EE5175:IMAGE SIGNAL PROCESSING

LAB-11

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EE20S049

Q1. L2 regularized NBD: PSNR vs Visual comparison - For the given image lena.png, perform NBD using L2 gradient regularization (using Eq. 4) for the following scenarios (σn - Gaussian noise σ, σb - Gaussian blur σ) :

• σn = 8, a) σb = 0.5, b) σb = 1.0, c) σb = 1.5

• σb = 1.0, a) σn = 5, b) σn = 10, c) σn = 15

For each case, vary λ from 0.01 to 2.0 in steps of 0.01 and pick the λ that gives minimum RMS error between the original image and the estimated image. Also, for each case, find the λ that gives visually the most appealing restored image (for this experiment vary λ according to your convenience). Comment on your observations

Input:

σn = 8 σb = 0.5:

Blurred Image :

DeBlurred Image

Visually appealing restored image λ=0.15

σn = 8 σb = 1.0:

Blurred Image :

DeBlurred Image

Visually appealing restored image λ=0.07

σn = 8 σb = 1.5:

Blurred Image :

DeBlurred Image

Visually appealing restored image λ=0.05

σb = 1.0 σn = 5:

Blurred Image :

DeBlurred Image

Visually appealing restored image λ=0.03

σb = 1.0 σn = 10:

Blurred Image :

DeBlurred Image

Visually appealing restored image λ=0.03

σb = 1.0 σn = 15:

Blurred Image :

DeBlurred Image

Visually appealing restored image λ=0.03

Observations: Blurring increased with the σb and the recovered image appeared more smooth as λ increases and noise reduced.By decreasing λ image becomes much sharper but noise also increases.

Q2 L2 Vs L1 regularization - For the given image lena.png, perform NBD using L2 gradient regularization (using Eq. 4) and compare the results with that of L1 gradient regularization. To obtain the result for L1 gradient regularization, we need to solve Eq. 5. Use the code 'admmfft.m' to solve the optimization problem in Eq. 5. Find the outputs from L2 and L1 regularization which is visually most appealing (by varying λ) for the following scenarios.

• σn = 1, σb = 1.5

• σn = 5, σb = 1.5

• σn = 5, h = mb-kernel.png (motion blur)

<u>σn = 1, σb = 1.5:</u>

Blurred Image :

Deblurred L1 Reg

Deblurred L2 Reg

<u>σn = 5, σb = 1.5:</u>

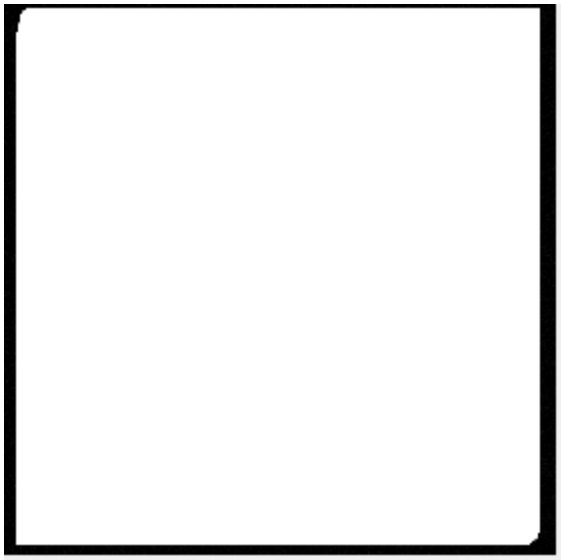
Blurred Image :

Deblurred L1 Reg

Deblurred L2 Reg

<u>σn = 5, h = mb-kernel.png (motion blur)</u>

Blurred



Deblurred L1 Reg

Deblurred L2 Reg