Hybrid Model Designing for Image Fusion and Comparative Analysis with Previous Techniques

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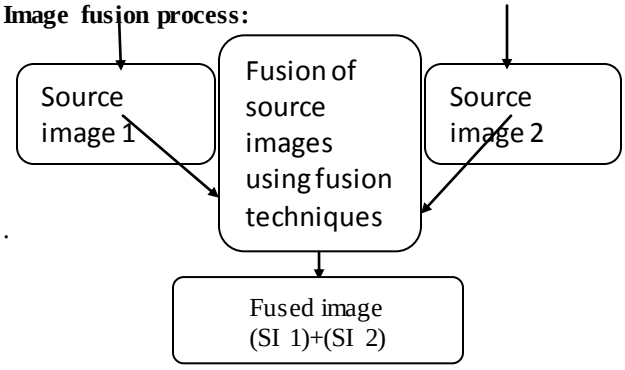
***Abstract*: -** Image fusion basically defines merging of two images in such a way that the resultant image can retain the most desirable characteristics of both source images. It is a process of combining the relevant information from different source images into a single image, with which the output fused image will be more informative than any of the input source images [1]. It extracts information from the several domains. The main goal of image fusion techniques is to enhance the applications of the source images, improve reliability and also improve capability of the images[5].Many fusion techniques like PCA,HIS and wavelet techniques are producing good results in past years but there are also some research papers describing the problems of these techniques[6]. This implementation paper is presenting the implementation of these three fusion techniques and hybrid of three fusion techniques HIS, PCA and wavelet for better results. The comparison of each technique with hybrid fusion technique is based on two parameters RGB content and Correlation parameter. Our Hybrid fusion technique is producing better results as shown in comparison of this implementation paper.

Keywords: Principal Component Analysis, Intensity Hue Saturation, Wavelet, RGB Contents, Correlation.

I. INTRODUCTION

Image fusion is the process that combines information from multiple images of the same scene[4].These input images may be captured from different sensors, clicked at different times, that is why these images having different spatial and spectral characteristics. The main object of the image fusion is to retain the most desirable characteristics of each image [6].With the availability of multisensory data in many fields, image fusion has been receiving increasing attention in the researches for a wide spectrum of applications [8].

Image fusion process:



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1.1 Fusion process

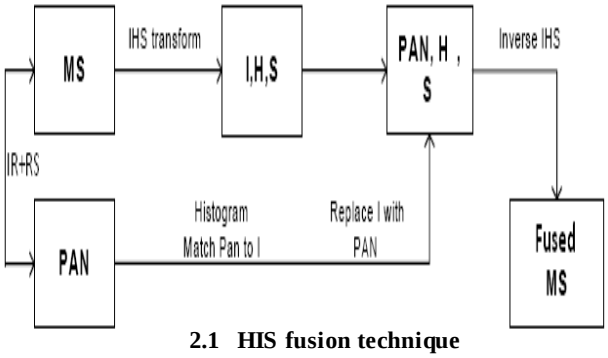
Example of image fusion: The following image is showing the image fusion:

1.1 Diagram showing image fusion

II. IMAGE FUSION TECHNIQUES

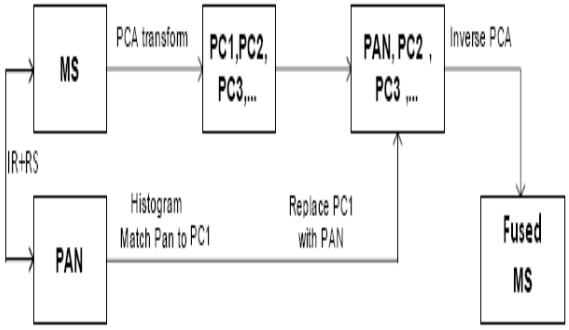
HIS Fusion Technique: As the MS image is displayed in RGB color space, we have to separate the intensity (I) and color information, hue (H) and saturation (S), by IHS transform.[9]The I component can be taken as an image having no color information.[3]Because the I component is same as of the PAN image, we match the histogram of the PAN image to the histogram of the I component. After it, the I component is replaced by the high-resolution PAN image and at last the inverse IHS transform is applied. The main steps, of the standard HIS fusion scheme are [7]:

(1)Perform image registration (IR) to PAN and MS, and resample MS.
(2) Convert MS from RGB space into IHS space.
(3) Match the histogram of PAN to the histogram of the I component.
(4) Replace the I component with PAN.
(5) Convert the fused MS back to RGB space.



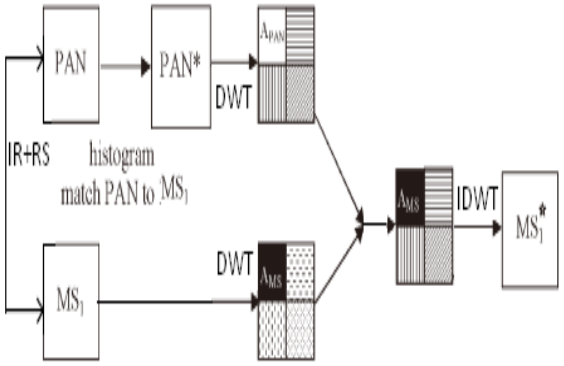
2.1 HIS fusion technique

PCA fusion technique: This technique is an alternative to IHS-based method [8]. The PCA transform can convert the correlated MS bands into a set of uncorrelated components, say PC1, PC2, PC3… Therefore, the PCA fusion scheme is similar to the IHS fusion scheme [7]:
(1)Perform IR to PAN and MS, and resample MS.
(2)Convert the MS bands into PC1, PC2, PC3,… by PCA transform.
(3) Match the histogram of PAN to the histogram of PC1.
(4)Replace PC1 with PAN.
(5) Convert PAN, PC2, PC3, … back by reverse PCA.



2.2 PCA fusion technique

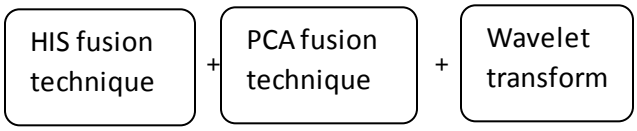
Wavelet transform fusion technique: The WT fusion method performs the minimizing of the spectral distortion.[3] The main steps, illustrated in DWT fusion scheme are[4]:
(1) Perform IR to PAN and MSi, and resample MSi.
(2) Match the histogram of PAN to the histogram of MSi.
(3) Apply DWT to both the histogram-matched PAN and MSi.
(4) Replace the detail sub-images (H1, H2 and H3) of MSi with those of PAN.
(5) Perform IDWT on the new combined set of sub-images.



2.3 Wavelet transform fusion technique

III. PROPOSED TECHNIQUE

In this implementation paper our proposed technique is **HIS + PCA + wavelet transform** image fusion technique. In this scheme we hybrid the main three image fusion techniques for better results.

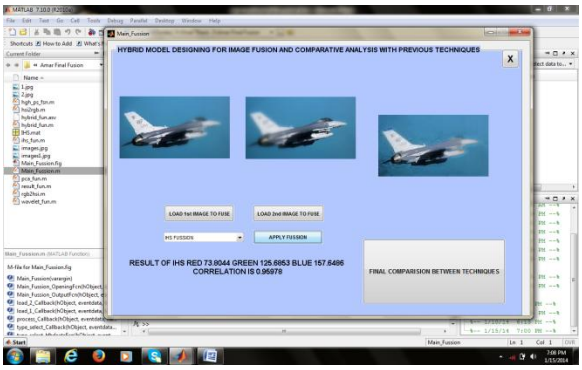


3.1 Hybrid fusion technique (Combination of three techniques)

Algorithm for hybrid technique:
1. The first step is to load the images (the images to which we want to fuse).
2. We will now rescale the images as per requirement.
3. Now we will apply the fusion techniques that is HIS ,PCA and wavelet individually on the rescaled images.
4. Also after rescaling we will apply the combination of the three of the techniques (HIS + PCA + wavelet) on rescaled images.
5. We will calculate the results based on RGB contents and correlation parameters for the individually applied techniques.
6. Again we will calculate the results based on the parameters RGB contents and correlation for the hybrid technique applied to the rescaled image.
7. Now after getting the results we will compare the result of individually applied techniques on image and hybrid of those techniques.

IV. RESULTS

4.1 HIS FUSION TECHNIQUE

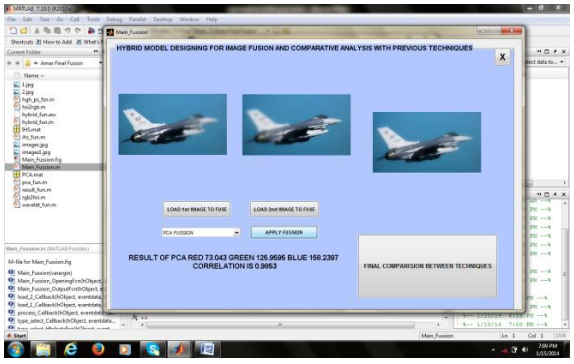


This snapshot illustrates the HIS FUSION and the values of RGB contents and correlation is calculated after applying fusion.

Table 4.1

PARAMETERS	VALUES
Red contents	73.8044
Green contents	125.6853
Blue contents	157.6486
Correlation	0.95978

4.2 PCA FUSION TECHNIQUE

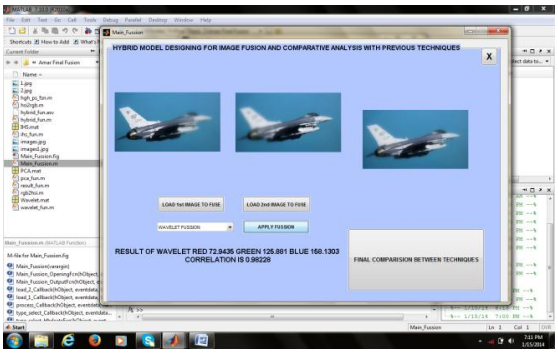


This snapshot shows the PCA FUSION and the values of RGB contents and correlation is calculated after applying fusion.

Table 4.2 :

PARAMETERS	VALUES
Red contents	73.043
Green contents	125.9595
Blue contents	158.2397
Correlation	0.9853

4.3 WAVELET TRANSFORM FUSION

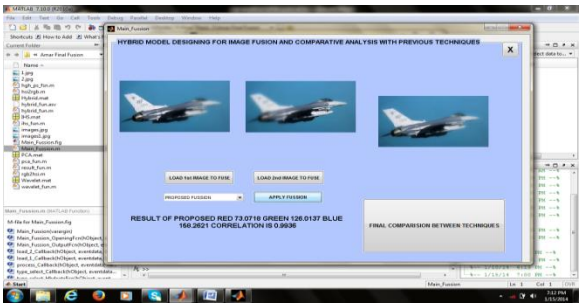


This snapshot illustrates the wavelet transform FUSION and the value of RGB contents and correlation is calculated after fusion.

Table 4.3

PARAMETERS	VALUES
Red contents	72.9435
Green contents	125.881
Blue contents	158.1303
Correlation	0.98228

4.4 HYBRID FUSION TECHNIQUE



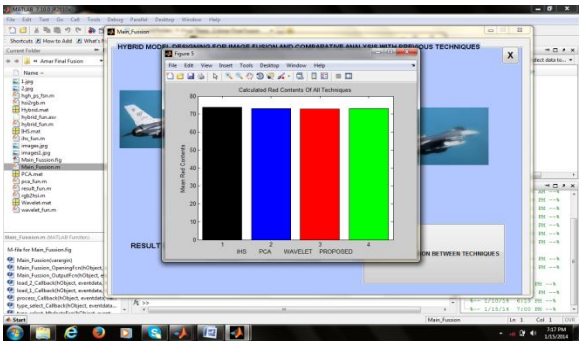
This snapshot is showing the fusion with proposed technique i.e. hybrid technique and the values of RGB contents and correlation is calculated after applying fusion.

Table 4.4

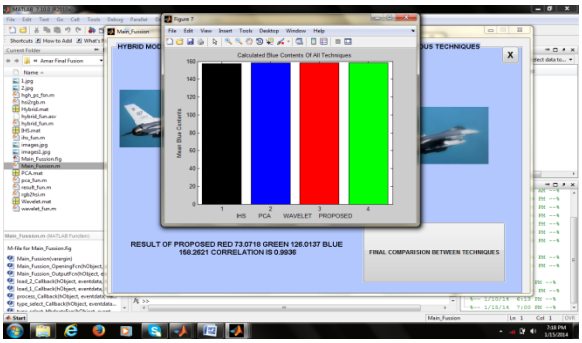
PARAMETERS	VALUES
Red contents	73.0178
Green contents	126.0137
Blue contents	158.2621
Correlation	0.9936

V. COMPARISON

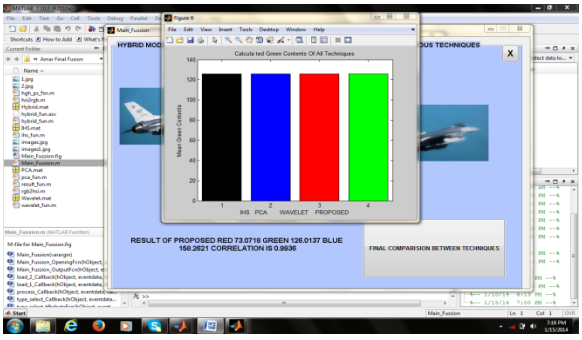
This section includes the comparison of all three techniques individually and also comparison of proposed technique with all three implemented techniques based on RGB contents and correlation parameters. The following shows comparison between each technique individually and comparison of hybrid technique with each technique.



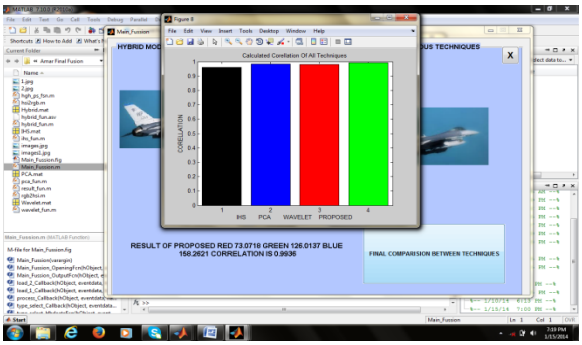
5.1 Comparison of HIS, PCA, Wavelet and Hybrid fusion technique based on red contents



5.2 Comparison of HIS, PCA, Wavelet and Hybrid fusion technique based on Blue contents



5.3 Comparison of HIS, PCA, Wavelet and Hybrid fusion technique based on Green contents



5.4 Comparison of HIS, PCA, Wavelet and Hybrid fusion technique based on correlation.

Table 5.1

Parameters	HIS	PCA	Wavelet	Hybrid
Red	73.8044	73.043	72.943	73.071
Green	125.685	125.95	125.88	126.01
Blue	157.648	158.23	158.13	158.26
Correlation	0.95978	0.9853	0.9822	0.9936

VI. CONCLUSION AND FUTURE SCOPE

Selection of fusion algorithm is problem dependent and also the spatial domain techniques have image blurring problem in previous implemented techniques. So with the implementation of hybrid technique, it proves in comparison that it is a better technique than HIS, PCA and wavelet that provides high quality spectral contents. It also shows the less blurring contents and have high Red, Green, Blue contents and High Correlation. Further it can be implemented on various parameters like: mean Square Error, PSNR, Bit Error Rate etc and may provide better results based on these parameters.

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