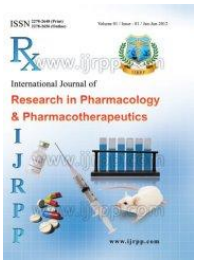
International Journal of Research in Pharmacology & Pharmacotherapeutics



ISSN Print: 2278-2648 ***IJRPP |Vol.4 | Issue 4 | Oct – Dec - 2015***
ISSN Online: 2278-2656 ***Journal Home page: www.ijrpp.com***

Research Article ***Open Access***

Wavelet based image fusion for detection of brain tumor

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ABSTRACT

The proposed work is to apply a wavelet based image fusion algorithm is applied on the Magnetic Resonance (MR) images and Computed Tomography (CT) images which are used as primary sources to extract the redundant and complementary information in order to enhance the tumor detection in the resultant fused image. The main features taken into account for detection of brain tumor are location of tumor and size of the tumor, which is further optimized through fusion of images using various wavelets, transforms parameters. The performance efficiency of the algorithm is evaluated on the basis of PSNR values.

Keywords: Brain Tumor, M R Image, C T image, PSNR Value and Wavelet analysis.

INTRODUCTION

Brain tumor, is one of the major causes for the increase in mortality among children and adults. Detecting the regions of brain is the major challenge in tumor detection. In the field of medical image processing, multi sensor images are widely being used as potential sources to detect brain tumor. In the last two decades medical science has seen a revolutionary development [1] in the field of biomedical diagnostic imaging. The current advancement in the field of artificial intelligence and computer vision technologies [2] have been very effectively put into practice in applications such as diagnosis of diseases like cancer through medical imaging [3]. Latest research in biomedical imaging also finds potential applications in the fields of 3-D tissue harmonics [4], extended field of view and new contrast agents [5]. The main emphasis of the latest developments in medical imaging is to develop more reliable and capable algorithms which can be used in real time diagnosis of tumors. Brain tumor is caused due to uncontrolled growth of a mass of tissue, which can be fatal among children and adults. The National Brain Tumor Foundation (NBTF) for research in United States estimates the death of 13000 patients while 29000 undergo primary brain tumor diagnosis every year [5]. Depending on the origin and growth, brain tumor can be classified into two types:

1. Primary brain tumor is developed at the original site of the tumor
2. Secondary brain tumor is the cancer which spreads to the other parts of the body.

Many segmentation algorithms are implemented based on edge detection on the grey scale images. Schendra et al [7] proposed a method based on multi scale image segmentation using hierarchical self-organizing map for the segmentation of brain tumor, which uses high speed parallel fuzzy c-mean algorithm. Another improved algorithm based on neuro fuzzy technique [8] while Chunyan et al. [9] designed a method for 3D variational segmentation for processes because of the high diversity in appearance of tumor from various patients. This paper seeks to bring out the advantages of segmentation of CT scan images and MR images through image fusion.

MOTIVATION

The detection of brain tissue and tumor in MR images and CT scan images has been an active research area [6]. Segmenting and detection of specific regions of brain containing the tumor cells is considered to be the fundamental problem in image analysis related to tumor detection. Image Fusion technique is effectively used to detect tumor in various complex backgrounds. Image Fusion is applied by merging multiple images resulting into precise information about the size, shape and location of the tumor. Wavelet analysis is an effective methodology capable of revealing aspects of data which other signal analysis techniques overlook like trends, breakdown points, discontinuities in higher derivatives, and self-similarity. In addition, wavelet analysis is capable of compressing or de-noising a signal without appreciable degradation.

EXISTING ALGORITHM

Pyramid hierarchy of 2-D DWT

The Image enhancement techniques involve point operations, mask operations, and global operations which sharpen image features for efficient analysis. In the proposed algorithm mask operations were used for the enhancement of brain tumor detection efficiency. These techniques improve the efficiency of the image fusion algorithm through elimination of ambient elements from the source images. In this paper various results are obtained by changing the wavelet used for decomposition. The paper further discusses the variation in result on changing the parameters of wavelet transforms used for the decomposition.

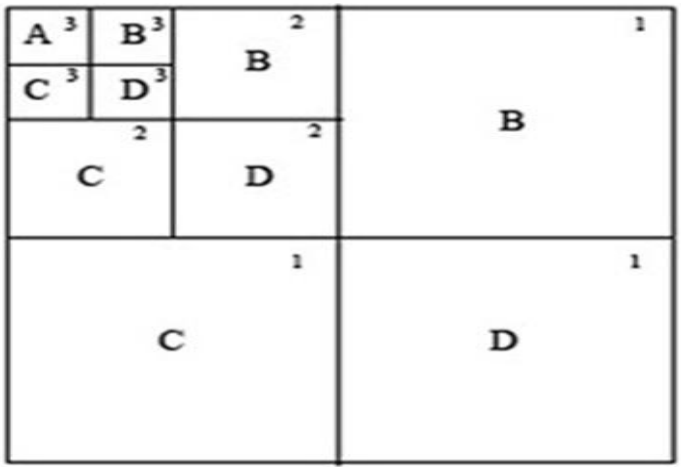

Figure 1: Pyramid hierarchy of 2-D DWT (A-LL, B-LH, C-HL, D-HIH), LL (Low-Low), LH (Low-High), HL (High-Low) and HIH (High-High), 1,2,3-Decomposition levels, H-high frequency bands and L-low frequency Bands

Mri and ct analysis

Fused images can be created [12] by combining information from multiple modalities, such as magnetic resonance image (MRI) and computed tomography (CT). CT images are used more often to ascertain differences in tissue density depending upon their ability to block X-rays while MRI provides good contrast between the different soft tissues of the body, which make it especially useful in detecting brain tissues, and cancers [5]. The fused image from multiple images produce an image which contains combined complementary and redundant information provided by both the source images i.e. the size of the tumor, the location through the various pixel values of the

gray scale images, hence resulting into better visibility of tumor.

Wavelet analysis

The concept of wavelets in its present theoretical form was first proposed by Jean Morlet and the team at the Marseille Theoretical Physics Centre working under Alex Grossmann in France [13]. In wavelet analysis, wavelet transform divides the image signal into wavelets representing each pixel of the original image as coefficients.

Image fusion

The principle of image fusion [14] using wavelets was first introduced by H. Li. in which image fusion was used for the fusion of synthetic aperture radar and multispectral image data. Image fusion can be defined as combining various signal sources from different sensors and multi-modality images. Simple image fusion can be achieved through taking pixel by pixel average of the source images. This process may lead to undesired side effects or distortions in the fused image. In order to avoid unnecessary distortions, the principle of pyramid transform is used to construct the pyramid transform of the source images. Pyramid transforms of the source images are combined and on applying inverse pyramid transform fused image is obtained. The basic idea used is to form multi scale transforms on the input images, and to form a multi scale composite representation from these and form the required image by applying inverse transforms. In case of Wavelet based image fusion, Wavelet decomposition is applied to the original images by passing the input images through a wavelet filter which gives the Approximation coefficients and Detail coefficients of the images. The Approximation and Detail coefficients of the two images are combined using average of the coefficients or the maximum or minimum of the coefficients. The resultant image is formed by passing the coefficients thus obtained through a reconstruction filter.

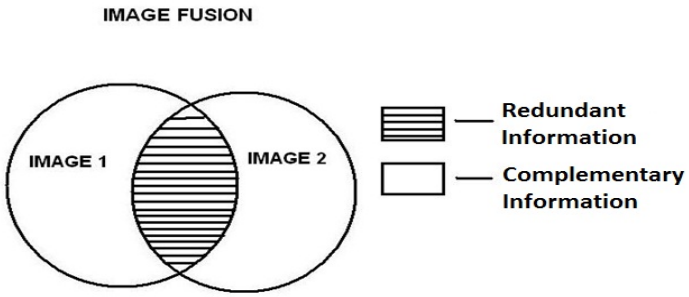

Figure 2: Block Diagram depicting basic image fusion

The image fusion algorithm

The MR image fusion approach first proposed by Burt and Adelson [15] was implemented using pyramid structures called the Laplacian pyramid. The basic idea was to use multi scale transform (MST) on the source images followed by inverse multi scale transform (IMST) resulting into composite of images. In the first step multi scale transforms or multi resolution analysis involves decomposition of the original image into different levels. The image signal consists of various bands like low-low, low-high, high-low and high-high on decomposition by wavelet transform. Higher number of decomposition levels [16] does not necessarily produce better result because by increasing the analysis depth the neighboring features of lower band may overlap. This leads to discontinuities in the composite representation and thus introduces distortions, such as blocking effect or ringing artifacts into the fused image. We may lose parts of the images composed of small objects as the depth of the pyramid increases, which is the main drawback of the above specified methodology.

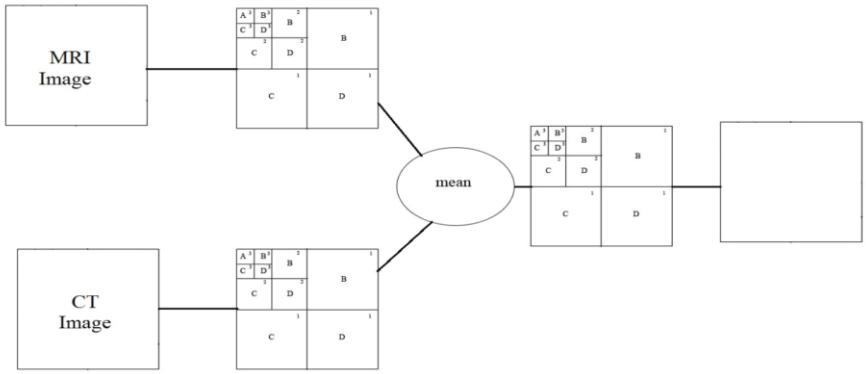

Figure 3: Block diagram depicting basic image fusion using multi resolution analysis

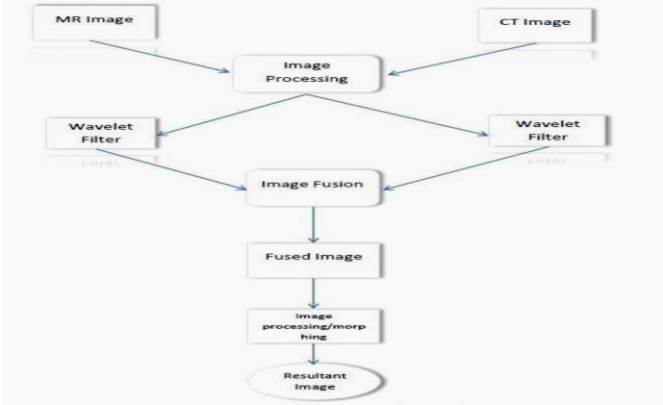

Figure 4: Flow Chart of the Proposed Algorithm

FUTURE PROSPECTS AND CONCLUSION

In this wavelet based image fusion algorithm, we propose a feature selection method for better efficiency of tumor detection. Image processing techniques are applied on the source images i.e. MR image and CT scan image to increase the contrast, brightness. In the next step, wavelet transform is further applied on these images by passing the processed images through the respective wavelet filters. The wavelet transform is applied on the source images with different wavelets such as Daubechies, Symlets, and Coiflets in order to try and obtain optimum results. Fusion can be performed either by taking the average of the coefficients either the minimum of the coefficients or maximum of the coefficients. In this paper, fusion is performed by taking the absolute maximum of the coefficients as the larger coefficients correspond to sharper brightness changes thus making the salient features visible. Thus fusion takes place in all resolution levels (as shown in Fig. 3) and the prominent features at each scale are preserved. The resultant image is formed by performing inverse wavelet transform. The wavelet transform technique of image fusion allows us to effectively extract the salient features of the input images due to the availability of directional information. The absolute transform coefficients obtained by wavelet transforms correspond to sharp changes in intensity of the input image. Selection of the highest absolute coefficient during the integration is a best suited method for optimization of relative resolutions of each image. This will result fusion to takes place in all the resolution levels in the new multi resolution representation further preserving the most dominant features at each scale. Subsequently a new and better image is formed by applying an inverse wavelet transform.

ACKNOWLEDGEMENT

Author would like to thank to Department of Computational Biology and Bioinformatics, JSBB, SHIATS Allahabad, U.P.-India for supporting this work by providing a good research environment and related facilities.

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