A Review of Image Denoising Techniques

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Abstract— Image Denoising is the process with which we reconstruct a signal from the noisy one or we can say remove the unwanted noise in order to restore the original image. Some sort of improvement or enhancement in images can be achieved with the help of image filtering. In this paper a review of some significant work in the area of image denoising is present. Also, we have studied an efficient image filtering technique using fuzzy logic in this paper. The proposed method used fuzzy membership functions in order to replace the noisy pixels based on the degree of membership of the neighboring pixels within a filter mask.

Key words: Image Denoising, Image Processing, Fuzzy Logic

I. INTRODUCTION

Digital images are prone to a variety of types of noise. In the image acquisition process noise is the result of errors that shows pixel values that do not reflect the true intensities of the real scene. There are various ways that noise can be introduced into an image, depending on how the image is created. For example:

1) If the images are scanned from a photograph made on film, the film grain is a source of noise. Noise can also be the result of damage to the film, or be introduced by the scanner itself.
2) If the image is taken directly in a digital format, then the mechanism for gathering the data can introduce noise.
3) Electronic transmission of image data can introduce noise.

Image denoising is one of the most important and essential component of image processing. The aim of denoising algorithm is to remove the unwanted noise while preserving the important signal features as much as possible. Noise elimination introduce artifacts and blur in the images. So image denoising is still a challenging task. Image filtering can be very useful in many applications like image analysis, computer vision, robot navigation, medical imaging, security surveillance, and so on.

Digital image processing is the use of computer algorithms to perform image processing on digital images. Digital image processing is the method to convert the images into a digital form and perform some specific operations on it, for getting an enhanced image or to extract some useful information from it. Digital image processing is the processing of images with the help of mathematical operations by using any form of signal processing for which the input is an image, a series of images, or a video, such as a photograph and a video frame and the output of image processing is either an image or a set of characteristics or parameters related to that image.

II. LITERATURE SURVEY

Xin Zhang et al, 2016 [1] In this paper, he used a depth image denoising using a light convolutional network. The network consists of three layers for high dimension projection, missing data completion and image reconstruction. He jointly use both depth and visual images as inputs. For the gray images, he design a pre-processing procedure to enhance the edges and remove unnecessary detail. For the depth image, he proposed a data augmentation strategy to regenerate and increase essential training data and after that he concluded that a very high computational efficiency and performance for pixel-wise denoising and enhancement is achieved. He believed that this model can be applied for real-time processing in real-world depth image pre-processing applications.

Cong Weihua et al, 2016 [2] He used a three-dimensional block matching image de-noise algorithm to suppress the speckle noise in SAS imaging processing. It adopts adjacent sub-blocks of the images for 3D transformation, and attains image de-noising by processing in the transform domain. So, an improved three-dimensional block matching image de-noising algorithm is used for 3D sonar image processing, in which the effectiveness of image denoising is produced by ensemble average and transform domain processing and because of the greater quantity of elements and greater similarity among the sub-blocks, the image processing results shows that the background noise is properly suppressed.

Xuefeng LIU et al, 2016 [3] In this paper a new method is used to remove non-white noise from hyperspectral images (HIS). It dose a prewhitening procedure to the original hyperspectral images (HIS) to change the noise being a white one, multidimensional Wiener filtering (MWF) can help to denoise the prewhitened data, and at last an inverse prewhitening processing is used to rebuild the estimated signal. Compare with other denoising methods he concluded that this approach is promising prospects in this field.

Nithish Divakar et al, 2016 [4] Non-local means is a state-of-the-art image denoising algorithm which uses weighted contribution of similar patches to denoise images. But its asymptotic complexity upper bounds are the degree to which the algorithm can be accelerated. This paper shows the approximate version of the same which uses Locality Sensitive Hashing to reduce the complexity and also he developed the denoising algorithm which follows a generic framework laid out by NL-means algorithm. This new algorithm provides a very good denoising performance while incurring a fraction of execution time. Moreover, his algorithm is very little position dependent branching and it is a very good algorithm for parallelization.

An JingYu et al, 2016 [5] This paper shows a new method for image denoise for furnace flame images. Furnace flame images mainly contains impulse noise and Gaussian noise. For this feature, the denoise method of median filter and wavelet transform combined are proposed. The specific method is: Firstly, remove the impulsive noise from furnace flame with adaptive weight median filter and then decompose the images with Daubechies. At last effective filtering are
performed in different sub-bands. He concluded that the proposed method can effectively remove the impulse noise and Gaussian noise and it improves the quality of the flame images and also it is better than the traditional denoising method.

Nikita Joshi et al, 2016 [6] Non local means filtering technique is a popular denoising technique for MR images. The objective of this paper is to denoise MRI by using a median and wiener filter in combination with the Non local means filtering technique. Performance of this approach has been assessed qualitatively and quantitatively with PSNR and MSE measures on various simulated MR images of brain. She concluded that better results are obtained as compared to NLM. But, computation time is increased.

Akash Kethwas et al, 2015 [7] used a mixed domain image denoising method based on the wavelet transform median filter and non-linear diffusion. The wavelet transform is used to convert the spatial domain image into wavelet domain coefficients. Wavelet transform produce approximation, horizontal, vertical or diagonal detailed coefficients which shows the various spatial frequency bands. These coefficients either filtered by wiener filter or fuzzy filter separately. This paper shows the two different techniques for image denoising, first technique is ATMAV (Asymmetrical Triangular Moving Average Filter) with HAAR wavelet transform and second is ATMED (Asymmetrical Triangular Median Filter) with HAAR wavelet transform. Both techniques are based upon fuzzy logic based filters and he conclude that ATMAV with HAAR give vulnerable results for image denoising, while HAAR with ATMED wavelet gives better result as compared to earlier techniques and also PSNR and mean square error represents that HAAR with ATMED wavelet is better technique for image denoising.

Qiaoling Yi et al, 2014 [8] focused on a Curvelet transform. The Curvelet transform is a new transform for image denoising. It makes the line as a basic cell for transforming, so it is able to show the smooth and edge parts of image with sparsity. Curvelet transform can also provide stable, efficient, and near-optimal representations of otherwise smooth objects discontinuity along smooth curves. It is a multiscale transform which is more adaptable to the image processing after wavelet transform and efter Comparing the results with various denoising approach, either from the visual effect or from data such as MSE, SNR, he get the conclusion that the effect of Curvelet denoising is better than the others.

Debajyoti Misra et al, 2013 [9] He used the Genetic Algorithm for removal of Rician Noise. Genetic Algorithm (GA) used a large number of solutions, instead of a single solution for searching. Rician noise mainly occurs in low signal to noise (SNR) regions. True low signals are corrupted due to the presence of Rician noise and measurements gets hampered in low SNR regions. The noise-reduction filtering (or denoising) are accomplished by Genetic Algorithm. A fresh genetic operator is used which combines crossover and adaptive mutation to improve the convergence rate and solution quality of GA. This technique reduces the standard deviation and lowers the rectified noise. There are various evolutionary optimization algorithms which is applied for image enhancement but GA is assumed to achieves better results, faster processing time and easy implementations with satisfactory performance. He concluded that GA based filter has provided high level of noise reduction which is useful both from the visual inspection as well as quantitative analysis of the performance matrix consider in the research.

Wen-jing Shao et al, 2012 [10] used a hybrid method for image denoising. Digital image processing is used to enhance resolution and noise reduction effectively and thus improves image quality with less cost. Aiming at reducing noise in CT images, this paper represents a hybrid algorithm with more improvements on existing algorithms including the constrained least-square-filter algorithm, the Lucy-Richardson algorithm or non-local-means-filter algorithm and wavelet-filter algorithm. After study of these algorithms, he conduct a hybrid approach which means that to combine two or more methods together for de-noising. He concluded that the algorithm combining with Lucy-Richardson algorithm and non-local means filter algorithm achieves the better performance in de-noising and raising image resolution.

XiangBo LIN et al, 2011 [11] This paper used a recent proposed transformation domain filter algorithm (BM3D) using the sparseness and selfsimilarity properties of the images are presented or adapted to lower the specific Rician distribution noise in MRI magnitude images. It is used to increase the SNR of different MRI images without affecting the noticeable structures in the images. He compared the R-BM3D method with the stateof-the-art transformation domain filter method (ODCT3D), which is proved to be superior for the blockwise nonlocal means filter and the wavelet sub-band coefficient mixing method and the anisotropic diffusion filter. He concluded that Comparative experimental results indicates that the R-BM3D is quite competitive in RMSE metrics, filter time and visual inspection.

Xu Chen et al, 2011 [12] This paper uses a secondary image denoising model based on the local energy operator. Details and textures will be compromised in the process of denoising, a local energy operator and a noise-texture operator are used. This is combined with Weickert’s coherence-enhancing model, textures and details filtered by mistake during the process of denoising can be extracted. After refilling the detailed information into the denoised image, the final denoised image can be obtained. He concluded that new method can be a follow-up process of any other denoising methods and the results will be improved after the secondary denoising process.

Li Xingmei et al, 2010 [13] used a Bayesian shrink threshold for image denoising. Bayesian shrink threshold is more selective threshold among all thresholds which have expressions. But the Bayesian shrink threshold do not connect with the value of the wavelet coefficients. To avoid this problem, an improved algorithm is proposed. In this algorithm, the larger coefficients are considered to be signal and given smaller thresholds, while the smaller coefficients are considered to be noise and given larger thresholds and he concluded that a new self-adaptive algorithm which they use to calculate the threshold which can change with the threshold and the large coefficients gives small threshold to keep the image while small coefficients gives large threshold to suppress the noise and he also get the result that he achieves better result.
Yaping Li et al, 2010 [14] If adaptive local smoothing in the process of image denoise is applied then the image edge will show the blurred image. Wavelet analysis is a powerful tool in image enhancement. He adopt the coupling method of adaptive local smoothing and wavelet analysis to cope with noisy maize leaf image. He concluded that proposed algorithm can give better image definition and contrast than the wavelet method and the adaptive local smoothing method. Simulation results shows that the proposed method keeps the merits of the wavelet and the adaptive local smoothing method.

III. CONCLUSION
Image denoising is a fundamental problem in image processing. After studying a number of methods in the survey, it is concluded that some methods suppressed impulse noise at their best while some methods also have a computational complexity in algorithms. Future work includes adaptation of new filtering schemes to suppress the noise in Color images which not only give better visual quality in images but also give better results in Edge Preservation.

REFERENCES