



Page 1 of 2

## Assignment in Computer Graphics II

Assignment 13 –
Computer Graphics and
Multimedia Systems Group
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Assignment 1 [1 Point] Forward Kinematics

Given the two-dimensional, three-tier (dreigliedrige) model:  $\phi_1 = 45^\circ$ ,  $\phi_2 = 270^\circ$ ,  $\phi_3 = 90^\circ$  and

$$P_1 = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \quad l_1 = 6, \ l_2 = 3, \ l_3 = 2$$

- 1. Calculate the end effector  $X_1$  by successively calculating the intermediate points  $P_2$  and  $P_3$  in global coordinates.
- 2. Specify the workspace of the end effector  $X_1$  and explain briefly your claim.

## Assignment 2 [1 Point] Robot arm

Given a simplified robot arm consisting of two unit cubes (-0.5...0.5).



- 1. Sketch the transformations depicted in an x-y-coordinate system.
- 2. Calculate: On which world coordinate is the point (0.5, 0, 0) of each upper and lower arm mapped?

Assignment 3 [1 Point] Programming with OpenGL (Bonus task)

Note! This task is a bonus task.

Program the robot arm from Task 2

- 1. Expand the downloaded file provided roboterarm.cpp.
  - *drawForearm()* and *drawUpperArm()* draw the cuboids, which will now have the length I. Use GL\_QUADS. Choose different colors, so you can distinguish upper and lower arm.
  - Complete the display functions. Where the translation and rotation matrices are applied to the objects. Use the functions *glPushMatrix()* and *glPopMatrix()*. Note that the geometry no longer consists of unit cuboids.
- 2. Now the forearm should be animated, beck (winken) (Rotation about the Z-axis between  $-45^{\circ}$  and  $+45^{\circ}$ ). Extend your program accordingly.



## Submission: 22.1.2015, before/at the beginning of the exercise.

Submit task 1 and 2on paper and send for task 3 an email with the modified file.  $\rightarrow$  Email to: david.bulczak@uni-siegen.de, christoph.schikora@uni-siegen.de

The **deadline** is the same for all tasks, e.g. emails will only be accepted till Thursday 12:00 clock. If we receive your mail, we will send you a confirmation as soon as possible.