KUKA LBR iiwa — Adaptive Assembly Analysis

Arjan Gupta
Robotics Engineering
Worcester Polytechnic Institute
Worcester, MA, USA
agupta11@wpi.edu

***Abstract*—This paper presents an analysis of the KUKA LBR iiwa robot's ability to perform rigid-body assembly tasks. The analysis is based on the first YouTube video presented in the prompt of the final exam. The video shows the robot's ability to adapt to the environment and perform manufacturing assembly tasks.**

***Index Terms*—KUKA, LBR iiwa, assembly, analysis**

I. Introduction

The KUKA LBR iiwa robot is a 7-axis robot that is capable of performing rigid-body assembly tasks, as shown in the YouTube video [1]. As per the data sheet of the robot, it is capable of performing assembly tasks with a payload of 7–14 kg, depending on the model. Its maximum reach is 800–820 mm depending on the model.

Fig. 1. KUKA LBR iiwa in its workspace from the video

In the video, the robot is first shown in its workspace, showing a HRC-suitable gripper. A drain valve, a connector for the drain valve, and a connection for the hoses are shown. A still from the video describing the gripper and workspace is shown in Figure 1.

After the setup is shown, the robot is shown performing the assembly tasks. The first part shows the utilization of the joint torque sensors for process recognition. The second part of the video shows the usage of the joint torque sensors for force-controlled joining processes. The third part of the video shows the safety features of the robot.

Our objective in this paper is to analyze the robot kinematics and dynamics being used in each of the three parts of the video. We will also describe how one would simulate the tasks being performed by the robot in MATLAB, using the Robotics ToolBox.

II. Materials and Methods

A. MATLAB setup for robot

We first describe the MATLAB setup for the robot. We use the Robotics Toolbox for building the robot model. The robot model is built using the `rigidBodyTree` MATLAB type. We use the KUKA LBR iiwa data sheet to populate the bodies and joints of the `rigidBodyTree`. The bodies and joints are created using the `rigidBody` and `rigidBodyJoint` functions in the Robotics Toolbox. At this point, we use the DH parameters to assign fixed transforms to the joints, using the function `setFixedTransform`. The joints are attached to the bodies using in the following way: `body1.Joint = joint1`. The bodies are then attached to the tree structure by using the `addBody` function. The tree can then be displayed using the `showdetails` function.

B. Analysis of first part

In this part of the video, the robot is shown performing a task where it correctly finds the gripping point of the drain valve. The robot then picks up the drain valve, traces the outline of the drain valve to the attached stopping point, and then inserts the drain valve into the connection for the drain valve. It then repeats the same process for a second drain valve.

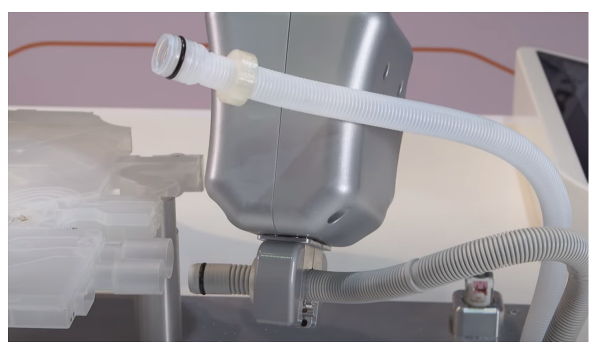

Fig. 2. Robot aiming to insert the first drain valve — still from the video

There are two key moments in this part of the video. The first is when the robot uses its torque sensing to arrive at the 'stopping point' in tracing the drain valve, which helps it recognize the correct gripping point. The second is when the robot is able to recognize the correct insertion point for the drain valve using its torque sensing.

REFERENCES

[1] *LBR iiwa - Adaptive Assembly*. KUKA YouTube, Sep 2014. [Online]. Available: LBR iiwa - Adaptive Assembly