Mestrado em Engenharia Electrotécnica e de Computadores

ROBÓTICA MÓVEL
Ano Lectivo 2004/2005

Homework 3

Handed-in: 3/6/2005 Due: 24/6/2005

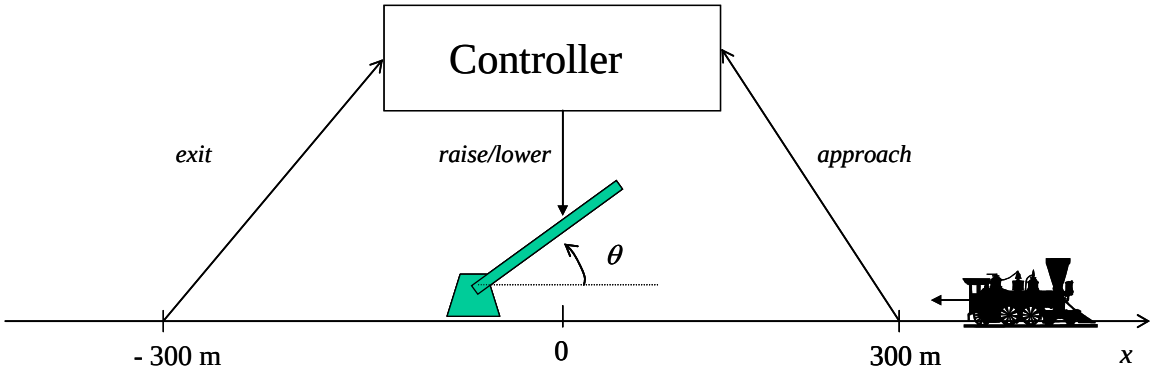
1. Explain why 2 *beacons* are **not** enough to determine, by *trilateration*, the 2D-position coordinates of a mobile robot moving on a flat surface. Following the same line of reasoning, how many *beacons* would be required to determine the 3D-position coordinates of an underwater (or aerial) robot. What if, in the latter case, the required number of *beacons* must be located on a plane (e.g., at the bottom of the sea), a very practical occurrence?
2. Describe, in words, including the algorithm steps, the *Markov Localization* method.
3. Write the *differential kinematics* for the following types of vehicles:
    - Differential-drive
    - Tricycle-like

providing intuition for its physical meaning.

4. Summarize the following approaches to mobile robot *guidance*:
    - Posture stabilization;
    - Path following;
    - Trajectory following;

comparing them regarding the need for a pre-planned path/trajectory and obstacle avoidance issues.

5. Summarize the STRIPS (STanford Research Institute Planning *System*) task planning method, underlining:
    - the world modeling methodology;
    - the planning algorithm.
6. Explain, including the corresponding equations, the reinforcement learning algorithm known as *Q-learning*.
7. Draw an Interpreted Petri net to model the *train-gate* problem described in the figure below. Split your overall Petri net model into 3 sub-models: *train*, *gate* and *controller*.



• train moves backward (i.e., along the negative *x*-axis), with speed $|\dot{x}| = 15 m/s$
• slows down to $|\dot{x}| = 8 m/s$ for distances between 300 m and -300 m
• when the train moves past –300m, it is assumed that a new train enters on the right side of the picture (i.e, close to 300m)
• the controller receives *exit/approach* signals from sensors located at the points on the train line depicted in the figure
• the controller can issue *raise/lower* commands to the gate, as depicted in the figure
• the gate opens and closes at a speed of 9 º/s