

Medical Image Processing

Instructor: Prof. Jayanthi Sivaswamy
IIIT Hyderabad

Assignment 4
February 15, 2021

Instructions:

- All your code should be uploaded in a folder named as 'Code'.
- The report should be in a '.pdf' format with your roll number as the filename.
- In the case of computing-based questions, the pdf should clearly report the experimental settings, results/observations and a discussion/conclusions based on the results.
- Upload the code and report in a single .zip file which has the following naming format: r_An where r is your full roll no; n is the assignment number.
- Any report without conclusions/recommendations will get only 50% marks.

Outline: *In this assignment, you will work on different algorithms for denoising medical images and compare the results across.*

Note: You are free to use any available code/packages online for the NLM variants or you can implement them on your own. You can use either MATLAB or Python in this assignment

DATA: The data required for this assignment can be downloaded from the following link:
https://iiitaphyd-my.sharepoint.com/:f:/g/personal/prathyusha_akundi_research_iiit_ac_in/EtM07z42tFhIoUBT-yiN8yUBXdadYONz19CA23nWtHp80Q?e=UY1f9v

Question 1a: Plot the diffusion functions proposed by (i) Perona-Malik[1] and (ii) Black[2]. Report your observations

Question 1b: Use the above non-diffusion based methods to remove noise in following images: (i) NoisyPhantom.tif (ii) OCTNoise.png and (iii) Fundus.png. Report the effect of the parameter K on the performance and compare the results of these algorithms using PSNR and MSE metrics

Question 2: Using NLM[3], ONLM[4], and ANLM[5] algorithms denoise the MRI scans given in 'MRI_data folder'. Compare the results using PSNR and MSE metrics and comment on the performance on each of the algorithms.

Question 3: Use XNLM algorithm[6] to denoise 'Chest_XRay.jpg' image. Also show the absolute difference between original image and the denoised image. Report the observations.

References

- [1] Pietro Perona and Jitendra Malik, “Scale-space and edge detection using anisotropic diffusion,” *IEEE Transactions on pattern analysis and machine intelligence*, vol. 12, no. 7, pp. 629–639, 1990.
- [2] Michael J Black, Guillermo Sapiro, David H Marimont, and David Heeger, “Robust anisotropic diffusion,” *IEEE Transactions on image processing*, vol. 7, no. 3, pp. 421–432, 1998.
- [3] Antoni Buades, Bartomeu Coll, and J-M Morel, “A non-local algorithm for image denoising,” in *2005 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR’05)*. IEEE, 2005, vol. 2, pp. 60–65.
- [4] Pierrick Coupé, Pierre Yger, Sylvain Prima, Pierre Hellier, Charles Kervrann, and Christian Barillot, “An optimized blockwise nonlocal means denoising filter for 3-d magnetic resonance images,” *IEEE transactions on medical imaging*, vol. 27, no. 4, pp. 425–441, 2008.
- [5] José V Manjón, Pierrick Coupé, Luis Martí-Bonmatí, D Louis Collins, and Montserrat Robles, “Adaptive non-local means denoising of mr images with spatially varying noise levels,” *Journal of Magnetic Resonance Imaging*, vol. 31, no. 1, pp. 192–203, 2010.
- [6] Paolo Irrera, Isabelle Bloch, and Maurice Delplanque, “A flexible patch based approach for combined denoising and contrast enhancement of digital x-ray images,” *Medical image analysis*, vol. 28, pp. 33–45, 2016.