AEEM 6117: Intelligent Robotics

Course Project Option #2

A Real-World Problem:

When two (or more) persons carry a large piece of furniture through a narrow door, they will have to come up with a good strategy to smartly maneuver the furniture in all the 6 degrees of freedom such that it can pass through the door. Understandably, the success and efficiency of the job mainly depends on (1) how much experience the two people have and (2) how well the two people collaborate with each other. What if two robots do the job? How do we control the robots to successfully accomplish the job? The truth is that no robots in the world today are smart enough to accomplish such a challenging job like humans. This has motivated many researchers across the world to do research in intelligent robotics and hopefully future robots will be able to do such jobs like humans do. Our project is to solve a similar but, of course, much simplified problem as defined in the next section.

Fig.1 A real world problem inspiring the project

Problem Definition:

Our problem is limited to a 2D space (3 degrees of freedom). Consider a room with an opening of width w and depth d, and a rod of length l, shown in Fig.2. Two robots, one at end A and the other at end B, intend to move the rod from its initial location inside the room to outside through the opening. The goal of this project is to train the two robots so that they can collaboratively carry the rod through the opening to the outside room. The key for collaboration is that each robot does not know how its partner robot moves but they have to manage themselves to maintain the distance as they are fixed on each side of the rod. The center position is defined as the rod position and the angle of the rod with respect to the horizontal line is defined as the rod orientation.

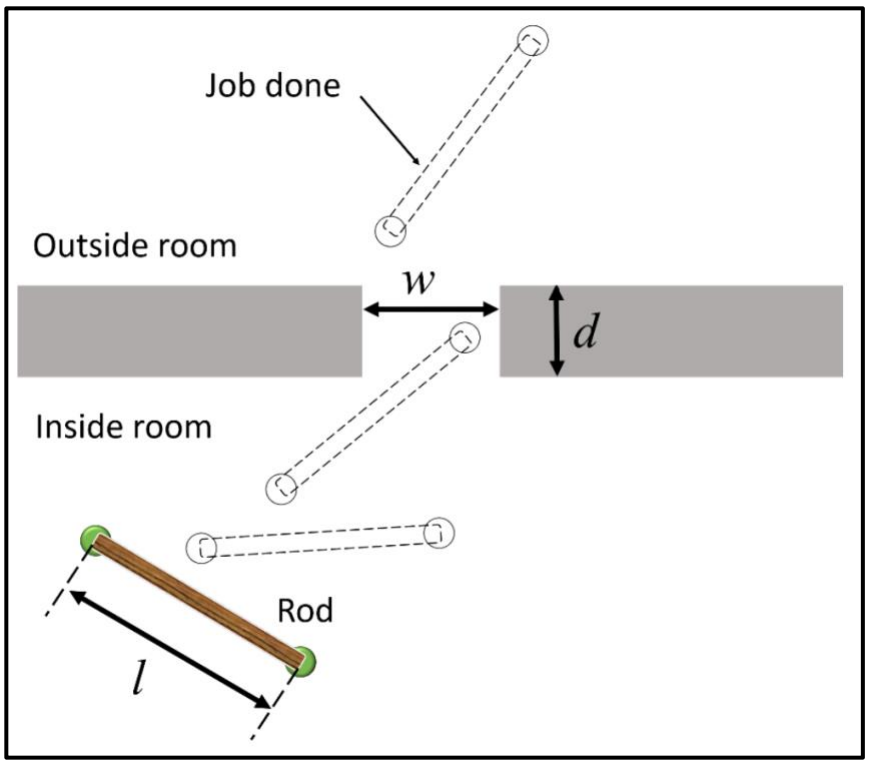

Fig. 2 Illustration of the problem to be solved by the system

3. Requirements:
Consider the following parameter values:

(a) Initial state of the rod can have an arbitrary position and orientation inside the room.
(b) The width and depth of the opening and the length of the rod are given. The length of the rod is 2.5 times the width of the opening.
(c) The two robots are independent which means you do not have a central controller to coordinate the movement of the two robots.
(d) The distance between the two robots should be l at all the time.
(e) The success criterion of the robotic task is that both ends of the rod are out of the opening.

4. Project Objectives:
(a) Model the kinematic system based on the given geometry and constraints.
(b) Design and implement a traditional control system (kinematics control) for the robots to accomplish the task in the sense that sum of the total travel distances of the two robots is minimum.
(c) Design and implement an intelligent control system for the robots to accomplish the task. The control strategy must have learning (training) capability.
(d) Use computer simulation to demonstrate the performance of the trained systems in comparison to the kinematics control case.