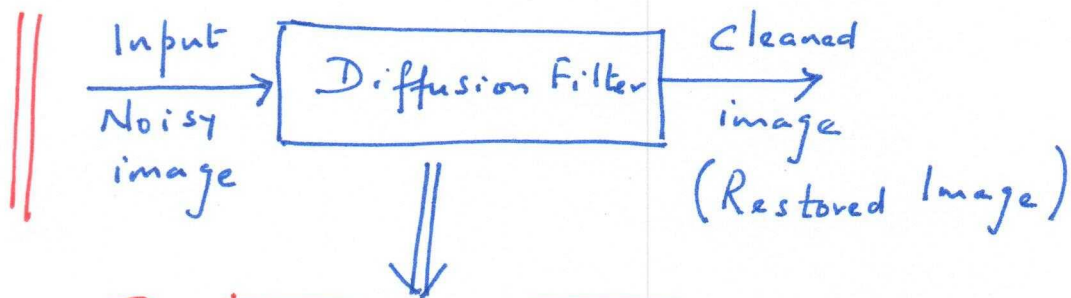


Assignment 06

Preamble:



I Linear Diffusion

$$\frac{\partial u}{\partial t} = \nabla \cdot (\nabla u) = \nabla^2 u \text{ in } \Omega \times (0, T)$$

$$u(x, 0) = u_0(x) \leftarrow \begin{array}{l} \text{Input image} \\ \text{Initial Condition } t=0 \end{array}$$

$$\frac{\partial u}{\partial \hat{n}} = 0 \text{ on } \partial \Omega \leftarrow \begin{array}{l} \text{Boundary Condition } t > 0 \end{array}$$

$$\Rightarrow u(x, t) = K_\sigma * u_0(x)$$

\uparrow
Gaussian Kernel

Gaussian Convolution

Remember $u(x, t) = u(x, y, t)$: Intensity value.

and σ is the smoothing parameter.

II

Perona-Malik Diffusion

$$\frac{\partial u}{\partial t} = \nabla \cdot (c(|\nabla u|^2) \nabla u) \quad \text{in } \Omega \times (0, T)$$

$$u(x, 0) = u_0(x) \quad \text{in } \Omega \quad t=0$$

$$\frac{\partial u}{\partial \eta} = 0 \quad \text{on } \partial \Omega \quad t > 0$$

where

$$c(|\nabla u|^2) = \frac{1}{1 + \frac{|\nabla u|^2}{\lambda^2}}$$

λ is a Contrast Parameter.

III

Catte et al Diffusion

$$\frac{\partial u}{\partial t} = \nabla \cdot (c(|\nabla u_0|^2) \nabla u) \quad \text{in } \Omega \times (0, T)$$

$$u(x, 0) = u_0(x) \quad \text{in } \Omega \quad t=0$$

$$\frac{\partial u}{\partial \eta} = 0 \quad \text{on } \partial \Omega \quad t > 0$$

where $c(|\nabla u_0|^2)$ as given in Model II.

u_0 : Linear Diffusion

Question Input

- (i) Use MATLAB for coding and appropriate MATLAB Tool Box.
- (ii) Take the standard images given in MATLAB (for example, Camel image, Lena image, peppers image, ...)
- (iii) Add noise Randomly (Random Noise) and treat it as Input Image.
- (iv) For color images do the analysis for Red, Blue and Green (RGB).

Question 1

- (1) Implement Linear Diffusion; (2) Show the image reconstruction taking different σ ; (3) Compute PSNR; (4) Compare the PSNR for $T = \frac{\sigma^2}{2}$ with $T > \frac{\sigma^2}{2}$ for a given σ ; (5) Check ^{all} the invariant properties

Question 2

- (1) Implement Perona-Malik Diffusion taking different λ ;
- (2) Compute PSNR and Compare with Question 1 ;
- (3) How do you compute λ ? ;
- (4) Demonstrate the result with the computed λ ;
- (5) What is the Best Stopping Criteria (numerically) ?

Question 3

- (1) Implement Catto et al Diffusion taking different combinations of σ and λ ;
- (2) Compute PSNR and Compare with Question 1 and Question 2 ;
- (3) What is the Best Stopping Criteria ? (numerically).

