CS 482 Final, 12/6/2002

Take home, Due: 12/12/2002

Name:

There are 20 bonus points on this exam.

1. (25p) What are all possible images of two parallel lines (lines are parallel in the scene). Discuss all special cases. What can be computed from these images? Show all math?

2. (35p) A camera in a low flying plane captures an image of a 100×100m planar wheat field. The four corners of the field have the following image positions (x, y) (in pixels): $(-30, -50)$, $(120, -30)$, $(100, 50)$, and $(-30, 60)$. You can assume that the field is perfectly flat/planar. The focal length of the camera is $f = 200$mm (2000 pixels). What can you say about the relative orientation of the camera and the field? What can you say about the distance between the camera and the plane?

3. (25p) A pair of parallel, perfectly aligned, cameras are observing a square in front of a flat wall. How would you design a *random dot stereogram* of the scene if the cameras and the scene have the following parameters: focal lengths of the cameras are $f = 20$mm (256 pixels), the baseline $b = 0.1$m (0.1 meters), the distance of the wall from the camera is $z_0 = 1$m, and the distance of the surface of the square from the camera is $z_1 = 0.9$m? Choose the position and the size of the square to fill the central portion of the image. What are the disparities of the points on the square? What are the disparities of the points on the wall?

4. (35p) Assume that you are given a perfect optical flow algorithm and that you can obtain optical flow from any pair of successive image frames. The camera is moving along a straight line towards a static rigid scene (pure translational motion). The velocity of the camera is 0.01m/frame and the scene is approximately 1m away from the camera. You can assume that the camera focal length is 0.02m (256 pixels). What can you compute if:

   a) The scene has a lot of feature points and their distances from the scene are not all equal?

   b) The scene is a plane?

   Give formal (mathematical) arguments. Draw the optical flow for the case of the camera moving along the z-axis towards a flat (fronto-parallel) wall. Compute exact flow values for at least 10 image points.