Medical Image Fusion Using Redundant Wavelet Based   ICA Co-Variance Analysis

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Abstract: In this paper the discussion is on research work dealing with medical image fusion combination utilizing the wavelet changes occurring for images in frequency domain is discussed. We have manufactured a model framework that permits experimentation with a different wavelet which exhibit reduced blend ratio and control techniques for fusion combination, utilizing an arrangement of essential operation of ICA or independent component analysis on wavelet decomposed bands. The fusion system concentrates utilizing a wavelet condition called when a valid number of components are needed called RDWT with great information handling capacity and enhancing traits. The technique enhances a standard wavelet merger for blending the lower recurrence segments of a multi-imaged data and using deviation rules with weighting normal absolute values. The systems was tested numerically with the previous approach of PCA analysis on the basis entropy calculation, fusion factor for fused and original images, the PSNR index values, MSE metric and the STD standard deviation of the fused image. The experimental results show the superiority of the proposed system over past approach.

Key Words: PCA, ICA, DWT, RDWT, Fusion, PSNR, MRI, CT.

I. INTRODUCTION

Medical image fusion is the process of registering and combining multiple images from single or multiple imaging modalities to improve the imaging quality and reduce randomness and redundancy in order to increase the clinical applicability of medical images for diagnosis and assessment of medical problems. Multi-modal medical image fusion algorithms and devices have shown notable achievements in improving clinical accuracy of decisions based on medical images. This review article provides a factual listing of methods and summarizes the broad scientific challenges faced in the field of medical image fusion. We characterize the medical image fusion research based on (1) the widely used image fusion methods, (2) imaging modalities, and (3) imaging of organs that are under study. This review concludes that even though there exists several open ended technological and scientific challenges, the fusion of medical images has proved to be useful for advancing the clinical reliability of using medical imaging for medical diagnostics and analysis, and is a scientific discipline that has the potential to significantly grow in the coming years.

The term combination implies by and large a way to deal with extraction of data obtained in a few spaces. The objective of picture combination (IF) is to coordinate correlative multi-sensor, multi-temporal and/or multi-view information into one new picture containing data the nature of which can't be accomplished something else. The term quality, its significance and estimation rely on upon the specific application.

Picture combination has been utilized as a part of numerous application regions. In remote detecting and in space science, multisensor combination is utilized to accomplish high spatial and unearthly resolutions by joining pictures from two sensors, one of which has high spatial determination and the other one high otherworldly determination. Various combination applications have showed up in medicinal imaging like concurrent assessment of CT, MRI, and/or PET pictures. A lot of utilizations which utilize multisensor combination of noticeable and infrared pictures have showed up in military, security, and reconnaissance regions. On account of multiview combination, an arrangement of pictures of the same scene taken by the same sensor however from diverse perspectives is melded to acquire a picture with higher determination than the sensor typically gives or to recuperate the 3D representation of the scene. Therapeutic picture combination envelops an expansive scope of strategies from picture

combination and general data combination to address restorative issues reflected through pictures of human body, organs, and cells. There is a developing interest and use of the imaging innovations in the regions of restorative diagnostics, investigation and authentic documentation. Since PC supported imaging procedures empower a quantitative appraisal of the pictures under assessment, it serves to enhance the viability of the therapeutic specialists in landing at a fair and target choice in a short compass of time. Also, the utilization of multi-sensor [2] and multi-source picture combination strategies offer a more noteworthy differences of the components utilized for the restorative examination applications; this regularly prompts powerful data handling that can uncover data that is generally undetectable to human eye. The extra data acquired from the combined pictures can be all around used for more exact limitation of irregularities.

II. LITERATURE REVIEW

Abhinav Krishn et al. (2014) [1] have introduced Medical image fusion for complementary diagnostic content study using Principal Component Analysis (PCA) and Wavelets. The given fusion approach utilizes sub-band decomposition using 2D-Discrete Wavelet Transform (DWT) in for better preservation of both spectral and spatial information. Also, PCA is applied on the decomposed coefficients of 2D DWT to maximize the spatial resolution. A high efficiency variant of the daubechies wavelet family has been selected experimentally for better fusion results. Simulation shows an improvement in visual quality of the fused image in comparison to other previous fusion approaches.

We Qiang Wang et al. (2004) [4] has examined that the Image combination is turning into one of the most sizzling strategy all combination structure, and subjective combination structure. What's more, the impacts of such picture combination structures on the exhibitions of picture combination are dissected. In the trial, creators clarified the common hyper unearthly picture information set is combined utilizing the same wavelet change based picture combination method, however applying vary rent combination structures. The distinctions among their melded pictures are examined. The exploratory results affirm the hypothetical investigation that the exhibitions of picture combination methods are connected to the combination calculation, as well as to the combination structures, and different picture combination structures that produces diverse combination execution even utilizing the same picture combination technique.

Desale, R.P et al. (2013) [5] clarified that the Image Fusion is a procedure of consolidating the important data from an arrangement of pictures, into a solitary picture, wherein the resultant combined picture will be more educational and complete than any of the info pictures. This paper examines the Formulation, Process Flow Diagrams and calculations of PCA (primary Component Analysis), DCT (Discrete Cosine Transform) and DWT based picture combination methods. The outcomes are likewise displayed in table & picture form for near investigation of above methods. The PCA & DCT are customary combination systems with numerous downsides, though DWT based methods are more great as they gives better results to picture combination. In this paper, two calculations taking into account DWT are proposed, these are, pixel averaging & most extreme pixel substitution approach.

Prakash, C et al. (2012) [6] clarified that the Image combination is fundamentally a procedure where different pictures (more than one) are joined to frame a solitary resultant melded picture. This melded picture is more beneficial when contrasted with its unique info pictures. The combination procedure in medicinal pictures is valuable for creative malady determination reason. This paper represents diverse multimodality therapeutic picture combination methods and their outcomes surveyed with different quantitative measurements. Firstly two enlisted pictures CT (anatomical data) and MRI-T2 (useful data) are taken as information. With quantitative measurements specifically Over all Cross Entropy(OCE),Peak Signal –to- Noise Ratio (PSNR), Signal to Noise Ratio(SNR), Structural Similarity Index(SSIM), Mutual Information(MI). From the determined results it is induced that Mamdani sort MIN-SUM-MOM is more gainful than RDWT furthermore the proposed combination strategies give more data contrasted with the information pictures as legitimized by all the measurement

Aribi, W et al. (2012) [7] explained that the quality of the medical picture can be assessed by a few subjective techniques. However, the objective technical assessments of the quality of medical imaging have been as of late proposed. The combination of data from distinctive imaging modalities permits a more exact examination. We have grown new strategies in light of the multi determination combination. X-ray and PET pictures have been combined with eight multi determination strategies. For the assessment of combination pictures got, creators picked by target procedures. The outcomes demonstrated that the combination with RATIO and difference strategies to offer the best results. Assessment by target specialized nature of medicinal pictures melded is attainable and effective.

Mohamed, M et al. (2011) [8] has characterize the Image combination is a procedure which joins the information from two or more source pictures from the same scene to create one single picture containing more exact subtle elements of the scene than any of the source pictures. Among numerous picture combination strategies like averaging, rule part

examination and different sorts of Pyramid Transforms, Discrete cosine change, Discrete Wavelet Transform unique recurrence and ANN and they are the most widely recognized methodologies. In this paper multi-center picture is utilized as a contextual analysis. This paper addresses these issues in picture combination: Fused two pictures by diverse systems which display in this exploration, Quality appraisal of intertwined pictures with above routines, Comparison of distinctive methods to focus the best approach and Implement the best procedure by utilizing Field Programmable Gate Arrays (FPGA).

Haghighat, M et al. (2010) [9] has clarified that the picture combination is a system to consolidate data from various pictures of the same scene so as to convey just the helpful data. The discrete cosine change (DCT) based systems for picture combination are more suitable and efficient progressively framework. In this paper a productive methodology for combination of multi-center pictures taking into account change ascertained in DCT space is exhibited. The exploratory results demonstrates the productivity change of our technique both in quality and intricacy lessening in examination with a few late proposed systems.

Pei, Y et al. (2010) [10] clarified that this paper proposes an enhanced discrete wavelet structure based picture combination calculation, subsequent to concentrating on the standards and qualities of the discrete wavelet system. The change is the cautious thought of the high recurrence subband picture district trademark. The calculations can productively blend the helpful data of the every source picture recovered from the multi sensor. The multi center picture combination investigation and restorative picture combination trial can confirm that our proposed calculation has the viability in the picture combination.

Li, H et al. (1995) [11] has talked about that in this paper, the wavelet changes of the information pictures are suitably consolidated, and the new picture is acquired by taking the converse wavelet change of the combined wavelet coefficients. A range based greatest determination standard and a consistency confirmation step are utilized for highlight choice. An execution measure utilizing uniquely created test pictures is additionally recommended.

III. Problem Formulation and Proposed Method

The image fusion problem is due to the uneven mixing of different components for two different set images of same spatial data, this nonlinear fusion is caused by selection of low detail components from both the images, the previous techniques which were used by authors relied on different set points for feature extraction and fusion, these features included PCA, wavelet, ICA, IHS and HPF. Later the hybrid

version of these methods were constructed and significantly increased the fusion efficiency the system of fusion however applied on MRI and CT pair images showed variations to a considerable level due to high contrast between the to different imaging methods. The new system uses the RDWT principle in order to extract the complete frequency based components and divide the details into 4 bands. The third step is to apply ICA and find independent edge profiles for both CT and MRI images. The obtained data is then fused and inverse RDWT is applied.

IV. Algorithm For Proposed Work

[1] Select the images to be fused
[2] Find the RDWT based four band decomposition of the first image
[3] Find the RDWT based four band decomposition of the second image
[4] Find the wavelet decomposition upto 4 levels
[5] Use the obtained bands and separate the real and imaginary parts from both the CT and MRI Image
[6] Find the mean of the image and extract the independent mean from the calculated above mean
[7] Find the mean deviation of the calculated for all the bands
[8] Use the square root component of the mean values for estimating the max value shift of local component on the image
[9] Multiplying the main decomposed image bands with extracted Independent component and then fuse the wavelet bands of the enhanced image
[10] Then calculate the parameters for analysis like fusion factor, entropy, mean square error, standard deviation, PSNR
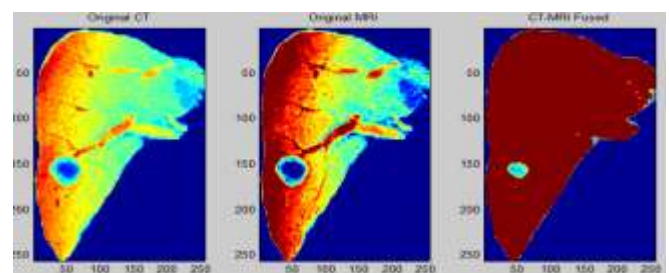
V. Results Evaluation

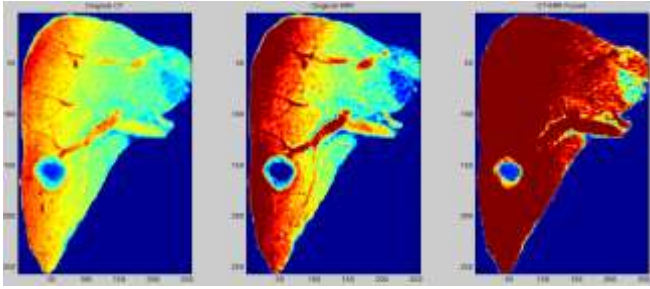**Figure 1 shows the results for base fusion approach**

Figure 2 shows the results for proposed fusion approach

Table 1 shows the output of the base system using different quality metrics

Entropy	MSE	FF Joint	PSNR
1.29E	11.6897	5.4819	30.8747

Table 2 shows the output of the proposed system using different quality metrics

Entropy	MSE	FF Joint	PSNR
1.34	11.5308	6.600	31.1870

VI. Conclusion

In this research, we proposed another Hybrid picture combination calculation fusion system for coordinating corresponding data from multi-sensor information so that the melded pictures will be improved and more human recognition inviting. We detail the picture combination as an enhancement issue whose arrangement is accomplished by the proposed technique. We have effectively tried the new system on combination of multi-center, multi-methodology (CT and MRI), and also tested the systems accuracy using comparative metrics such as Entropy, Fusion Factor and MSE, PSNR to backup the robust capability of proposed system.

VII. REFERENCES

[1] Krishn, Abhinav, Vikrant Bhateja, and Akanksha Sahu. "Medical image fusion using combination of PCA and wavelet analysis." In Advances in Computing, Communications and Informatics (ICACCI, 2014 International Conference on, pp. 986-991. IEEE, 2014.

[2] B. V. Dasarathy, A special issue on natural computing methods in bioinformatics, Information Fusion 10 (3) (2009) 209.

[3] O.Rockinger. "Image sequence fusions using a shift-invariant wavelet transform." In image processing , 1997 International Conference on, vol. 3, pp. 288-291. IEEE1997.

[4] T.Zaveri, M.Zaveri, V.Shah and N.Patel. "A Novel Region Based Multifocus Image Fusion Method." In Digital Image Processing, 2009 International Conference on, pp. 50-54. IEEE, 2009.

[5] Aribi, Walid, Ali Khalfallah, Med Salim Bouhlel, and Noomene Elkadri. "Evaluation of image fusion techniques in nuclear medicine." In Sciences of Electronics, Technologies of Information and Telecommunications (SETIT), 2012 6th International Conference on, pp. 875-880. IEEE, 2012.

[6] Pei, Yijian, Huayu Zhou, Jiang Yu, and Guanghui Cai. "The improved wavelet transforms based image fusion algorithm and the quality assessment." In Image and Signal Processing (CISP), 2010 3rd International Congress on, vol. 1, pp. 219-223. IEEE, 2010.

[7] Shen S. – Discrete wavelet transform www.csee.umbc.edu/~pmundur/courses/CM SC691M-04/sharon-DWT.ppt [01/12/2009]

[8] Li, Hui, B. S. Manjunath, and Sanjit K. Mitra. "Multisensor image fusion using the wavelet transforms." Graphical models and image processing , vol. 3,pp. 235-245. IEEE 1997.

[9] Ghimire Deepak and Joonwhoan Lee. "Nonlinear Transfer Function-Based Local Approach for Color Image Enhancement." In Consumer Electronics, 2011 International Conference on, pp. 858-865 . IEEE,2011

[10] Patil, Ujwala, and Uma Mudengudi. "Image fusion using hierarchical PCA." In image Information Processing (ICIIP), 2011 International Conference on, pp. 1-6. IEEE, 2011.

[11] He, D-C., Li Wang, and Massalabi Amani. "A new technique for multi-resolution image fusion." In Geoscience and Remote Sensing Symposium, 2004. IGARSS'04. Proceedings. 2004 IEEE International, vol. 7, pp. 4901-4904. IEEE, 2004.