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گروه کنترل و سیستم
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بنام آنکه جان را فکرت آموخت

رباتیک

تمرین سری دوم

۱۳۰۷
دانشگاه صنعتی خواجه نصیرالدین طوسی
استاد: حمید رضا تقی راد

Case Study 1: Consider a simple anthropomorphic arm in Fig.1. Several practical uses of this arm can be seen in 1 and 2.

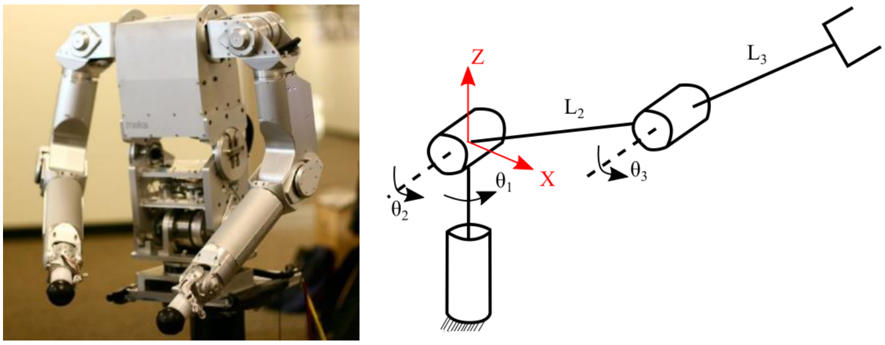


Fig1. Kinematic Structure of the simple anthropomorphic arm

Case Study 2: Palletizing is a demanding application of stacking boxes, bags, cases, bottles, and cartons onto pallets as the last step in the assembly line before being loaded onto a shipping truck. A schematic of a 3-DOF palletizer robot can be seen in Fig 2.

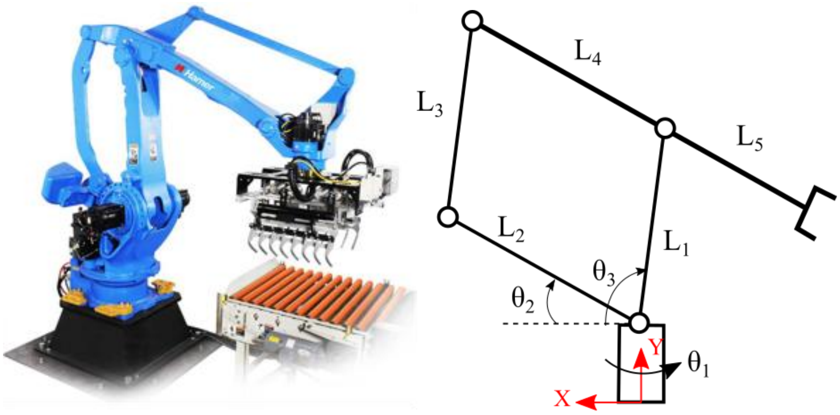


Fig2. Kinematic Structure of 3-DOF palletizer robot

Project: Consider a 3-DOF parallelogram-based robot in Fig.1. Such kinematic Structure has been used in many surgical robots such as Da Vinci and PRECEYES.

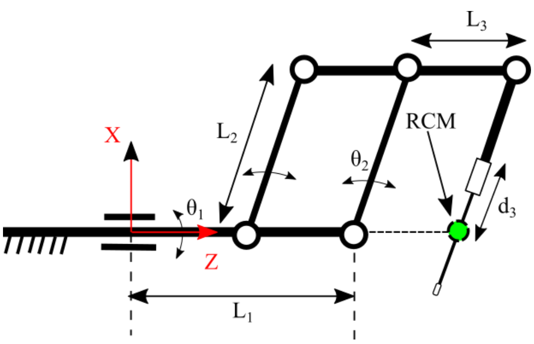
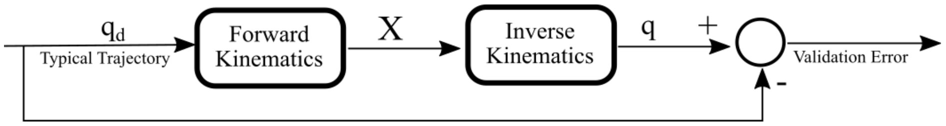


Fig1. Kinematic Structure of 3-DOF parallelogram-based robot. To better understand the above schematic, see this link.

For both case studies and the project part, do the following analysis:

1. Extract the Denavit-Hartenberg parameters with respect to the base coordinate system (XYZ). Use D.H. parameters to calculate forward kinematics.
2. Derive screw parameters and use successive screw method to calculate forward kinematics. The result should be identical to part 1.
3. Draw the robot workspace. Use appropriate values for the kinematic parameters from the references.
4. Extract the analytical solution for inverse kinematics and validate it as follows:



Note: For part 4, you can use a simple sinusoidal trajectory inside the robot workspace as the desired trajectory, q_d.

P.S. Just for the project part, examine the robot workspace for

$$-45° \leq \theta_1 \leq 45°, -45° \leq \theta_2 \leq 45° \text{ and } 0 \leq d_3 \leq 3cm.$$

Late homework policy: Please submit your assignments on time, in case you run out of time, you can still send it as late submission only by one day with the expense to lose some marks depending on the time you submit your work.

Collaboration policy: Collaboration with humans is very beneficial but restricted to the "whiteboard level", meaning that we recommend you to discuss approaches and solutions with your peers, but write your code, reports, and analytical derivations by yourself.

How to submit: Zip your files within the format of HW#_Name_StudentID, and submit them to the LMS website.

Contact us through Email: ta.robotics.1399@gmail.com

Good Luck!