INF3480 - spring 2010

Compulsory exercise 1

Deadline: Monday, March 8th (before midnight)

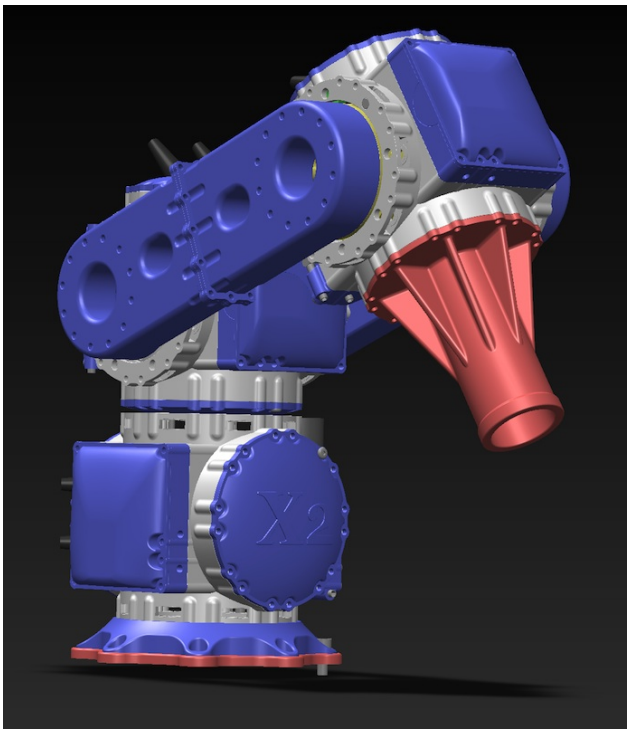

Figure 1: Robot

Introduction

Figure 1 displays the robot that we will work with in the compulsory exercises in this course. The robot consists of three identical parts, the first one is attached to the surface beneath the robot, and does not rotate. The next part is attached on top of the first part, and rotates along the vertical axis. The second and third parts are connected with a link (the long blue one in figure 1). In each end of this link, there is a revolute joint. A pen will be attached to the tip of the outermost part.

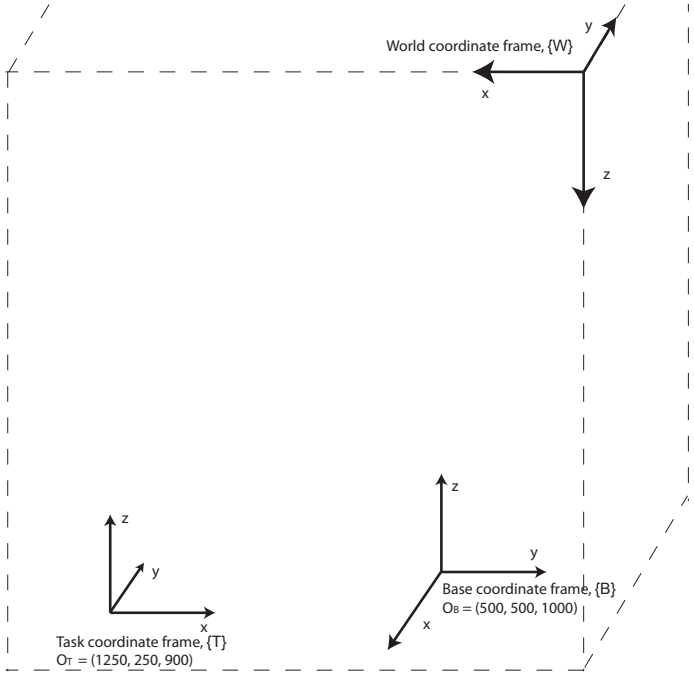

Figure 2: Coordinate frames (see also figure 4)

1

Figure 2 shows three coordinate frames. We name them *World coordinate frame* {W}, *Base coordinate frame* {B} and *Task coordinate frame* {T}.

Origo of coordinate frame {B} is located at position X = 500, Y = 500, Z = 1000 in {W}.

Origo of coordinate frame {T} is located at position X = 1250, Y = 250, Z = 900 in {W}.

The axes Z_W, Z_B and Z_T are parallel to each other
The axes X_W, Y_B and X_T are parallel to each other
The axes Y_W, X_B and Y_T are parallel to each other

Look at Figure 2 to find the direction of the axes.

Find T_T^B ,
(the transformation matrix expressing the position and orientation of {B} with respect to {T})

Show your solution by setting up the necessary expressions and calculations.

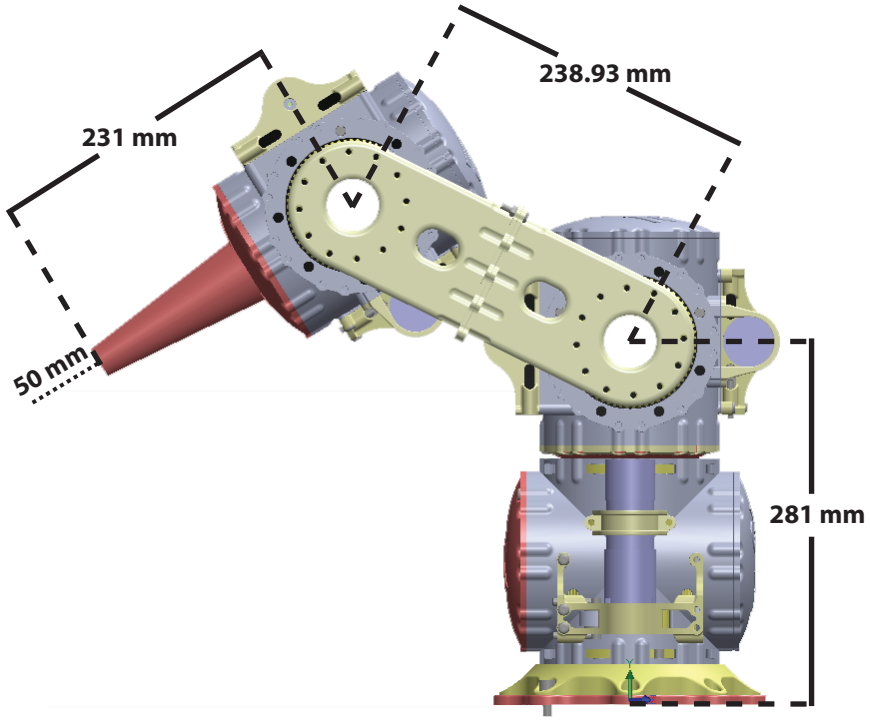

Figure 3: Robot

2

Figure 3 shows the necessary measures to work with the robot. The dotted line at the end of the robot denotes the pen that will be attached at the end of the robot.

a) Sketch the workspace of the robot.

b) Draw a simple illustration of the robot, showing the coordinate frames and the Denavit-Hartenberg parameters. Explain briefly your choice of origo and rotation axis. Show the DH-parameters in a table.

c) Calculate the forward kinematics for this robot. Your answer should be a transformation matrix T_t^B denoting the transformation of the tool coordinate frame {t} located at the tip of the pen, with respect to the base coordinate frame {B}. This transformation matrix is a function of the angles of the three joints.

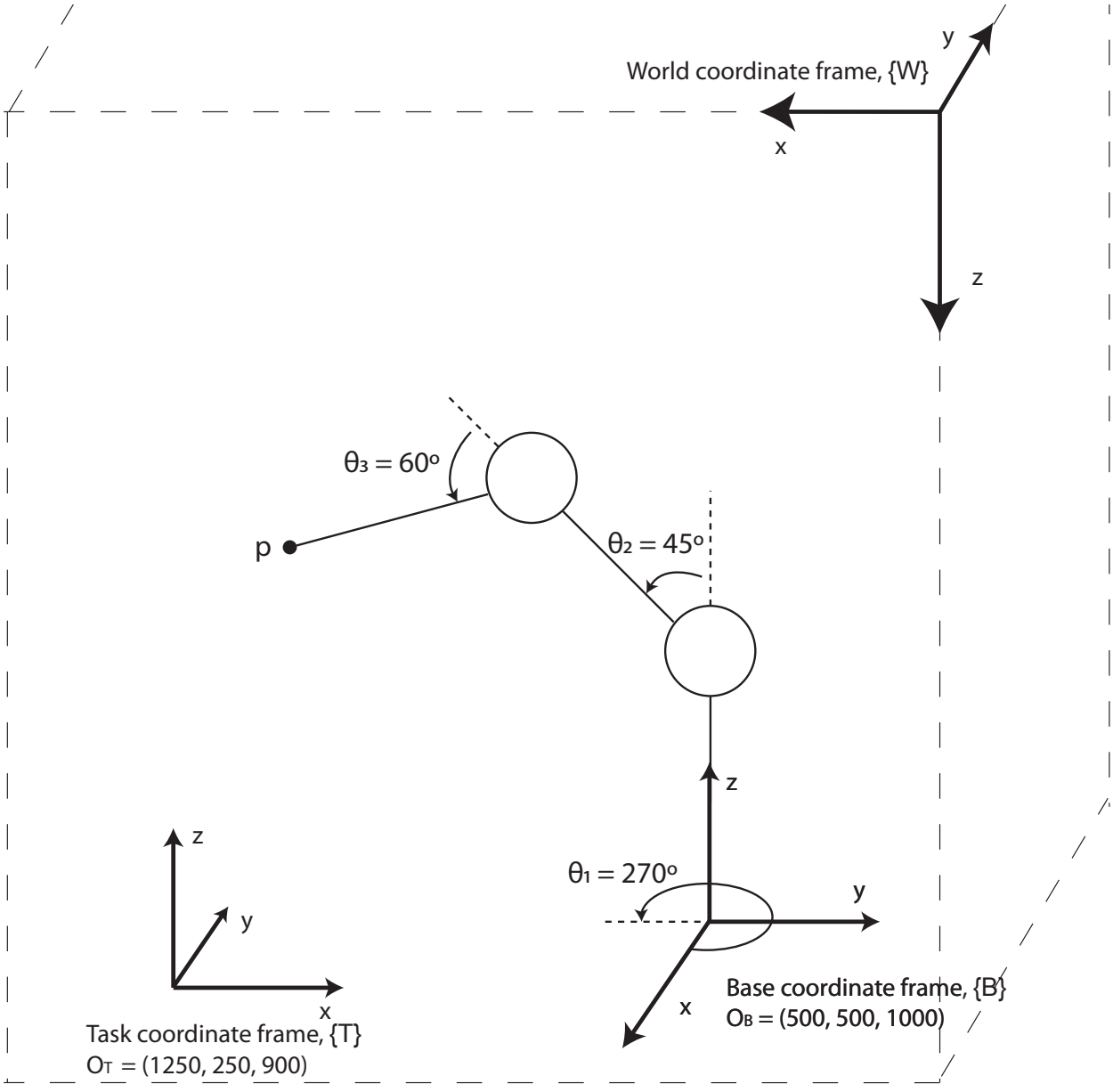

Figure 4: Robot

3

Point p is located at the tip of the robot (where the tip of the pen is). We adjust the robot as displayed in figure 4, where $\theta_1 = 270°, \theta_2 = 45°, \theta_3 = 60°$

Dimensions of the robot are as given in exercise 2.

Find p^T, the coordinates of point p given in the task coordinate frame {T}.

Hint: Use your calculations from question 1 and 2c to find the answer to this question

Requirements:
Each student must hand in their own assignment, and you are required to have read the following requirements to student submissions at the department of informatics: http://www.ifi.uio.no/studinf/skjemaer/declaration.pdf

Your submission should be as a pdf-document (or a zip-file if you have multiple files). Send it by e-mail to
vokjelse[at]student.matnat.uio.no.

Your submission must include:

- A pdf-document with answers to the questions.
- The two illustrations asked for in question 2a and 2b

To create the pdf-file, you can for instance use the free software from http://www.pdf995.com/. If you prefer to make hand-drawn illustrations, use a scanner or a camera.

Name the file: "inf3480-ex1-*your_username.pdf*".

Deadline: Monday, March 8th

Vegard is available to help with the compulsory exercises at the group sessions on mondays.