ENSC-887: Computational Robotics
Assignment 2: Basic Motion Planning Approaches

Due March 5, 2012

1. `This exercise will help you clearly understand the considered approaches.`

   For path planning of a planar polygonal robot (translation only) amidst planar polygonal obstacles, clearly illustrate (using an example of your own with a robot and couple of obstacles) (i) a roadmap based approach, and (ii) an exact cell decomposition based approach. Make sure you draw figures where needed to illustrate your approach. What is the complexity of each approach in terms of the problem size. Your answer should include pseudo-code for your algorithms. You may assume sub-routines for algorithms discussed in class, such as visibility graph, rectangular decomposition, Dijkstra's or A* shortest path search are available. But clearly mention the input/output of these algorithms.

2. `This exercise will help you understand the Cspace potential.`

   Consider the same planar rod robot $\mathcal{A}$ and the polygonal obstacle $\mathcal{B}$ as in Assignment 1, Problem 6. Define a goal configuration of your choice for the robot. Using work space potentials (define them clearly), and two control points (the endpoints of the rod), write the exact expression for the C-space potential. At a configuration of your choice, determine the C-space potential value. Using a grid of reasonable resolution for the C-space, determine the potential value at a neighboring configuration as well. Outline a search algorithm that searches the C-space (based on C-space potential) to reach the goal.

`Part II: Programming Assignment`

Due March 12, 2012

1. `This exercise will give you some perspective on implementing motion planners albeit simple ones.`

   Using your program in Assignment 1, Part II, Problem 1, implement a motion planner for a convex polygonal mobile robot (pure translation) among known polygonal obstacles. Show an example of a path (in C-space and in workspace) constructed by your planner for a typical scene. You may use any algorithm within the the three paradigms

that we discussed in class: roadmap based, cell decomposition (exact or approximate) based, and potential field based. Comment on the complexity and completeness of your planner. Feel free to discuss with me should you have questions.