Assignment 1: Trajectory generation for Pick and Place tasks

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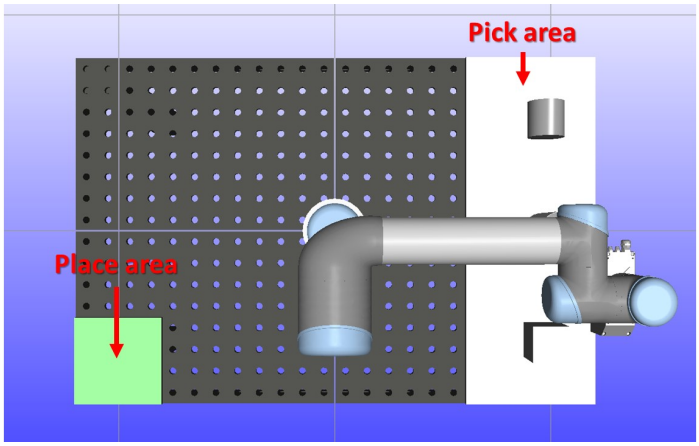


Figure 1 Pick and place locations.

1 Introduction

Pick and Place tasks are one of the most frequent tasks executed by robots. In general production the Pick and Place locations are well known in advance and do not change, meaning, the parts are placed in specialized holders, preventing them from changing their pose although a perturbance can occur. In the majority of the cases, the part fixtures add additional complexity which increases the cost of the application. In recent years with the emergence of sophisticated pose estimation algorithms, there is a strive to adapt vision-based localization solutions in order to overcome the limitations and make the application more flexible.

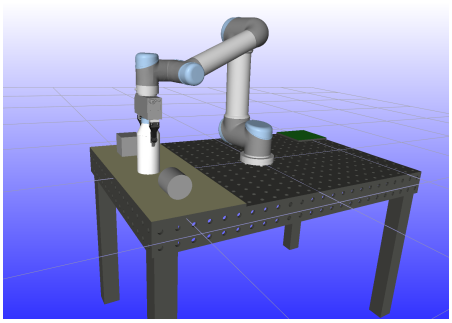
2 Preparation of the worcell

2.1 Workcell setup

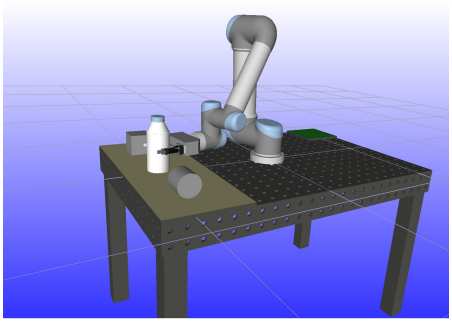
In order to start the simulation, you first have to setup the work environment. All of the needed models for this step are provided in the zip file, which can be downloaded from itslearning. In the zip file you will find a folder called `scene`, containing the cell definition and some additional folders with the robot, gripper, table and object representations. The requirements of this section are:

- Add the base mount of the robot to the scene (the robot should be placed in the middle of the table),
- add the robot and attach the gripper to the Tcp frame of the robot, so it will be included in the kinematic chain,
- define the robot Home pos,
- add the test objects to the predefined pick area (Fig. 1) in the scene.

After fulfilling all of the requirements, the scene is ready for the next step.



(a) Grasp from the top



(b) Grasp from the side

Figure 2 Grasp configurations

2.2 Robot trajectory generation

In order to execute the pick and place action, you are asked to calculate the robot trajectories for this specific task. To do so use / implement the following:

- Define the relevant configurations to fulfill the task (5 configurations minimum).
- Trajectories should be generated in joint space.
- Point to Point interpolator.
- Point to Point interpolator with parabolic blend (where it makes sense).

Implement the two approaches and test their performance with at least 2 different pick configurations of the object in the scene (see fig. 2). The place location can be the same for all approaches. The implementation should be done with the help of RobWorks, introduced during the programming exercises.

3 Report structure

The content of the report should be **MAX** 5 pages long - excluding the front page and references if applicable. The report shell have the following sections:

3.1 Introduction

1/5 page MAX
A short introduction to the problem of the assignment.

3.2 Methods

Short deception of the two trajectory generation methods should be provided here, you should focus on:

- Differences and similarities when comparing the two approaches.
- Explain how the methods work based on the position, velocity, and acceleration profile of the generated trajectories

- give a simple pseudo algorithm outlining the implementation of the two methods.

Size **MAX 1 PAGE**

3.3 Results and Discussion

- Evaluate the implemented algorithms and present the results in a graphical form - time series plots of the generated trajectories.
- combine the plots of both methods on a single plot, which shows the trajectories by DOF.
- Calculate the DK for the two executions and pot them as a separate plot by DOF.
- calculate the velocity and acceleration profiles for both cases and plot them on a single plot by DOF.
- discuss the results, focus on comparing the performance of the two methods.

Size **MAX 2.5 PAGE**

3.4 Conclusion

Evaluate the performance of the two algorithms, propose what can be improved,
Size **MAX 1/2 PAGE**

4 Hand-in details

The hand-in is individual and will be handled threw ItsLearning. Under the Robotics tab, you can find a plan (Assignment) where the current open assignment will be active. The assignment must be handed-in on the agreed date, see details in the current open assignment and assignment plan. Use the provided latex template for writing the report! **You have to hand in only the report as a compiled pdf.**