CMSc 426
Final exam

1. Given a camera with a focal length of 100 pixels, what are the image coordinates of the following 3-D points [10 points]

   a. (50,70,90)

   b. (100, 200,300)

2. Given a point in an image, what can we say about the location of the point in 3-D space that we are viewing? That is, what locus of points in 3-D can image to that point? [10 points]

3. Given a set of parallel lines on a plane, what do we mean by the vanishing point of that set of lines? What is the effect on the vanishing point of rotating those lines, in 3-D, on that plane? Use, to illustrate your answer to the second question, parallel lines on a horizontal plane (that is, a plane of the form Y=c, for some constant c). [10 points]

3. Stereo

a. Explain why, given a stereo pair of images and a point in one of the stereo images, its conjugate point must lie on a line in the second image. [5 points]

b. What are the advantages and disadvantages of a large baseline in stereo imaging? [10 points]

c. When a stereo pair of images is obtained in which the two cameras share the same x axis, and have their y axes pointing in the same direction, then the conjugate line of a point in the left image is a row in the right image. Suppose, instead, that the second image in a stereo pair is obtained by moving the second camera foward, along the z-axis of the coordinate system of the first camera. Now, if the center of the first image is at location (0,0), what is the conjugate line of a pixel at location (x,y) [10 points]

4. Suppose that we have a light source with the following illumination function:

λ	$e(\lambda)$
100	60
200	80
300	100
400	80
500	60

and a surface with a spectral reflectance function of

λ	$s(\lambda)$
100	0.30
200	0.80
300	0.70
400	0.60
500	0.50

a) What is the color function, as a function of λ, that will reach the color camera. [10 points]

b) Suppose we have a color sensor with the following spectral sensitivity function [10 points]

λ	$R(\lambda)$
100	0.20
200	0.30
300	0.40
400	0.50
500	0.40

What will its response be to the color signal produced in (a).

5. Suppose we have a camera that is undergoing a purely translational motion, and that the camera, with a focal length of 100, is moving with velocity (U,V,W) = (20, 30, 50).

a) Generally, what is the focus of expansion for a moving camera? [5 points]

b) What is the location of the focus of expansion for this particular motion? [5 points]

c) What is the pattern of the optical flow vectors for this type of motion? [5 points]

d) What is the aperture problem in computing optical flow? How is it related to the linear constraint on optical flow determined by the differential technique for computing flow? [10 points]