Project in Multidimensional Signal Processing, (ET2546) December 2017[1]

Group Division for Target Students

Each group of two students should download its corresponding files from Its Learning according to the registered group number for laboratories in Its Learning. Then, each group has approximately three weeks to perform the tasks defined in this manuscript.

Finally, both students will be given time to demonstrate their work and to answer questions regarding the project. There would be no need for a written report unless it is specifically required by the tutor!

Image Restoration and Enhancement

The overall task in this project is to restore and enhance (as much as possible) an image which has been distorted in an imaging system with imperfect lens and CCD. Figure 1 shows the model of the distortion process.
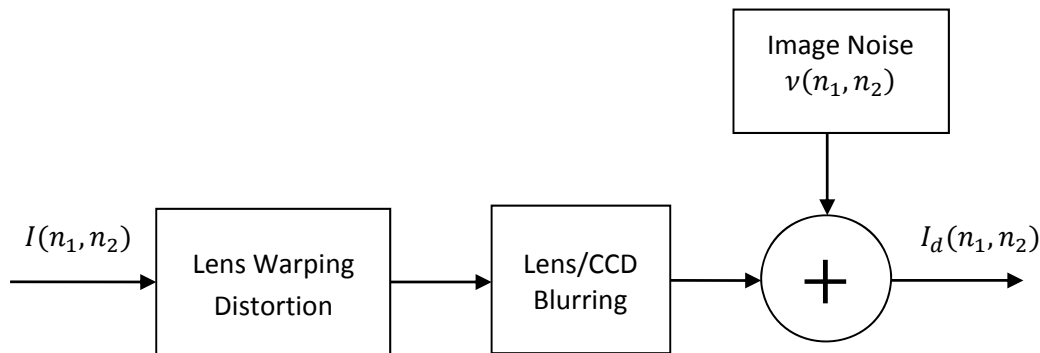

Figure 1. Model of distortion of the image

Image warping

In the first stage of the distortion model, the lens is assumed to have imperfections which cause a nonlinear distortion called **warping**; which is defined by the following model:

$$r'_{ij} = R_0 \sin\left(\frac{r_{ij}}{R_0}\right)$$

$$\theta'_{ij} = \theta_{ij}$$

Here (r_{ij}, θ_{ij}) and (r'_{ij}, θ'_{ij}) are the polar coordinates of each point, before and after the transformation respectively, with respect to a pixel with the matrix coordinates (i, j) after the transformation. The matrix coordinates (i, j), where $1 \leq i \leq 380$ and $1 \leq j \leq 380$, are referring to the resulting image and we have

$$x'_{ij} = j - 190.5$$

$$y'_{ij} = 190.5 - i$$

The parameter R_0 can be found in the mat-file for your group number, it is different for different groups! Your corrected image may be enlarged after inverse transformation to 480×480!
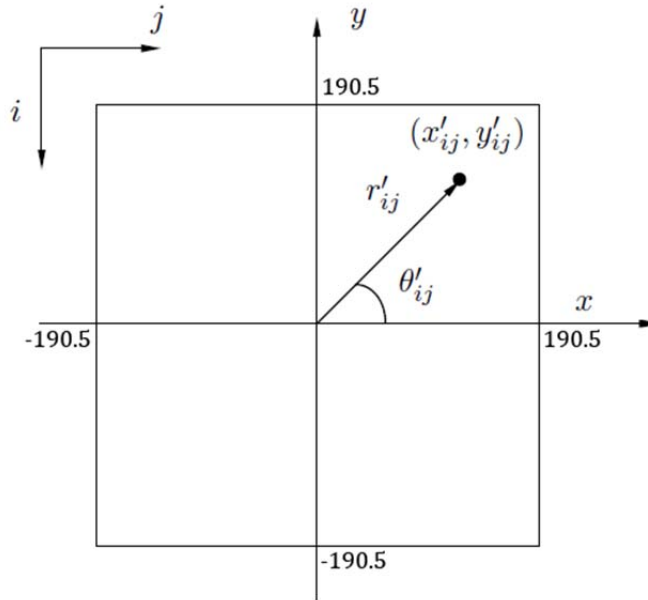

Figure 2. Output image coordinate

Blurring

In the next stage, consider the imperfection of the lens again as well as possible imperfections in the CCD detector which may cause **blurring**. In the "Blurring_spectrumXX.jpg" file for each group, the spectral characteristics corresponding to this blurring can be seen. For each group this blurring is a little bit different, so that students in each group need to think and solve it in different manner!

Noise

In this stage, consider that there exits some **additive noise**, which distorts the image. Information about this distortion may be obtained by observing the image and looking at the spectral characteristics of the noise in "NoiseSpektrumXX.jpg" file for each group. This is the last part of the distortion system and the task of each group is to solve it at the correct step in its restoration process!