Introduction to Robotics

Lab - 2 : Configuration Space*

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Consider a robot arm with a fixed base and two rigid links. The length of the links are represented by a length vector $l = [l_1;\ l_2]$ where l_1 and l_2 are lengths of each link. The links are connected by two rotational joints one at the base and one between the links and the configuration of the robot is described via an angle vector $\theta = [\theta_1;\ \theta_2]$ where θ_1 and θ_2 are angles between the first link and $x-$axis and between first and the second link as shown in Figure 1. For this robot

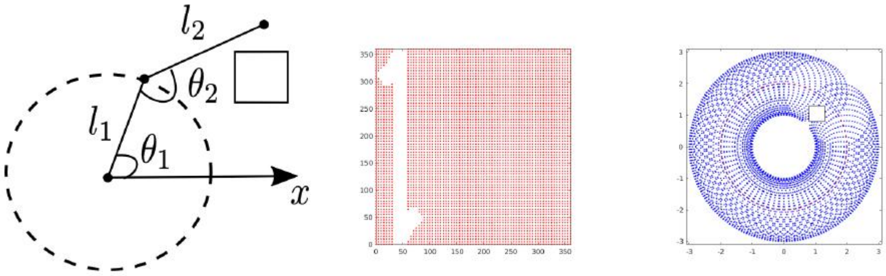

Figure 1: Example of robot arm, configuration space and work space.

1. Write a Matlab function `parameter2pose.m` which takes length and angle vectors of the robot as inputs and outputs the position of the end effector.

2. Write a Matlab function `pose2parameter.m` which takes the length vector and position of the end-effector as inputs and outputs the angle vector.

3. Write a Matlab script to plot the workspace and configuration space of the robot with a give obstacle (a rectangular box) in the work space. Consider the following steps:

   (a) Take a dense sampling of angles θ_1 and θ_2 to define the configuration space.

   (b) For each point in this dense sampling:

      i. Check if the links collide with the obstacle, i.e. check if the line segments representing the links intersect with the boundary of the rectangular box.

      ii. If there is no collision than the point is a valid point in the configuration space.

      iii. Plot the point using the plot function for configuration space.

      iv. Plot the position of the end-effector for the work space.

*Refer to Chapter 2 of book on Robotics, Motion and Control by Peter Corke for definitions and representative examples.