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Salient Region Detection based on frequency domain analysis for remote sensing image

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Abstract—In a present days, detecting salient regions visually in remote sensing approaches a traditional method, which is difficult and not accurate. In this paper salient region detection (FDA-SRD) and frequency domain analysis proposed which is an efficient method and also fast. At first ,to preprocess the remote sensing picture, HSI transform is used which can convert image from RGB space to HSI space. Next to generate the saliency map frequency domain analysis used which is based on the quaternion Fourier transform. At last adaptive threshold segmentation algorithm is used to describe salient regions which is based on the Gaussian pyramids. On comparing with the present methods, this Proposed method is very competent and has given results correctly and efficiently in sight.

IndexTerms— Remote sensing imageprocessing.Region of interest, quaernion Fourier Transform ,Frequency domain analysis , salient region detection (FDA-SRD)

1.INTRODUCTION:

Numerous computer visualization applications, such as recognition of objects and content-based image recovery could function more consistently and successfully if regions of interest were inaccessible from their backdrop. Normally this technique has been applied on the face recognition for security purposes. Image processing playing a vital role in security, medical and also in space applications to extract the rare features from the satellite images. For example in nasa photography of the satellite, to extract the minerals and rare features in the satellite images, we go for the thresholding. By giving a threshold value, region of interest in the satellite images has been found. Now, a new technique for regions of interest exclusion from color images based on the frequency domain analysis and segmentation techniques is proposed in this research work. The frequency domain analysis will be performed using various Transforms for color images. Visual attention mechanism uses the Region of interest recognition in the remote sensing image analysis field. It is the efficient approach in providing the exactness in mass-data image processing. After getting the Region of interest , the visionary can hunt for specific objects in the region. For enhancing the operating efficiency, the computer resources has been allocated in an image processing system. Focus of attention (FOA) is defined as the region which draws attention, hence it is known as ROI or target. For simulating the human visual system(HVS), several models has been arraised. Adaptive spatial sub sampling visual attention model is the most efficient ROI detection algorithm proposed by the zhang et al.[1]. Multiple saliency detection benchmark datasets, does not use any special pre- or post-processing steps and computes saliency maps 18 to 100 times faster than competing systems has been proposed by Zhiming Luo[2]. Radhakrishna Achanta presented an approach of computing saliency in images which is tunned approach and using low level facial appearance of color and luminance, which is simple to execute, fast, and provides total l resolution saliency maps[3]. Main contribution is the detection of spectral lasting and its general capability to distinguish proto-objects proposed by Xiaodi Hou a[4]. A novel bottom-up visual saliency model, Graph-Based Visual Saliency (GBVS), is proposed[5]. Multi resolution wavelet domain foveation (MWDF) is proposed to advance efficiency in coding of image and video compression by Chenlei Guo[6]. The adaptive IHS method produced images with advanced spectral resolution at the same time as it is maintaining the high-class spatial

resolution of the original HIS proposed by Sheida Rahmani[7]. Congyan Lang and Libao Zhang proposed visual saliency better in their papers [8][9].

High amount of data is present in the Remote sensing images. HVS model can be simulated by biological models, but it leads to difficult and also it does not consider the frequency domain charecteristics. In remote sensing image without the frequency domain charecteristics, human illustration system doesn't reflect the actual date in an image sensing image. ROI gives the features of image itself. In addition to that accuracy and low computation is needed. Hence, we recommend a FDA-SRD method. This model improves the efficiency and accuracy of the ROI in the remote sensing images. Later based on quaternion a novel frequency domain strategy is required ,which is given by HSI transform. Besides, a Gaussian pyramids is applied on the remote sensing image where an adaptive threshold segmentation algorithm is used. Practical experimental results shown the proposed method is the convenient to save time and to get accurate values.

2.Proposed Method: During the proposed method FDA-SRD method , salient image is taken as input and sub-sampled the input image by a factor of two times in order to condense the amount of data. Later it is processed by means of the HSI transform. To generate the saliency map, a new frequency domain strategy is considered. At last by using segmentation based on adaptive thresholding algorithm which is intern based on the Gaussian pyramids to get the detected regions and also to improve the accuracy in the detection of the target region. Block diagram of the proposed technique has shown below

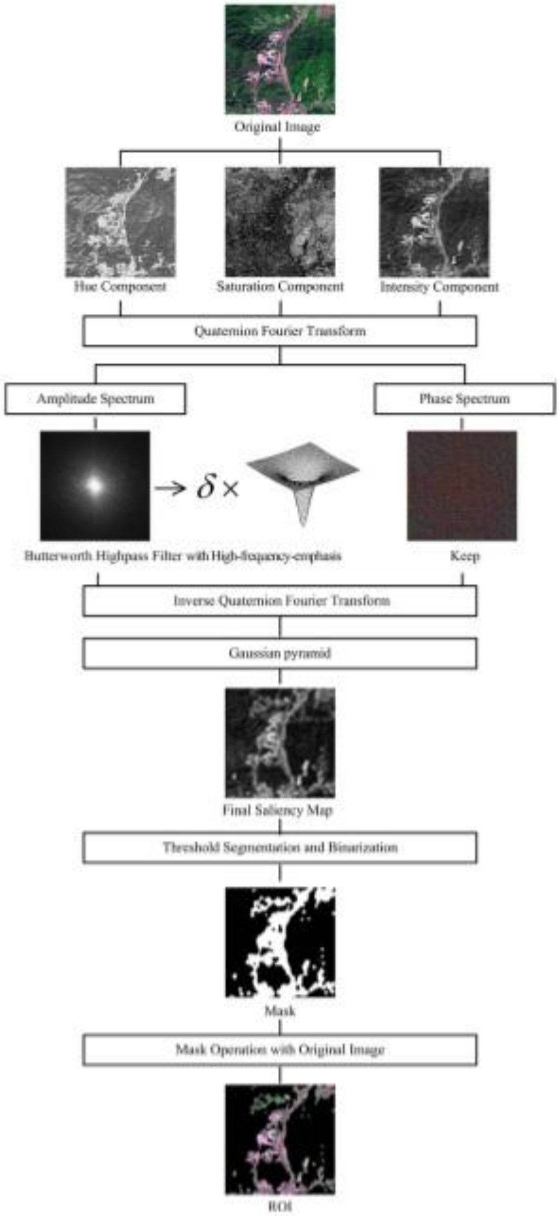

Fig:1 FDA-SRD model with QFT to obtain ROI

At first by applying the HSI transform method, all the remote sensing images are converted into HSI method. Later quaternion fourier transform applied to the HSI components of the remote sensing RGB image H(n,m), S(n,m), I(n,m)[4]. represents the hue satuation and the components of intensity of in the remote sensing image pixels. The μ value varies.

In Extraction of Region of Interest, A Series of images has been generated by the Gaussian pyramid technique. Next, low pass filter technique has been performed to get the region of interest. After Gaussian pyramid Ostu method is used to know the threshold value to identify the region of interest. For Preprocessing several image enhancement techniques can be used.

HSI Transform: In image processing applications two normally used color models are present: one is RGB(red,green,blue) and HSI (Hue Saturation Intensity). HSI color model is superior than the RGB because HSI color space is convenient with the human color perception. Hence, the remote sensing images are converted from RGB to HSI space. Finally, HSI gives high efficiency and high resolution in the images. Convert the RGB image to HSI components, based on the formula [2].

$$I = \frac{1}{3}(R + G + B)$$

$$H = \cos^{-1}\left\{ \frac{\frac{1}{2}[(R-G)+(R-B)]}{[(R-G)^2+(R-B)(G-B)]^{1/2}} \right\}$$

$$S = 1 - \frac{3}{(R+G+B)}[\min(R,G,B)] \qquad (1)$$

Quaternion Fourier Transform with FDA-SRD Model:
Irish mathematician William Rowan Hamilton firstly developed the quaternions and used for mechanics in a 3-D space[3]. After the conversion of image from RGB to HSI, the output of the hsi image is represented in the quaternions by using the expression

$$f(n,m) = H(n,m)\mu_1 + S(n,m)\mu_2 + I(n,m)\mu_3 \qquad (2)$$

Where H(n,m),S(n,m), I(n,m) represents the hue, saturation and intensity components of the image. Where μ represents the arbitrary constant. Quaternion Fourier transform is given by

$$F_i(u,v) = \frac{1}{\sqrt{MN}} \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} e^{-\mu_1 2\pi((mv/M)+(nu/N))} f_i(n,m). \qquad (3)$$

For the above transform, amplitude and phase spectrum has been calculated based on polar co-ordinates of F(u,v) given below as

$$F(u,v) = |F(u,v)|\, e^{\mu\Phi(u,v)} \qquad (4)$$

Ø(u,v) is the phase spectrum and |F(u,v)| is the magnitude

Gaussian Pyramid: Next finally the image F|u,v| is divided into series of images by low pass filter using convoluting guassian filtering technique with the down sampling operator

$$g_k = \mathrm{Re}(g_{k-1}). \qquad (5)$$

K ranges from 0 to N. N is the size of the pyramid mask. By the Gaussian pyramid the density of the image has been reduced.

Later, adaptive threshold technique is Practically applied on the output image of the Gaussian pyramid. Where the whole pixels in the image has been divided into two blocks based on the threshold value K. pixel values from 0 to K represents as the background and pixel values from K to L-1 represents the foreground which is nothing but our region of interest. ROI has been found from the pixels ranges from K to L-1.

3.Experimental Results: To appraise the performance results of the planned method. Here, the proposed method is applied to the remote sensing images of high resolution of five different images. ROI has been found out on these images with the charecteristics like texture features, rich edge, brightness area and highlighting color area. Size of the images are 2048X2048.

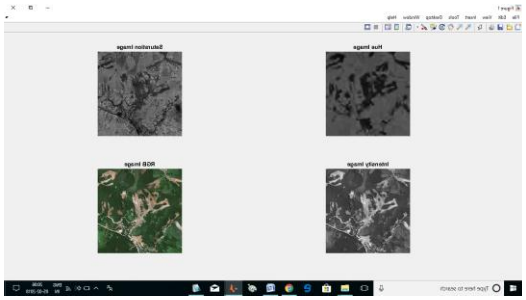
Fig 2:conversion from RGB to HSI

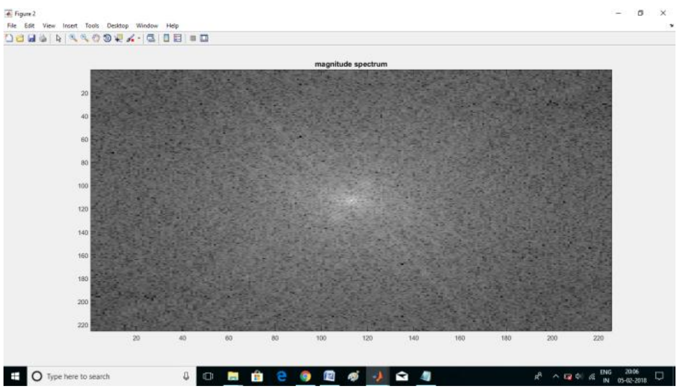

Fig 3: Power Spectrum of above image

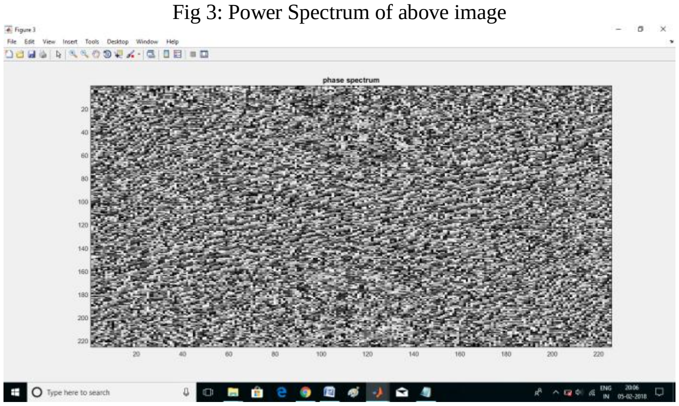

Fig 4: Phase Spectrum of Fig 1

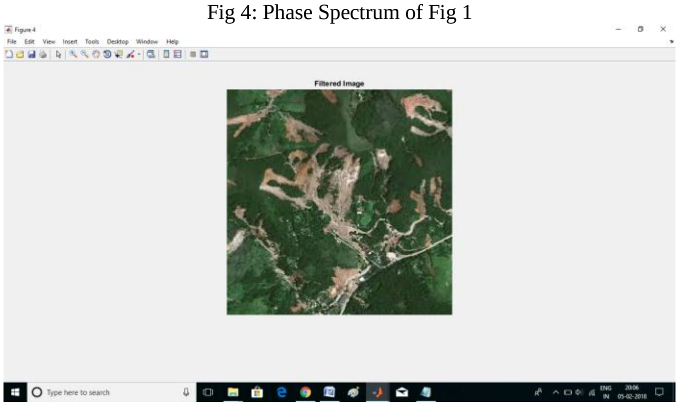

Fig 5: Guided Filtered image of fig 2

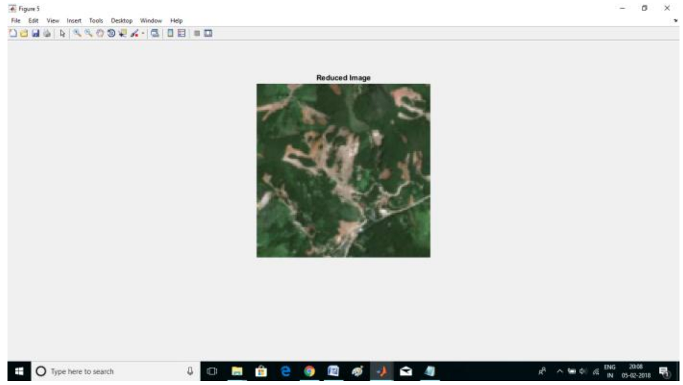

Fig6: Resultant reduced image of fig2

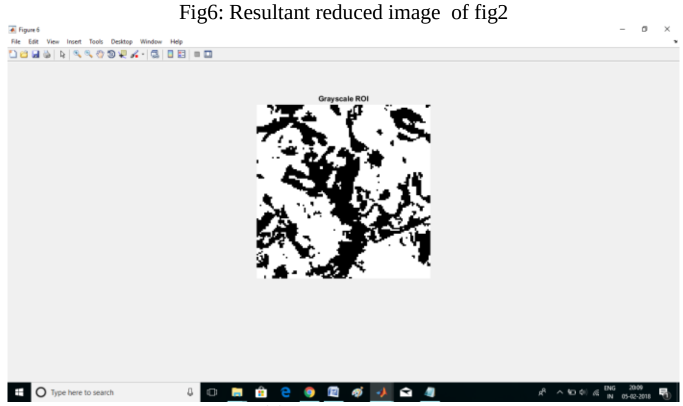

Fig7:Grayscale ROI of fig2 based adaptive threshold technique

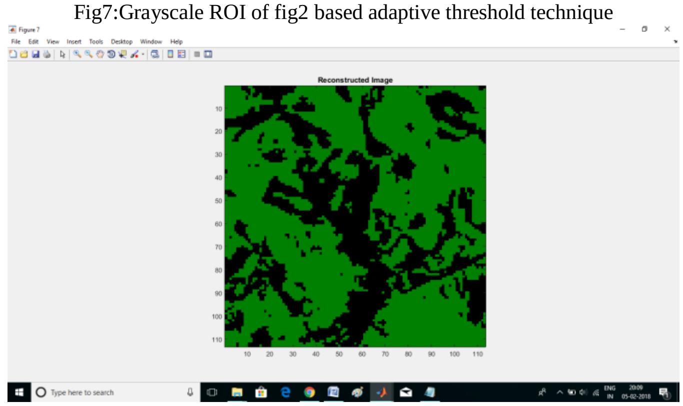

Fig7:Reconstructed image of fig2

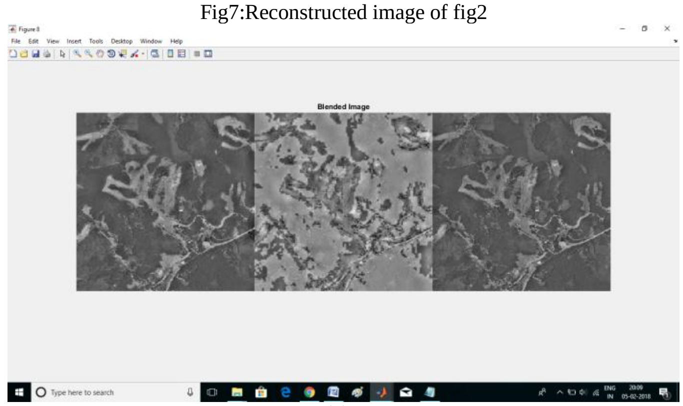

Fig9:Blended image of fig1with rgb components

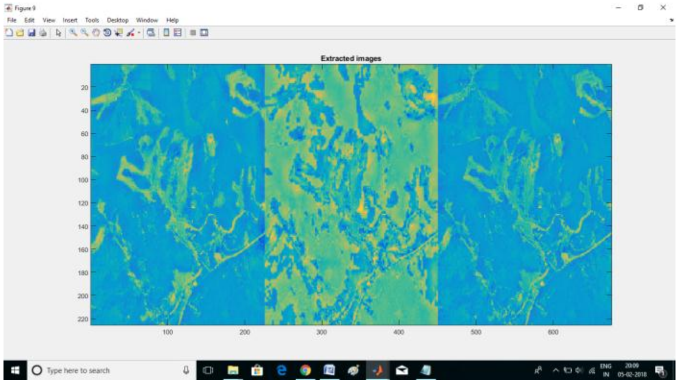

Fig10: Extracted image of the fig1

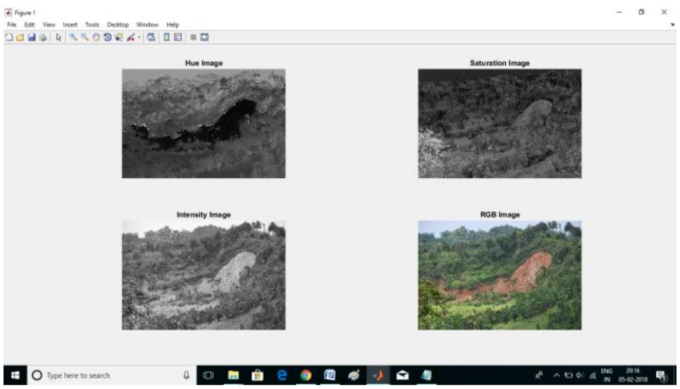

Fig 11: RGB with HIS Image Components

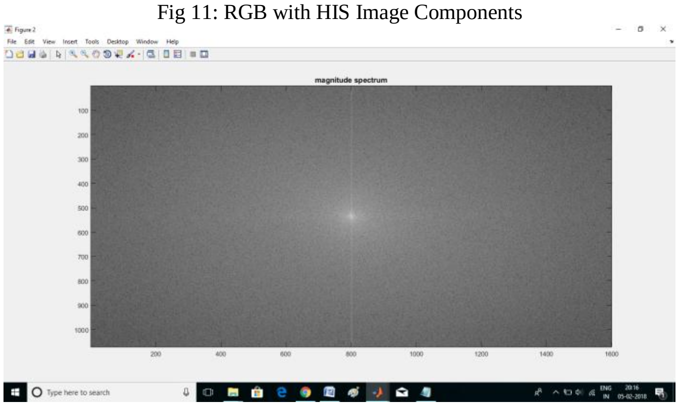

Fig 12: Magnitude spectrum

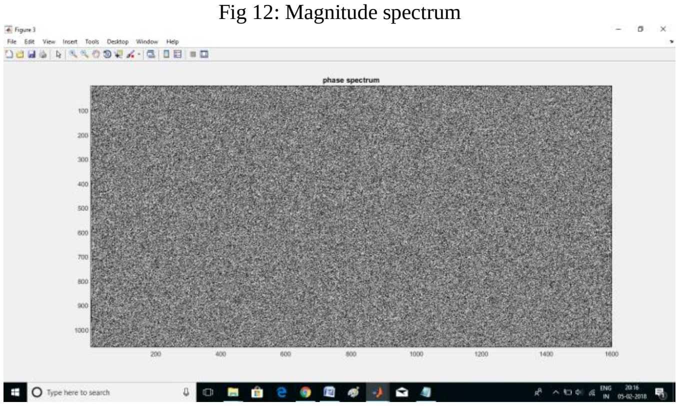

Fig 13: Phase Spectrum

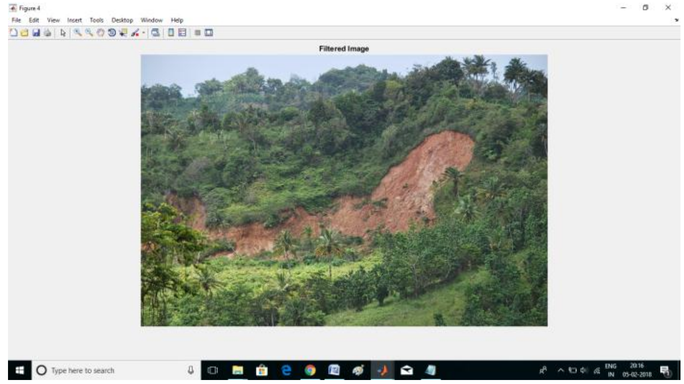

Fig 14: Guided Filtered image

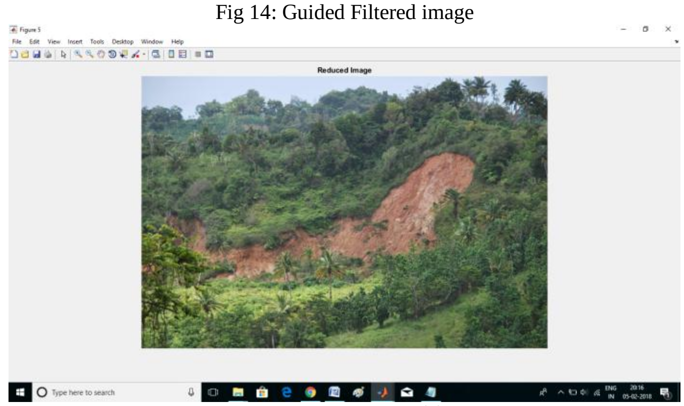

Fig 15: Reduced image of fig 11

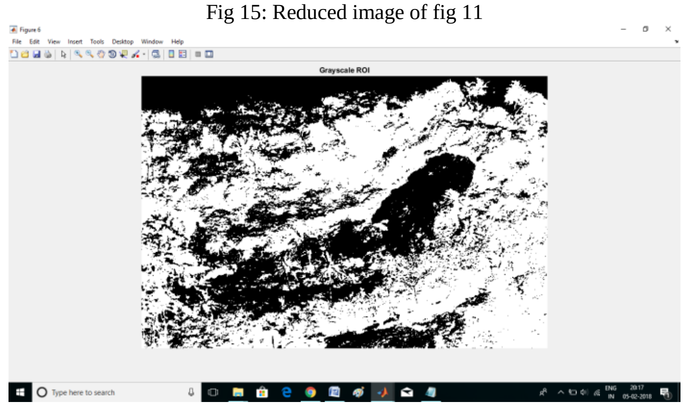

Fig 16: Grayscale ROI by adaptive threshold technique

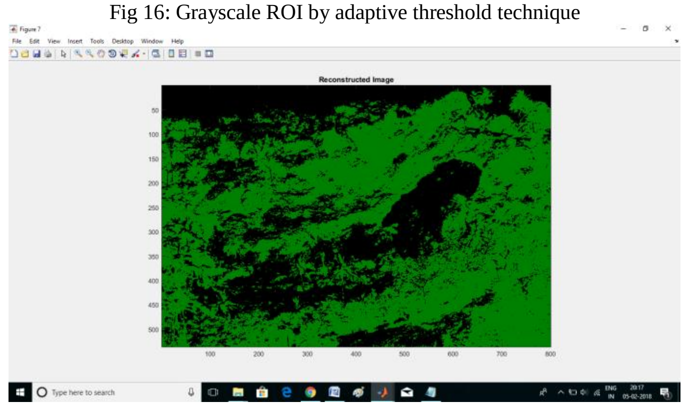

Fig 17:Reconstructed image

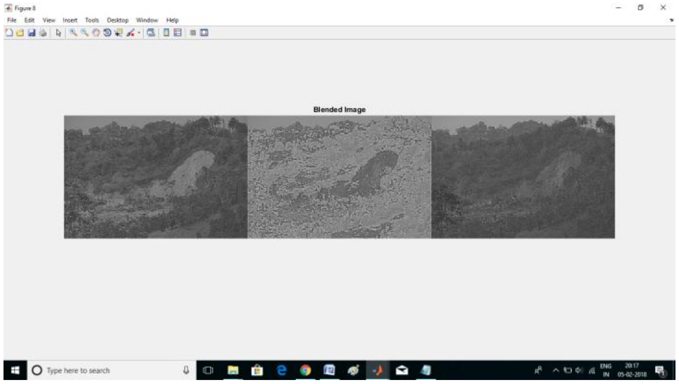

Fig 18:Blended image

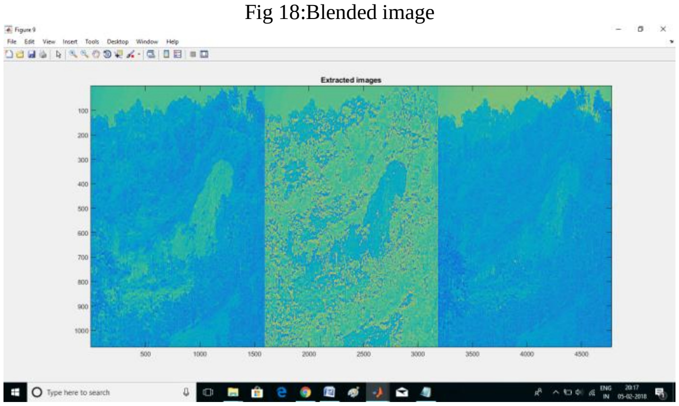

Fig 19:Extracted image

Accuracy	Sensitivity	Specificity	Precision	Recall	F Measure	Gmean
0.7498	1	0.0016	0.7497	1	0.8569	0.0400

Table 1: Qualitative Metrics of Fig2

Accuracy	Sensitivity	Specificity	Precision	Recall	F Measure	Gmean
0.7761	1	0.0016	0.7760	1	0.8739	0.0403

Table 2: Qualitative metrics of Fig 11

In the experimental results, two images Fig 2 and Fig 11 are the high resolution satellite images has been taken. For this two images hue, saturation and intensity components has been calculated later magnitude spectrum, phase spectrum has been evaluated by using the formula. Guided filter is used to reduce the image. By, using the adaptive threshold technique image has been converted grayscale based on the threshold value K. the pixel values greater than the threshold value is considered as the Region of interest. Image has been reconstructed by the rgb components, blended image and extracted image has been shown. Qualitative metrics has been tabulated for the two images, where we have calculated accuracy, sensitivity, specificity, precision, recall, f measure, and geometric mean which are very accurate and clear.

Conclusion: The two images which were taken as an input where FDA-SRD model is used. It is dependent on the quaternion fourier transform. The above model is used to find the adaptive threshold segmentation for region of interest by the Gaussian pyramids. Qualitative metrics has been found for the two images which has shown the excellent results with 100% accuracy. Computation efficiency problem has been solved by the proposed method. So , this method can be extended to the remote sensing images to extract the minerals or the region of interest with accuracy.

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