Design of a Robotic Manipulator

The goal of this project is to design a robotic manipulator using Dynamixel MX-28AR servo motors to accomplish some task defined by yourselves. Your team, with at most 4 students, will be graded upon:

Table 1: Grading Rubric.

#	***Content***	***Point***
1	Design	10%
2	Forward Kinematics	30%
3	Inverse Kinematics	30%
4	Simulation	10%
5	Presentation	10%
6	Report	10%

Design

You are required to design a robotic manipulator, operated in 3D with at least 4 DoF, using Dynamixel MX-28AR servo motors as actuators. SolidWorks is available in SEASnet Lab via remote access. When you are designing, you can consider:

- The configuration to accomplish the task
- The link length constrained by the motor torque
- The joint angle constrained by the physical interference
- A gripper as the end-effector can be a bonus
- Prismatic joints can be a bonus
- Any interesting mechanisms can be a bonus

Forward Kinematics

You are required to derive the forward kinematics for your designed manipulator, from the base frame to the end-effector frame. The numerical values must **not** be used until the very end.

Inverse Kinematics

You are required to derive the inverse kinematics for your designed manipulator, using either algebraic or geometric method. The numerical values must **not** be used until the very end. Describe how you deal with multiple solutions.

Simulation

You are required to code your kinematics in MATLAB and do a simple task simulation to verify your kinematics via animation. An example is provided. Additional animation in SolidWorks is highly recommended but not required.

Report

You are required to submit a report by the midnight of Dec. 18th. The .pdf file should be emailed to the TA, along with everything you should deliver as a .zip file. The following contents can be included not necessarily in the exact order:

- Manipulator configuration to accomplish the task
- Design highlights and difficulties
- Static force analysis
- Derivation of kinematics
- Solution selection for inverse kinematics
- Singularity discussion
- Workspace analysis
- Task simulation
- Performance analysis in comparison with the commercial products
- Any constructive comments for the project can be a bonus
- An interesting team name/logo can be a bonus
- A well-written report can be a bonus
- The maximum page number is 10 **excluding** the cover page, references, appendix, etc.
- At **least** 12-point font in Times New Roman

Presentation

You are required to present your work (partially if not finished) in class on Dec. 8th and Dec. 10th. The total time should not exceed 15 minutes including Q&A.