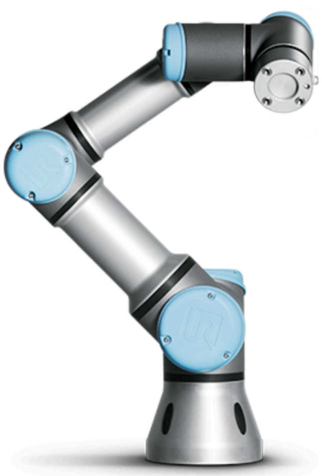
Robótica de Manipulação 2017/2018

Trabalho Laboratorial : UR3

Mestrado Integrado em Engenharia Mecânica

The proposed work consists in the Kinematic and Dynamic analysis of the UR3 manipulator from Universal Robots. In your report, provide complete, concise answers to the points below, using your own code. For developing your computational models, a Symbolic Robotics Matlab Toolbox is provided in the course webpage, as the starting point.



Kinematics: (Due on April 22nd via Fenix)

1. Build the kinematic model of the manipulator according to the Denavit-Hartenberg convention. Present a figure with the link reference frames and the corresponding table of parameters.
2. Using the provided Toolbox, create a Simulink model for the direct kinematics of the robot. Validate your model by creating a set of joint trajectories and plotting the resulting end effector trajectories (in terms of pose).
3. Using the provided Toolbox, create a Simulink model for the inverse kinematics of the robot. Validate your model against the direct kinematics model implemented in 2. NOTE: the wrist is not spherical.
4. Using the provided Toolbox, create a Simulink model for the geometric Jacobian of the robot. Show the effect of the arm and wrist kinematic singularities on the rank of the Jacobian matrix.
5. Using the direct kinematics and the geometric Jacobian models calculated in points 2. and 4., implement a Simulink model for the Closed Loop Inverse Kinematics of the robot. Validate your model against the results of point 2.

Dynamics and Control: (Due on June 1st via Fenix)

1. Using simple solid shapes (bars, cylinders, etc), calculate approximate values for the mass, center of mass, and tensor or inertia of each link of the robot.
2. Using the provided Toolbox, create a Simulink model for the dynamics of the robot. You are free to choose either the Lagrange-Euler or the Newton-Euler method.
3. Calculate the worst-case inertia configuration for each link of the robot manipulator, and design and implement decentralized PID type joint controllers for the robotic arm.
4. Design and implement a centralized inverse dynamics controller for the robot arm.
5. Choose a task for the end-effector, and design the corresponding task-space trajectory. Compare the performance of the controllers in points 3 and 4 for your task.