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Image Fusion of Medical Modalities Using Dual Tree Complex Wavelet Transform with PCA

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Abstract- Combining numerous modalities of medical pictures will increaserobustness and improve accuracy in medical analysis and designation of diseases. a big task for retrieving complementary information from totally different modality of medical pictures appreciate MRI, CT, PET and SPECT may be achieved by multimodal medical image fusion. totally different characteristics of low and high frequency sub bands area unit taken into consideration and fusion rules area unit applied. In the planned methodology, DTCWT (Dual Tree advanced rippling Transform) is applied to extract salient info from every modality. Fusion rule is applied with PCA options. Performance analysis is meted out between the planned fusion methodology and other existing strategies. Improvement in visual quality may be seen in the planned methodology.

Index Terms - DWT, DTCWT, PCA, decomposition, fusion rules.

I IINTRODUCTION

Medical pictures corresponding to X-ray, computerized axial tomography(CT), resonance Imaging (MRI), antilepton Emission Tomography (PET) and Single gauge boson Emission Computed Tomography (SPECT) square measure required to support a lot of careful clinical data. it's attainable for the physicians to extract features from the coalesced pictures of various modalities that will not be visible within the traditional pictures. parenthetically, MR image will provide traditional and pathological soft tissue data, but it cannot support the data concerning bones. Details concerning internal organs, tumors, bones and vessels square measure provided by CT. The dynamic behavior of tissues and metabolism is provided by PET. SPECT offers the indication concerning the blood flow [1]. All these data cannot be obtained in an exceedingly single image. This problem may be solved by victimization multimodal medical image fusion [2]. therefore, multimodal medical image fusion is outlined as combining multiple pictures of single modality ormultiplemodalities to boost the image quality, which may be used for accurate clinical designation. Three completely different levels of image fusion square measure pixel level, feature level and call level. very cheap level of fusion is pixel level in which fusion method is allotted on pixels. supply pictures are divided into regions and options like pixel intensities, edges or texture square measure used for fusion in feature level fusion [2]- [4]. assimilative data at the next level of abstraction is seen in call level fusion. Image fusion is either on special domain or on remodel domain. the favored methodology below transform domain is victimization separate riffle remodel (DWT) which gives a awfully blast frequency analysis removing spatial distortion. The problems connected with DWT square measure, it doesn't give sufficient directional data and leads to a picture with shift variance and additive noise. A recent intensifying to DWTwith necessary extra properties is twin Tree complicated Wavelet remodel (DTCWT). it's nearly

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shift invariant, directionally selective in 2 and better dimensions and computationally effective. It conjointly preserves time and frequency information and thence could be a appropriate approach for medical image fusion [5]-[8]. A combined methodology called DTCWT-PCA is used for fusion during this work that is associate improvement over DWT-PCA fusion. applied math parameters adore normal deviation (S), entropy (E), fusion issue (FF), RMSE, and PSNR are accustomed show the improved performance. Section II explains DTCWT methodology, III describes analysis of fusion theme, and section IV offers experimental results.

II PROPOSEDSCHEMES

Selenick and Kingsbury [6] projected that twin tree riffle transform is employed to beat disadvantages of ancient wavelet rework that suffered from reduced directional selectivity, shift variance and nonattendance of part information [5]. Block diagram of the projected fusion theme is shown in Fig.1 (a). during this work, the supply pictures thought of area unit the combination of man, CT, PET and SPECT. These RGB pictures are reborn to grey scale. By applying DTCWT, the source images area unit rotten. The approximation and elaborated coefficients area unit extracted from rotten supply pictures. Fig.1 (b) shows the third level DTCWT decomposition. At each level 2nd DTCWT produces sub-bands in six directions to reveal the details of a picture at -150, -450, -750, 750, 450, a hundred and fifty directions with 4:1 redundancy. On every of those sub-bands, principal component analysis (PCA) has been applied to collect salient information.

The applicablecomplex moving ridge coefficients of decomposed image square measure combined mistreatment PCA fusion rule asshown in Fig.1 (c). As medical image information is large, to cut back thedata PCA technique is important. PCA removes the redundant information gift in DTCWT. PCA is that the simplest of actuality Eigen vector primarily based multivariate analysis. Its operation are often thought of as enlightening the inner structure of the info that explains the variance within the information [7]. PCA includes computation of Eigen values and therefore the corresponding Eigen vectors of variance matrix C. These square measure organized in down order. Normalize the column vector appreciate larger Eigen worth by dividing each element with mean of Eigen vector as p_1 ,p_2 .These normalized Eigen vector values act as weight values that square measure increased with every pixel of the rotteninput image. total of the 2 scaled matrices are calculated to obtain the united image matrix. Once the PCA fusion rule is applied, the reconstruction of the processed constant is distributed mistreatment IDCTWT to come up with the fused image. The main aim of an image fusion process is that all sensibleand efficient information should be secured. At the same time, the reconstructed image must not be changed due to the undesirable introduction of artifacts [7]. Performance evaluation of the proposed method is conducted using various parameters. No reference methods such as Entropy (E), Standard Deviation (S) and Fusion Factor (FF) are responsible for the restored information content in the fused image. Objective evaluation of the fused image quality can beobtained by using full reference methods such as Root Mean Square Error (RMSE) and Peak signal to Noise Ratio (PSNR).

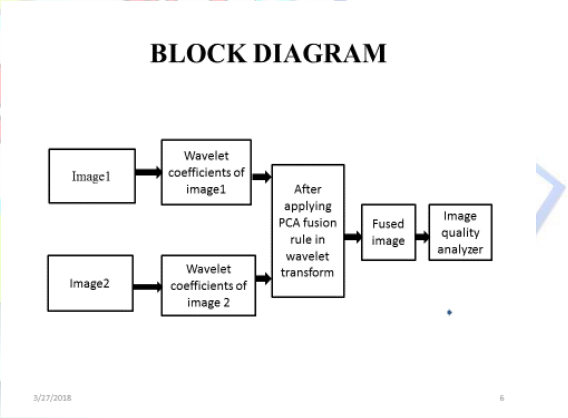

fig1: block diagram

RESULT AND DISSCUSSIONS

Experiments are performed over four totally different modalities of images; imaging, CT, PET and SPECT of size 512x512. The datasets of various slices of brain with diseases in a single person are obtained from “The Whole Brain Atlas” database. Simulation is dispensed victimization MATLAB R2014a.DTCWT-PCA based mostly medical image fusion provides high entropy compared to

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alternative strategies for all the information sets. High value of entropy obtained indicates that a amalgamate image is of fine quality and has raised data content. Fusion issue is high for CT/CT combination compared to alternative datasets that specifies that the amalgamate image has smart mutual data. The proposed technique has high PSNR compared to DWT-PCA in case of dataset one, knowledgeset three and data set four with low RMSE. Thisis because of the absence of artifacts in DTCWT-PCA coalesced image while it's gift in DWT-PCA coalesced pictures. Computation time for DTCWT-PCA fusion is lesser compared to DWT-PCA fusion methodology. In DWT-PCA, 3 level decomposition is 1st performed so PCA fusion rule is applied to individual coefficients in every level. Whereas in DTCWT-PCA fusion method, decomposition into 3 levels and PCA fusion is performed at the same time in every levels. therefore process efficiency is high in DTCWT-PCA fusion methodology compared to DWT-PCA fusion.

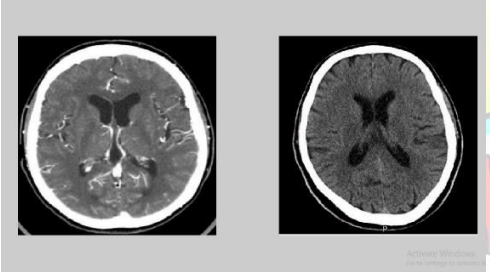

Fig 2:example image from CT and MRI input medical image.

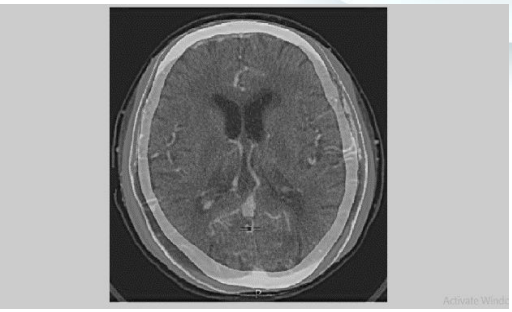

Fig3:fused different modalities medical image

CONCLUSION

Medical image fusion of assorted modalities in advanced wavelet domain with PCA is given during this work. Thisapproach is a lot of appropriate for medical image fusion attributable to shift unchanging and high directivity property of +DTCWT and feature improvement property of PCA. The coalesced image of the projected fusion approach is a lot of refined in representing spectral, spatial and soft tissue details of the tumor. High values of entropy, fusion issue and PSNR of the projected method proves that it performs well compared to alternative fusion methods. In addition image quality to determined and to compare the other fusion rules.

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