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Research paper

Performance of the low rank matrix technique in image de-noising

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Abstract

Generally, the technique of low rank matrix (LRM) estimation is a very handy tool in signal processing. The same can be further extended to two dimensional problems in image processing. The tool also emerged as a favourable method to provide solutions through the machine learning and other statistical techniques. In this paper, an attempt is made to employ the LRM to denoise the image which is subjected to guassian noise of certain variance. The performance analysis has been made in terms of calculated peak signal to noise ratio (PSNR).

Keywords:*Low Rank Matrix Method;Denoising; PSNR.*

1. Introduction

The processing of separating the noise from the image is known as denoising. The denoising process becomes more complicated when the noise induced into the image is immune to general denoising processes. Several spatial filtering techniques are often considered as very simple means of filtering the noise. However, it involves in direct manipulation of the pixel value. This may impact theimage quality leading to some undesired effects which are irreversable. To avoid such issues, the trnasformation techniques are such issues, the transformation techniques introduced. Thus transformation techniques involve in transforming from one domain to another domain. Further, the mitigations are carried out on the transformed domain. Later, the inverse transformation is applied to retrive to its original domain. As a result, the image remains uneffected. However, the techniques fail in many ways in handling typical noise models. Hence, the process of matrix completion methods are used.

In this paper a matrix estimation on low rank matrix model is applied for denoising. Further, the paper is organisation as follows. A brief discription of the low rank model is given insection 2. The corresponding results are given in section 3. Overall conclusion are given in section 4.

2. Problem description

Let us consider that the signal to be retained can be represented as mathematical form. The mathematical form often represented in matrix notation as follows.

$$M \in R^{n_1 \times n_2}$$

The 'M' here is known as a low rank matrix.

Accordingly, the problem is referred as to estimate the matrix 'M'. if the matrix 'M' is adulterated with'N', then the process of estimating thematrix 'M' in L is considered as the denoising. This is given as

L=M+N. where $L, M, N \in R^{n_1 \times n_2}$.

The estimation is given as $E = \sum \Delta(Y - E_i)$

Here the E is obtained from the low rank 3D method.

3. Results

Results pertaining to the proposed low rank matrix model are presented in this section. Initially a 'Lena' image is taken for the simulation based study. The Gaussian noise is added to the original input image such that the peak signal to noise ratio is of 18.61 dB. The simulation is carried out for ten iterations and an improvement in the PSNR in every iteration is noticeable form the convergence graph, as shown in Fig.1.Initially it can be inferred the PSNR improvement is almost linear over iterations. However, the improvements saturates after certain iteration and seems to be constant further.

The input noise free image is as shown in fig.2. further the noised inducted image is as shown in fig.3. upon applications of the low rank matrix technique, the denoised image is as shown in fig.4.

Similar response is observed even with the case of another image which is considered for demonstration. The second image is 'peppers'. The convergence plot shows the similar response as that of the previous case which is evident from fig.5.the input noise free image, noise inducted image and the corresponding denoised images are as shown in fig.6, fig.7 and fig.8 respectively.

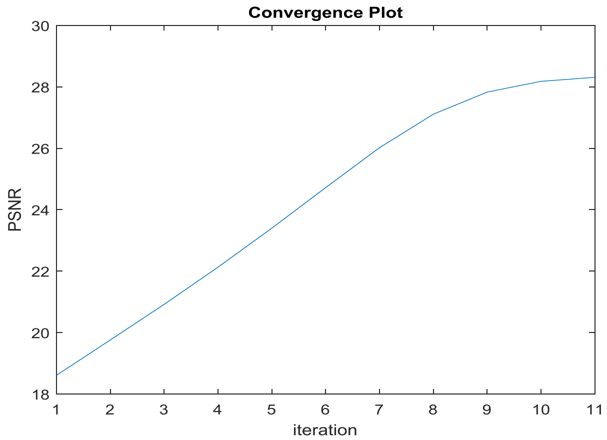

Fig. 1: Convergence Plot.

Fig. 2: Input Image.

Fig. 3: Noise Added Image.

Fig. 4: Denoised Image.

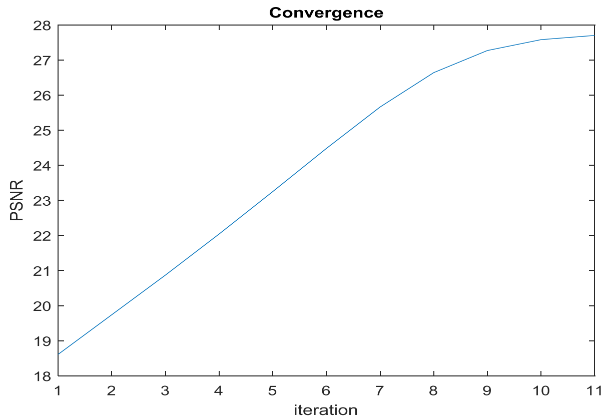

Fig. 5: Convergence Plot of Peppers Image.

Fig. 6: Noise Free Image.

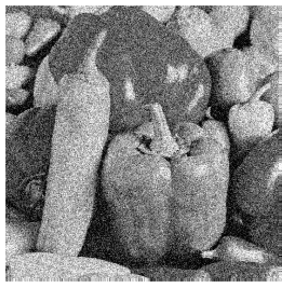

Fig. 7: Noise Inducted imageof Peppersof Peppers.

Fig. 8: DenoisedImage.

4. Conclusion

The low rank matrix method is effectively implemented for a set of two images and the corresponding denoised features are evaluated using PSNR metrics. The convergence characteristics are studied to analyse the performance of the technique. The similarity in the plots reflect the consistency of the technique which can be further extended to color images

References

[1] J. F. Cai, E. J. Cand_es, and Z. Shen. A Singular Value Thresholding Algorithm for Matrix Completion. SIAM J. Opt., 20:1956, 2010.https://doi.org/10.1137/080738970.

[2] E. J. Cand_es and Y. Plan. Matrix completion with noise.Proc. IEEE, 98(6):925{936, 2010.

[3] W. Dai and O. Milenkovic. SET: an algorithm for consistent matrix completion. 2009. Availableat http://arxiv.org/abs/0909.2705.

[4] Ankit Parekh and Ivan W. Selesnick, "Enhanced Low-Rank Matrix Approximation", IEEE SIGNALPROCESSING LETTERS, VOL. 23, NO. 4, APRIL2016.

[5] W. He, Y. Ding, Y. Zi, and I. W. Selesnick, "Sparsity-based algorithm for detecting faults in rotating machines,"Mech. Syst. Signal Process., vol. 72, pp. 46–64, 2016.https://doi.org/10.1016/j.ymssp.2015.11.027.

[6] H. Hu, J. Froment, and Q. Liu, "Patch-based low-rankminimization for image denoising," [Online]. Available:http://arxiv.org/abs/1506.08353, 2015, pp. 1–4.

[7] B. Huang, C. Mu, D. Goldfarb, and J. Wright, "Provablemodels for robust low-rank tensor completion," Pac. J.Optim., vol. 11, no. 2, pp. 339–364, 2015.