

HOMEWORK ASSIGNMENT #1

DUE: Tuesday, September 12, 2017

CSCI 677: Advanced Computer Vision, Prof. Nevatia

Fall Semester, 2017

You may choose to write solutions by hand; in that case, please submit a scanned copy.

1. Suppose that our image coordinate system has its origin at the bottom left corner, the x -axis is along the bottom-row (pointing to the right) and the y -axis to be pointing upwards at an angle of 85 degrees to the x -axis. Assume that the focal length is 25 millimeters and that pixel spacing along the x -axis is .04 millimeters and along the y -axis is .05 millimeters. Let the image be 1000 x 1000 pixels and the principal ray intersect the image plane in its center. For these conditions, derive the intrinsic matrix, K , which helps map a point, P , specified in the camera coordinate frame to the image coordinates $(x, y, 1)^T$ expressed in pixel units (ignore the issue of rounding off pixel coordinates to integers). Choose a convenient alignment of the axes of the camera coordinate frame.
2. a) Show that a set of parallel lines converge to a common point, called a *vanishing* point, and that the location of this point is determined solely by the directions of the lines (expressed in the camera coordinate system).

b) Now, consider sets of parallel lines lying in a plane. Show that the vanishing points corresponding to the lines of different orientation in the plane all lie on a common line, called the *vanishing* line. Derive an expression for the image of this vanishing line (note that the line will be a function of the orientation of the plane and the intrinsic parameters of the camera).

You are encouraged to use projective geometry formulations to help simplify the derivation.