Assignment #4

Image Restoration

How TA evaluates your assignments:

Report: half of your score will be graded proportional to the quality of your report. You should provide a distinct section for each problem, include the desired outputs and explain what you've done. Don't forget to discuss your results as well. Note that in your reports, all your figures must have captions. It is not necessary to accommodate your source codes in your reports unless you want to refer to them. Compactness, expressiveness and neatness are of high importance.

Source Code: create an m-file for any problem and write all your codes there. If a problem consists of several sub-problems, separate them by comments in your code. Finally, name your m-files according to the number of the problems.

For evaluating your codes, TA creates two empty folders just beside your m-files, named as "input" and "output" (in the same directory). Then, he copies the input materials into the "input" folder and executes your m-files. Next, the output files will be checked in the "output" folder. Therefore, write your codes so as to load input files from an "input" folder and save the output files in an "output" folder. The exact name of the input and output files will be provided in the problem descriptions.

What to hand in:

You must submit your report (.pdf), source codes (m-files) and output files for each assignment. Zip all your files into an archive file and use the following template to name it:

HW4_XXXXX.zip

where XXXXX must be replaced with your student ID. Your file size must not be bigger than 20MB. If there is any question, don't hesitate to contact us through nasiri.hamid@gmail.com, s.izadi@live.com

The Due Date for This Assignment is: May 24

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1. Load the image "BWCheckboard.bmp" and corrupt it by the following types of noises. Show the histogram of the noisy images and analyze their forms. What do you see? Explain your observations and include the results in your report.

Salt and Pepper	Uniform	Gaussian
Rayleigh	Gamma	Exponential

Note: You are not allowed to use *imnoise* function in MATLAB, instead you may find *random* function helpful. All values should be in the range of [0,1].

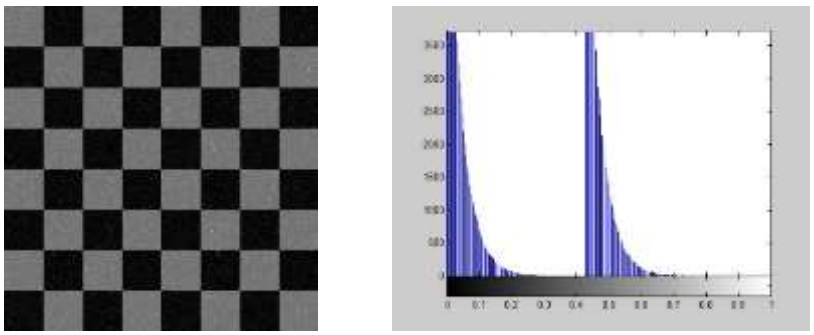

Figure 1. Image corrupted by Exponential noise and its corresponding histogram

2. The image "Niepce.jpg" is the oldest photograph which has been survived till now. Approximately in 1826 Joseph Niepce captured this photograph. The photo shows some building on a farm in France. The exposure time was 8 hours!

a) Use order-statistics filters (such as alpha-trimmed, median, etc.) and try to improve the image. If you wish, you may apply more than one filter one after the other – your choice. You may apply smoothing or sharpening, if you wish, but the final result must be worth the effort. Save all versions of your enhancements in the output directory, and include in your report.

Figure 1

3. Choose two of the images "blindstree.jpg", "blindscity.jpg", "blindsguitar.jpg", or "blindsnow.jpg". In these images, periodical noise consists of a pattern of blinds that obscures the view. Use notch-filter to remove these patterns in the selected images. Note that the images are in color, so you must use the same notch-filter in every channel and reassemble the channels to produce the restored image. Name the resultant images with the postfix of "_restored" and save them into the output directory.

4. The image "presidentBLURRED.tif" was taken with an out-of-focus lens system, and then noise became superimposed on the image. The Fourier transform of the PSF (point spread function) of the lens system is given in "presidentFILTER.tif" as an image with maximum equal to 255, but it should be scaled so that its maximum is 1.

a) Use only the intensity image of "presidentBLURRED.tif" and construct and implement a Wiener filter *W* using the filter as well as an appropriate constant *K*. Apply the Wiener filter and produce a sharpened and noise-reduced monochrome image. Name the resultant image as "presidentBLURRED_gray_restored.tiff" and save it into the output directory. Also illustrate the effect of the Wiener filter by using a too small *K* and a too large *K*.

b) Repeat the procedure on the color image. The Wiener filter must now be applied to each channel and the final image must be reassembled. Once again, illustrate the effect of too small *K* and too large *K*.

Note: *A more accurate FT of the PSF may be obtained by using presidentFILTER.mmm, changing the extension to .mat and then loading it into MATLAB. The matrix name is sHHH.*

5. Load the image "aerial.bmp" and do the following task:

a. Degrade the image to produce the **severe**, **mild** and **low** atmospheric turbulence degradations. Name the resultant images as "aerial_severe.bmp", "aerial_mild.bmp" and "aerial_low.bmp" respectively and write them into the output directory.

b. Load the image "cover.bmp" and degrade the image to produce a set of linear motion blurred images. Examine the effect of parameters *a* and *b* on the results. Include the results in your report.

Figure 5.

6. Prat [1] has proposed a "pseudo-median" filter in order to overcome some of the speed disadvantages of the median filter. For example, given a 5-element sequence {a, b, c, d, e} its pseudo-median is defined as:

$$psmed(a,b,c,d,e) = \frac{1}{2}\max[min(a,b,c) + min(b,c,d) + min(c,d,e)] + \frac{1}{2}\min[max(a,b,c) + max(b,c,d) + max(c,d,e)]$$

So for a sequence of length 5, we take the maxima and minima of all subsequences of length three. In general, for an odd-length sequence *L* of length *2n+1*, we take the maxima and minima of all subsequences of length. We can apply the pseudo-median to 3×3 neighborhood of an image, or cross-shaped neighborhoods containing 5 pixels, or any other neighborhood with an odd number of pixels.

a) Apply the pseudo-median to the following matrices, using 3×3 neighborhoods of each pixel:

8	17	4	10	15	12
10	12	15	7	3	10
15	10	50	5	3	12
4	8	11	4	1	8
16	7	4	3	0	7
16	24	19	3	20	10

1	1	2	5	3	1
3	20	5	6	4	6
4	6	4	20	2	2
4	3	3	5	1	5
6	5	20	2	20	2
6	3	1	4	1	2

b) Implement pseudo-median filter and apply it to the images "kid1.jpg" and "kid2.jpg". Does it produce good results? Explain.

Good Luck,

Hamid Nasiri

Saeed Izadi