Norwegian University of Science and Technology
Department of Engineering Cybernetics

TTK4195
Modeling and Control of Robots
Spring 2015

Exercise set 2

Hand-in date: January 27th, 23:00

The following problems are found in the physical book: "Robot Modeling and Control" (2006) by Spong et al.

Your solution to problems 1, 2, 3 and 4 should include:

- Sketch of the robot with link frames
- Table of DH parameters and link numbers
- Distinguish parameters between constant and not constant (actuated parameters)
- The forward kinematic transformation matrix T_n^0 (except for problem 3-8, where only the three preceding items are required)

You may use software tools to simplify the calculation, although it's a good practice for the exam to do some of the problems by hand.
You may use software such as the Robotics toolbox for MATLAB[1], or SpaceLIB for Maple[2] to simplify calculations, and/or verify your A and T matrices. If software is used for the calculations, either showing your work on paper or attaching your code is required.

1. Problem 3-3

Consider the two-link Cartesian manipulator of Figure 1. Derive the forward kinematic equations using the DH convention. 2 Points.

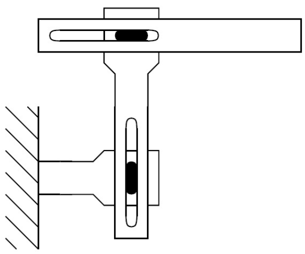

Figure 1: Two-link Cartesian robot of Problem 3-3

[1]http://www.petercorke.com/Robotics_Toolbox.html
[2]http://www.maplesoft.com/applications/view.aspx?SID=1428

2. Problem 3-5

Consider the three-link planar manipulator of Figure 2. Derive the forward kinematic equations using the DH convention. 2 Points.

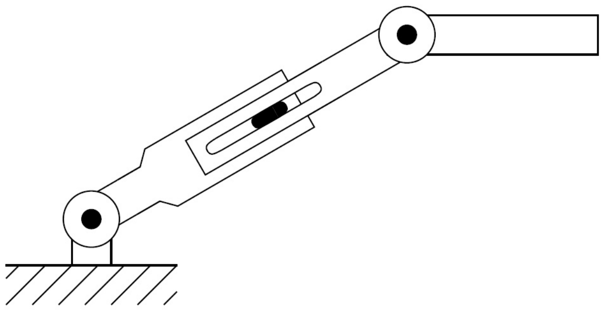

Figure 2: Three-link planar arm with prismatic joint of Problem 3-5

3. Problem 3-7

Consider the three-link planar manipulator of Figure 3. Derive the forward kinematic equations using the DH convention. 2 Points.

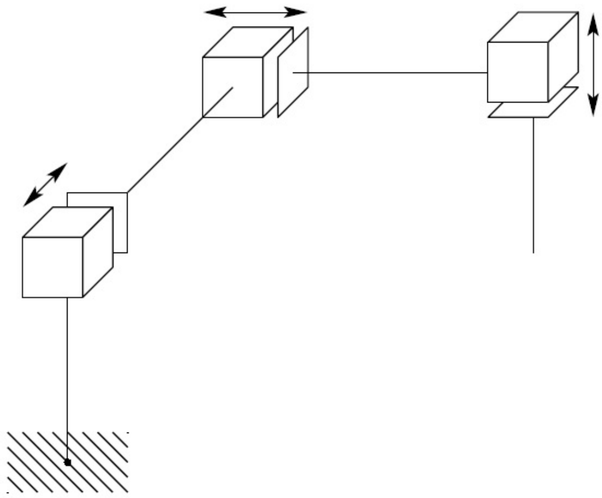

Figure 3: Three-link Cartesian robot

4. Problem 3-8

Attach a spherical wrist to the three-link articulated manipulator of Problem 3-6 as shown in Figure 4. Derive the forward kinematic equations for this manipulator. 2 Points

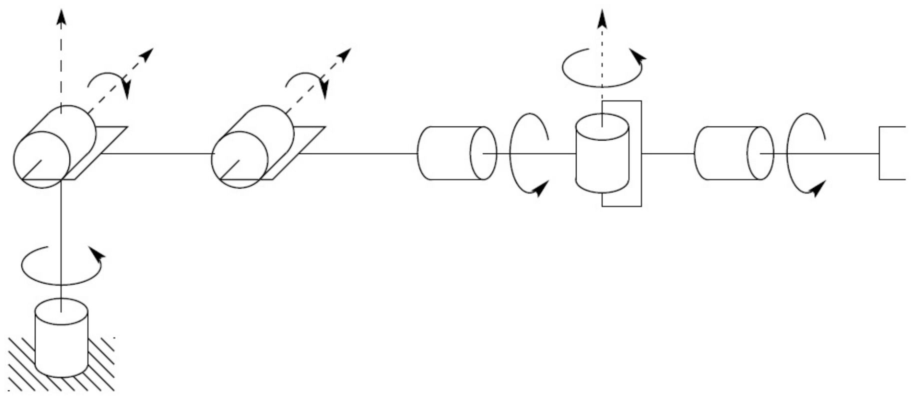

Figure 4: Elbow manipulator with spherical wrist

5. Problem 3-13

Solve the inverse position kinematics for the cylindrical manipulator of Figure 5. 2 Points

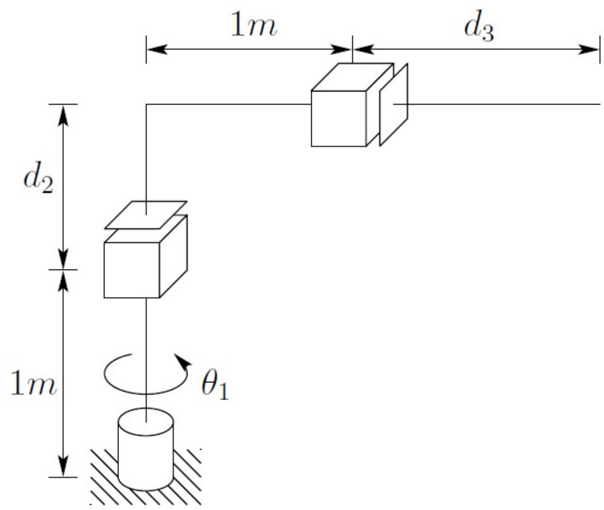

Figure 5: Elbow manipulator with spherical wrist