Master CIMET and 3DMT - Computer Vision course

Exam April 2014 - 2h without documents

(3 parts with a total of 13 questions accounting for 21 points, the exam will be scored for 20 points)

Part 1: 3D reconstruction

Question 1 *(2 points)***:** Show how to map the coordinates of a 3D point in the scene to the coordinates of a 2D point in the image.

Question 2 *(1 point)* : Is it possible to recover depth from a monocular point of view? Justify

Question 3 *(2 points)*: Show how to map the coordinates of interest points in multiple 2D images of the same 3D scene viewed from different points of view.

Question 4 *(1 point)*: Is it possible to recover depth from a binocular point of view?

Question 5 *(2 points)*: The two images below are a stereo pair taken using parallel cameras, aligned horizontally. Describe a framework (i.e. a solution) for matching corresponding features in the two images and estimating their disparities. State clearly how your method exploits the epipolar constraint.

Question 6*(2 points)*: Explain how to obtain estimates of the 3-D positions of the objects in the scene above from stereo disparities. What information about the cameras is required for this?

Question 7 *(2 points)*: If only one of the two images in the pair above was available, what computational processes might be used to make inferences about the 3-D structure of the scene? What assumptions are involved in applying these processes?

Part 2: pinhole model

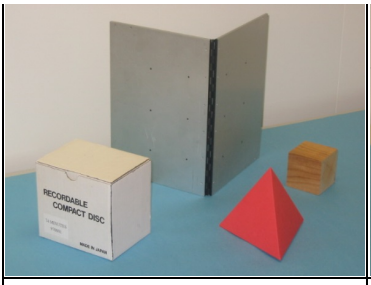
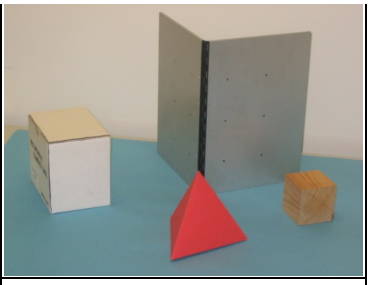
Question 1*(1 point)***:** What is the name of the mathematical equation of a thin lens which models the relationship between the focal f, the distance Z of a point in the scene to the camera frame and the distance z of its 2 projection in the image frame? Write this equation.

Question 2 *(2 points)*: With the pinhole model the most distant objects appear smaller, why? With the pinhole model parallel lines in the scene can intersect in the image, show with a graphic why?

Question 3 *(1 point)***:** For the Kyoto Street image, shown below, estimate manually the positions (in the image plane) of the three major vanishing points, corresponding to the building orientations.

Part 3: 3D reconstruction (related to lab sessions)

Consider the pair of image shown below which you have used in **Lab-4** for the purpose of Fundamental matrix computation (1st part) and 3D reconstruction (2nd part).

	
Left Image	Right Image

During the lab you manually selected several corresponding points from both images. Now let us suppose that we want to perform this task (finding corresponding points) automatically.

Question 1 *(2 points)***:** How will you do that using the knowledge and tools that you have developed during the lab sessions 1-5?

Question 2 *(1 point)***:** How will you verify (using objective measure) if the matching algorithm that you developed is correct?

Question 3 *(2 points)***:** The 3D reconstruction that you performed in this lab was sparse. Now you are planning to reconstruct dense 3D map for which you need to obtain dense disparity from these images. How will you do it (i.e. compute dense disparity)?

Note:

- The sparse 3D reconstruction process involved several steps: calibration, projections, reconstruction.

- If you need any additional tool to perform this task then do not hesitate to mention it. However, you must specify why you need it?