

## Exercises in 3D Computer Vision

### Exercise 5 Euclidean Transformations (Exemplary Solution)

- a)  $T_1 = [1 \ 0 \ 3; 0 \ 1 \ -4; 0 \ 0 \ 1];$
- b)  $a = 20 * \pi / 180; T_2 = [\cos(a) \ -\sin(a) \ 0; \sin(a) \ \cos(a) \ 0; 0 \ 0 \ 1];$
- c)  $T_3 = [\cos(a) \ \sin(a) \ 3; -\sin(a) \ \cos(a) \ -4; 0 \ 0 \ 1];$  or  $T_3 = T_1 * T_2;$
- d)  $T_4 = T_2 * T_1;$
- e)  $T_3 = \begin{bmatrix} \mathbf{R} & \mathbf{t} \\ \mathbf{0} & 1 \end{bmatrix}$  and  $T_4 = \begin{bmatrix} \mathbf{R} & \mathbf{Rt} \\ \mathbf{0} & 1 \end{bmatrix}$

### Exercise 6 Affine Transformations (Exemplary Solution)

- a)  $A = [1 \ 2 \ 0; 0.5 \ 3 \ 0; 0 \ 0 \ 1];$  plotHomo(A\*p\_h) For the function plotHomo() see below.
- b) Since the bottom right point of the house is  $[1, 0]^T$  which has to be transformed to  $[2, -0.5]^T$  the first 2 rows of the first column of the affine transformation matrix has to be set to  $[2, -0.5]^T$ . The left top point of the house is  $[0, 1]^T$  and that is why the first 2 rows of the second column of the matrix must be  $[-1, 1]^T$ . The whole matrix is:

$$\begin{bmatrix} 2 & -1 & 0 \\ -0.5 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

### Exercise 7 Projective Transformations (Exemplary Solution)

- a)  $H = [1 \ 0 \ 0; 0 \ 1 \ 0; 0.3 \ 0.5 \ 1];$  plotHomo(H\*p\_h)
- b) % plots 2D points in homogeneous coordinates  
function plotHomo(p)  
[dim, nr]=size(p);  
for i= 1:nr  
    p(:,i)=p(:,i)/p(3,i);  
end %for  
figure;  
plot(p(1,:),p(2,:));  
axis equal;
- c) We have  $G = [4 \ 0 \ 0; 0 \ 4 \ 0; 0 \ 0 \ 4];$  plotHomo(G\*p\_h);  
There is no difference because the constraint that the third value of a point in homogeneous coordinates has to be 1 scales all of the vectors back to their original version.