

Image Processing Evaluation: A Review

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Abstract— Image processing domain has been seeing lots of extensions and appraises since its conceptualization. It's said nothing can match which is seen by natural eye retina but in order to capture the memories, scientific data images have been clicked and video have been created. But when it comes to data collection the quality of image being captured becomes of crucial importance and this has led to establishment of image processing field. It's not only about image capturing but it involves lot of background like capturing the exact characteristics of image to convert it into a digital signal so that it can be transmitted and restored back retaining the same characteristic as that of original image. Its common phenomenon that whenever any data is being transmitted via any media, data is vulnerable to get noisy and loose its original characteristics. Our main attempt in this thesis is to bring the innovative concept into discussion for image processing and de-noising. For better understanding; correlation among two phenomenon has been explored like Enhanced Empirical Mode Decomposition and wavelet transform keeping different parameters like Mean square error & Peak signal to noise ratio under observation. In this thesis a concept of smart Empirical mode decomposition is used which is blend of Enhance Empirical Mode Decomposition and wavelet thresholding along with relative differentiation between different kinds of thresholding analysis. In lieu of coming up with more possible combinations for best of the de-noising technique a new act threshold limitation has been put low pass components or the other way is to keep it intact before adding inverse DWT. Increasing one more step towards image reconstruction, algorithm has been tested with image blurring error and it has been noticed that the proposed scheme works more efficiently for image de-blurring then de-noising. In previous study it is always found that, there is a research gap to decide which IMFs must be used for reconstruction once all are extracted. Hurst exponent has been sued to choose potential IMF. The whole algorithm is implemented in MATLAB R2013a's image processing toolbox along with graph visualization toolbox is used. Results are compared on the basis of peak signal to noise ratio (PSNR) and mean square error (MSE).

Key words: MATLAB, PSNR, MSE

I. INTRODUCTION

Image processing is a domain that is already established and still growing at a rapid pace with new applications/functionalities getting created at an expedited pace. It is a desirable and exciting area to be concerned in these days with application areas starting from the industry to the programme. One of the foremost interesting facets of this data revolution is that the ability to send and receive complicated information that transcends normal written communication. Best part of this field is that it can applied from huge space images researches to defence image searches to medical industry's human body image researches and processing. Visual information, transmitted via digital images, is the most pre-dominant method for pictorial

communication in today's era. Image process is any type of signal processing that the input is a picture, such as picture frames or series of picture frames making videos and also the output of image process will be either a picture or a collection of characteristics or parameters associated with the image. Most of the imaging techniques involve considering the image as a 2-dimensional signal and make them undergo through digital/visual signal-processing techniques. Some of the applications in image process need the analysis to be localized within the abstraction domain. The classical way of doing this is through what's referred to as Window Fourier transform. Central idea of windowing is mirrored in STFT - Short Time Fourier transform. STFT exhibits the presence of the local frequency component in signal within small window time frame and same philosophy can be applied to a two-dimensional abstraction image wherever the localized frequency parts could also be determined from the windowed transform. This is one in all the premise of the conceptual learning of wavelet transforms. Hence entire concept of thesis is revolving around wavelet transforms. It is learnt that even in normal scenarios abnormalities get into image taking the input image leaving the noisy image for future process. There is corrupted image naturally by presence of noise and making them de-noised is an old issue within the field of signal or image process. Additive random noise can simply be removed by easy threshold ways. De-noising of natural images corrupted by noise victimisation wavelet techniques is very effective due to its ability to capture the energy of a signal. The wavelet de-noising theme thresholds the wavelet coefficients arising from the wavelet transform. The wavelet transform results a massive range of tiny coefficients and a little range of big coefficients.

II. LITERATURE REVIEW

- 1) Shiru Zhang, Xiaotong Chen, Qingfu Sun and Caiying Zhang, IJ3C, 2015 proposed Denoising Algorithms Based on EMD and Wavelets. It took medical research into consideration. Various disease information of the human body is often contained in their pulse signals. The change of the pulse signal characteristics is often the earliest embodiment of human disease. Research of human pulse signals is very helpful to disease diagnosis. Human pulse signals are often corrupted with noise, and it is difficult to extract the clean pulse signals. Therefore, denoising is a very important and difficult job before pulse signal analysis. This paper starts at pulse signal analysis and focuses on denoising algorithms.
- 2) Hsuan Ren, Yung-Ling Wang, Min-Yu Huang, Yang-Lang Chang and Hung-Ming Kao, MDPI, 2014 proposed a new approach to measure the similarity between spectra to discriminate materials and evaluate the performance of parameter-selection procedures. Many pure pixel vector-based similarity measurements have been developed in the past to calculate the distance between two pixel vectors. However, those methods may not be effective since they do not take full advantage of the spectral

correlation. In this study, we adopt Ensemble Empirical Mode Decomposition (EEMD) to decompose the spectrum into serial components and employ these components to improve the performance of spectral discrimination. Performance evaluation was conducted with several commonly used measurements, and the spectral samples used for experimentation were provided by the spectral library of United States Geological Survey (USGS). The experimental results have demonstrated that EEMD can extract the spectral features more effectively than common spectral similarity measurements, and it better characterizes spectral properties. Our experimental results also suggest general rules for selecting noise standard deviation, the number of iterations for EEMD and the collection of Intrinsic Mode Functions (IMFs) for classification

- 3) Rinku Kalotra, Sh. Anil Sagar, International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 6, June 2014 proposed Restoration of medical images like X-ray is very crucial and sensitive matter. Hence their restoration must be done to maximum possible level. The performance of BID technique while recovering X-ray images is commendable but LRA needs a lot of improvement. The ringing effects present at the edges of the restored image due to the process of deconvolution need improvement
- 4) X Xie, ISEE, 2014 proposed an EMD-based scheme to preprocess shadows on face images. Our method is in accordance with the physical imaging model. By preserving the intrinsic facial features as well as lessening the effect of shadows, the ability of existing methods in restoring the frontal-illuminated face image can be significantly enhanced. In our method, the IMF function is analyzed separately and the shadows in each IMF image are also processed separately. In the future, we would like to consider the relation between enhancements of different IMF functions to improve the processing performance
- 5) Nelly Pustelnik, Pierre Borgnat, and Patrick Flandrin, IEEE, 2014 proposed that decomposition of a signal into a collection of intrinsic mode functions. More specifically, we aim to revisit Empirical Mode Decomposition (EMD) based on a sifting process step, which highly depends on the choice of an interpolation method, the number of inner iterations, and that does not have any convergence guarantees. The proposed alternative to the sifting process is based on non-smooth convex optimization allowing to integrate flexible in the criterion we aim to minimize. We discuss the choice of the criterion, we describe the proposed algorithm and its convergence guarantees, we propose an extension to deal with multivariate signals, and we figure out the effectiveness of the proposed method compared to the state-of-the-art.
- 6) Rama Singh, Neelesh Gupta, Journal of Information Engineering and Applications Vol.3, No.6, 2013 proposed that image restoration method is widely used for the reconstruction which is mainly recovered an original image from deformed images using MATLAB. This method primary focus on restoration of degraded images which have been blurred by much degradation. The degradation function has mainly divided into two parts: -
Blind and non-blind. Blind de-convolution technique its recover the original part from the blurry image in the presence of PSF.
- 7) Sheena Kumar, Yogendra Kumar Jain, International Journal of Computer Applications, 2013 proposed that how the image is de-noising using partial differential equation i.e. heat equation and Perona-Malik equation and other conventional filters .The partial differential equation (PDE) based modal is used which provided the original data after applying the standard mathematical technique and reverse the filtering process. In conventional filter original data is last duo to mathematical process which is reversible. It's based on the noise present in the image these equations provide a better result than filter. In which de-noising is applied to the digital images
- 8) Lei Xuanhua¹, Hu Qingping, Kong Xiaojian, Xiong Tianlin," International Conference on Multimedia Technology, 2013 proposed Image degradation in laser underwater imaging system is due to the scattering of water. Image restoration is an effective method to improve the quality of image, but its solving process is an ill-posed problem and the solution is not easily obtained in actual applications. A regularization blind image restoration method using particle swarm optimization was proposed in this paper. Regularization technique was adopted to solve ill-posed problem in the process of blind image restoration, the selection of regularization parameter still remains a difficult problem due to the amplification of noise in the inversion process. So two kind of particle swarm optimization were used to estimate regularization parameter and point spread function alternately. The results of image simulation and experiment show that the algorithm has a good effect of restoration for underwater image.
- 9) Mohsin Bilal, Muhammad Shams-ur-Rehman, Smart Computing Review, 2013 proposed a PSO based regularization technique which adapts the regularization parameters depending on the noise and blurring conditions in the degraded image. Experimental results are presented to validate the efficiency of the proposed scheme
- 10) S. K. Satpathy, S. Panda, K. K. Nagwanshi and C. Ardil," International Journal of Computer, Information Science and Engineering, 2012 proposed new techniques based on MDB. It's mainly focused on image restoration. The aim of this algorithm to reconstruction the original image from the degraded image. Linear filter is simple method where output pixel is linear combination of neighbor values which will blur the image so we use nonlinear method where like median filter. But its work only on small neighbourhood have, weighted mean average filter could be used for large neighbourhood. But it's also add lot of noise.so MDB approach (minimum detector basis) takes 3x3 window w and pick the centre pixel as test & check test pixel>max (rest of the pixel in w) then the test pixel is corrupted. This window keeps shifting for multiple iterations.
- 11) Aloysius George, B. R. Rajakumar, B. S. Suresh, International Journal of Computer Applications, June 2012 proposed that; MRF based algorithm which performing the image restoration. In which new and simple numerous MRF based restoration method were

used which performing image restoration process. The proposed image restoration technique is composed of two steps: core processing and post processing. In core processing the pixel values of the blurring image or noisy image are find out then restore the noise free pixels value by MRF (Markov Random Field). In post processing the restoration quality of the image are improved and sharpened boundary edges. When comparing the result of MRF with another existing restoration technique, its gives a high quality restoration ratio for the blurred image than existing ratio in terms of PSNR

- 12) O. Niang, A. Thioune, M. C. E. Gueira, E. Delechelle and J. Lemoine, IEEE, 2012 proposed the 2-D case, the use of an alternative implementation to the algorithmic definition of the so-called "sifting process" used in the original Huang's EMD method. This approach, especially based on partial differential equations (PDEs), was presented by Niang et al. in previous works, in 2005 and 2007, and relies on a nonlinear diffusion-based filtering process to solve the mean envelope estimation problem. In the 1-D case, the efficiency of the PDE-based method, compared to the original EMD algorithmic version, was also illustrated in a recent paper. Recently, several 2-D extensions of the EMD method have been proposed. Despite some effort, 2-D versions for EMD appear poorly performing and are very time consuming. So in this paper, an extension to the 2-D space of the PDE-based approach is extensively described. This approach has been applied in cases of both signal and image decomposition. The obtained results confirm the usefulness of the new PDE-based sifting process for the decomposition of various kinds of data. Some results have been provided in the case of image decomposition. The effectiveness of the approach encourages its use in a number of signal and image applications such as denoising, detrending, or texture analysis.
- 13) Y. T. Chen, M. Ou-Yang, S. D. Wu, S. G. Lin, Y. T. Kuo and C. C. Lee, IEEE, 2012 proposed the ensemble empirical mode decomposition (EEMD) method to decompose the mixed image into several intrinsic mode functions (IMFs), and then removing one or more IMFs to reduce the influence of the mixing fringe in the mixed image. The procedure of reducing mixing fringe can reconstruct the OPD profile of the mixed image easily. In the simulation, using EEMD to reduce the influence of the mixing fringe, the root mean square (RMS) value of the OPD is 0.081 waves as the residue image subtracted from the OPD profiles of original image. In the experiment, the EEMD method reducing the noise of the mixing fringe has the advantage on the high frequency as spherical aberration.
- 14) Yao Pei, Yangang Wu; Dacheng Jia, 2011 proposed principle and process of image signal denoising, a kind of image denoising algorithm based on Bidimensional Empirical Mode Decomposition is proposed. This paper has improved the traditional Bidimensional Empirical Mode Decomposition method. Bidimensional Empirical Mode Decomposition method is used to decompose the image signal and selective denoising is done to decomposition result by applying self-adaptive median filtering. Denoising result can fully retain the non-stationary feature which is inherent in image signal and it also has the characteristics of strong self-adaption, flexibility and effectiveness. Its computation speed and computational accuracy are greatly increased. It is proved by experiment that when processing noising image, this method not only greatly reduces the noise, but also retains the detail information like the edge of original image well.
- 15) Vaddimukkala Naga, Dr. G. Samuel Vara Prasad, International Journal of Computer Applications, May 2011 proposed that It suggested that in image processing the restoration techniques deals with the Tychono off regularization. It is well known techniques followed in the last two decades. The number of holes drilled in each segmentation and the parameter controlled the total number of holes. A complete MATLAB code has been developed for this method.
- 16) Atsushi Ito, Aswin C. Sankaranarayanan, ACM Transactions on Graphics, Vol. VV pp1-15 suggested blur removal in the presence of some noise which is added intentionally to recover the original signal. Basically we convolve the original signal & point spread function where convolution is integral product of two signal with one signal reversed and shifted. PSF is a impulse response of focused optical system.
- 17) M. E. Torres, M. A. Colominas, G. Schlotthauer and P. Flandrin, IEEE, 2011 proposed an algorithm based on the ensemble empirical mode decomposition (EEMD) is presented. The key idea on the EEMD relies on averaging the modes obtained by EMD applied to several realizations of Gaussian white noise added to the original signal. The resulting decomposition solves the EMD mode mixing problem, however it introduces new ones. In the method here proposed, a particular noise is added at each stage of the decomposition and a unique residue is computed to obtain each mode. The resulting decomposition is complete, with a numerically negligible error. Two examples are presented: a discrete Dirac delta function and an electrocardiogram signal. The results show that, compared with EEMD, the new method here presented also provides a better spectral separation of the modes and a lesser number of sifting iterations is needed, reducing the computational cost.
- 18) Faten BEN ARFIA, Mohamed BEN MESSAOUD, Mohamed ABID, IWSSIP, 2010, proposed a method for image denoising in the filter domain based on the characteristics of the Empirical Mode Decomposition (EMD) and the wavelet technique. The proposed method uses the EMD to the decomposition and double density wavelet to filter components. Our experimental results show that these image denoising methods are more efficient than the wavelet denoising method. Finally, the PSNR (peak signal noise ratio) and the visualization of the denoising image are used as performance comparison indexes
- 19) Jagadish H. Pujar, Kiran S. Kunnur," Journal of Theoretical and Applied Information Technology proposed Images restoration algorithm is used in MATLAB. It accuracy used the property of its neighbored pixel and highlight in case there is huge & random change in the adjacent pixel.

III. CONCLUSION

Our motive to write this paper is to present an analytic review of work done so far in image restoration field. During the process of reviewing, major stack of papers considered are of 2009-2013 time period. A lot of work in this field was published in 2011 and 2013 in which influence of wavelet transform algorithms in combination with other nonlinear filters and optimisation algorithms used direct or to tune other parameters, is visible. Wavelet transform algorithm is always a hot cake for image restoration. Authors have been using it since 2009 (oldest one in our collection) and consistently giving satisfactory results. Irrespective of approach took by researcher in image restoration, not much difference in evaluation parameters are analysed. Common parameters used are PSNR, MSE, NCC etc.

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