LUT Engineering Science
Data-Centric Engineering
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BM40A0902 3D Computer Vision
Exercise 9
Stereo vision 2

1. Linear Triangulation with DLT (2 points).

   The task is to implement linear triangulation, i.e. find 3D point coordinates that would project to the given 2D coordinates. This task can be solved by completing the following steps:

   (a) Load the fundamental matrix F and points from task1.mat

   (b) Create camera matrices M_L and M_R by using the definitions from Slide 26 of the lecture slides 8.

   (c) Perform linear triangulation using the approach from Slides 34-35 of the lecture slides 8

   Note: the slides show how to find a suitable 3D point for a single pair of corresponding 2D points, you will need to repeat it 8 times to find 3D points for each pair of point correspondences from the 8-point algorithm.

   Finally, apply the algorithm to the point correspondences to receive 3D points P. Calculate reprojection error

$$E(p_L, p_R, \hat{p}_L, \hat{p}_R) = \sum_{i=1}^{N} ||p_{Li} - \hat{p}_{Li}||_2 + ||p_{Ri} - \hat{p}_{Ri}||_2, \tag{1}$$

   where p_{Li} is the i-th point from the left image, p_{Ri} is the i-th point from the right image, $\hat{p}_{Li}$ is the result of projecting 3D point P_i using projection matrix M_L, $\hat{p}_{Ri}$ is the result of projecting 3D point P_i using projection matrix M_R. How large is the error?

a) b)

Figure 1: a) Left image, b) Right image.

2. Rectification (2 point).

   Implement the rectification algorithm. Load the fundamental matrix F, camera matrices (M_R, M_L), and points from task2.mat. You can use the provided functions to warp the images according to the found rectification mappings. Warp and plot the resulting rectified images.

   What is the purpose of rectification? Are the features from both images aligned vertically after the rectification?