

Assignment 1

Deadline: 24 Sep 2012

Lens Radial Distortion

You join a surveillance company as a specialist in computer vision. In surveillance applications, the images are often distorted by lens radial distortion. You look at a computer vision book and realized that the radial distortion equation is given as follows:

$$x' = x(1 + \kappa_1 r^2 + \kappa_2 r^4) \quad (1)$$

$$y' = y(1 + \kappa_1 r^2 + \kappa_2 r^4) \quad (2)$$

where (x, y) are the coordinates of the undistorted coordinates, (x', y') are the distorted coordinates, $r^2 = x^2 + y^2$, and κ_1 and κ_2 are the radial distortion parameters.

Your task is to estimate κ_1 and κ_2 . To solve the problem, you set up an experiment to measure the distorted coordinates (x'_i, y'_i) of a set of image points with known coordinates (x_i, y_i) , for $i = 1, \dots, n$. After the measurement, you set up the following system of linear equations to solve for κ_1 and κ_2 :

$$\mathbf{A} \mathbf{k} = \mathbf{v} \quad (3)$$

where \mathbf{A} is a matrix, \mathbf{v} is a column vector, and \mathbf{k} is the column vector

$$\mathbf{k} = \begin{bmatrix} \kappa_1 \\ \kappa_2 \end{bmatrix}. \quad (4)$$

(a) Write the matrix entries in \mathbf{v} .

(b) Write the matrix entries in \mathbf{A} .