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Lappeenranta University of Technology

LUT Engineering Science
Computational Engineering and Technical Physics
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BM40A0901 Computer Vision
Exercise 2, January 19, 2017.
Frames.

See Lecture Slide Set 2 (available in Moodle) for the basic information on points, homogeneous coordinates, rotations, translations, frames, and transformations between the frames.

1. Transformations between frames. (1 point)

   The following frame definitions are given (known):

$$ {}^{U}T_{A} = \begin{pmatrix} 0.866 & -0.500 & 0.000 & 11.0 \\ 0.500 & 0.866 & 0.000 & -1.0 \\ 0.000 & 0.000 & 1.000 & 8.0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \qquad {}^{B}T_{A} = \begin{pmatrix} 1.000 & 0.000 & 0.000 & 0.0 \\ 0.000 & 0.866 & -0.500 & 10.0 \\ 0.000 & 0.500 & 0.866 & -20.0 \\ 0 & 0 & 0 & 1 \end{pmatrix} $$

$$ {}^{C}T_{U} = \begin{pmatrix} 0.866 & -0.500 & 0.000 & -3.0 \\ 0.433 & 0.750 & -0.500 & -3.0 \\ 0.250 & 0.433 & 0.866 & 3.0 \\ 0 & 0 & 0 & 1 \end{pmatrix} $$

   Plot a frame diagram showing the qualitative arrangement (the frames with the corresponding transforms between them). Then solve for ${}^{B}T_{C}$. You need to show also the numeric answer, for which you can use a calculator or Matlab if necessary. Also plot the frames in the world frame W (using the settings and Matlab function `drawtransf(T)` from Exercise 1).

2. Plotting a cube. (1 point)

   A cube in Fig. 1 is described using vertices and edges. Each vertex has *(x,y,z)*-coordinates and each edge is defined using two vertices.

   a) download a data file containing a description of a cube, `kuutio.mat`.

   b) which vertices are available? Which edges are available?

   c) draw the cube using the e.g. Matlab function plot3.

   e) control the viewpoint of the 3D plot.

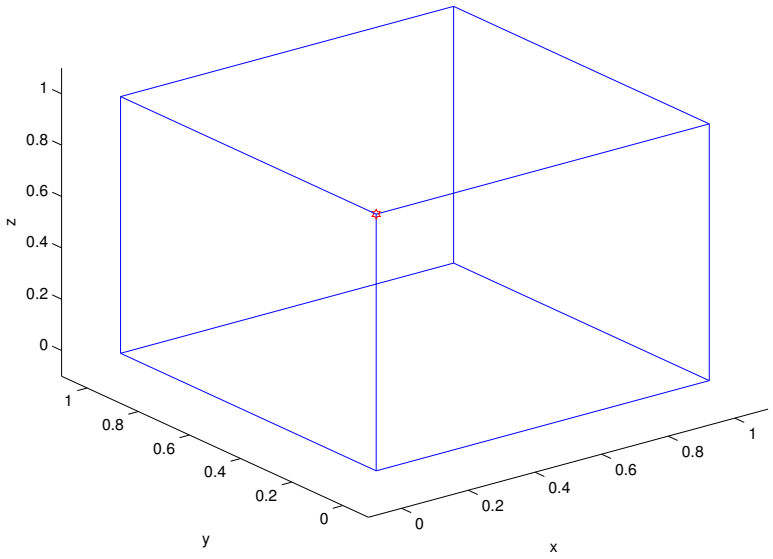

Figure 1: Cube with one vertex marked.

3. Coordinate mappings for a point. (1 point)

   Using the three frames (the world, the camera, the robot) defined in Task 2 in Exercise 1 map the coordinates from the robot frame to the camera frame.

   The coordinates for a cube are given in the previus task. Consider these coordinates given in the robot frame, i.e. each point P in the robot frame R as $P = {}^{R}P = (P_x, P_y, P_z, 1)^T$.

   Find the coordinates of each point ${}^{R}P$ in the camera frame C, i.e. ${}^{C}P$.

   Use the Matlab function `drawtransf(T)` (from Exercise 1) to plot the setting. Also locate the viewpoint in the camera frame origin and look towards the robot frame. What is seen?