TÉCNICO LISBOA

# Robotics

MEEC - MEIC-A - MEBiom

Spring 2016

Departamento de Engenharia Electrotécnica e de Computadores

1st lab assignment

## Direct and Inverse Kinematics of Serial Manipulators

(Due by March 21-25/2016)

# 1 Objectives

Develop competences on

- Use of homogeneous matrix transformations to represent positions and orientations of the physical components of a robot, and
- Synthesis of kinematic models for serial manipulators.

# 2 Syllabus

The aim of the work is to compute the kinematic model for a serial manipulator with 6 degrees-of-freedom (dof) Figure 1.

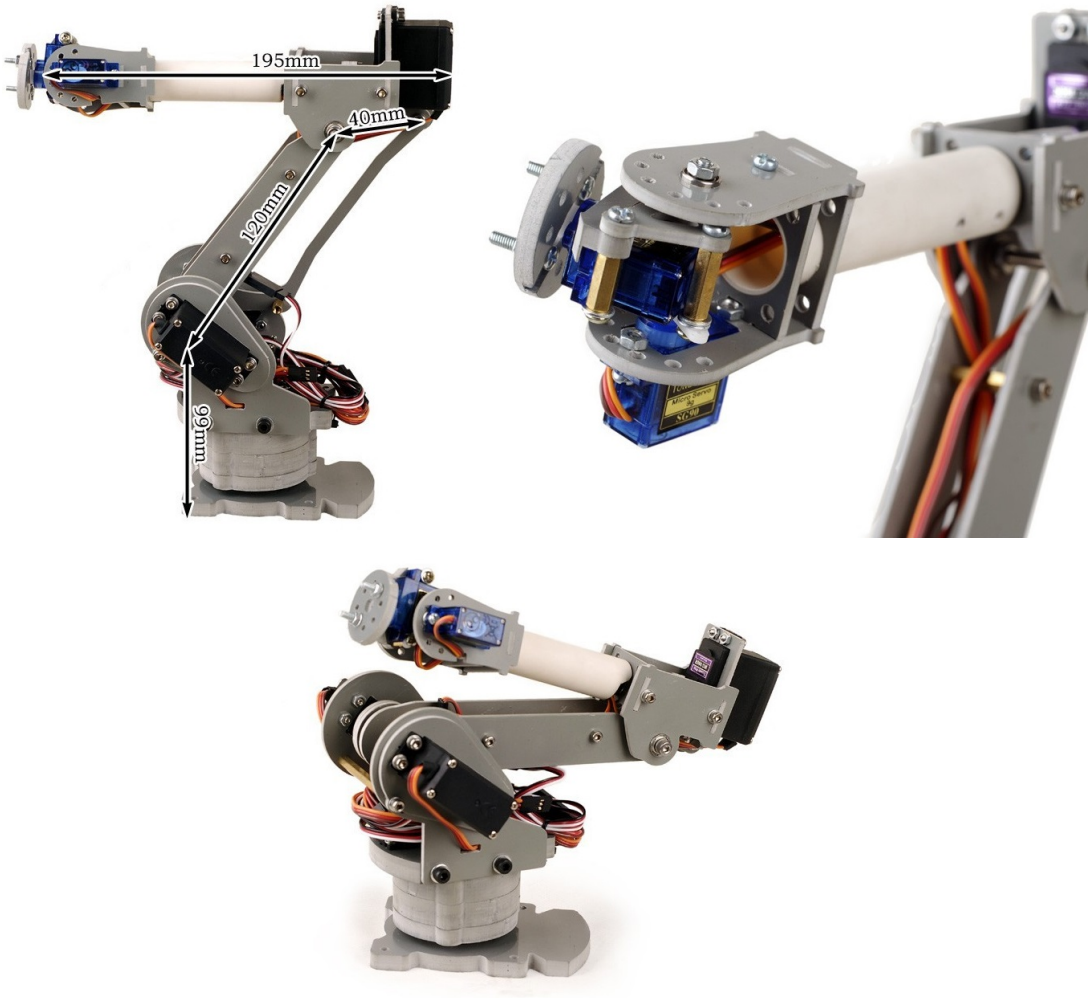


Figure 1: The 6-dof serial manipulator

In this assignment students are required to develop two M-functions (Matlab functions) that compute, for the robot in the figure,

1. The direct kinematics,
2. The inverse kinematics, and
3. Relevant singularities, if any.

The direct kinematics function must accept a set of 6 angles (one for each dof) and return the position and orientation of the end-effector. The position returned must refer to a reference frame with the origin located at the base of the robot. The orientation must be described by 3 Euler angles or by a rotation axis and a rotation angle.

The inverse kinematics function must accept a position and orientation of the end-effector and return all the corresponding solutions in the angles space.

Figure 1 also shows the physical dimensions (in mm) to be used to determine the direct and inverse kinematics.

It is not necessary to account for the physical limits of each of the joints.

# 3 Expected outcome

- Two Matlab$^{TM}$ (M-files) implementing the direct and inverse kinematics of the robot, respectively.
- Report detailing all the steps and assumptions taken. **Conventions to represent orientations and the link transformations must be carefully explained**.

  The report must include

  - A set of tests showing the output of the direct and inverse kinematics for a significant set of input data, and
  - A user manual or brief explanation on how to use the M-functions developed.

  The report should not have more than 8 A4 pages.
- A zip/rar file with the Matlab code and the report in pdf format is to be handed to the course responsible.