(t_0) = 0, K(t_f) = 0, \dot{K}(t_0) = 1, \dot{K}(t_f) = 1$.

Required analysis

Construct under-constrained, exactly constrained, and over-constrained linear systems using the above data and plot the obtained trajectories. For convenience in plotting, sample from t_0 to t_f in increments of 0.1.

Also, note that you have been provided with a function that computes various integrals involved in the expression for y, i.e., we give the expressions for $F_0, F_1, .., F_5$ in the equation $y = W_0F_0 + .. + W_5F_5$. This is done via the function `get_coeff.m` provided along with the assignment.

For each case, generate the following plots:

- x vs t
- y vs t
- θ vs t
- $\dot{x}$ vs t
- $\dot{y}$ vs t
- y vs x (the planned trajectory)

Deliverables

1. A zipped (`.zip`) folder (try not to use any other format such as `.bz2`, `.tar.gz`, etc.) whose name is composed of the ID numbers of the two team members, separated by an underscore, eg. `201507666_201507555.zip`. The folder should have a `report.pdf` file which contains the other deliverables for the assignment.
2. Additionally the code written for the assignment should be enclosed in the zip file.