

# EXERCISES FOR IMAGE PROCESSING I

## PROBLEM SHEET 3

**Due date:** 13.11.14 before 12:00h

**Topics:** Perspective Projections

**Submission:** Please send your solutions via email to [seppke@informatik.uni-hamburg.de](mailto:seppke@informatik.uni-hamburg.de).

### 1 PERSPECTIVE TRANSFORMS

10 P.

- Show that 3D straight lines in a scene are depicted as 2D straight lines in an image by perspective projection.
- Show that the perspective projections of parallel 3D straight lines in a scene intersect in a single point, the vanishing point. In which case is the vanishing point located in infinity?
- What shapes have the perspective projections of spheres? Justify your answer.

### 2 CAMERA TRANSFORMATIONS

10 P.

A camera with focal distance 35 mm is placed at the corner of a room at a height of 3 m. The optical center is located exactly at the edge of the room. The optical axis is declined by a nick angle of  $60^\circ$  and turned towards the room center by a pan angle of  $45^\circ$ . There is a table in the room, 75 cm high, located as shown in the sketch.

- Write a python script, which performs the necessary matrix operations, as described in the slides to perform a camera projection.
- Instantiate the matrices with the parameters of the given scene. What are the image coordinates (expressed in the camera coordinate system) of the marked table corner?

