MA5710: Mathematical Modelling in Industry

Assignment-6

Siddharth Betala

BE19B032

References used

1. Prof. Sundar's Classnotes
2. PDE-Based Diffusion Filters: Modelling Aspects by S.Sundar and J.Mahipal
3. *Algorithms for Non-Linear Diffusion: Matlab in a Literate Programming Style* by Rein van den Boomgaard
4. *The Mathematics Of Diffusion* by J. Crank
5. Comparing two matrices in MATLAB
6. Papers mentioned in the assignment

Note: I had discussed some concepts discussed in class and shared some of the references with my classmates for better understanding.

Solution for Question 1: Linear Diffusion

Filtered Image for Sigma value (σ) = 0.9

Filtered Image for Sigma value (σ) = 1.5

Please refer to BE19B032_Q1.m for trying out the code for different sigma (σ) values and getting the corresponding PSNR values and property checks.

After running the code for different values, I observed the following:

- For σ < 1, there is hardly any effect of filtering.
- For σ > 1, there is too much of a smoothing effect on the image.
- The extent of smoothing is similar in all directions.
- For σ = 1, T = 0.5.
- For T > 0.5, PSNR value starts to decrease.
- This method leads to blurring of edges.

Solution for Question 2 (Perona-Malik Diffusion)

Please refer to BE19B032_Q2.m for trying out the code for different lambda (λ) values and getting the corresponding PSNR values.

After running the code for different values, I observed that:

- For some specific lambda (λ) values, the PSNR is higher for Perona-Malik Diffusion than that of linear diffusion.
- The maximum PSNR for Perona-Malik diffusion is higher than the maximum PSNR for linear diffusion.
- However, for meager values of lambda (λ), the PSNR falls below that of linear diffusion as well. Thus, Perona-Malik diffusion gives better PSNR than linear diffusion at the right contrasting parameter.

(iii) For finding the optimal contrasting parameter, we find the top 5 percentile mark of the Histogram Cumulative Distribution Function. From the code, the optimal contrasting parameter is found to be **0.0588** for this image.

(v) From the list of PSNR values, it is seen that the best stopping criterion is around **t = 1.5**.

Solution for Question 3 (Catte et al. Diffusion)

For Catte et al. Diffusion, there is a strong dependence on sigma (σ). For the right lambda (λ) and sigma (σ) values, I observed that the PSNR value for Calle et al. diffusion is higher compared to the Perona-Malik and linear diffusion cases. Like the Perona-Malik case, the PSNR is low for most lambda-sigma pairs.

Hence, the best PSNR values for Catte > PM > Linear.

Filtered Image for Sigma value (σ) = 1 and lambda value (λ) = 0.05

At the optimal lambda (0.0588) and sigma = 1, we see that the best stopping criterion is roughly t=0.6. (this criterion is dependent on the sigma value taken)