
Image formation and Camera calibration

Exercise Sheet 2

2020

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Exercise 1 Lens distortion

A widely used model for lens distortion is the quadratic model :

$$\begin{bmatrix} u_d \\ v_d \end{bmatrix} = (1 + k_1 r^2) \begin{bmatrix} u - u_0 \\ v - v_0 \end{bmatrix} + \begin{bmatrix} u_0 \\ v_0 \end{bmatrix}$$

where $r^2 = (u - u_0)^2 + (v - v_0)^2$.

Propose a method to estimate the parameter k_1 . Illustrate your technique using a numerical example.

Exercise 2 Camera calibration

In camera calibration, given an estimated matrix M , we can recover the intrinsic and extrinsic parameters from the decomposition

$$M = K(R|T)$$

. Explain how to enforce the constraint that R is orthogonal ($R^T R = I$).

Exercise 3 Camera calibration

The Direct Linear Transform (DLT) From planar grids is a method for camera calibration. Derive the Equation $QH = 0$. Give all relevant details.

Exercise 4 Camera calibration : Zhang's method

Derive the explicit formula of the energy of the Zhang's method. Compute the gradient.

Stereo vision