问题包-2

1. Consider the convergent binocular imaging system shown in Fig. 1. The cameras and all the points are in the $y = 0$ plane. The image planes are perpendicular to their respective camera axes. Find the disparity corresponding to the point P. (Hint: The perpendicular distance between any pint (x_0, z_0) and a line given by $Ax + Bz + C = 0$ is $(Ax_0 + Bz_0 + C)/\sqrt{A^2 + B^2}$. (15 points)

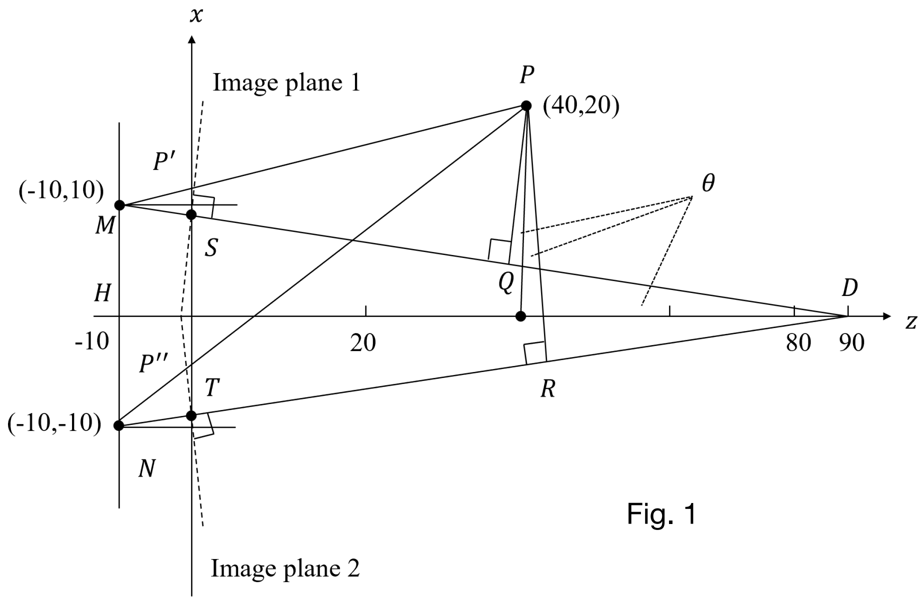

Fig. 1

2. Consider the binocular stereo imaging system shown in Fig. 2, find the disparity, $x_d = |x_1 - x_2|$, for the point P located at (10, 20, 10). (15 points)

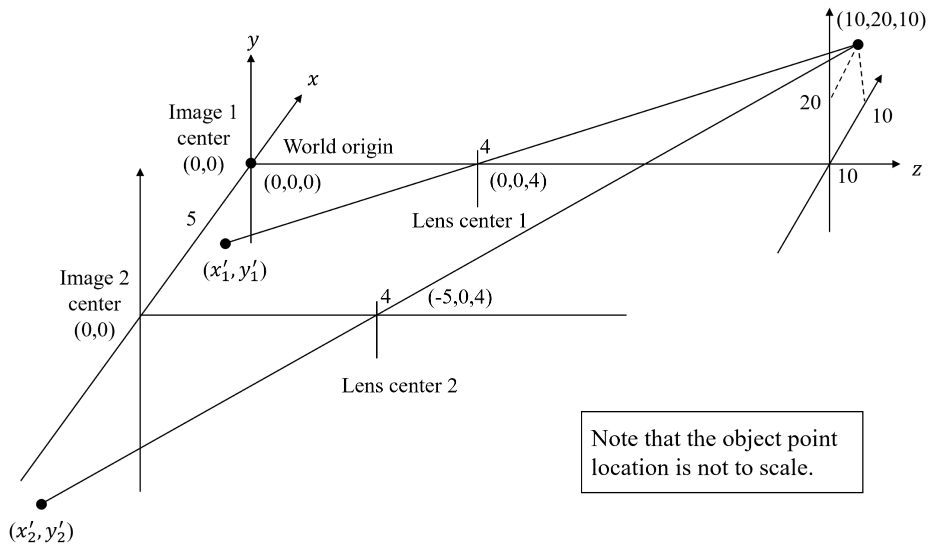

Fig. 2

3. Use the definition of disparity to characterize the accuracy of stereo reconstruction as a function of baseline and depth. (20 points)

4. Show that one of the singular values of an essential matrix is 0 and the other two are equal. (Huang and Faugeras [1989] have shown that the converse is also true; that is, any 3×3 matrix with one singular value equal to 0 and the other two equal to each other is an essential matrix.) Hint: The singular values of E are the eigenvalues of EE^T. (20 points)

5. Implement the following simple algorithm (stereo pair rectification). Rotate both cameras so that they are looking perpendicular to the line joining the two camera centers c_0 and c_1. The smallest rotation can be computed from the cross product between the original and desired optical axes. (Read section 11.1.1 Rectification of reference 2 at first) (30 points)

Reference

1. Huang, T. and Faugeras, O. (1989), 'Some properties of the E-matrix in two-view motion estimation', IEEE Trans. Pattern Analysis and Machine Intelligence 11(12), 1310– 1312.
2. Richard Szeliski (2010), 'Computer Vision: Algorithms and Applications'