



MULTI SPECTRAL MEDICAL IMAGE FUSION NSCT

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Abstract-Multispectral image fusion seeks to consolidate disparate spectral and spatial data into a single image by combining relevant data and eliminating noise. In this paper, we provide a Non-subsampled Contourlet Transform (NSCT)-based multispectral image fusion model that makes use of PCA, Phase congruency, directional contrast, and entropy. The proposed method utilises principal component analysis (PCA) for dimensionality reduction, fusion rules, and colour alterations to the multispectral input image. Different fusion rules are used for the high-pass and low-pass bands: The fusion rule is implemented using phase congruency for low-frequency coefficients, and with a combination of directed contrast and normalised Shannon entropy for high-frequency coefficients. The proposed model provides a more thorough scene characterisation than any other image, and this technique is utilised to cut down on a great deal of superfluous information. The advantages of the fusion reaction may be seen when compared with other modern fusion processes.

Keywords: NSCT,PCA,CT/MRI,MRI/PET,
SPECT/MRI

1. INTRODUCTION

Combining a high-resolution panchromatic image with a low-resolution multi-spectral one is the goal of the image Fusion method. The combination of panchromatic spatial data with multi-spectral picture colour data is what makes these pictures so useful for creating high-resolution multi-spectral photographs (Al-Azzawi and Abdullah, 2011 [1]). Medical diagnosis and evaluation need several types of medical imaging, including x-rays, CT scans, MRAs, MRIs, and PET scans (Adu, j. et al., (2016) [17]).

The information included in multi-modal medical pictures may be both complimentary and discordant. There is often less distortion in a CT scan of a dense structure such a bone, implant, or physiological alteration. Although the MR image may still reveal abnormalities and details about soft tissues, it is useless for gaining insight into bone. In this case, a single picture type may not be enough for conveying clinically relevant information to clinicians. Therefore, integrating medical pictures from different modalities is important and has recently emerged as a promising and difficult area of study (Aggarwal, 2013 [3]; Aktar, M. et al., 2018 [22]).

When two medical photos are fused together in accordance with predetermined guidelines, it seems as if they are a single image. Examining a medical fusion picture was all it took for the doctor to determine the exact location of the ailment. CT, DSA, X-ray, PET, SPECT, MRI, etc. are only few of the clinical diagnostic modalities shown in the medical picture.

High spatial resolution CT and MRI, for example, may provide information about the anatomical organ structure, but this is only one example of how the numerous aspects of medical images can reveal important details about various systems in the body. However, PET and SPECT may provide data on organ metabolism. As can be seen in Figure 1.1, the anomalies are represented in a new way as the modality is increased. Calcifications, bone architecture, and tumour shapes are all strongly seen by CT. Magnetic resonance imaging (MRI) is the gold standard for studying soft tissue anatomy.

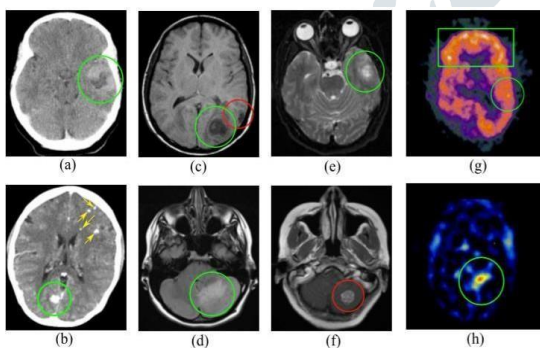


Fig1.1 Brain anomalies as shown by several medical imaging methods.: (a) lesion with necrosis and edema in CT, (b) Calcifications in CT,(c) lesions with necrosis and edema in T1 weighted MRI, (d) edema in MRI FLAIR, (e) lesion with edema in T2 weighted MRI, (f) distinct mass in T1 weighted MRI with contrast, (g) abnormal metabolic representation in PET, (h) central functional activity map in SPECT

Damage to the skin might be seen. This aids in the healing of wounds and other ailments affecting the soft tissues. Tissues afflicted by cancer seem to have an aberrant metabolic rate on PET and SPECT scans. However, MRI is unable to detect calcification and CT has poor soft tissue contrast. In terms of spatial and systemic discrimination, PET and SPECT are rather lacking. Therefore, no

system can provide all the required data for a certain illness. As a result, medical professionals often recommend that patients undergo many types of imaging tests prior to arriving at a definitive diagnosis. Almost seldom do medical facilities benefit from consolidated data across several modalities from a single device. Due to the high price tag, no Indian hospital has access to hybrid imaging technology. While scanners may be accessible, patients will still incur excessive fees due to the high price of imaging. It's possible that soon patients from economically developed nations like India won't be able to benefit from such a service.

A PET-CT scanner, which is the most popular hybrid modality device, often combines pictures from both modalities. The present PET-MRI scanner is at the experimental stage. Thus, a few images seem to be at odds with one another, yet they all end up being complimentary and connected to the same organ. Therefore, the resultant picture fusion calls for a variety of properties that become crucial for a clinical diagnosis. The term "fusion" is often used to describe a process through which data is combined from many sources.

Image fusion is an approach that seeks to merge data from many photographs of the same scene while preserving the integrity of each original print's fundamental qualities. The purpose of image fusion in this case is to combine data from several photos into one comprehensive picture. As a consequence, the final picture is more precise and comprehensive than any input display, making it more suitable for both machine and human eyes. Using a process called "image fusion," we may take disparate views of the same scene and piece together a more complete picture. This new concept is meant to keep the image's core elements while including new ones. Accordingly, the new model gives the most specific scene specification to date. By storing a single fused picture rather of many images, storage costs are reduced. When combining medical pictures from many sources, Curvet Transform (CVT) is often employed.

Having access to medical pictures from several sources may be informative in other ways. It was here that doctors were able to combine many medical concepts into a single picture, a technique that greatly aids in diagnosis (Alfano et al., 2007 [2]). Different picture fusion techniques are discussed, and their respective strengths and weaknesses are weighed against one another (Amolins et al., 2007 [4]; Ardeshir and Nicolov, 2007 [5]). To that end, MRI is often used to detect cancers and abnormalities in other tissues due to the enhanced vision of soft tissues it gives. The brain's oxygen and glucose metabolism, as well as the blood flow to those regions, may all be gleaned from PET scans (Baum, J. et al., 2007 [6]).

2. PROPOSED SYSTEM

In this article, we present a novel framework for medical image fusion to address the problems encountered with the current approaches. Here, we investigate the NSCT as a means of splitting the source picture into low- and high-frequency components. Further, AC is employed to combine the LF and HF subband pictures, while the energies associated with each are also taken into account. The providing of pictures with constant luminance at the LF subband is the primary advantage of the angular consistency. Sub-band adaptive filtering also helps cut down on calculation time and expenses. An easy-to-understand illustration of picture decomposition using NSCT.

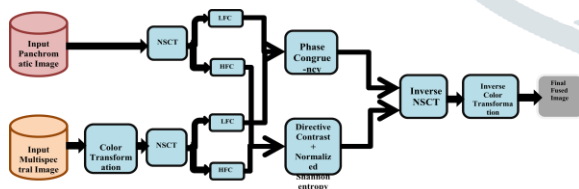


Fig1.2: System Architecture

3. ALGORITHM

- Step 1: Start
- Step 2: Read input image1, input image 2.
- Step3: Color Transformation of images from RGB to YUV.
- Step 4: Normalization of images.
- Step 5: Apply NSCT transform.

Step 6: Apply lower fusion techniques to LFC and higher fusion techniques to HFC.

Step 7: Apply Inverse NSCT transform.

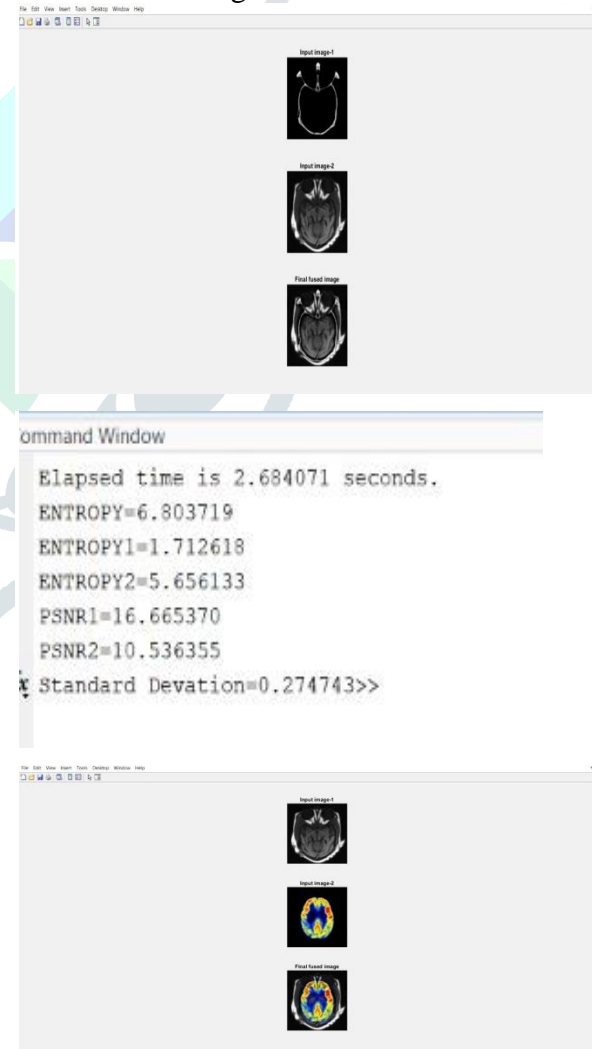
Step 8: Inverse Color Transformation from YUV back to RGB.

Step 9: Display the input images and the final fused image.

Step 10: Stop

4. RESULTS

A more detailed and informative picture may be obtained from the multi-modal source images, whereas the fused image provides less information. Below, we compare the quality of the fused picture to that of the input photos using both medical and non-medical images.



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Command Window
Elapsed time is 4.469987 seconds.
ENTROPY=6.840020
ENTROPY=5.656133
ENTROPY=3.695645
PSNR1=10.549280
PSNR2=9.946871
Standard Deviation=0.258057
Standard Deviation=0.242870
Standard Deviation=0.243259>>

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5. CONCLUSION

The development of NSCT compared to other multi-scale transform bases led to its selection. Non-subsampled contourlet transform provides a multiscale, multidirectional, shift-invariant picture decomposition that may be readily implemented using fusion techniques or algorithms. To improve contrast and edge definition in the future, these fusion methods might be used with non-linear enhancement techniques. Clinical examples using combinations of CT and MRI, MRI and PET, or SPECT and MRI images might be utilised to evaluate the system's potential superiority over existing options. When compared to other proposed fusion methods, the objective evaluation of the final fused image yields much higher values of fusion metrics. Using a fusion method like this not only allows for accurate diagnosis and analysis, but also helps save storage costs by simply requiring a single, unified image to be kept.

FUTURE SCOPE

To improve contrast and edge definition in the future, these fusion methods might be used with non-linear enhancement techniques. In order to improve medical picture fusion, researchers have turned to spatial domain, transform domain, and deep learning techniques. For scanning techniques and statistical research in image analysis, precise image values must be extracted. The rapid expansion of this sector demonstrates the urgent need for advancing computer-aided clinical diagnostics. Non-subsampled contourlet transform is the foundation of our method; this transform combines the input images and produces useful information that is more insightful and more suited for usage in medical applications.

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