ISSN: 2581-3404 (Online)
International Journal of Innovative Research in Technology and Management, Vol-4, Issue-3, 2020.

Comparative Performance Evaluation of Noise Reduction Filters for Image

Naveen chaturvedi[1], Prof. Jitendra Mishra[2]

[1]M. Tech Scholar, Department of EC, PCST, Bhopal (India)

[2]Head & Professor, Department of EC, PCST, Bhopal (India)

ABSTRACT

Image Denoising is an important pre-processing task before further processing of image like segmentation, feature extraction, texture analysis etc. The purpose of denoising is to remove the noise while retaining the edges and other detailed features as much as possible. This noise gets introduced during acquisition, transmission & reception and storage & retrieval processes. As a result, there is degradation in visual quality of image. During acquisition, transmission, storage and retrieval processes an image signal gets contaminated with noise. In this paper we present the comparative performance evaluation study for the various noise reduction filters for the image. Here we used the filters like winner filter, point spread function filter for the cameraman image and apple image etc.

Keywords:- Image denoising, signal-to-noise ratio, Total variation, Object recognition, Image processing.

INRODUCTION

Digital images play an important role both in daily life applications such as satellite television, magnetic resonance imaging, computer tomography as well as in areas of research and technology such as geographical information systems and astronomy. Data sets collected by image sensors are generally contaminated by noise. Imperfect instruments, problems with the data acquisition process, and interfering natural phenomena can all degrade the data of interest [5].

Noise is undesired information in images like gaussian, salt & pepper, speckle and Poisson. Unfortunately a signal or an image is corrupted by noise during its (transmission or acquisition) or blur from through (camera motion, object motion, an optical system that is outside of concentrate and the disturbance in atmospheric). The denoising process is the one of the applications of the DWT, which leads to remove the noise from images. The goal of image denoising is removing noise and preserving useful information. Wavelet denoising image is the process the noise removal by using wavelet thresholding based on optimal selection of threshold rules. Wavelet thresholding technique was non-linear, which is made by using wavelet coefficient, where each coefficient is compared with threshold, if the threshold value is bigger than coefficient, it is kept otherwise represent to zero.

Furthermore, noise can be introduced by transmission errors and compression. Thus, denoising is often a necessary and the first step to be taken before the images data is analyzed. It is necessary to apply an efficient denoising technique to compensate for such data corruption. Image denoising still remains a challenge for researchers because noise removal introduces artifacts and causes blurring of the images. Noise modeling in images is greatly affected by capturing instruments, data transmission media, image quantization and discrete sources of radiation.

Different algorithms are used depending on the noise model. Most of the natural images are assumed to have additive random noise which is modeled as a Gaussian. Speckle noise [1] is observed in ultrasound images whereas Rician noise [2] affects MRI images. Image Denoising has remained a fundamental problem in the field of image processing. Wavelets give a superior performance in image denoising due to properties such as sparsity and multi-resolution structure. With Wavelet Transform gaining popularity in the last two decades various algorithms for denoising in wavelet domain were introduced.

The focus was shifted from the Spatial and Fourier domain to the Wavelet transform domain. Ever since Donoho's Wavelet based thresholding approach was published in 1995, there was a surge in the denoising papers being published. Although Donoho's concept was not revolutionary, his methods did not require tracking or correlation of the wavelet maxima and minima across the different scales [13]. Thus, there was a renewed interest in wavelet based denoising techniques since Donoho [4] demonstrated a simple approach to a difficult problem. Researchers published different ways to compute the parameters for the thresholding of wavelet coefficients. Data adaptive thresholds [6] were introduced to achieve optimum value of threshold. Later efforts found that substantial improvements in perceptual quality could be obtained by translation invariant methods based on thresholding of an Undecimated Wavelet Transform [7].

These thresholding techniques were applied to the no orthogonal wavelet coefficients to reduce artifacts. Multiwavelets were also used to achieve similar results. Probabilistic models using the statistical properties of the wavelet coefficient seemed to outperform the thresholding techniques and gained ground. Recently, much effort has been devoted to Bayesian denoising in Wavelet domain. Hidden Markov Models and Gaussian Scale Mixtures have also become popular and more research continues to be published. Tree Structures ordering the wavelet coefficients based on their magnitude, scale and spatial location have been researched.

Data adaptive transforms such as Independent Component Analysis (ICA) have been explored for sparse shrinkage. The trend continues to focus on using different statistical models to model the statistical properties of the wavelet coefficients and its neighbors. Future trend will be towards finding more accurate probabilistic models for the distribution of non-orthogonal wavelet coefficients.

II SIGNAL-TO-NOISE RATIO (SNR)

The noise is unwanted information that corrupts the image that used in distorting part of image information. An image is contaminated with noise through its transmission or acquisition. Noise elimination is a significant process in image processing. There are various models of noise like additive and multiplicative. For various purposes, remote sensing images and data are employed to extract certain parameters, detect the presence or extent of different phenomena, or for interpretation. These applications require high signal-to-noise ratio (SNR) data to achieve good performance. The data that are contaminated with noise can cause a failure to extract valuable information and hamper further interpretation. In presence of noise in the image, extraction of all the useful information becomes difficult and noise can lead to artifacts and loss of spatial resolution in the image.

III PRPOSED AND EXPERIMENTAL WORK

There are several methods for noise elimination, they are linear and nonlinear filtering. Image denoising techniques will remove these kinds of noises while keeping the significant properties. Mean and median filters are represented spatial filters that utilized to eliminate the noise from images. The drawback of them is that they are make a soft data to minimize noise and blur edges in image. The detail coefficients are used for removing noise from image. Removing the noise from the signal will ease the processing. A good image denoising system is the removing noises in addition to edges are kept.

The filter was introduced by Norbert wiener in 1940's. A major contribution was the use of a statistical model for the estimated signal. It is solve the estimated problem for stationary signal. Wiener filters are a class of optimum linear filters which involve linear estimation of a desired signal sequence from another related sequence. In the statistical approach to the solution of the linear filtering problem, we assume the availability of certain statistical parameters (e.g. mean and correlation functions) of the useful signal and unwanted additive noise. The problem is to design a linear filter with the noisy data as input and the requirement of minimizing the effect of the noise at the filter output according to some statistical criterion. A useful approach to this filter-optimization problem is to minimize the mean-square value of the error signal that is defined as the difference between some desired response and the actual filter output. For stationary inputs, the resulting solution is commonly known as the Weiner filter. Its main purpose is to reduce the amount of noise present in a signal by comparison with an estimation of the desired noiseless signal.

The proposed system consists of main four stages are discrete wavelet transform, denoising wavelet, fusion stage and inverse discrete wavelet transform. The key idea of this proposed is applying DWT on a set of images with two decomposition level. Then is utilized denoising wavelet techniques on the detail coefficient which is performed by soft and hard thresholding with using universal and Bayes thresholds. After that the optimal sub bands for fusion process is selected. Finally, apply IDWT process on fused image to convert it to spatial domain for purpose getting on the output image.

Fig 1. Upload the original image of cameraman for experimental work.

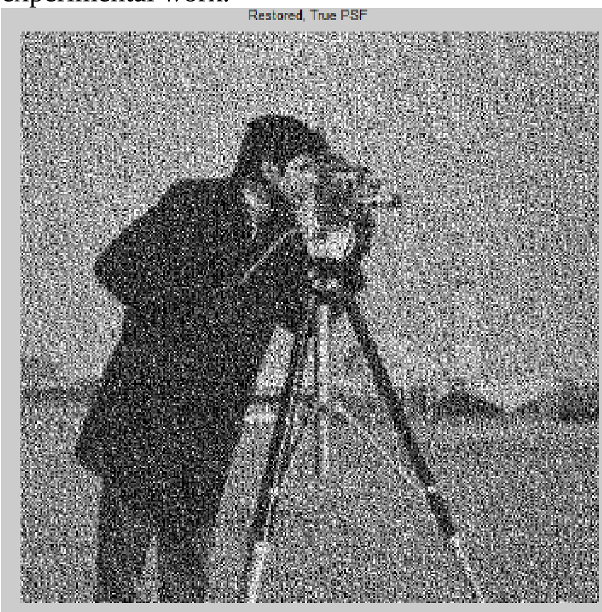

Fig 2. Restored image with true SAF.

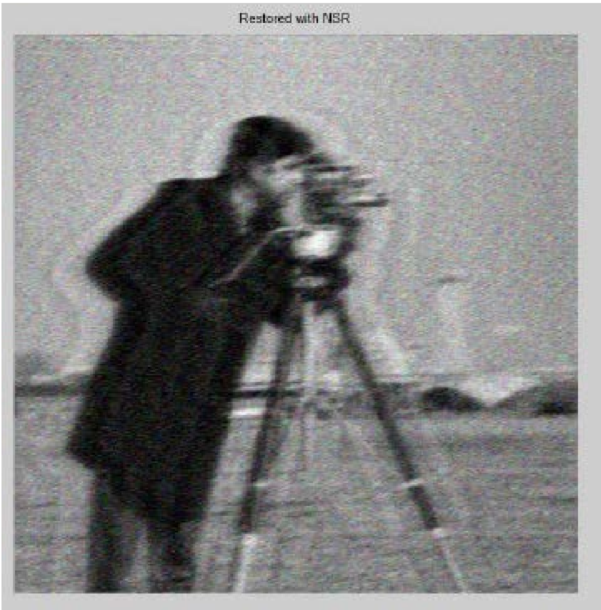

Fig 3. Restored image with noise to signal ratio.

IV CONCLUSION AND FUTURE SCOPE

Image processing is a field that continues to grow, with new applications being developed at an ever increasing pace. It is a fascinating and exciting area with many applications ranging from the entertainment industry to the space program. Image processing is any form of signal processing for which the input is an image, such as photographs or frames of video and the output of image processing can be either an image or a set of characteristics or parameters related to the image. The image denoising naturally corrupted by noise is a classical problem in the field of signal or image processing. Images are often corrupted with noise during acquisition, transmission, and retrieval from storage media.

REFERENCES:

[1] Yuan Liu, Stephane Canu, Paul Honeine, Su Ruan, "Mixed Integer Programming For Sparse Coding: Application to Image Denoising", IEEE Transactions on Computational Imaging, Vol-5, 2019, pp 354-365,

[2] JunFang Wu, XiDa Lee, "An Improved WNNM Algorithm for Image Denoising", IOP Conf. Series: Journal of Physics, 2019, pp 1-7.

[3] Ling Ding, Huyin Zhang, Jinsheng Xiao, Junfeng Lei, Fang Xu, Shejie Lu, "Mixed Noise Parameter Estimation Based on Variance Stable Transform", Computer Modeling in Engineering & Sciences CMES, 2020, pp 675-690. 2020.

[4] Yuda Song, Yunfang Zhu, Xin Du, "Dynamic Residual Dense Network for Image Denoising", Sensors 2019, 19, pp 1-14.

[5] Xiangyang Kong, Yongqiang Zhao, Jize Xue, Jonathan Cheung-Wai Chan, "Hyperspectral Image Denoising Using Global Weighted Tensor Norm Minimum and Nonlocal Low-Rank Approximation", remote sensing, 2019, pp 1-22.

[6] Qiongshuai Lyu, Min Guo, Miao Ma, Richard Mankin, "External prior learning and internal mean sparse coding for image denoising", J. Electron. Imaging, 2019, pp 1-17.

[7] Madhu Golla, Sudipta Rudra, "A Novel Approach of K-SVD-Based Algorithm for Image Denoising", IGI Global, 2019, pp 354-357.

[8] Rui Lai, Yiguo Mo, Zesheng Liu, Juntao Guan, "Local and Nonlocal Steering Kernel Weighted Total Variation Model for Image Denoising", Symmetry 2019, pp 1-16.

[9] Zhenhua Gan, Fumin Zou, Nianyin Zeng, Baoping Xiong, Lyuchao Liao, Han Li, Xin Luo, Min Du, "Wavelet Denoising Algorithm Based on NDOA Compressed Sensing for Fluorescence Image of Microarray", IEEE access, 2018, pp 13338-13346.

[10] Arundhati Misra, B Kartikeyan and S Garg "Wavelet Based SAR Data Denoising and Analysis", IEEE, 2014, Pp 1087-1092.

[11] Yatong Xu, Xin Jin and Qionghai Dai "Spatial-temporal Depth De-noising for Kinect based on Texture Edge-assisted Depth Classification", Digital Signal Processing, 2014, Pp 327-332.

[12] Zayed M. Ramadan "A New Method for Impulse Noise Elimination and Edge PreservationUne nouvelle méthode pour l'élimination du bruit impulsif et la préservation des contours", Electrical And Computer Engineering, 2014, Pp 2-10.

[13] Tae Hyun Kim and Kyoung Mu Lee "Segmentation-Free Dynamic Scene Deblurring", IEEE, 2014, Pp 2766-2773.

[14] Mostafa Karbasia, Sara Bilala, Reza Aghababaeyanb, Abdolvahab Ehsani Radc, Zeeshan Bhattia and Asadullah Shaha "Analysis And Enhancement of The Denoising Depth Data Using Kinect Through Iterative Technique", Jurnal Teknologi, 2016, Pp 185-0193.

[15] Linlin Xu, Graduate Student Jonathan Li, Yuanming Shu and Junhuan Peng "SAR Image Denoising via Clustering-Based Principal Component Analysis", IEEE, 2014, Pp 6858-6869.

[16] Ladan Ebadi, Helmi Z. M. Shafri, Shattri B. Mansor and Ravshan Ashurov "A review of applying second-generation wavelets for noise removal from remote sensing data", springer, 2013, Pp 2679-2690.

[17] Charles-Alban Deledalle, Loıc Denis, Florence Tupin, Andreas Reigber and Marc Jager "NL-SAR: a unified Non-Local framework for resolution-preserving (Pol)(In)SAR denoising", HAL, 2014, Pp 1-18.

[18] Mario Mastriani, and Alberto E. Giraldez "Neural shrinkage for wavelet-based SAR despeckling", arxiv, 2016, Pp 1-12.

[19] Arundhati Misra, B Kartikeyan and S Garg "Wavelet Based SAR Data Denoising and Analysis", IEEE, 2014, Pp 1087-1092.

[20]Yatong Xu, Xin Jin and Qionghai Dai "Spatial-temporal Depth De-noising for Kinect based on Texture Edge-assisted Depth Classification", Digital Signal Processing, 2014, Pp 327-332.

[21] Tae Hyun Kim and Kyoung Mu Lee "Segmentation-Free Dynamic Scene Deblurring", IEEE, 2014, Pp 2766-2773.

[22]Mostafa Karbasia, Sara Bilala, Reza Aghababaeyanb, Abdolvahab Ehsani Radc, Zeeshan Bhattia and Asadullah Shaha "ANALYSIS AND ENHANCEMENT OF THE DENOISING DEPTH DATA USING KINECT THROUGH ITERATIVE TECHNIQUE", Jurnal Teknologi, 2016, Pp 185-0193.

[23]Linlin Xu, Graduate Student Jonathan Li, Yuanming Shu and Junhuan Peng "SAR Image Denoising via Clustering-Based Principal Component Analysis", IEEE, 2014, Pp 6858-6869.

[24] Ladan Ebadi, Helmi Z. M. Shafri, Shattri B. Mansor and Ravshan Ashurov "A review of applying second-generation wavelets for noise removal from remote sensing data", springer, 2013, Pp 2679-2690.

[25] Charles-Alban Deledalle, Loıc Denis, Florence Tupin, Andreas Reigber and Marc Jager "NL-SAR: a unified Non-Local framework for resolution-preserving (Pol)(In)SAR denoising", HAL, 2014, Pp 1-18.

[26] Mario Mastriani, and Alberto E. Giraldez "Neural shrinkage for wavelet-based SAR despeckling", arxiv, 2016, Pp 1-12.

[27] Asoke Nath "Image Denoising Algorithms: A Comparative study of Different Filtration approaches used in image restoration", Communication Systems and Network Technologies, 2013, Pp 157-163.

[28] Mario Mastriani "Denoising and compression in wavelet domain via projection onto approximation coefficients", arxiv, 2016, Pp 1-11.

[29] Kanika Gupta and S.K Gupta "Image Denoising Techniques- A Review paper", IJITEE, 2013, Pp 6-9.

Naveen Chaturvedi received his Bachelor`s degree in Electronics & comunication engineering, JNCT, Bhopal, M.P., in 2013. Currently he is pursuing Master of Technology Degree in Electronics & Comunication (Digital communication) from PCST, (RGPV), Bhopal, Madhya Pradesh India. His research area include wireless communication.

Mr. **Jitendra Mishra** he is Associate Professor and Head of the Department of Electronics and communication in PCST, Bhopal (RGPV). His received Master of Technology and Bachelor's of engineering respectively in Digital communication from BUIT, Bhopal and from RGPV, Bhopal. He has more than 12 years of teaching experience and publish 50+ papers in International journals, conferences etc. His areas of Interests are Antenna & Wave Propagation, Digital Signal Processing, Wireless Communication, Image Processing etc.