Homework 8

Noise Removal

•You must include your noisy image be for processing and after processing in your report.

•You must calculate the signal-to-ratio (SNR) for each instance and write them in your report. Use this formula if any conflicts occur.

•You are to generate gaussian noise with amplitude of 10 and 30, salt-and-pepper noise with probability 0.1 and 0.05. You must use the 3x3, 5x5 box filter and median filter, both opening-then-closing and closing-then opening filter (using the octogonal 3-5-5-5-3 kernel, value = 0) on those images. You will produce 24 images (preprocessed and postprocessed) and 4 noise figures.

•Here is a simple pseudo normal random number generator with mean 0 and variance 1. If your programming language provides an API for pseudo normal random numbers (i.e., *RandG* in BCB6(in math.hpp) and *randn* (?) in matlab, you may use it as an exception to hard core programming.

•Due date: 2018/11/27 2:20pm

Project due Nov. 27

Write the following programs

1. Generate additive white Gaussian noise
2. Generate salt-and-pepper noise
3. Run box filter *(3X3, 5X5)* on all noisy images
4. Run median filter *(3X3, 5X5)* on all noisy images
5. Run opening followed by closing and closing followed by opening

- Generate additive white Gaussian noise

$$I(nim,i,j) = I(im,i,j) + amplitude * N(0,1)$$

$N(0,1)$:Gaussian random variable with zero mean and st. dev. 1

amplitude determines signal-to-noise ratio, try 10, 30

- Generate additive white Gaussian noise with *amplitude = 10*

- Generate additive white Gaussian noise with *amplitude = 30*

- Generate salt-and-pepper noise

$$I(nim,i,j) = 0 \quad if\ uniform(0,1) < 0.05$$
$$I(nim,i,j) = 255 \quad if\ uniform(0,1) > 1 - 0.05$$
$$I(nim,i,j) = I(im,i,j) \quad otherwise$$
$$uniform(0,1) : random\ variable\ uniformly\ distributed\ over\ [0,1]$$
$$try\ both\ 0.05\ and\ 0.1$$

- Generate salt-and-pepper noise with *threshold = 0.05*

- Generate salt-and-pepper noise with *threshold = 0.1*

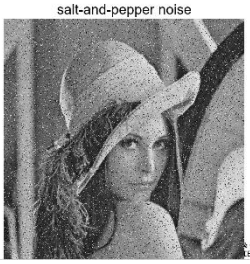
- box filter on white Gaussian noise with *amplitude = 10*

Gaussian noise

After 5x5 box filter

- box filter on salt-and-pepper noise with *threshold = 0.05*

salt-and-pepper noise



After 5x5 box filter

- median filter on white Gaussian noise with *amplitude = 10*

Gaussian noise

After 5x5 median filter

- median filter on salt-and-pepper noise with *threshold = 0.0*

salt-and-pepper noise

After 5x5 median filter

$$VS = \frac{\sum_{\forall n} (I(i,j) - \mu)^2}{\|n\|}$$

$$\mu = \frac{\sum_{\forall n} I(i,j)}{\|n\|}$$

$$VN = \frac{\sum (I_N(i,j) - I(i,j) - \mu_N)^2}{\|n\|}$$

$$\mu_N = \frac{\sum_{\forall n} (I_N(i,j) - I(i,j))}{\|n\|}$$

$$SNR = 20 \log_{10} \frac{\sqrt{VS}}{\sqrt{VN}}$$