Part II

1 II.1 (3 points) Camera Calibration and Outliers

The goal is to calibrate a camera from correspondences of 2D and 3D points, as shown in the lecture, in the case where some of these correspondences may be wrong (outliers). Please describe, step-by-step, a robust method for doing so, following the RANSAC scheme seen in the lecture. The description should be complete, especially it should explain how calibration hypotheses are generated, how many correspondences are needed for a hypothesis, how to compute scores for hypotheses.

2 II.2 (2 points) Accuracy of 3D Reconstruction

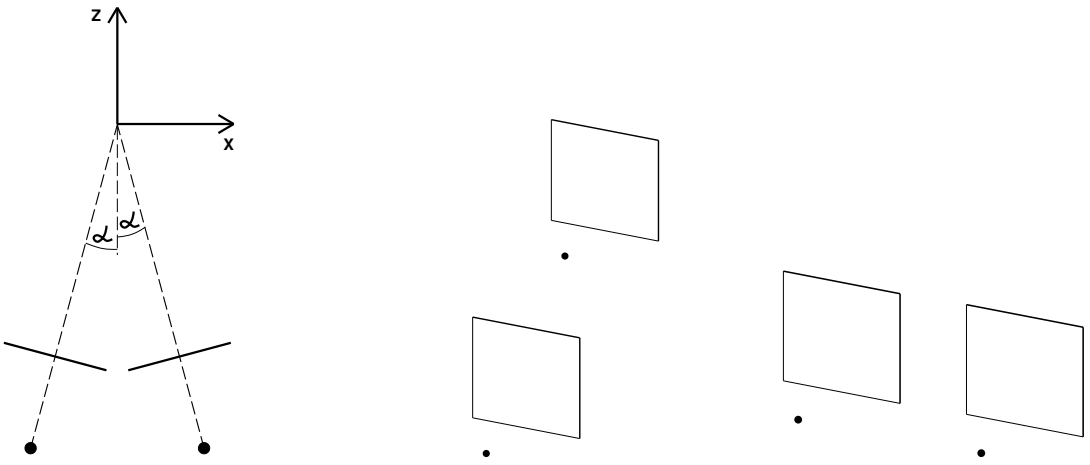
The figure below shows configurations of stereo systems. The systems are used to reconstruct points seen in both cameras, in 3D. Because of noise in the image point coordinates, reconstructed 3D point coordinates will be erroneous. To answer the following questions, it is not necessary to give formal proofs, intuitive explanations, possibly based on drawings, are sufficient.

(a) For the configuration shown in the left part of the figure below, which coordinate of a reconstructed 3D point (among X and Z) will, intuitively, be more affected by the noise, i.e. will be reconstructed with more error?

(b) For which angle α would the error in the reconstructed coordinates be roughly equal?

(c) Consider the two configurations shown in the right part of the figure below. The first one corresponds to a camera moving forwards, the second one to a camera moving sideways. Which of the two configurations should give better 3D reconstruction results, i.e. 3D reconstruction with less error?

(d) If you had to do a complete 3D reconstruction of an object and if you had at your disposal n cameras, how would you position the cameras and why?



Part III

1 (3 points) Shape Modeling

We are given a 3D modeling system composed of n cameras. The cameras are fixed and we consider the image silhouettes $S_{i\in[1..n]}$ of a fixed object that appears entirely in all images.

- How can we obtain such silhouettes ?
- We assume the silhouettes to be exact, what 3D model can we obtain from them ?
- What becomes such model when the camera calibration is not exact ?
- What is the relationship between the 3D model and a silhouette when the calibration is exact ?
- Explain how we can use this relationship to improve a calibration which is not exact ?
- Explain the limitations of such 3D model and how it can be improved.

2 (2 points) Motion Modeling

Modeling motion from images consists in recovering information on the motion of a moving object observed from several viewpoints.

- How can such information be encoded when considering human motions ?
- How can it be recovered from images ?