International Journal of Advanced Computer Research (ISSN (print): 2249-7277 ISSN (online): 2277-7970)
Volume-3 Number-3 Issue-11 September-2013

Result Analysis of Image Denoising Method based on Fourth-Order Partial Differential Equations

Anand Swaroop Khare[1], Ravi Mohan[2], Sumit Sharma[3]

Abstract

Images are evermore corrupted with noise during acquisition, transmission, and retrieval from storage media. Distinct dots in reality are stipple in a Photograph taken with a digital camera under low lighting conditions. Abstract of sound is absolute especially in the field of image processing. Two researchers are non-stop lively in this direction and provide some good insights, but still there are lots of scopes in this field. Sound differing with image does not provide good results. In this paper we used an efficient PDE approach for reducing noise and blur parameters. In our approach we provide the comparison considering the image of for comparison we consider the database of James Z. Wang [1] which is the collection of 1000 Databases. There are 10 categories in the database.

Keywords

Image Denoising, Partial Differential Equation, Wang Database, Noise reduction.

1. Introduction

Many related algorithms had been proposed recently, such as algorithms based on wavelet transform [2] [3] [4],algorithm based on spatial filters [5] and algorithm based on fuzzy theory [6]. In [7] and [8] the authors used the method of least squares support vector machines and image decomposition respectively. Later, some researchers proposed an algorithm using non-aliasing contour let transform [9] and partial differential equation [10]. Empirical mode decomposition (EMD) was firstly proposed by Huang [11]. EMD is mainly used to one dimension signals processing, such as sound signals. Later, bi-dimensional empirical mode decomposition (BEMD) was used to image signal processing [12] [13] [14]. In this paper, we proposed the algorithm using partial differential equation & bi-dimensional empirical mode decomposition. Firstly, we execute BEMD to original image and get the intrinsic mode functions (imfs) and residue. Secondly, we filter noise of the imfs with partial differential equation (PDE).
Lastly, we reconstruct the image with the filtered imfs and residue.

We provide here a comparision of Image denoising Technique. Other sections are arranged in the following manner: Section 2 introduces Literature Review; section 3 shows the proposed work. Section 4 shows the result analysis; Section 5 describes Conclusion.

Anand Swaroop Khare,SRIT,Japalputr, M.P.
Ravi Mohan, SRIT,Jabalpur,M.P.
Sumit Sharma, SRIT,Jabalpur,M.P.

2. Literature Review

BEMD is to vilify bi-dimensional bust into main functions and residue like one dimensional EMD. Lenient hand-me-down EMD to get a fix on denoising, which upon the image as one dimensional row signals. But this ignores the affair between adjacent pixels.

A complicated data set can be adaptively decomposed into a finite number of components of different frequencies called IMFs using an iterative shifting process that continues until the number of extrema is < 2 (one maximum and one minimum).

The detailed process can be described as follows:

1. Look for the local extremum and form the envelopments of the original image f (x, y).
2. Compute the average $m_1(x, y)$ of the top envelopment and bottom envelopment and denote that
   $l_1(x, y) = f(x, y) - m_1(x, y)$… (1)
3. Replace f (x, y), with $l_1(x, y)$, and execute the above three steps. Then we can get $l_i(x, y)$, until the standard deviation *SD* is smaller than the threshold predefined. We used $I_1(x, y)$ to replace $l_i(x, y)$, If the local mean of $I_1(x, y)$ is zero, we view it as imf_1. Where $SD=\sum_{(x=0)}^{X}\sum_{(x=0)}^{y}(l_{i+1}(x,y)-l_i(x,y)^2/l_i^2(x,y))$…. (2)
4. Replace f (x,y) with f (x,y) - $I_1(x, y)$ and execute the above four steps until the extremum number of residue is smaller than two. Then we complete the decomposition.
5. $f(x,y)=\sum_{i=1}^{N} imf_i(x,y) + r_N(x,y)$…..(3)

In 2011, Jia Liu et al. [15] proposed an image denoising method using partial differential equation and bi-dimensional empirical mode decomposition. The bi-dimensional empirical mode decomposition transforms the image into intrinsic mode function and residue. Different components of the intrinsic mode functions present different frequency of the image. The different with the classic method of partial differential equation denoising is that we use partial differential equation of the intrinsic mode functions to filter noise. Finally, they reconstruct the image with the filtered intrinsic mode functions and residue. In 2012, Guo-Duo Zhang et al. [16] proposes an image denoising method based on support vector regression; also this paper describes several other methods of image denoising. Simulation results show that the method can save the image detail better, restore the original image and remove noise. In 2012, Meenal et al. [17] survey and analysed different traditional image denoising method using different methods. They also suggest a new approach which provides a heterogeneous way of the above challenging issue. Their approach is the combination of three different approaches first is for blur, second is for noise and finally for blur and noise. After analysing several research works they analyse that not a single method can provide better method for blur and noise both. So their proposed solution can provides betterment in this issue.In 2012, Meenal et al. [18] proposed an image denoising method using partial differential equation. In their proposed approach they proposed three different approaches first is for blur, second is for noise and finally for blur and noise. These approaches are compared by Average absolute difference, signal to noise ratio (SNR), peak signal to noise ratio (PSNR), Image Fidelity and Mean square error. They achieve result on different scenario. They also compare our result on the basis of the above five parameters and the result is better in comparison to the traditional technique. In 2012, Kehua Su et al. [19] introduce a sparse and redundant representations algorithm based on over complete learned dictionary to process different types of images. They use the K-SVD denoising framework and modify its initial dictionary, and then mainly focus on using it to study its denoising performance and suitability for different types of Images, and then compare it with some other image denoising algorithms. As to the remote sensing images denoising, the experiment results show that the K-SVD algorithm can leads to the state-of-art denoising performance at low noisy levels, but for high noisy levels, its performance isn't good on PSNR and visual effect, that is it cannot retain the local details of images.

3. Proposed Approach

Ideally, we want Filtering (diffusion) within the object boundary and No filtering across the edge orientation. I will try to reduce the effect of these shortcomings on restored image by improving anisotropic diffusion technique based on PDE for image denoising. The capability of PDE-based methods in image denoising prompted many researchers to search for an improvement in the technique.

After studying different approaches we observe that we can work with the reduction of noise and SNR[20][21]. There is also some scope for the reducing the time of denoising while unaffected the accuracy. So in this section we using fourth order PDE for improving the SNR ratio.

4. Experimental Results

We used the Matlab R2010a to run the experiment under the PC environment of Windows 7 ultimate and CPU Pentium Dual-core which frequency is 1.86 GHz and memory with 2 GB.

In order to prove the performance of our algorithm, we consider the database of James Z. Wang [1] which is the collection of 1000 Databases. There are 10 categories in the database [22][23]. We consider 5 categories one by one for comparison. We used SNR to evaluate the algorithm.

The table 1 shows the comparison which shows the effectiveness of our approach. Their pictorial representations are shown in figure 1 to figure 5.

Table 1: Result Analysis

Noise Parameter	**Image with Noise**	**Mean Filter**	**PDE**	**BEMD and PDE**	**Proposed PDE**
Category 1	22.101	24.099	25.069	28.351	30.005
Category 2	8.242	14.522	18.350	17.537	20.436
Category 3	17.721	20.403	21.703	24.347	26.539
Category 4	15.855	17.011	18.279	21.323	23.159
Category 5	12.597	16.504	17.513	21.073	24.257

5. Conclusion

In this paper we apply our approach on wang database [1] and check the effectiveness of the approach. We provide here a comparison consider three different noise parameters and improves the SNR ratio, which reduces the noise and blur. After applying our approach we found good results when the noise parameter is increases but if the noise is less than BEMD and PDE are performed approximately same.

References

[1] Jia Li, James Z. Wang, ``Automatic linguistic indexing of pictures by a statistical modeling approach," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 25, no. 9, pp. 1075-1088, 2003.
[2] Rafael C.Gonzalez, Richard E.Woods, " Digital Image Processing" Prentice Hall 2004.
[3] Bruce.Fisch,Eric L.Schowart,"learning an Integral Equation Approximation to Nonlinear Anisotropic Diffusion in Image processing", Dept.cognitive and Neural Systems Boston University.
[4] P. Perona, J. Malik, Scale-space and edge detection using anisotropic diffusion, IEEE Trans. PAMI 12 (7) (1990) 629–639.
[5] G. Aubert, P. Kornprobst, Mathematical Problems in Image Processing: Partial Differential Equations and the Calculus of Variations, Springer, New York, 2002.
[6] L. Alvarez, F. Guichard, P.L. Lions, J.M. Morel, Axioms and fundamental equations of image processing, Arch. Ration. Mech. 123 (1993) 200–257.
[7] J. Weickert, Nonlinear diffusion scale-spaces: From the continuous to discrete setting, in: M.O. Berger et al. (Eds.), Proceedings ICAOS'96: Images, Wavelets and PDE's 219, Springer, New York, 1996, pp. 111–118.
[8] F. Catté, P.L. Lions, J.M. Morel, T. Coll, Image selective smoothing and edge detection by nonlinear diffusion, SIAM J. Numer. Anal. 29 (1992) 182–193.
[9] G. Gilboa, N. Sochen, Y.Y. Zeevi, Image enhancement and denoising by complex diffusion processes, IEEE Trans. PAMI 26 (8) (2004) 1020–1036.
[10] Y.L. You, W.Y. Xu, A. Tannenbaum, M. Kaveh, Behavioral analysis of anisotropic diffusion in image processing, IEEE Trans. Image Process. 5 (11) (1996) 1539– 1553.
[11] L. Shui, Z.-F. Zhou, J.-X. Li. "Image denoising algorithm via best wavelet packet base using Wiener cost function". IET Image Process, Vol. l, No.3 Sep. 2007.
[12] Wei Zhang, Fei Yu, Hong-mi Guo. "Improved Adaptive Wavelet Threshold for Image Denoising". 2009 Chinese Control and Decision Conference.
[13] Zao-Chao Bao, Xin-Ge You, Chun-Fang Xing, Qing-Yan He. "Image Deniosing by Using Non-tensor Product Wavelets Filter Banks". Proceedings of the Sixth International Conference on Machine Learning and Cybernetics, Hong Kong, 19-22 August 2007.
[14] Aboshosha, A., Hassan,M., Ashour,M, EI Mashade,M. "Image Denoising Based on Spatial Filters, an Analytical Study". Computer Engineering & Systems,2009.
[15] Jia Liu, Caicheng Shi and Meiguo Gao, "Image Denoising Based on BEMD and PDE", IEEE 2011.
[16] Guo-Duo Zhang, Xu-Hong Yang, Hang Xu, DongQing Lu, Yong-Xiao Liu, "Image Denoising Based On Support Vector Machine", IEEE 2012.
[17] Meenal Jain, Sumit Sharma, Ravi Mohan Sairam, "Effect of Blur and Noise on Image Denoising based on PDE", International Journal of Advanced Computer Research (IJACR) Volume-3 Number-1 Issue-8 March-2013.
[18] Meenal Jain, Sumit Sharma, Ravi Mohan Sairam, "Result Analysis of Blur and Noise on Image Denoising based on PDE", International Journal of Advanced Computer Research (IJACR) Volume-2 Number-4 Issue-7 December-2012.
[19] Kehua Su, Hongbo Fu, Bo Du, Hong Cheng, Haofeng Wang and Dengyi Zhang, "Image Denoising based on Learning Over-complete Dictionary", 2012 9th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD 2012).
[20] Anand Swaroop Khare, Ravi Mohan, Sumit Sharma," Image Denoising based on Fourth-Order Partial Differential Equations: A Survey", International Journal of Advanced Computer Research (IJACR) Volume-3 Number-1 Issue-9 March-2013.
[21] Anand Swaroop Khare, Ravi Mohan, Sumit Sharma," An Efficient Image Denoising Method based on Fourth-Order Partial Differential Equations", International Journal of Advanced Computer Research (IJACR), Volume-3 Number-1 Issue-9 March-2013.
[22] N. Jain, S. Sharma and R. Sairam, "Content Base Image Retrieval using Combination of Color, Shape and Texture Features," International Journal of Advanced Computer Research , Vol. 3 No. 1, Issue-8 March 2013, pp. 70-77.
[23] Neha Jain, Sumit Sharma, Ravi Mohan Sairam," Result Analysis on Content Base Image Retrieval using Combination of Color,Shape and Texture Features", International Journal of Advanced Computer Research (IJACR),Volume-2 Number-4 Issue-7 December-2012.

Anand Swaroop Khare was born on 1-10-1985. He has completed his B.E in 2008 in EC Branch from SIRT Bhopal. Currently he is pursuing his M.Tech (EC) from SRIT Jabalpur, Madhya Pradesh.

Figure 1: Category 1

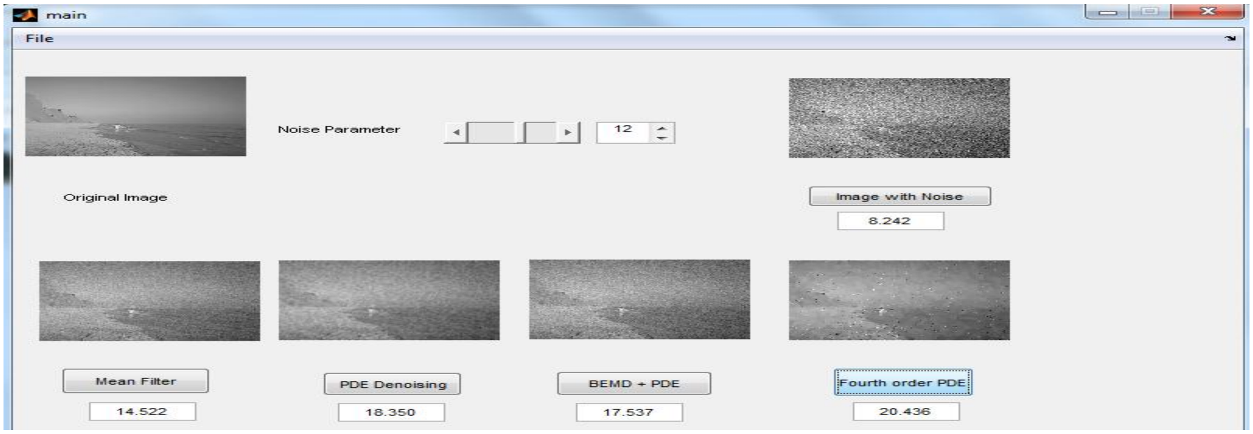

Figure 2: Category 2

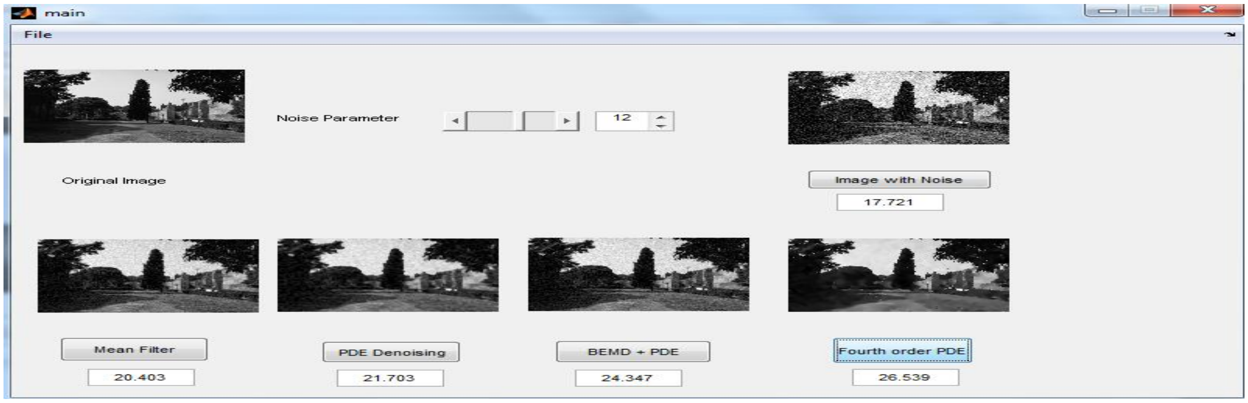

Figure 3: Category 3

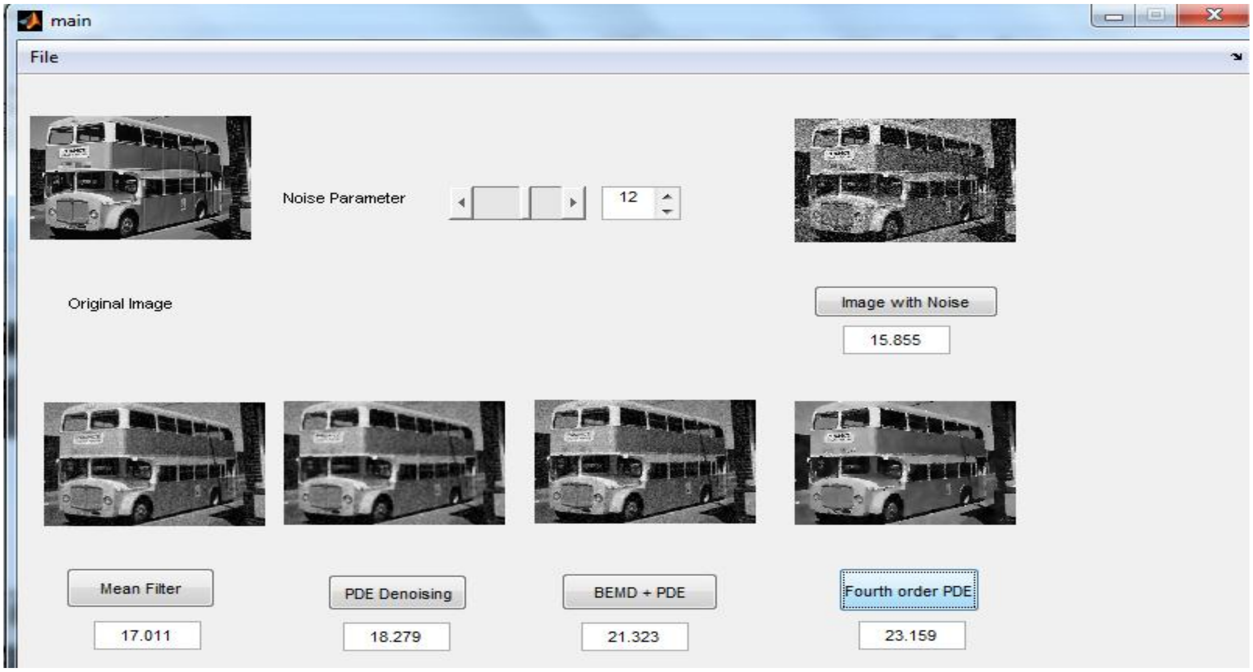

Figure 4: Category 4

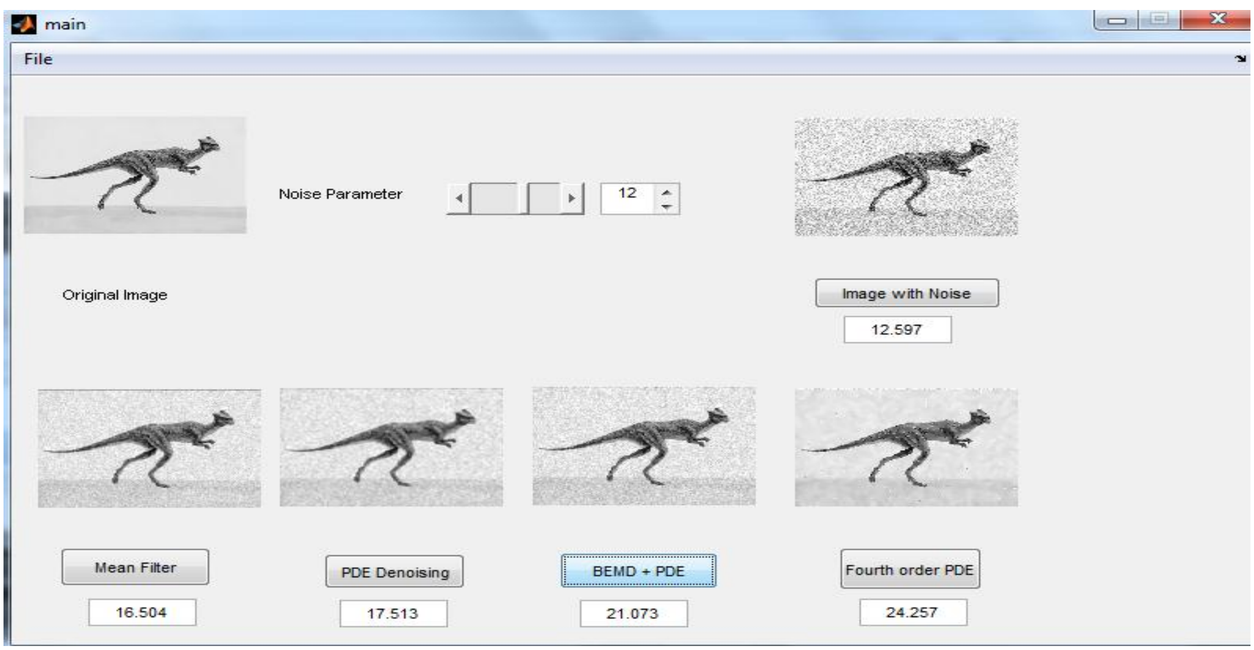

Figure 5: Category 5