

Image Enhancement using Image Fusion

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Abstract

Image fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more informative than any of the input images. In this paper we are performing image fusion of two images of same scene to get better image as an output. The input images used for fusion are partially blurred at different parts of images. PCA (Principal Component Analysis) is the fusion method used for fusion of images. The result of fusion is a new image which is more suitable for human and machine perception. This paper discusses about the formulation, process flow diagrams and algorithms of PCA (Principal Component Analysis). The results are also furnished in picture and table format for analysis of above technique.

Keywords : image fusion, PCA, Eigen value, Eigen vector.

Introduction

Image fusion is the process of combining information from two or more images of a scene into a single composite image that is more informative and is more suitable for visual perception or computer processing[2]. The objective in image fusion is to reduce uncertainty and minimize redundancy in the output while maximizing relevant information particular to an application or task. Given the same set of input images, different fused images may be created depending on the specific application. There are several benefits of using image fusion: wider spatial and temporal coverage, decreased uncertainty, improved reliability, and increased robustness of system performance[3]. The term quality, its meaning and measurement depend on the particular application. In this paper PCA based image fusion system is consider which can have 2 or 3 blurred input images and resulting in single clear image.

Principal Component Analysis

Principal component analysis (PCA) is a data analysis technique that can be traced back to Pearson (1901). It is a mathematical tool from applied linear algebra. Principal component analysis (PCA) is a vector space transform often used to reduce multidimensional data sets to lower dimensions for analysis[4]. PCA is the simplest and most useful of the

true eigenvector-based multivariate analyses, because its operation is to reveal the internal structure of data in an unbiased way. Normalize column vector corresponding to larger Eigen value by dividing each element with mean of Eigen vector. Those normalized Eigen vector values act as the weight values and are multiplied with each pixel of input image. Sum of the two scaled matrices are calculated and it will be the fused image matrix.

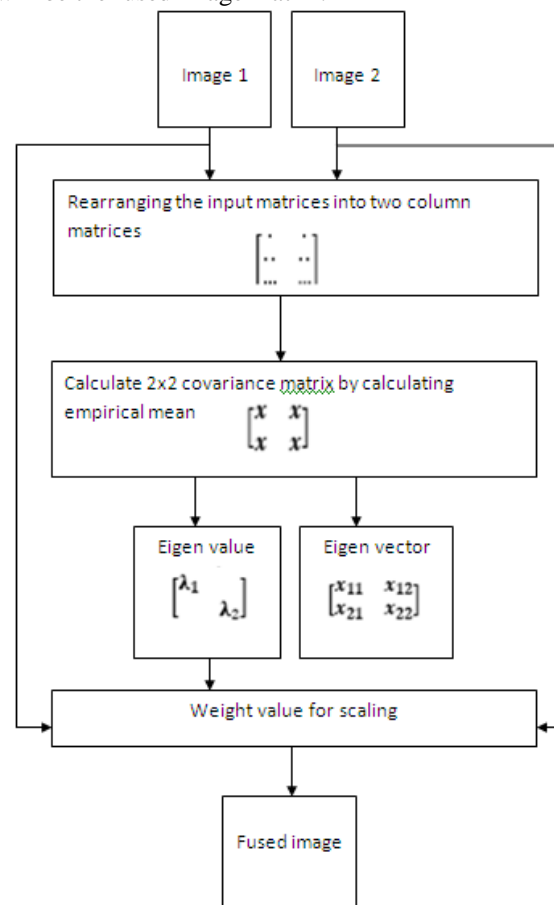


Fig 1 : PCA algorithm

Principal Component Analysis Algorithm[6]

- Generate the column vectors, respectively, from the input image matrices.

- Calculate the covariance matrix of the two column vectors formed in 1
- The diagonal elements of the 2x2 covariance vector would contain the variance of each column vector with itself, respectively.
- Calculate the Eigen values and the Eigen vectors of the covariance matrix
- Normalize the column vector corresponding to the larger Eigen value by dividing each element with mean of the Eigen vector.
- The values of the normalized Eigen vector act as the weight values which are respectively multiplied with each pixel of the input images.
- Sum of the two scaled matrices calculated in 6 will be the fused image matrix.

The system considered for analysis is shown in figure 2 which receives two images as a input and provide single image as output.

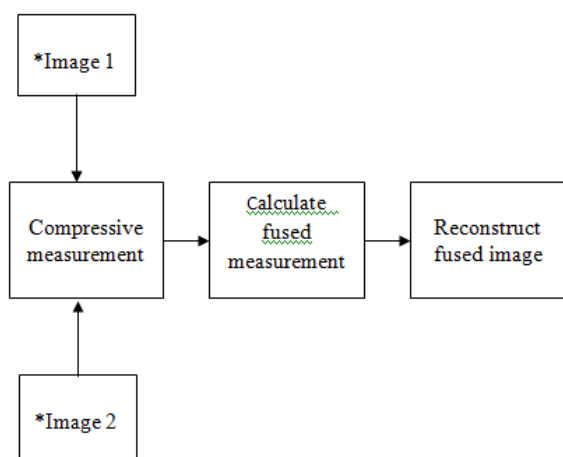


Fig 2 : PCA based image fusion system.

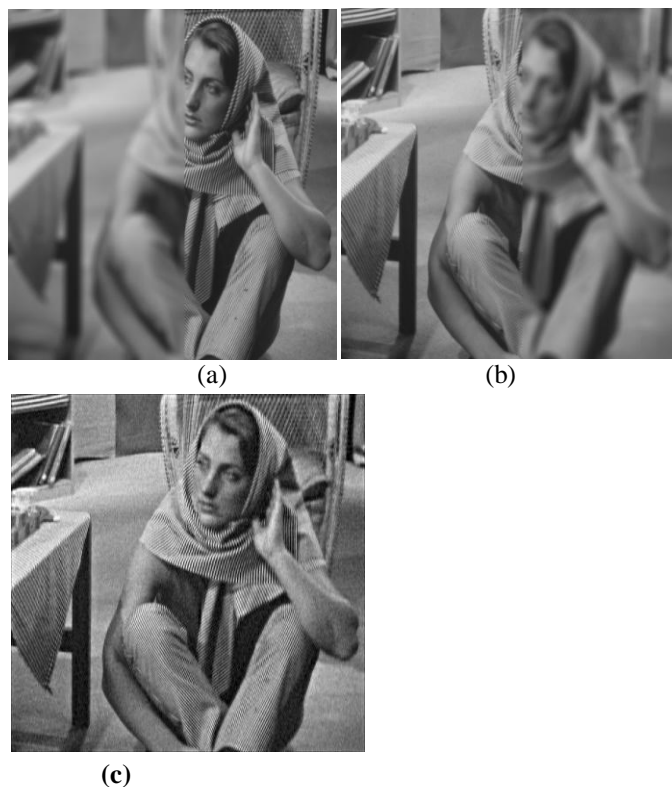


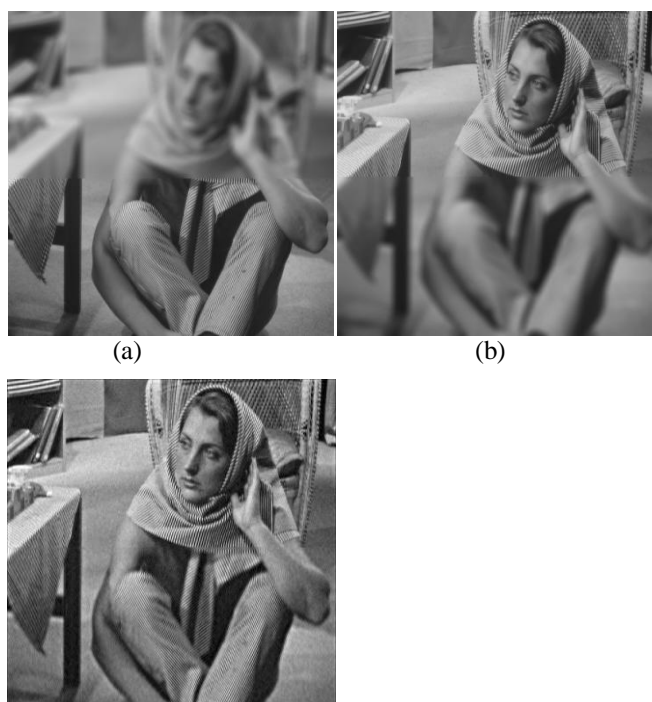
Fig 3: (a) Image 1, (b) Image 2, (c) fused Image

	Image 1	Image 2	Fused image
PSNR	78.47	80.15	84.87
MSE	43.6	35.91	20.85

Case 2: consist of two images which having horizontal blur portions.

Image 1 :horizontal upper half is blur

Image 2 :horizontal lower half is blur



Results

For analysis of system four different cases are taken under study. PSNR and MSE values are calculated for each image in every case.

PSNR : It is parameter which gives ratio of signal power to noise power. The higher the value of the PSNR, the better the fusion result.

MSE :The smaller the value of the MSE, the better the fusion performance.

Case 1:consist of two images which having vertical blur portions.

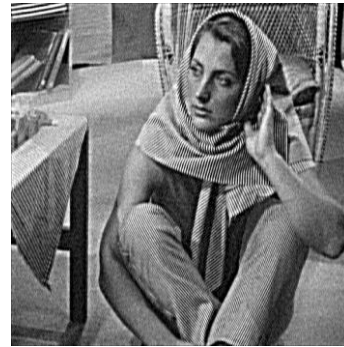
Image 1 : vertical left half is blur

Image 2 : vertical right half is blur

(c)

Fig 4 : (a) Image 1, (b) Image 2, (c) fused Image

	Image 1	Image 2	Fused image
PSNR	80.38	78.66	85.21
MSE	34.92	42.64	20.05



(c)

Fig 6: (a) Image 1, (b) Image 2, (c) fused Image

	Image 1	Image 2	Fused image
PSNR	78.93	83.48	83.9
MSE	41.31	24.47	23.33

Case 3: consist of two images which having blur portions at corners of images

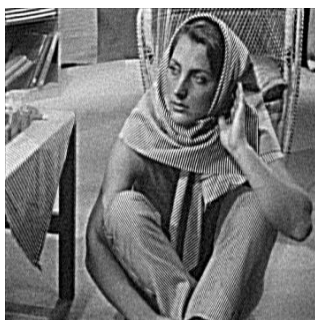
Image 1 : left top corner & bottom right corner is blur

Image 2 : right top corner & bottom left corner is blur



(a)

(b)



(c)

Fig 5: (a) Image 1, (b) Image 2, (c) fused Image

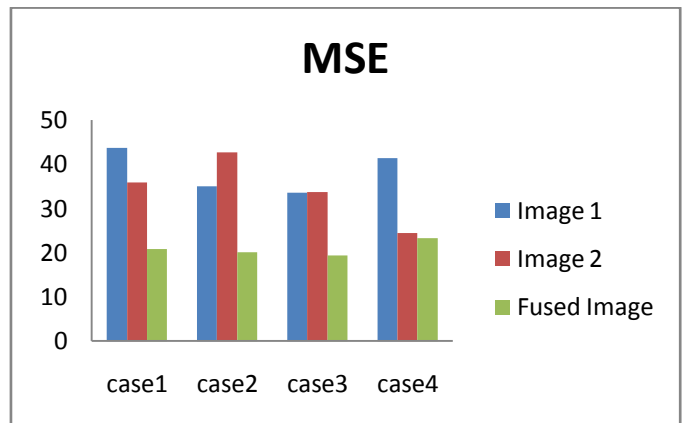
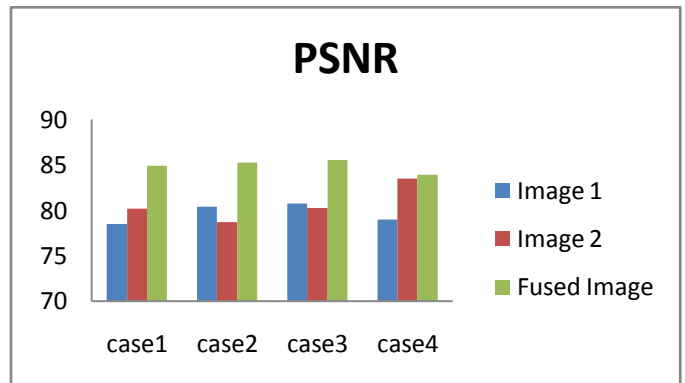
	Image 1	Image 2	Fused image
PSNR	80.73	80.23	85.52
MSE	33.58	33.62	19.35

Case 4: consist of two images which having blur portions at random



(a)

(b)



Case 1: consist of two images which having vertical blur portions.

Image 1 : vertical left half is blur

Image 2 : vertical right half is blur

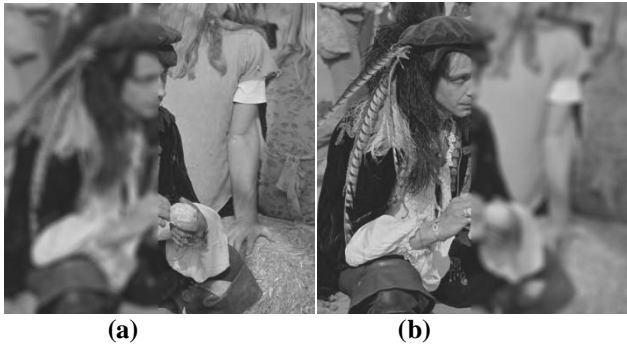


	Image 1	Image 2	Fused image
PSNR	80.26	81.53	83.3
MSE	35.47	30.65	24.98

Case 3: consist of two images which having blur portions at corners of images

Image 1 :left top corner & bottom right corner is blur

Image 2 :right top corner & bottom left corner is blur



Fig 7: (a) Image 1, (b) Image 2, (c)fused Image

	Image 1	Image 2	Fused image
PSNR	80.51	80.26	80.3
MSE	34.47	28.06	24.14

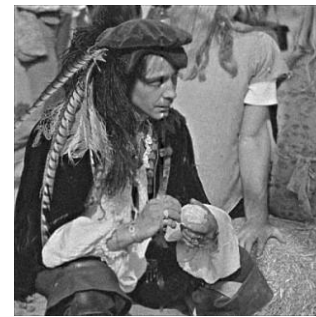


Fig 9: (a) Image 1, (b) Image 2, (c)fused Image

	Image 1	Image 2	Fused image
PSNR	80.3	82.21	83.31
MSE	35.29	28.33	24.96

Case 4: consist of two images which having blur portions at random

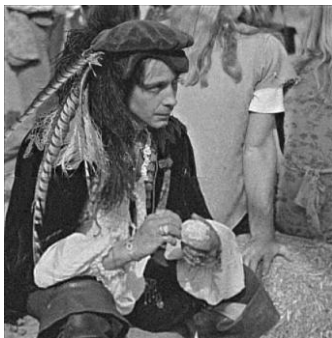
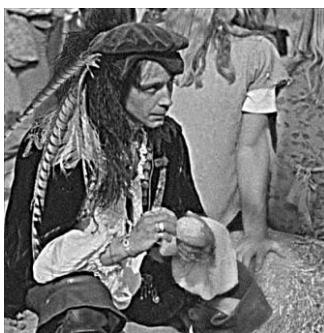


Fig 8: (a) Image 1, (b) Image 2, (c)fused Image

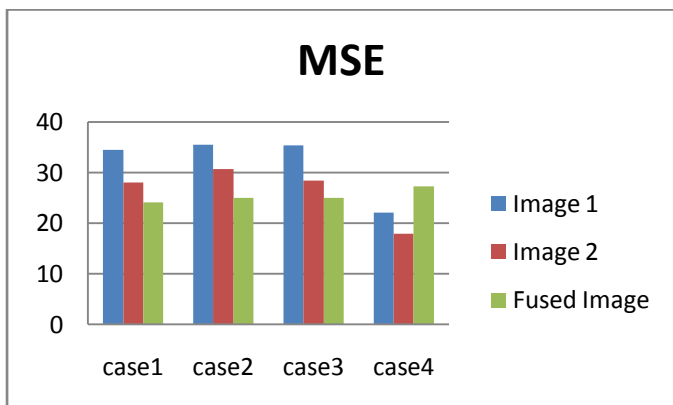
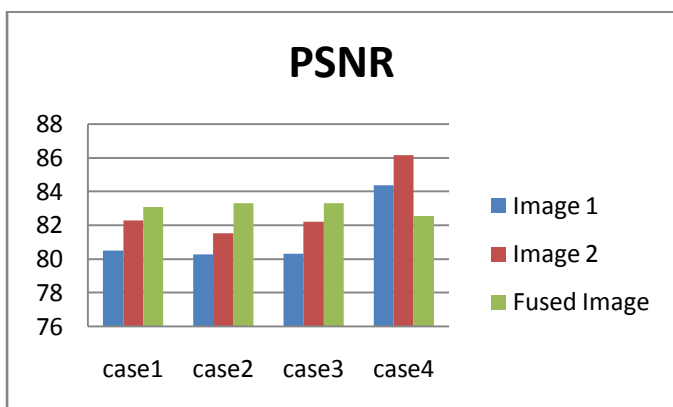


(c)
Fig 10 : (a) Image 1, (b) Image 2, (c)fused Image

	Image 1	Image 2	Fused image
PSNR	84.37	86.16	82.55
MSE	22.08	17.97	27.24

References

- [1] Nisha Gawari and Dr. Lalitha.Y.S. "Comparative Analysis of PCA, DCT & DWT based Image Fusion Techniques", International journal of emerging research in management & technology ISSN : 2278-9359(vol-3issue-5) may 2014
- [2] Ashishgoud Purushotham, G. Usha Rani and Samiha Naik. "Image Fusion Using DWT & PCA". International Journal of Advanced Research in Computer Science and Software Engineering Volume 5, Issue 4, 2015 ISSN: 2277 128X
- [3] Shalima, Dr. Rajinder Virk "REVIEW OF IMAGE FUSION TECHNIQUES". International Research Journal of Engineering and Technology (IRJET) Volume: 02 Issue: 03, June-2015
- [4] A. Umaamaheshvari, K. Thanushkodi "IMAGE FUSION TECHNIQUES". IJRRAS 4 (1) July 2010
- [5] Jan Flusser, Filip Sroubek, and Barbara Zitov "Image Fusion: Principles, Methods, and Applications". Tutorial EUSIPCO 2007.
- [6] Shivsubramani Krishnamoorthy "Development of Image Fusion Techniques And Measurement Methods to Assess the Quality of the Fusion"



Conclusion :

In this paper the PCA based fusion technique is used to get better image from two blur images. The parameters PSNR and MSE are used to check the performance of system. From tables it is seen that the PSNR values of fused images are greater than their respective input images and MSE values are smaller than that of respective input images. This indicates that the quality of output fused image is better than the blurred input images.