4103026_01 多媒體技術概論

Assignment #2

Due: 11:59pm, 2020/11/04 (Wed)

Image Convolution

Implement the image convolution by Gaussian filter for image smoothing. Assume that there are zero-valued pixels around the edges to ensure the same-size image after image convolution. The following Matlab code creates a Gaussian filter with hsize = [3 3] and sigma = 1. *G = fspecial('gaussian', [3 3], 1);*

(a) Creates the Gaussian filter with hsize = 3x3, 5x5 and 7x7. Apply image convolution to image **柴犬飛飛.jpg** by three Gaussian filters, and compute the PSNR with the original image. [3 image]

(b) Creates the Gaussian filter with sigma = 1, 5 and 10 with hsize = 3x3. Apply image convolution to image **柴犬飛飛.jpg** by three Gaussian filters, and compute the PSNR with the original image. [3 image]

(c) Compare and discuss the results from the above three methods and give the meaning of PSNR values to these results.

(d) Apply Unsharp mask、Edge detection mask to the **柴犬飛飛.jpg** and show the resilts.

$$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

Note:

You should not use the MATLAB built-in functions, such as imfilter, conv2, filter2, convn, etc. You are allowed to use ‘psnr‘ provided by Matlab.

Reminder

- MATLAB built-in functions listed in problem description are prohibited.
- Your code should work correctly and the generated results (display or output files) must be consistent to your results in report.
- Report format can be in Word, PowerPoint or others that can clearly describe your work and results. You should convert your report to a PDF file.
- Your report should contain how you implement the methods and discussion about the output results.
- **Pack {student_ID}_report.pdf, the output result images, and codes in {student_ID}.zip. Your package should also contain a README file about how to execute your program.**

- **Something about PSNR**

Signal-to-Noise Ratio (SNR)

- SNR is a measure , which is used to quantify how much a signal has been corrupted by noise

$$SNR = \frac{P_{image}}{P_{noise}} = \left(\frac{A_{image}}{A_{noise}}\right)^2$$

$$SNR_{DB} = 10\log_{10}\left(\frac{P_{image}}{P_{noise}}\right) = P_{signal,DB} - P_{noise,DB}$$

$$SNR_{DB} = 10\log_{10}\left(\frac{A_{image}}{A_{noise}}\right)^2 = 20\log_{10}\left(\frac{A_{image}}{A_{noise}}\right)$$

- P_{image} – image power, P_{noise} – noise power
- A_{signal} – image amplitude, A_{noise} – noise amplitude

Mean Square Error and Standard Deviation Between Two Images

- For two *N*x*M* digital images *A* and *B* the mean square error (deviation) (MSE) is defined as follows: $$MSE = \frac{1}{NM}\sum_{i=0}^{N-1}\sum_{j=0}^{M-1}\left(A(i,j)-B(i,j)\right)^2$$
- For two *N*x*M* digital images *A* and *B* the standard deviation (the root mean square error - RMSE) is defined as follows:

$$RMSE = \sqrt{MSE} = \sqrt{\frac{1}{NM}\sum_{i=0}^{N-1}\sum_{j=0}^{M-1}\left(A(i,j)-B(i,j)\right)^2}$$

Peak Signal-to-Noise Ratio (PSNR)

$$PSNR = 10\log_{10}\left(\frac{(L-1)^2}{MSE}\right) = 20\log_{10}\left(\frac{L-1}{RMSE}\right)$$

- where *L* is the number of maximum possible intensity levels (the minimum intensity level suppose to be 0) in an image, MSE is the mean square error, RMSE is the root mean square error between a tested image and an “ideal” image