

MAE 490 MAE 594

FINAL PROJECT

DUE: MAY 8TH , 2020 LAST DAY OF CLASSES

**HAND-IN: DR. KALANOVIC'S MAIL-BOX IN MAE DEPARTMENT – 2ND FLOOR
BELL HALL**

For a real FANUC Co-Bot CR-4iA fully described at
https://www.fanuc.co.jp/en/product/robot/f_r_collabo.html#cr4ia

perform the following engineering analysis tasks. You may use any kind of a software package that will help your tasks including Matlab.

1. Form a D.H. analysis and obtain transformation matrices.
2. Obtain Jacobian matrices that relate the C.G of each link.
3. Obtain differential equations of motion using Lagrange method shown in class. Some of the mass moment of inertia characteristics are given in the robot's technical data. Calculate the data that you need and that is not explicitly given.
4. Obtain a solution to differential equations of motion for an arbitrary and given vector torque input. Record, angular position, angular velocities and accelerations for each joint.
5. Close a PD (proportional, derivative) control loop for each joint. Assume that the sensors have a unity gain transfer function.
6. Your task is to drive the robot along the positive Y0 axis for 1 m and then along the Z0 axis for 1 m. Using inverse kinematics knowledge and Jacobian relationships that you have obtained, determine how each of the joints needs to move in order for the tool to move along the Y0 and Z0 axes. The orientation of the joint 6 nameplate is to be normal to the XY plane during this motion. You may assume that the J6 angle remains constant.
7. Joint values obtained in (6) should be used as desired inputs for control systems defined in (5). Show that the robot moves along the Y0 and Z0 axes under the action of the control systems by obtaining solutions to differential equations of motion. You may assume maximum linear speed of 1 m/s . Your response should not contain any oscillations. If it does, experiment with PD gains of the joint controllers.

SUBMIT: A report that documents all your work and simulation results needed to answer questions 1- 7.