Assignment #4 Due Thursday April 11th at 9:00 AM

1. In Figure 1 on the last page there are three cameras where the distance between the cameras is B, and all three cameras have the same focal length f. The disparity dL = x0 – xL, while the disparity dR = xR – x0. Show that |dL| = |dR|. You should prove this relationship holds mathematically by using the appropriate equations. **2 mark**

2. Consider two points A and B in a simple stereo system. Point A projects to Al on the left image, and Ar on the right image. Similarly there is a point B which projects to Bl and Br. Consider the order of these two points in each image on their epipolar lines. There are two possibilities; either they ordered on the epipolar lines in the same order; for example they appear as Al, Bl and Ar, Br, or they are in opposite order, such as Bl, Al and Ar,Br. Place the two 3d points A and B in two different locations in a simple stereo diagram which demonstrates these two possibilities. (Draw a different picture for each situation). **2 mark**

3. There is a simple stereo system with one camera placed above the other camera in the y direction (not the x direction is as usual) by a distance of b. In such a case there is no rotation between the cameras, only a translation by a vector T = [0,b,0]. First compute the essential matrix E in this case. You are given a point p_1 in camera co-ordinates in the first image as (x_1,y_1,f), and a matching point p_2 in the second image where p_2 is (x_2,y_2,f). Write the equation of the epipolar line that contains the matching point p_2 in camera co-ordinates in the second image. In this case you are given p_1 and you have computed E, and you need to write the equation of the line that contains p_2 (the free variables are x_2,y_2) using p_1 and the elements of E as the fixed

variables. Now repeat the entire process again for the case where T = [b,b,0] (a translation of 45 degrees to the right in the x,y plane), and finally where T = [0,0,b] (a translation straight ahead in the Z direction). For the particular case where p_1 = (0, 1, f) what is the equation of the epipolar line for all three situations? And where p_1 = (1, 1, f) what is the equation of the epipolar line in these three situations? Draw the epipolar lines for all three cases, you just need to show the basic shape of the epipolar lines.
4 marks

4. If F is the fundamental matrix of the camera-pair (P, Q) then what is the fundamental matrix of the camera pair (Q, P).
1 mark

5. There are two stereo images; in the first there is a point p which matches to a point q in the second image. If for a point p in the first image the associated epipolar line in the second image is Fp then what is the associated epipolar line in the second image for the point q. **1 mark**

Figure 1