IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

MEDICAL IMAGE FUSION IN HUE SATURATION COLOR SPACE

Gurpreet Kaur[1]
[1]Associate Professor
[1]P G Department of Computer Science,
[1]SGGS College, affiliated to Panjab University, Chandigarh, India

Abstract. The spatial clinical content from source to the fused image is only partially confined in multimodal image fusion. In order to improve the diagnostic confidence factor a novel method of clinical fusion using Discrete Fractional wavelets in Hue-saturation-value color domain is proposed. The weighted energy fusion rules are used. The multimodal brain analysis case of Herpes encephalitis well exemplifies the performance of the proposed technique. Visual subjective assessment validate higher visual content values indicating more information obtained in the fused image with better contrast.

***IndexTerms* - Image fusion, Spatial Domain, Spectral Information, Transform Domain Techniques.**

I INTRODUCTION

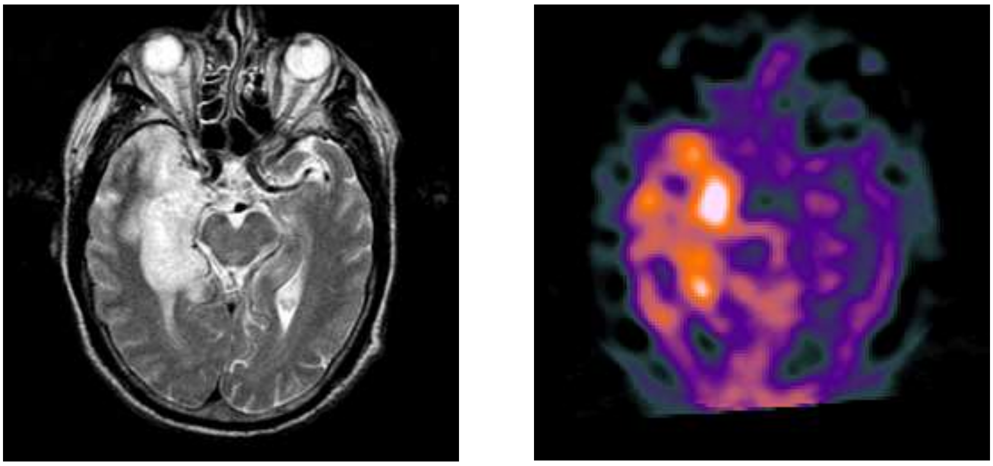
Image processing presides over medical acquisition, analysis and understanding, in order to diagnose the disorder[1]. The patient medical images are combined and fused to gather all clinical content [2].
Images modalities are anatomical as Magnetic Resonance Imaging (MRI) and of functional modality as Single photon emission computed tomography (SPECT) [3.4]. Both anatomical and functional modalities provide only partial investigative information [5].
The pixel based techniques work on the source image pixel sets, keeping the original values intact[6] . Transform domain techniques are broadly categorized into pyramids, wavelets and advanced wavelets. These techniques exhibit similarity with human visual system due to similar neuron response to spatial frequencies [7]. Pyramid transforms are classified as Laplacian [8], Gradient [9], Morphological [10], Ratio-to-Low Pass [11] Pyramids. These transforms provide no directional information and result in poor signal to noise ratio. Pyramid multimodal image fusion methods suffer from artifacts and limited representation of diagnostic features [12]. Wavelets can well preserve the anatomical structures in fused images with localization properties [13-15] Each technique is limited in its ability to preserve diagnostic content. The key lies to precisely extracting and combining vital information from medical images and transmitting into the final fused image [16]. The Discrete fractional wavelet transform is used to propose a novel fusion technique in Hue saturation value (HSV) color space. The sections are as follows. Section 2 gives medical perspective, section 3 Proposed medical fusion techniques. Result and Discussion is given in section 4, which is followed by conclusion in section 5.

II MEDICAL PERSPECTIVE

The modalities process on certain principles of acquisition in order to assimilate, interpret and deliver diagnostic information. The underlying spatial key points and the
distinguishable structural features from the underlying organ, tissue or tumor are processed and correlated with the neighboring structures. The interlinking helps comprehend the underlying physiological aspects.

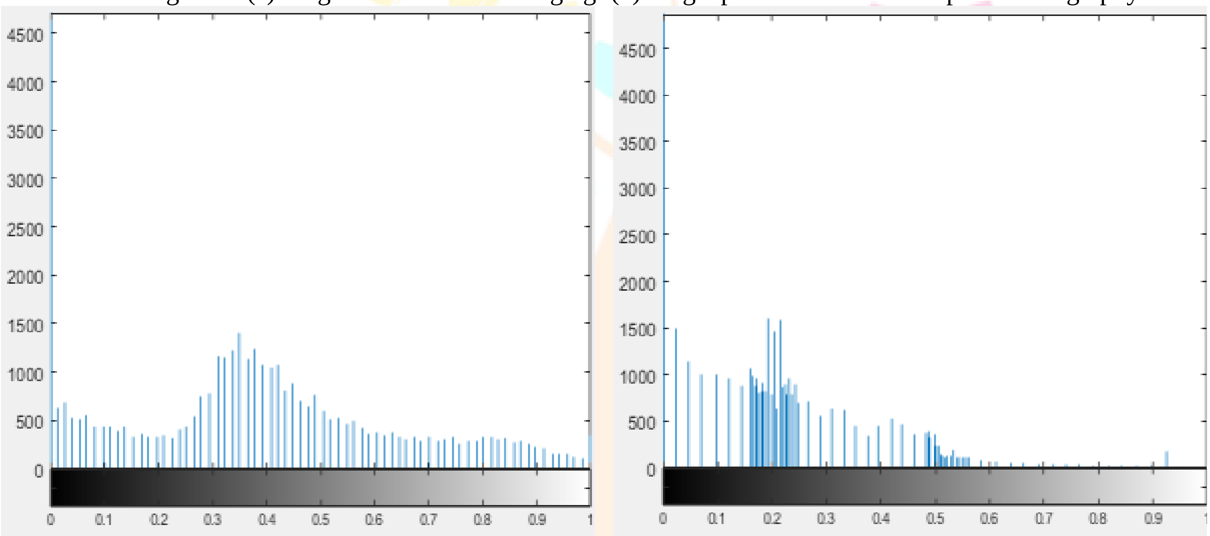
2.1 Medical Image Inputs

Dataset includes MRI and SPECT neurological image set of Herpes encephalitis medical condition. The benchmark images from the brain ailment condition are given in figure 1 and respective histograms in figure 2 below .



(a) (b)

Figure 1. (a) Magnetic Resonance Imaging (b) Single photon emission computed tomography



(a) (b)

Figure 2. Histogram DS 1 (a) MRI T2 (b) SPECT ; Histogram DS 2 (c) MRI (d) SPECT

III Proposed Medical Image Fusion

The benchmark images are pre-processed for noise reduction and contrast enhancement[17]. Preprocessing enhances the anatomical structures and the physiology is better defined [18]. These pre-processed images are transformed from color space Red-Green-Blue (RGB) to Hue-Saturation-Value (HSV) color domain in order to better visualize the functional content,

The color space conversion is given in equation (1) below by

$$H = cos\text{-}1\left(\frac{\frac{1}{2}(r^{im} - g^{im}) + (r^{im} - b^{im})}{\sqrt{r^{im} - {g^{im}}^2 + (r^{im} - b^{im})(g^{im} - b^{im})}} \right) \qquad (3.1)$$

where r^{im}, g^{im}, b^{im} refer to the representation of red, green and blue colors in RGB space respectively. The conversion is performed with least correlation between the colors, keeping the color of hue arranged in radial slice varying from 0 (saturated) to 1 (unsaturated) [19].

The conversion enhances the color contrast by exploiting the color opponency in human perception and transformed back to RGB space post processing.

The Data set MRI and SPECT images with Components in HSV space conversion are depicted in figure 3.

IV Results and Discussion

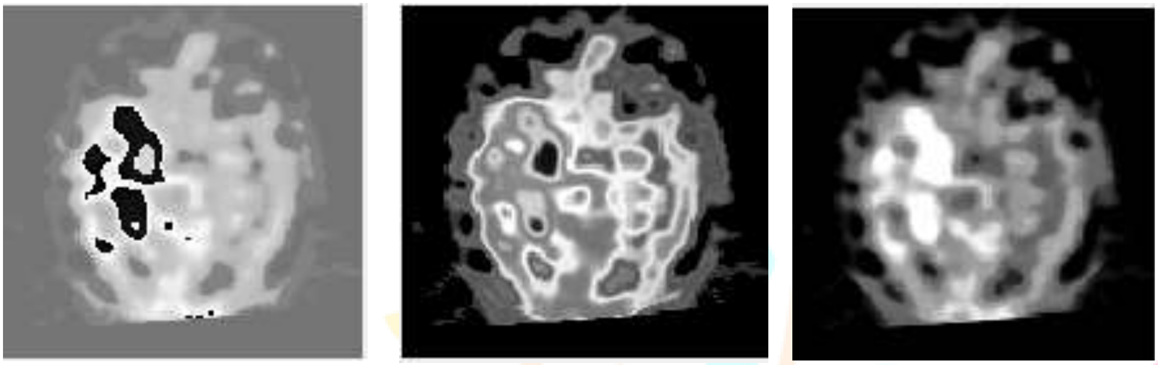
The performance evaluation is performed using subjective measures. Subjective evaluations is time consuming and also maybe be limited by individual perceptive and interpretational details [20]. There remain indistinct issues as these grasp only specific aspects. Aspects like colored images, varied resolution, and underlying organ are a few to mention.

The fused image in HSV space directs concentration towards segments more relevant in clinical perspective. The fused image depicts clarity in terms of diagnostic output with better contrast

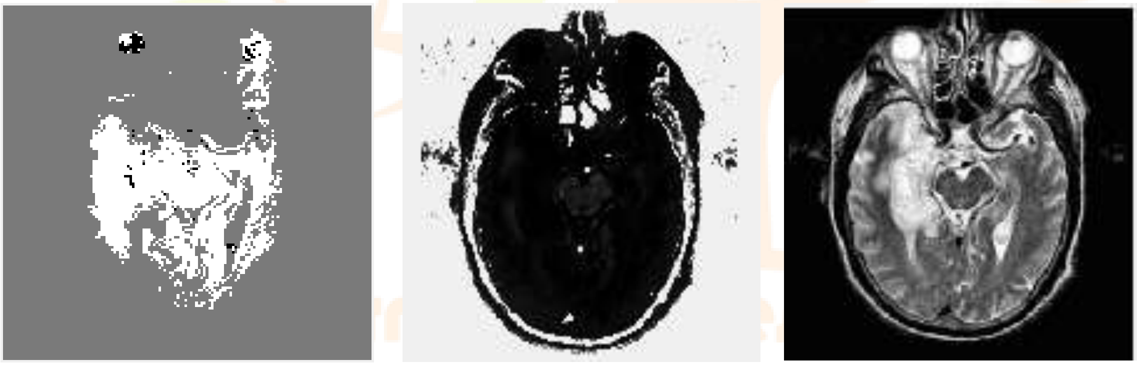
V CONCLUSION

Basic fusion strategy involves acquisition of different images, which need to be synergized and combined in order to achieve superior fused image with salient features from original images and clinical reinforcement of diagnostic data. Converting the medical input images from RGB color spare to HSV better exploits the clinical physiology in order to aid better diagnosis.

With few modifications the proposed scheme can be accommodated for soft real time applications having the flexibility of selecting any medical modality and further extended to higher dimension fusion.



(a)



(b)

Figure 2. DS: Components in HSV Space (a) MRI T2 (b) SPECT

VI COMPETING INTERESTS

The authors have no Competing interests at stake and there is No Conflict of Interest.

VII ACKNOWLEDGEMENTS

The benchmark images used in the study are downloaded from the neuro imaging website of Med Harvard Brain atlas http://med.harvard.edu/AANLIB/home.html.

REFERENCES

[1] Kaur, G., Singh, S., & Vig, R. (2019). Multimodal Image Fusion in Clinical Research. In International Journal of Recent Technology and Engineering (IJRTE) (Vol. 8, Issue 3, pp. 5202–5211). Blue Eyes Intelligence Engineering and Sciences Engineering and Sciences Publication - BEIESP. https://doi.org/10.35940/ijrte.c5820.098319

[2] Wang Z, Ziou D, Armenakis C, Li D and Li Q 2005 A comparative analysis of image fusion methods. *IEEE transactions on Remote Sensing*. 43(6) : 1391-1402

[3] Jingzhou Z, Zhao Z, Jionghua T, Ting L and Zhiping M 2009 Fusion algorithm of functional images and anatomical images based on wavelet transform in *BMEI'09. 2nd International Conference on Biomedical Engineering and Informatics IEEE* pp. 1-5.
[4] Angenent S, Pichon E and Tannenbaum A 2006 Mathematical methods in medical image processing, *Bulletin of the American Mathematical Society*. 43(3) : 365-396
[5] Hasegawa B H and Zaidi H 2006 Dual-Modality Imaging: More Than the Sum of its Components 35-81. 10.1007/0-387-25444-7_2
[6] Kaur Gurpreet; Singh Sukhwinder; Vig Renu: 'Medicalfusion framework using discrete fractional wavelets and non-subsampled directional filter banks', IET Image Processing, 2020, 14, (4), p. 658-667, DOI: 10.1049/iet-ipr.2019.0948 IET Digital Library, https://digital-library.theiet.org/content/journals /10.1049/iet- ipr.2019.0948
[7] Chetan K. Solanki Narendra M. Patel, 2011 Pixel based and Wavelet based Image fusion Methods with their Comparative Study. *National Conference on Recent Trends in Engineering and Technology*, 13-14 May
[8] Burt P and Adelson E 1983 The Laplacian pyramid as a compact image code. *IEEE Trans.Commun*. 31(4): 532-540
[9] Petrovic V and Xydeas C 2004 Gradient -based multiresolution image fusion. *IEEE Trans. Image Process*. 13(2) : 228-237.
[10] Laporterie F and Flouzat G 2003 Morphological Pyramid Concept as a Tool for Multi Resolution Data Fusion in *Remote Sensing, Integrated Computer-Aided Engineering*. 63-79.
[11] 11 Toet A 1989 Image Fusion by a ratio of Low pass pyramid. *Pattern Recogn. Lett*. 9(4) : 245-253
[12] Shutao Li 2017 Pixel level image fusion: a survey of the state of art. *Information Fusion* 33: 100-112.
[13] Yang, Yong, Park D S, Huang S, and Rao N, 2010 Medical image fusion via an effective wavelet-based approach, *EURASIP Journal on Advances in Signal Processing*
[14] Teng J, Wang X, Zhang J, and Wang S, 2010 Wavelet-based texture fusion of CT/MRI images in *3rd International Congress on Image and Signal Processing (CISP)*. 6: 2709-2713.
[15] Calhoun V D 2009 Feature-Based Fusion of Medical Imaging Data. *IEEE Transactions on Information Technology in Biomedicine*. 13(5): 711-720.
[16] Gurpreet Kaur, Sukhwinder Singh, and Renu Vig, "Medical Fusion of CLAHE Images using SWT and PCA for Brain Disease Analysis" Springer LNNS Series 2nd International Conference on Communication, Computing and Networking (ICCCN2018), NITTTR, Chandigarh, Springer , International, 29-30 March 2018.
[17] Bhatnagar G, Wu Q M J and Liu Z 2015 A new contrast based multimodal medical image fusion framework. *Neurocomputing* 157: 143–152.
[18] Chibani Y and Houacine A 2002 The Joint Use of IHS Transform and Redundant Wavelet Decomposition for Fusing Multispectral and Panchromatic Images. *int. j. remote sensing* 23(18): 3821–3833.
[19] Kaur G, Vig R and Singh S 2017 A review on medical image fusion aspects and techniques, in *Proceedings of 1st International Conference on Communication, Computing and Networking—ICCCN* (NITTTR) Chandigarh, India
[20] Kaur G, Vig R and Singh S 2017 A review on medical image fusion aspects and techniques, in Proceedings of 1st International Conference on Communication, Computing and Networking—ICCCN (NITTTR) Chandigarh, India