International Journal of Advance Research in Science and Engineering
Volume No.06, Issue No. 11, November 2017
www.ijarse.com
IJARSE
ISSN: 2319-8354

Performance improvement of image quality enhancement using Pixel level based Hybrid algorithm

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ABSTRACT

The successful diagnosis of a disease depends on the accuracy of the image from medical mage modalities. Medical image fusion acts as a 'life saving tool'-thus it has emerged as a promising research field in recent years. The objective of medical imaging is to acquire a high resolution image with more information for the sake of diagnostic purposes. This paper proposes a hybrid fusion algorithm for multimodality medical images. There are two types of modalities one is 'Anatomy', which gives the information about functional details of cell activity in the organ, such as SPECT, PET. Structure without function is a corpse and function without structure is a ghost.

Therefore, both of the Anatomy, Physiology and Metabolism images are investigated. So, this work makes fusion of CT and PET images. Specifically it aims at the gathering relevant, disparate and complementary data in one order to enhance the information apparent in the images, as well as to amplify the reliability of the interpretation. This leads to more accurate data and increased utility. In addition, it has been stated that combined data provides for robust operational performance such as increased confidence, reduced ambiguity, and improved reliability.

This paper introduced a pixel level based 'Hybrid Concept' by integrating the conventional and advance fusion methods to overcome their demerits and enhance image processing qualities like PCA(Principal component analysis), DWT (Discrete Wavelet Transformation), DCT (Discrete Curvelet Transformation) to form a DWT-PCA, DCT-PCA, and proposing one DWT-DCT-PCA algorithm. These are analytically examined, observed and compared the results among them using the performance matrices MSE, PSNR and ENTROPY.

Keywords: CT,PET images, DCT,DWT-PCA,DCT-DWT-PCA,MSE,PSNR.

I.INTRODUCTION

The successful diagnosis of a disease depends on the accuracy of the image obtained from medical imaging modalities. Medical image fusion acts as a _life saving tool'. 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. The objective of medical imaging is to acquire a high resolution image with more information for the sake of diagnostic purposes. In our project we use hybrid fusion algorithm for multimodality medical images. There are two type of modalities one is _Anatomy', which gives structural details of body parts, such as X-ray, CT, MRI, and other _Physiology and Metabolism', it gives the information about

functional details of cell activity in the organ, such as SPECT, PET. Structure without function is a corpse and function without structure is a ghost.

Therefore, both of the Anatomy, Physiology and Metabolism images are investigated. So, this work makes fusion[1] of CT and PET images. Specifically it aims at the gathering relevant, disparate and complementary data in one order to enhance the information apparent in the images, as well as to amplify the reliability of the interpretation. This leads to more accurate data and increased utility. In addition, it has been stated that combined data provides for robust operational performance such as increased confidence, reduced ambiguity, and improved reliability

In this paper, we have introduced a pixel level based _Hybrid Concept by integrating the conventional and advance fusion methods to overcome their demerits and enhance the image processing qualities like, PCA (Principal component analysis)[2][3], DWT(Discrete Wavelet Transformation),[5] DCT(Discrete Curvelet Transformation) to form a DWT-PCA, DCT-PCA, and proposing one DWT-DCT-PCA[1] algorithm.

According to the stage at which image information is integrated, image fusion algorithms can be categorized[4][8] into pixel, feature and decision levels. Pixel-level fusion generates a fused image in which information content associated with each pixel is determined from a set of pixels in source images. Feature-level fusion[8] requires the extraction of special features which are depending on their environment such as pixel intensities, edges or textures[6]. These similar features from the input images are fused. Decision- level fusion, higher level of fusion. Input images are processed individually for information extraction.

Generally these algorithms can be categorized into spatial domain fusion and transform domain fusion. There are SIDWT, DWT[5], DCT type transform techniques. So, most of we are using simple minimum, simple maximum and simple average type basic image fusion techniques and PCA[7][3] , which is using in spatial domain techniques. When we are using transform domain then we have to use parameters like, PSNR, EN, etc... For wavelet transforms, SF and SD this parameters are using in SWT technique[8][9]. This ratio are decided the different results between different methods. So morphological processing is collection of non-linear operations related to the shape or morphology of features in an image It‘s showing with a small shape or template called structuring element. It have basic operators like erosion, dilation, opening, closing, filling, cleaning, etc..[10].

II. PROPOSED MODEL : FUSION DOMAIN

Transform Domain Fusion Method

They are several transforms domain used in image fusion. In this paper we are using mainly four types and its hybrid algorithms. Those are following below

1).The Hybrid algorithm: DWT-PCA

The process flow diagram shows the integration of the two methods DWT and PCA to get a hybrid algorithm DWT PCA. The general flowchart is given below.

The algorithm explained below:

- As an initial step, the both images are resized to same size and mapping of RGB TO gray done. The DWT[5] is applied, as explained in Section A. Here one modification in fusion rule i.e. the obtained

decomposed coefficients A1, A2, A3, A4 and B1, B2, B3, B4 of both images M1and M2 are fused by applying PCA algorithm as explained in Section C. Resultant will be the fused coefficients.

- Then, to reconstruct fused image apply inverse DWT to obtain the final fused image F.
- Using fused image F and reference image as M1, calculate the performance matrices using Eqns (8)-(10), MSE, PSNR, and Entropy.

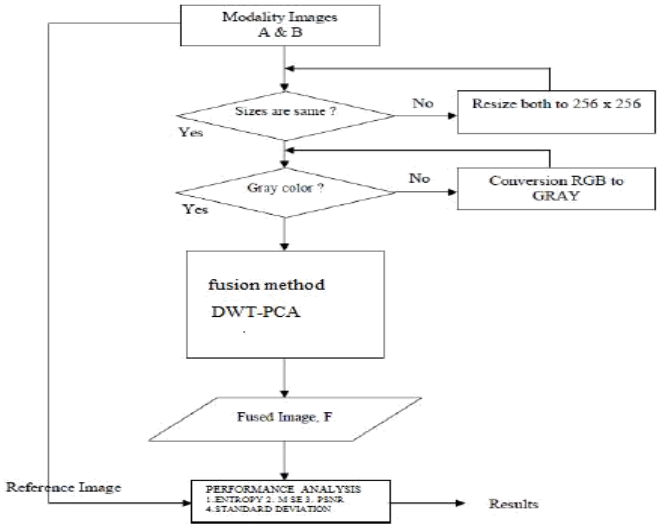

Figure2: Flowchart of DWT-PCA

2). DCT-PCA

The FDCT and PCA algorithms are integrated to give a new one called DCT-PCA hybrid algorithm. The general flowchart is given below Figure 4.8

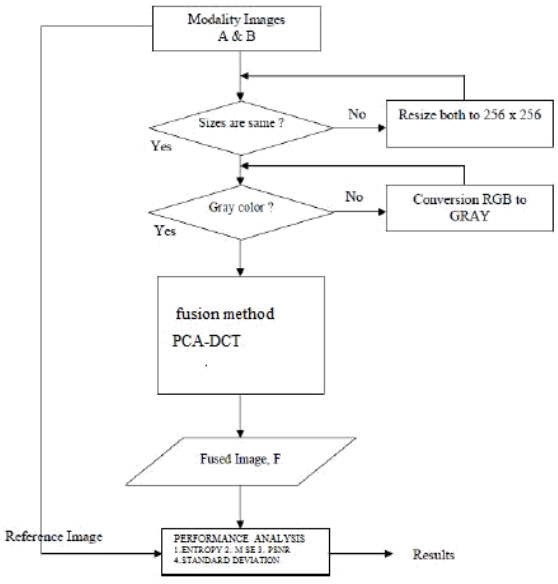

Figure 3: Flowchart of DCT-PCA

The algorithm is explained below:

- Initially, the pre-processing steps are applied to get same sized images and mapped to gray images.
- Using the FDCT Wrapping algorithm, as discussed in previous Section B and to find the C1{1, i }{1,j} and C2{1, i}{1, j} curvelet coefficients [5].
- As a fusion rule apply the PCA (refer section C) to obtain the fused Curvelet-PCA[1] coefficient.
- Reconstruction of image is by applying inverse FDCT wrapping. The resultant is the fused image of both modality images.
- Finally, perform qualitative and quantitative analysis. Using reference image and fused image

3).DWT-DCT-PCA

The hybrid algorithm: DWT-DCT-PCA

This hybrid algorithm is combination of DWT[21], FDCT and PCA; to integrating the all the features, merits having among each others. Also over comes the problem faced among the methods. The basic processing flow diagram is shown in the figure 4.8

The algorithm is given as below:

- The registered medical images of different modality, image A and B. Let consider these images are M1, M2. These are mapped to a RGB to gray colors, following with resizing both to same size 256 x 256 dimensions.
- Now, apply DWT[19] algorithm (as explained section A) to get a set of 4 decomposed frequency band coefficients for each images.
- For each respective image‘s decomposed frequency band coefficients, apply FDCT wrapping transformation to get respective curvelet descriptor coefficients of all set of decomposed coefficients.
- Using, the PCA as a fusion rule to selectively combine the coefficients decomposed in previous step to form fused pca_ct_dwt coefficients.
- To regenerate, sets of frequency bands from above stage‘s resultants are applied with inverse FDCT wrapping to respective coefficients.
- After getting a set of four fused frequency coefficients, apply inverse DWT to reconstruct the final fused image, F.
- Using M1 as reference image and final fused image F, the performance analysis is done.

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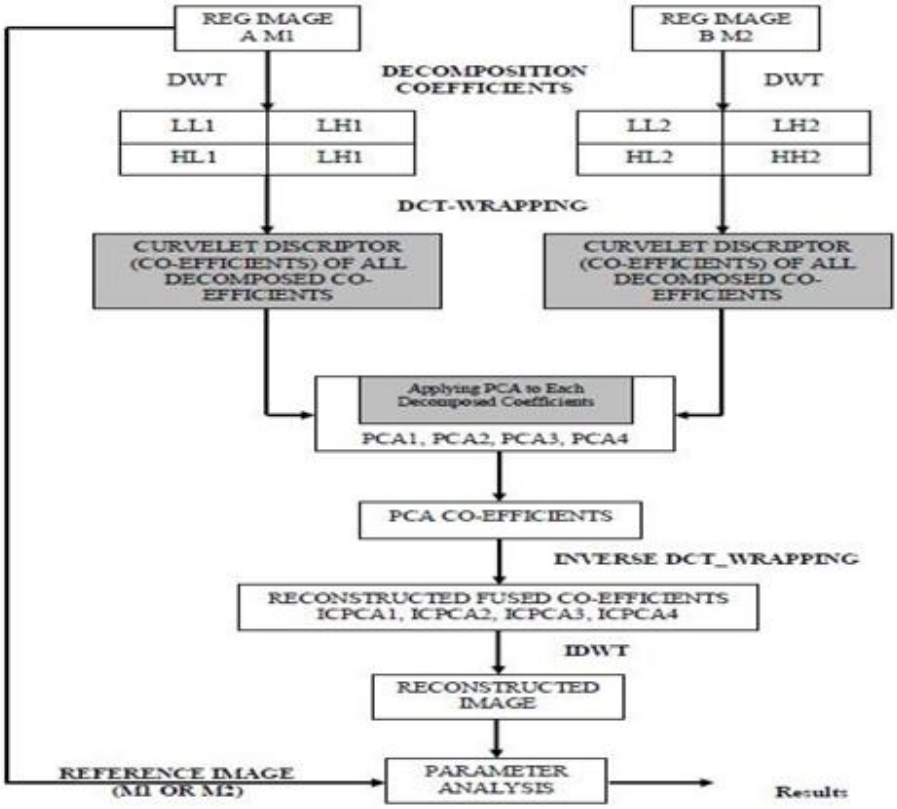

Figure 4.8: The basic processing flow diagram of hybrid algorithm, DWT-DCT-PCA.

III..Results:

Take the two input images i.e. CT and PET images of same size. After loading images we get results as shown in below.

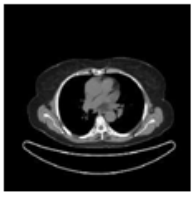

Figure 1: CT image output

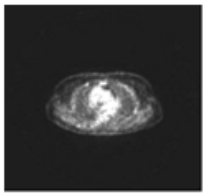

Figure2: PET image

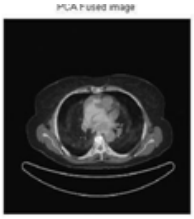

Figure3:PCA Output

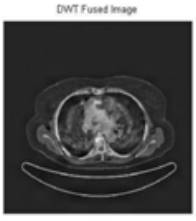

Figure4:DWT

This is the output of PCA transform method. Its gives the best entropy compared to other transforms. The PSNR value of PCA is 27.18. But the main disadvantage is it provide the high standard deviation i.e. 125.19.So in order to overcome we go for DWT method. Last figure shows the output of DWT transform method. In this method the image can be divided into wavelets. Because data are shattered into more components, it becomes much easier to filter.

The below figure 5 is the output of DCT transform method. Its gives the best entropy compared to other transforms. The entropy value of DCT is 3.48 .It also having high MSE and standard deviation. So in order to

overcome this problem we go for fusion transform methods. Actually each transform as its own specialty like PCA have the best PSNR and DCT have the high entropy value. so in order to get better output we go for the hybridization.

Figure 4: DCT image

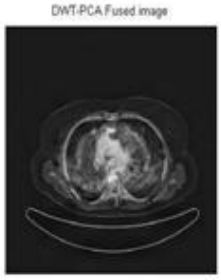

Figure5: DCT-PCA

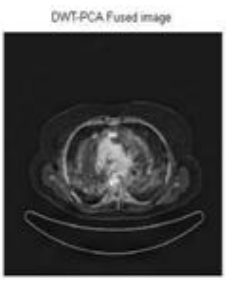

Figure6:DWT-PCA Output

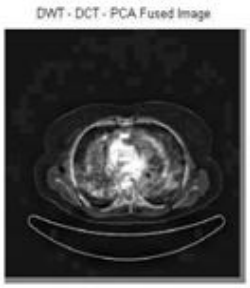

Figure7:DWT-DCT-PCA

Figure6. points out the output of DCT-PCA transform method. Its gives the best entropy, PSNR compared to other transforms. The entropy value of DCT-PCA is 3.45 and PSNR value is 26.92 .It also having high MSE and standard deviation. So in order to overcome this problem we go for fusion transform methods.

Figure 7 is the output of DWT-PCA transform method. Its gives the best entropy, PSNR and low standard deviation compared to other transforms. The entropy value of DWT-PCA is 3.40 and PSNR value is 26.72 . It also having high MSE. So in order to overcome this problem we go for fusion transform methods.

Figure8.points out the output of DWT-DCT-PCA transform method. Its gives the best entropy, PSNR and low standard deviation compared to other transforms. The entropy value of DWT-DCT-PCA is 3.768 and having low standard deviation i.e. 109.37.But in this hybrid one DWT is having the shift variance error.

Table 1: Comparision table for hybrid transforms

S.NO	TRANSFORM METHOD	PSNR	ENTROPY	MSE	STANDARD DEV IA TIO N
1	PCA	27.18	3.15	126.10	125.19
2	DWT	26.49	3.41	146.85	104.87
3	DCT	26.72	3.48	138.43	107.69
4	DWT-PCA	26.72	3.40	139.46	109.09
5	DCT-PCA	26.92	3.45	133.16	110.67
6	DWT-DCT-PCA	26.81	3.76	135.58	109.37

IV.CONCLUSION

The quality evaluation & analysis is done through tabulation of calculated values and graphs using some matrices like MSE, PSNR, and entropy. However the results given by the tests and analysis, quite uneven among the algorithms used. But, it has given better results for hybrid algorithms.

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