Manipulation with industrial robot

Preliminary assignment instructions

ELEC-C1310 - Automaatio- ja systeemitekniikan laboratoriotyöt

11.01.2019–26.05.2019

General information

Overview The purpose of this assignment is to give you hands-on practice on the coordinate systems and kinematics in robotics, such as learned in course ELEC-C1320 Robotics. The knowledge of kinematics and coordinate systems is essential in all robotics applications. The actual task will be a simple pick-and-place, *i.e.,* you will pick up objects with the robot and move them to another position. Different scenarios will be proposed during the experiment.

The robot The robot that you will perform the experiments with is the *Franka Emika Panda* robotic arm (shown in Figure 1).

Figure 1: Franka Emika Panda robotic arm

The Panda offers a graphical UI called *Desk*: an intuitive interface that runs on all web browsers and does not require software installation. In Desk you can easily

program a task by arranging available action blocks. Then, simply press “Run” and Panda carries out the task.

In this lab, you will use Desk and the action blocks available in it to carry out a few experiments that will help you understanding some basic robotic concepts.

The experiments

During this lab you will perform a series of task using the graphical interface of the Panda robot.

Task 1 In the first task you are asked to use the robot to move six wooden cubes from their initial configuration (a line) to a pyramid configuration as visualized in Figure 2. You can manually move the head of the robot in order to find the relative position of the cubes from the robot and then propose a sequence of action blocks that will enable the robot to move each cube from one position to another.

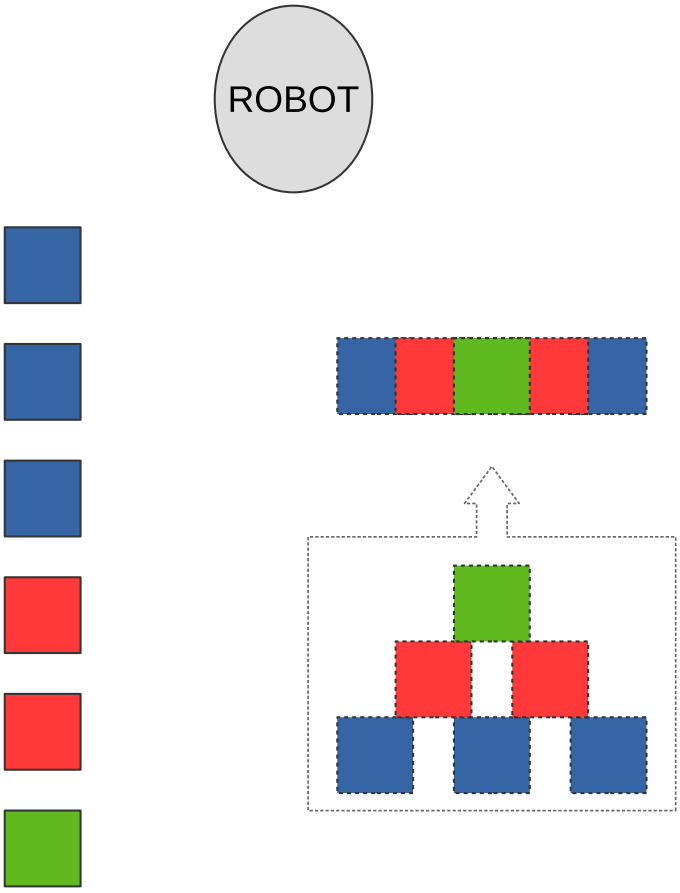

Figure 2: The setup for Task 1 and Task 2

Task 2 In the second task you will perform again the first task, but this time the robot should be allowed to move until it makes contact with the table or the previous row of cubes while building the pyramid. This will make you familiarize with the contact detection and force capabilities of the robot.

Task 3 In the third task the robot will be setup with a circular peg held in the gripper and a hole of the size of the peg will be located on the table as visualized in Figure 3. The robot should be programmed to find the hole without directly inputting the position of the hole.

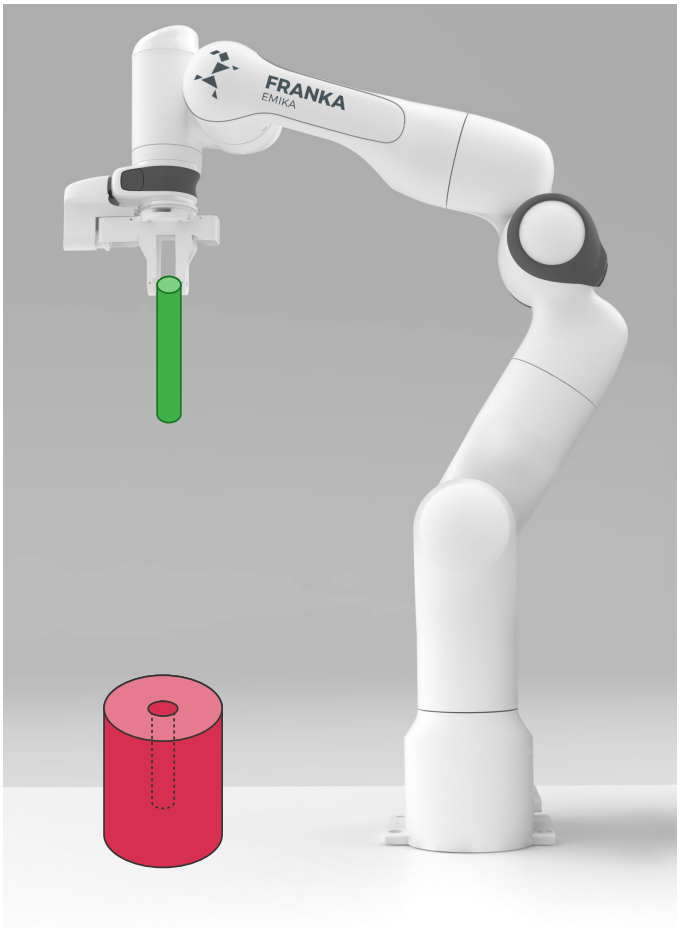

Figure 3: The setup for Task 3

Pre-hearing assignments

Before coming to your lab appointment, your group should have completed the following assignments:

1. Each group member should have read though the documentation included; more precisely:

   `panda_doc_extract.pdf` containing information about how to operate the robot.

   `panda_doc_apps.pdf` containing detailed information over the action blocks in the graphical interface for commanding the robot.

   At the beginning of the lab session the instructor will question you about the meaning of a few action blocks.

2. You should write down a tentative solution to the three tasks that will compose the experiment by using the action blocks described in `panda_doc_apps.pdf`. Before each of the tasks, you will need to explain to the instructor the solution you propose. Then, after their feedback, you should try to verify the proposed solution on the real robot, and eventually refine it if necessary.