RRY025-- Image Processing

Exercises 9 – Lecture 12 – Image Restoration I

EX 1. PSF and Deconvolution.

Simulate a blurred image you might get from camera motion. Create a PSF corresponding to linear motion across 15 pixels, at an angle of 0 degrees. To simulate the blur, convolve the filter with the image using imfilter().

Study the importance of knowing the true PSF in deblurring by perform the following restorations:

- 1: Using the true PSF computed from the distorted and original images (G / F) Hint: The corrected result, by definition, will look like the original.

- 2: Using an estimated PSF that is X times longer than the correct blur length (this could be a guesstimate of the true motion, gone quite a bit wrong).

- 3: Using an estimated PSF that has the correct length but wrong angle, by α degrees (e.g., error by a few degrees).

Experiment with the errors X and α in the cases 2 and 3 above. How badly wrong can your PSF be to yield “a recognizable” result?

EX 2. Effect of noise; Wiener filter.

Simulate additive noise by using normally distributed random numbers. Then add the noise to the blurred image created in Exercise 1.

Restore the blurred and noisy image using an inverse filter, assuming zero noise, and compare to the deblurring by the known PSF (point 1 in exercise 1). Can you see the effect of “amplifying noise” in the restoration?

Use now deconvwnr() with some provided noise-to-signal power ratio. Vary the ratio and see how the restoration is affected.

Try to find out by experimenting how much noise can you add to an image and still correct for it using Wiener filter and a constant noise-to-signal power ratio “guessed” via a measurement of the noise variance from some part of the image. Can you imagine possible routes to immediately improve the noise reduction via this approach?

EX 3. … continued.

Estimate the noise-to-signal power ratio as s function of frequency (this should be an array size of the original image) and deblur using deconvwnr. This should demonstrate the impact of having realistic noise-to-signal ratio in the restoration.

EX 3. Wiener filter, full application.

Reproduce with Matlab the classroom demonstration about Star Trek crew with the image collection of your choice.

Warning: Depending on the choice of the image set, it is possible that the wiener filtering does not return a very good result. The goal here is to learn the process of applying the filtering. If you choose an image set “similar” to the Star Trek crew, a good result should follow. One point for reflection can be that what makes images “similar” enough that this will work?