Homework #1 Camera: Geometry

Due Feb. 11, 2014 5:00pm

Problem #1: Orthographic v.s. perspective cameras (2 points)

Figure 1 shows two pictures taken by two different cameras, answer the following questions.

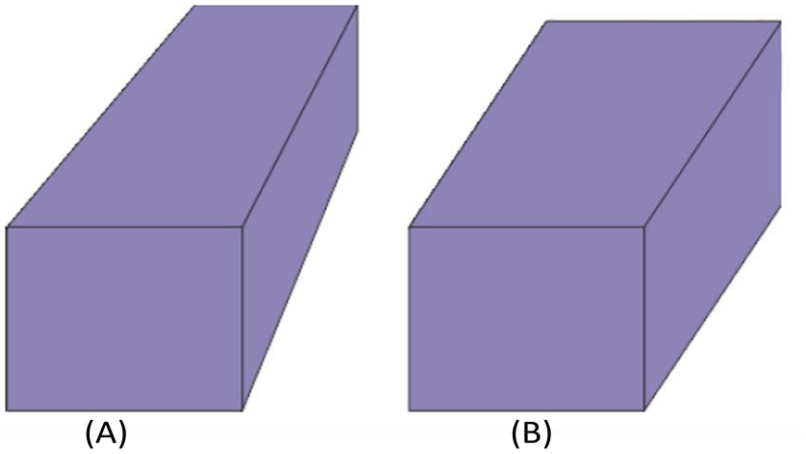

Figure 1: Two pictures taken by two different cameras.

(1) For the two pictures shown in Figure 1, which one is taken with a perspective camera and which one is taken with an orthographic camera? (1 point)
(2) What is the camera projection matrix for a perspective camera? What is the camera projection matrix for an orthographic camera? Why an orthographic camera can be considered as a special perspective camera? In your own language, discuss their differences. (0.5 point)
(3) Identify a set of lines in either picture A or picture B that are intersecting in a varnishing point with a finite coordinates. (0.5 point)

Problem #2: 2D geometry (1.5 points)

Here are the homogeneous coordinates of two 2D points

y1=[1 1 2]; y2=[2 3 1]

Here are the dual homogeneous coordinates of some 2D lines

l1=[2 3 3]; l2=[1 -1 2]

(1) What are the coordinates of y1 and y2 in the 2D coordinate system (i.e., Euclidean coordinates). (0.5 point)

(2) Determine the intersection points of line I1 and I2, in the form of both homogenous coordinates and Euclidean coordinates. (1 point)

Problem 3: 3D geometry (1.5 points)

Here are the homogeneous coordinates of some 3D points

x1=[1 2 3 4]; x2=[4 3 2 1];

Here are the dual homogeneous coordinates of a 3D plane

p1=[1 -1 2 -1];

(1) Which 3D points do the homogeneous coordinates represent? (0.5 point)
(2) What is the normal vector and distance to the origin for the plane? (1 point)

Problem 4: Cameras (bonus 1 point)

Here is the camera matrix of a pin-hole camera

C=[1 2 3 4;4 3 2 1;1 1 2 2]

What is the 3D coordinates of the camera center? (Hint: the camera center is projected to $(0, 0, 0)^T$ in homogeneous coordinate)

What to turn in?

You should make your answers in a PDF file and name it as:

[yourfirstname]_[yourlastname]_HW1.pdf

Please submit it through the Moodle system.

****Important Notice: Please also bring a printed copy of your answers to the class in the due day of the assignment. This is mandatory*****

Grade: 5% with bonus

Late submission policy applies universally with no exception.

If you have a compelling excuse, you must inform me at least 2 days before the due date. I don't accept excuses such as "I am overloaded by other courses".