cmput412 Robotics Exam 1

Feb 26 2013

Last Name:
First Name
Student ID:

Instructions: Read all questions first. You can write on the back side of sheets if needed, but space provided is a hint of the expected length of the answer. Short and concise answers are preferred. **Allowed:** 2 single sided letter size sheets with your own notes, calculator.

I. Basic Concepts (2% each, 12% total)

a. What robot types are there? Motivate why this categorization is good Give examples of robots and their properties from each category.

b. What is the difference between a holonomic and non-holonomic robot. Draw/illustrate examples of each kind.

c. Why is a kinematic model not enough to accurately position a mobile robot?

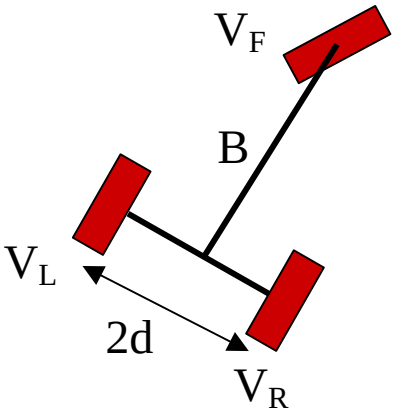
d. Give 2 examples of useful sensors. Explain how they work (physical principle). Give an example what they can be used for on a robot.

e. Describe, draw and give some properties of:
   - Serial revolute arm (e.g. PUMA/WAM)
   - SCARA
   - Cartesian robot

f. Define robot positioning accuracy, repeatability and resolution. Which measurement matters for
   - Control based on kinematic model?
   - Visual servoing?

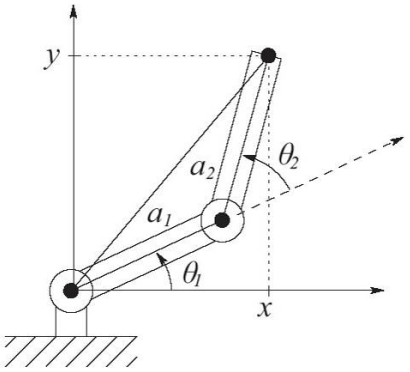
II. Mobile Robot Kinematics (6%)

Define kinematics of a tricycle robot (se fig) given the velocity V_F and steering angle a. Distances 2D and B are known. Where is ICC? How fast is the robot rotating around it? What are V_L and V_R ?



III. Forward and Inverse Kinematics of serial link robots: (6%)

a. Derive the forward kinematics for the planar 2 link arm in the image. Use homogenous transforms. Define the workspace given the two link lengths a1 and a2.



b. When solving the inverse Kinematics for the planar 2 link arm in the above image, explain under which conditions you can find: one solution, two solutions, no solutions, or infinite solutions.

c. Explain the steps in using Newtons's numerical method for solving inverse kinematics. Discuss how to deal with convergence and singularities