Medical Image Fusion based on New Features in NSCT Domain

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***Abstract:*In this paper, a new NSCT based Multimodal medical image fusion is proposed by considering the internal characteristics of NSCT coefficients and derived two new fusion rules for low frequency and high frequency coefficients. The low frequency coefficients are fused based on the phase congruency and high frequency coefficients are fused based on their Log-Gabor energies. Since the direct fusion of NSCT coefficients causes some information loss, this work evaluated the internal characteristics for fusion. The performance evaluation is carried out over various test images visually and numerically. The visual analysis is shown in the figures of fused images and numerical evaluation is done through the parameters named as Edge based meausre, SSIM based measure and mutual information. Both the visual and mumerical analysis illustrated the enhancemnet of proposed approach over convnetional approaches.**

Keywords:MMIF, NSCT, DWT, CT, Gabor, $Q^{(AB/F)}$, Q_S, Mutual Information

I.INTRODUCTION

In recent years,Medical imaging has attracted increasing attention due to its vital component in medical diagnostics and treatment [1].However, each imaging model provides information in limited domains that some are common, and some are unique [2]. For example, magnetic resonance imaging (MRI) image is better visualized in the case of soft tissues [3] whereas computed tomography (CT) image can provide dense structures like bones and hard tissues with less distortion. Similarly, T1-MRI image provides the details of an anatomical structure of tissues while T2-MRI image provides information about normal and pathological tissues [4]. As a result, multimodal medical images which have relevant and complementary information are necessary to be combined for a compendious figure [5]. The multimodal medical image fusion is the possible way to integrate complementary information from multiple modality images [6].The image fusion not only obtains a more accurate and complete description of the same target, but also reduces the randomness and redundancy to increase the clinical applicability of image-guided diagnosis and assessment of medical problems [7].

This paper proposes a new multimodal medical image fusion technique based on NSCT which utilizes the statistical characteristics of NSCT coefficients to fit the high frequency coefficients with less distortion and maximum information transfer. Considering the statistical features such as phase congruency of low frequency sub image coefficients and the Log-Gabor energies of High frequency sub image coefficients, the maximum amount of information will be transferred to the fused image form source images. Various types of medical images are processed for the performance evaluation of proposed approach. The performance is carried out both visually and numerically. For numerical evaluation, this paper considered edge based measure, SSIM based measure and Mutual information as the performance metrics.

Rest of the paper is organized as follows: section II gives the details about the Non-subsampled contourlet transform. Section III provides the complete details about the proposed approach of medical image fusion. Section IV represents the simulation results and finally section V concludes the paper.

II. RELATED WORK

In earlier, there are so many approaches proposed for medical image fusion. Basically, there are two main methods for image fusion. One is the spatial domain-based methods, which select pixels or regions from clear parts in the spatial domain to compose fused images [8-9]. Another is the transform domain based methods, which fuse images with certain frequency or time–frequency transform [10-13].The simplest fusion method in spatial domain is to take the average of the source images pixel by pixel. However, along with simplicity come several undesired side effects including reduced contrast. To improve the quality of the fused image, some more reasonable methods were proposed to fuse source images with divided blocks or segmented regions instead of single pixels [8,9]. Most of these methods combine the blocks or regions according to measurement which evaluate the part are clear or not. Another important spatial domain-based method is to identify the focused regions in each image, and then these regions are fused into a single image by simply copying them into the resultant image. However, for the block-based methods, the fused images often suffer from block effect, and the focused regions identify based (named as focused regions-based) methods may easily produce artificial information or erroneous results at the focused border regions, because the boundary of focused regions often cannot be accurately determined. All of these effects will affect the appearance of fused image a lot.Nowadays, multiresolution decomposition (MRD) basedMIF has been recognized as an emerging approach, which can extract more abundant information from source images ofdifferent modalities. This technique has had a fast developmentand extensive application

A Novel Method For Medical Image Fusion Using Modified Non-Sub Sampled Contour Let Transform

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Abstract:In this paper, a novel multimodal medical image fusion is proposed based on Non-subsampled contourlet transform (NSCT), which almost transfers the information from source images to fused image. Initially, the source images are subjected to NSCT followed by the fusion of low frequency sub images and high frequency sub images. The low frequency sub images are fused based on the phase congruency rule where as the high frequency sub images are fused based on the dependencies of Log-Gabor energies. The proposed approach is compared with conventional approaches such as DWT, Contourlet Transform (CT), and some approaches based on NSCT over various test images. Performance evaluation is carried out visually and numerically. Both the visual and numerical results illustrate the effectiveness of proposed approach and also show the enhancement of proposed approach over conventional approaches.

Keywords: MMIF, NSCT, DWT, CT,

I. INTRODUCTION

Medical imaging has been playing a very important in the field of medical diagnosis since many years. This is a major source for the doctors to diagnose the diseases. Whatsoever the medical imaging has its own kinds of Imaging techniques like X-ray, computed tomography (CT), magnetic resonance imaging (MRI). However the characteristics and results of each of these medical imaging techniques are unique. For instance, X-ray and CT can provide images as dense like structure with which the physiological changes could not be detected whereas in MRI images even the soft pathological tissues can be visualized better. As a result the anatomical and functional medical images are needed to be combined for better visualization and for accurate diagnosis.

To serve this purpose the multimodal medical image fusion is an effective way to provide solution to generate information from medical image fusion. This fusion technique not only provides accurate diagnosis and analysis but also helps in reducing the storage cost by reducing storage to a single fused image.Various image fusion techniques have been discovered and implemented so far. These techniques are generally categorized three stages. They include pixel level, feature level and decision level fusion. Most medical image fusion goes with the pixel level fusion. Pixel level fusion has the advantages of retaining the original measured quantities and found to be computationally efficient. And so this paper can also be considered with the pixel level fusion.

II. BACKGROUND AND RELATED WORK

Traditional image fusion algorithms serve the purpose of fusing the images from multimodality images and produce a single fused image as output. Some of the images fusions techniques are based on discrete wavelet transform (DWT), Wavelet packet transform (WPT), Ripplet transform, Framelet transform, Curvelet transform and so on Many comparative studies shows the Wavelet decompositions servers good for discontinuities that are isolated in an image but it is not so much good at edge and texture regions. And further it captures limited information from the images such as the horizontal, vertical and diagonal directions only. To overcome these issues the multiscale decomposition technique known as the NSCT decomposition technique can be adopted in fusion of the medical images which is very important for the medical experts to diagnose the health issues of a person. For example the wavelet transforms perform the image compression and denoising efficiently. Same way each and every technique has its own unique features and functionality which are very important in image processing.

Same way the non-subsampled contourlet transform has the property of providing a multiscale, multidirectional, shift invariant image decomposition that can be efficiently implemented by means of the fusion techniques or algorithms.

III. THE NON-SUBSAMPLED CONTOURLET TRANSFORMS

A.NON-SUBSAMPLEDPYRAMID STRUCTURE (NSP)

The multiscale property of the nonsubsampled contourlet transform is preserved by this NSP. The contourlet transform is constructed by combining laplacian pyramid and the directional filter banks. The pyramidal filter bank structure plays important roles in the compression

This book gives how to design an efficient MIF system which mainly concentrates on the edges,textures and boundaries of medical images.Further it also tries to achieve a fused image which could be shift-invariant,rotation-invariant, multi-scale and multidirectional in nature.The complete accomplishment of this approach is done in the Non-subsampled Contourlet Transform(NSCT) domain.Initially the source images are transformed through NSCT into Low frequency and high frequency sub band images.Since the NSCT is shift-invariant,multi-scale and multi-directional in nature,the source images are transformed through NSCT only such that the fused images should be robust to such issues. To make the fused image rotation-invariant,the dominant features in every orientation needs to be captured and this is accomplished through Gabor filter. Two new fusion rules are also derived based on the Angular Consistency(AC) and Spatio-Frequency energy of low frequency sub bands and high frequency sub bands respectively.The new rule based on AC helps in the observation of phase variations in the low frequency sub bands and the Spatio-Frequency energies noise invariant.

Dr. H. Devanna has received Ph.D from Jawaharlal Nehru Technological University Anatapur, Anathapuramu, Andhra Pradesh, India, in medical image processing. He has twenty years of teaching experience. He published more than 35 Paper in international journals, 12 Papers in international conferences and 8 Papers in national conferences.

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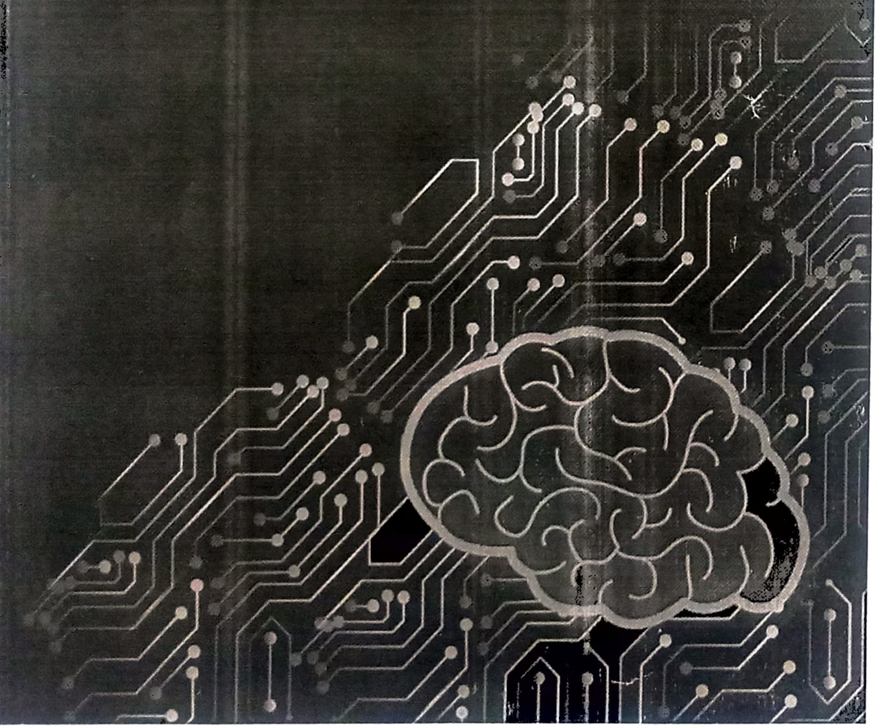

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