Frequency Analysis for Region of Interest Extraction in Satellite Images

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Abstract- Saliency object detection is considered as the preprocessing technique to study the features of the specific area in the satellite images. Multiplicity in surroundings texture and target clutter also adds up to the difficulty of the problem of localizing saliency regions in satellite images. Extraction of a characteristic of an image is very complicated due to having to discover the suitable image segmentation techniques and combine different methods to detect the Region of Interest (ROI) most efficiently. In this paper we deal with the trouble of the region extraction in different methods and recommended a new technique depend on the discrete cosine stock well transform (DCST) for the generation of saliency map and for segmentation of the required area we suggest inhomogeneity active contour model in order to provide high degree of results. The results in the proposed approach may increase the detection capability of the target region.

Keywords- Region of interest, Inhomogeneity active contour model, DCST.

I. INTRODUCTION

As remote sensing technology is increasing rapidly in various applications there is need to extract the saliency objects for further processing of images. The saliency object detection needs to detect the image with perfect edges and of high quality. Saliency detection of remote sensing images has various applications in the fields of image segmentation, image restoration and image compression etc. It is not an easy task to extract the saliency regions in the remote sensing images with our naked eye and if possible, it is not accurate and in some images it turns into problematic. So, we develop an automatic detecting algorithm based on some features and certain conditions.

Automatic detection of military targets such as oil tanks, aircrafts, artillery, etc. in high resolution satellite imagery has great significance in military applications. With the rapid development of satellite imaging and geographic information systems, a large amount of high resolution images can be acquired effortlessly from Google Earth. The non-hyper spectral image data has been used in many civil and military applications. Various techniques and features have been proposed so far for automatic target detection in satellite imagery. Target recognition is an imperative aspect in several defense applications. A target usually means an entity or a region of interest and significance, such as urban areas, roads, railway tracks, shipyards, etc. The mission in target recognition is to set and label a particular target among non-targets in a landscape. This task has been expansively considered in computer vision where the major steps are categorization of the scene into regions of interest, looking for possible structures, construction of geometric analysis of these
structures and finally confirming the existence or nonexistence of a target using right knowledge base. But,its function in remote sensing had been incomplete since of the insufficient ground resolution of the image presented in the past. However, with resolution better than 30-40 m provided by the present remote sensing tools, it is now probable to a large scope to identify even lesser targets, like bridges, runways and buildings.

As a result, the extent of function of remotely-sensed imagery in defense has considerably widened. Z. Li and L. Itti [1] in his paper developed an automatic approach to detect and classify the objects in satellite images. In this paper the broad are satellite images are divided into small sized image chips which are examined into two ways. In Saliency analysis, the local features and their interactions and gist analysis non spatial features and their statistics are calculated. Based on the support vector machine these classes of features are classified and produces region of interest.

A novel model named as adaptive spatial subsampling visual attention model works on the principle of the visual attention mechanism to reduce dimensionality such a way that the segmentation is not applicable to the entire image was proposed by L. Zhang, H. Li, P.Wang, and X. Yu [2]**.** To provide finer description of results we apply discrete momentum transform for feature extraction along with the edges. Chencheng Huang, Li Zeng [7] addresses the problem of segmentation during the intensity inhomogeneity. In this model energy function is defined by considering the difference between the measured image and estimated image. In this method we can accurately acquire both the segmented image and the bias field. In this process the energy function is estimated based on the level set regularization set formulation. An image coding based on the local operators of many scales was developed by P. Burt and E. Adelson [10]. The encoding process is equivalent to the sampling the image based on these local operators stated above. By this process the salient features of the image is enhanced. In this process the image is also compressed which results to reduction in storage space.

II. EXISTING METHOD

The existing method consists of the Region of interest extraction based on the Lifting transform to obtain saliency map and uses bit plane coding for acquiring the extracted region. The block diagram of the existing method is given below:

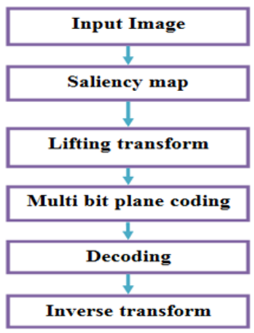

Fig.1: Block diagram of the existing method.

i. **Input image**:

The input image is the satellite or remote sensing image from which the region of interest to be extracted.

ii. Saliency map:

A saliency map is an image that suggests every pixel's precise first-class. The intention of a saliency map is to simplify and/or alternate the illustration of an image into some thing that is greater significant and easier to research. For instance, if a pixel has a excessive gray stage or other particular color great in a color image, that pixel's first-class will display within the saliency map and in an obvious manner. Saliency is a type of image segmentation.

The result of saliency map is set of contours extracted from the image (see aspect detection). Each of the pixels in an area is similar with appreciate to a few characteristic or computed property, which includes coloration, depth, or texture.

Procedure to calculate the saliency map:

Calculate the gap of the every pixel from the relaxation of pixels in the identical body as proven inside the below equation:

The value of I_k is in the range of [0,255]. When there are N numbers of samples in the current frame then we reconstruct the above

$$SALS(I_k) = \sum |I_k - I_i| \text{ ----------(1)}$$

$$\sum F_n |I_K - I_i|$$

formula has follows:

SALS (I_k) =--(2)

Where F_n is the frequency of I_n and the n belongs to the [0, 255]. These frequencies are expressed in the form of histograms.

iii. Lifting transform:

This method is used both for the construction of wavelets and to perform the discrete cosine turn out to be. This procedure of designing and performing the wavelet filters is known as second generation wavelet transform. The lifting scheme factorizes any discrete wavelet turn into with finite filters into a series of basic convolution operators, so-known as lifting steps, which reduces the number of arithmetic operations by means of virtually a factor two.

The discrete wavelet transforms applies a number of filters separately to the identical signal. Not like that, for the lifting scheme, the signal is split like a zipper. Then a sequence of convolution-accumulate operations across the divided signals is applied.

As stated above, the lifting scheme is an substitute procedure for performing the DWT utilizing biorthogonal wavelets. In order to participate in the DWT making use of the lifting scheme, the corresponding lifting and scaling steps need to be derived from the biorthogonal wavelets. The analysis filters (i, k) of the particular wavelet are first written in poly phase matrix.

$$P(z) = \begin{pmatrix} I_{even}(z) & K_{even}(z) \\ I_{odd}(z) & K_{odd}(z) \end{pmatrix}$$

The polyphase matrix includes the low pass and high pass filters, each cut up into their even and odd polynomial coefficients and normalized. Through utilizing this polyphase matrix, upper and scale down triangle matrices are formed each with diagonal values are equal to unity. A matrix such as all zeros except the diagonal values may be extracted to derive the scaling- step coefficients. In step with matrix theory, any matrix having polynomial entries and a determinant of 1 can be factored as described above. For this reason each wavelet turn out to be with finite filters will also be decomposed into a sequence of lifting and scaling steps.

iv. Multi bit plane coding:

Consider an N x— N image in which each pixel value is represented by k bits. By selecting a single bit from the same position in the binary representation of each pixel, an N x— N binary image called a bit plane can be formed [6]. For example, we can select the most significant bit of each pixel value to generate an N x— N binary image representing the most significant bit plane. Repeating this process for the other bit positions, the original image can be decomposed into a set of k, N x N bit planes.

Decoding: The decoding procedure is the inverse approach of encoding procedure. As a result of some steps of encoding process like quantization, the output image after decoding will not be very the equal as the normal image. But the measure of loss ness will also be managed by way of the quantization matrix in order that the error is tolerated.

v. Inverse transform:

The inverse transform technique can be used to sample from exponential, the uniform, the Weibull and the triangle distributions. The basic principle is to find the inverse function of F, r = F(x) such that

$$F\ F^{-1} = F^{-1}\ F = I$$

F^{-1} Denotes the solution of the equation in terms of *r*, not 1/F. For example, the inverse of y

F^{-1} = x is x = y, the inverse of y = 2 x + 1 is x = (y- 1)/2

vi. Disadvantages of Lifting transform:

- For well frequency analysis, it becomes computationally intensive.
- Its discretization, the discrete wavelet transform (comp. efficient), is less efficient and natural
- It takes some energy to spend in wavelets be able to prefer the proper ones for a specific purpose, and to apply it correctly.

III. ROPOSED METHOD

To overcome the drawbacks of existing method, we developed a novel method depend on the discrete stockwell cosine transform. The block diagram of the above method is given below.

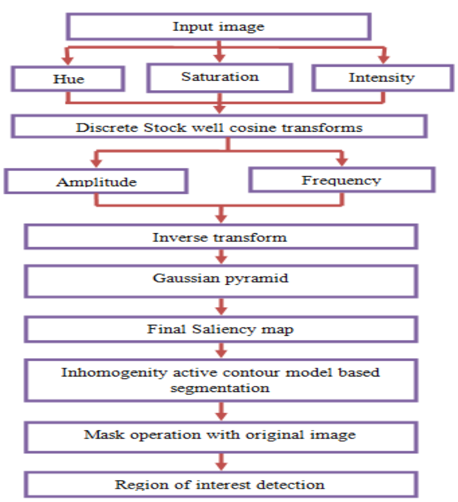

Fig.2: Block diagram of the proposed method.

a. Input image:

The input image is the satellite image or any other image in which the region of interest is extracted. For this process the input image is divided into the HIS color space. Since HIS color space is more sensitive to human than the RGB color space, the image is converted into HIS image from the RGB image.

b. Discrete cosine stockwell transform:

For better frequency analysis of the image the discrete cosine stock well transform is applied to the HSI images. The procedure for discrete cosine stockwell transform is given below:

1. Consider x (n) be the discrete time series of an input signal. The ADCT of input signal is calculated by using N points. The obtained N- point one sided signal is conjugate symmetrically extended to 2N points to formulate it similar to DFT. For this, the DC point (0th) and the midpoint (N) of 2N are made real by taking its absolute value.
2. Find the localizing Gaussian w (l, k) for the required frequency k using Eq. (14).
3. Shift the spectrum $C^{k}(x)$ to $C^{k}(l + k)$ for the frequency k.
4. Multiply the spectrum $C^{k}(l + k)$ by w (l, k) to get D(m, K].
5. Inverse Fourier transform of D (m,K] to give the row of S(m,K) corresponding to the frequency k.
6. Steps 3–5 are repeated until all the rows of S(m,k) corresponding to all discrete frequencies have been obtained.

c. Region of interest Extraction:

The image formed from the inverse transform of the DCST is used to form the gaussian pyramid obtained from the low pass filtered output of the predecessors. The final saliency map is formed from these pyramids. Then for thresholding in homogeneity active contour model is used in which the input image i.e., final saliency map is described based on the dissimilarity between the measured image and approximated model. The local energy function of our method is defined based on the K-means clustering technique. This energy function is further modified based on the level set method and also by consider all the pixel values. But in this level set process the re- initialization step is not effective. So, we develop a regularization term as an extra term such that the re-initialization is eliminated. This regularization term can force the level set function to be blocked to a signed distance function in the process of curve evolution. Based on this energy function the image segmented is performed and formed as a mask with the region to be segmented. By using this mask and performing the masking operation the region of interest is extracted from the segmented region.

d. Advantages:

- Better frequency analysis through the DCST transforms.
- High accurate segmentation through active contour model.
- The segmentation process can estimate the bias field without blurriness.

e. Applications:

- Medical processing
- Satellite imaging.
- Military applications.
- To extract region in mining.

IV. RESULTS

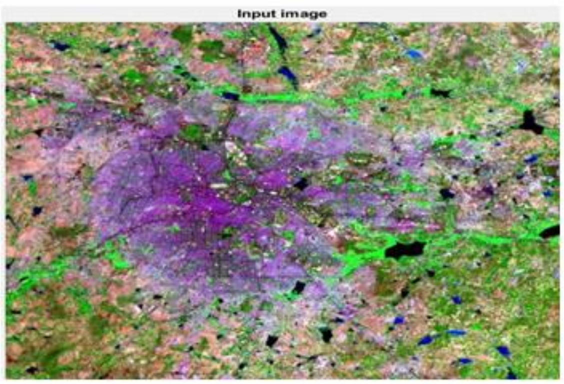

Fig.3: Input image

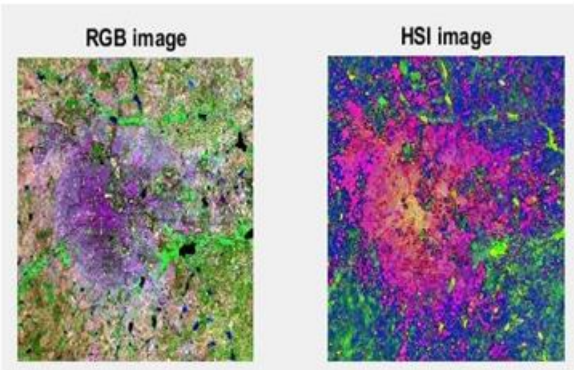

Fig.4: HIS image

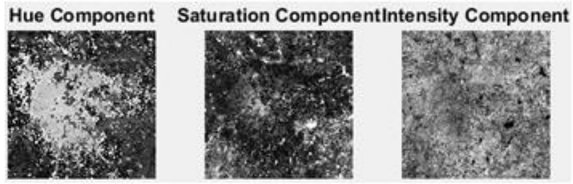

Fig.5: Hue, Saturation, Intensity component

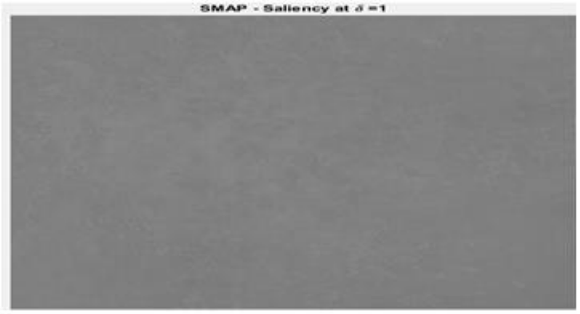

Fig.6: Saliency map

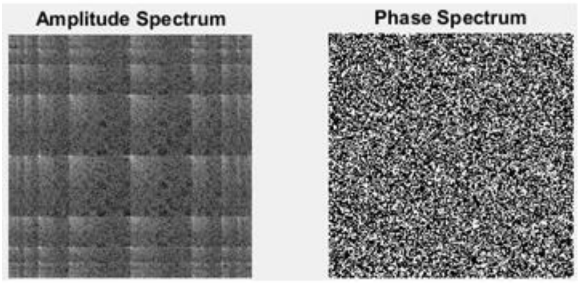

Fig.7: Amplitude and phase of the Hue component

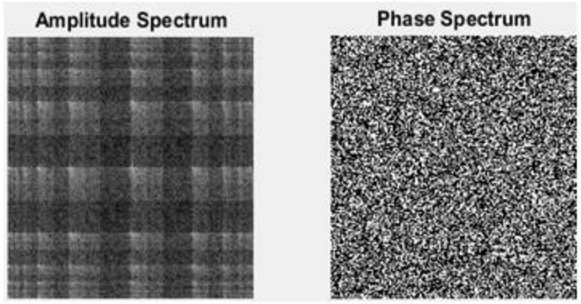

Fig.8: Amplitude and phase spectrum of the saturation component

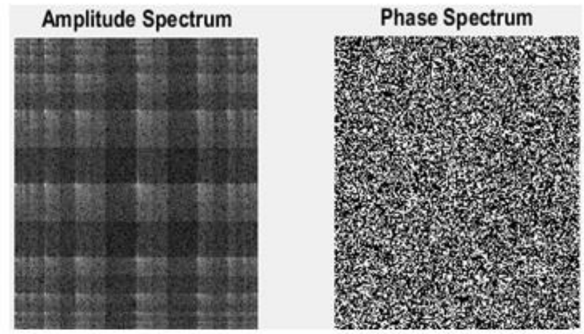

Fig9: Amplitude and phase of the Intensity component

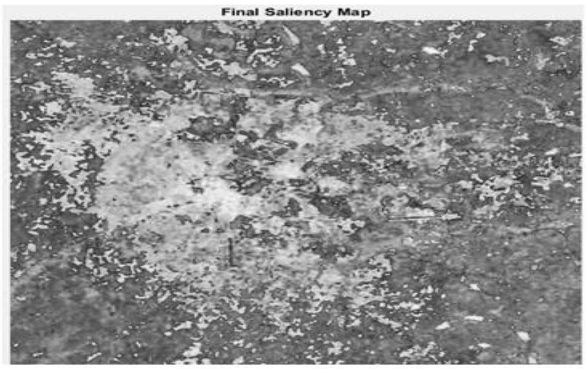

Fig.10: Final Saliency map

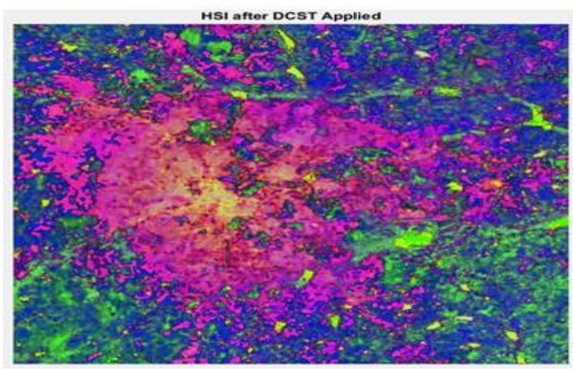

Fig.11: HIS after DCST applied

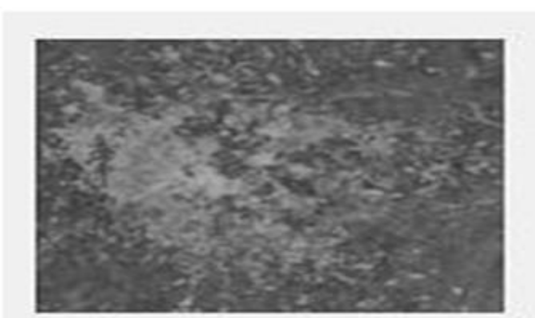

Fig.12: Gaussian pyramid

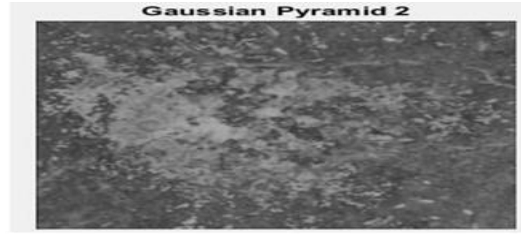

Fig.13: Gaussian pyramid 2

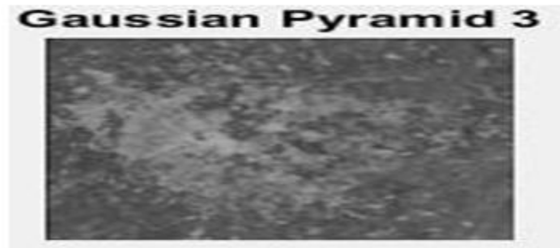

Fig.14: Gaussian pyramid

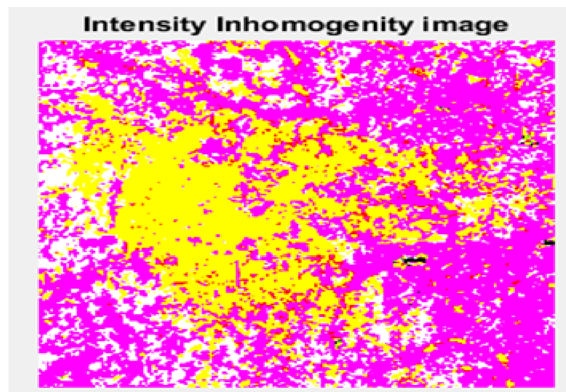

Fig.15: Intensity inhomogenity image

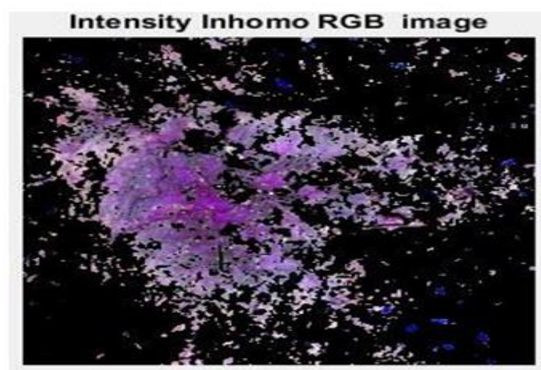

Fig.16: Intensity Inhomo RGB image

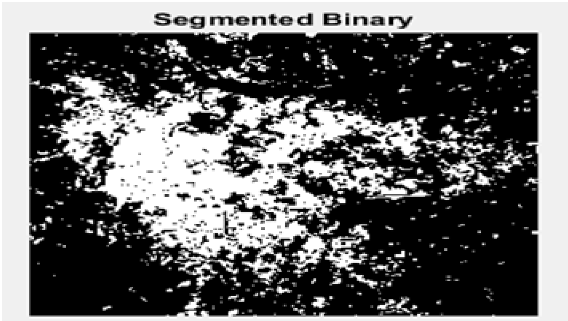

Fig.17: Segmented image

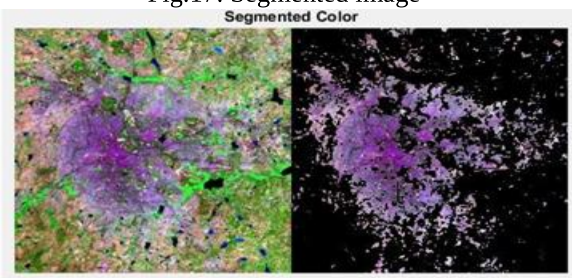

Fig.18: Segmented color image

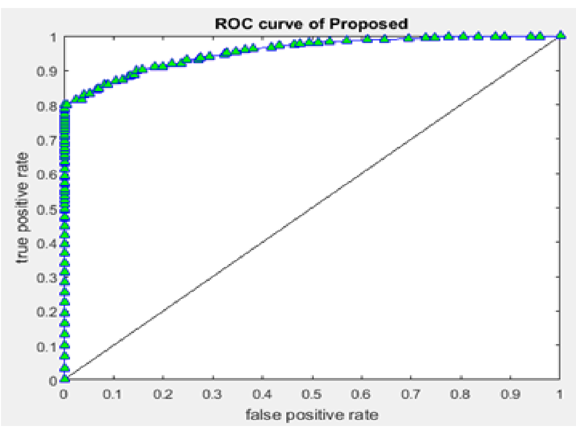

Fig.19: ROC curve of proposed Metrics values:

Parameter	Existing method	Proposed method
Precision	0.7734	0.9965
Recall	0.7756	0.9904
Fmeasure	0.7723	0.9952
P_Precision	0.1084	0.2091
P_Recall	0.7729	0.9920
P_Fmeasure	0.7782	0.9960
Sensitivity	0.8835	0.9904
Specificity	0.875	1
BCR	0.7792	0.9952
AUC	0.7791	0.9952
BER	0.7148	0.4804
SFmeasure	0.7786	0.9952
Accuracy	0.7745	0.9930
GAccuracy	0.7743	0.9952
NRM	0.0032	0.0048
PSNR	14.2757	21.5372
DRD	0.3479	0.6321
MPM	0.0032	0.0071
Elapsed time	1.45 seconds	1.19 seconds

V. CONCLUSION

In this paper a novel technique based on the discrete cosine stock well transform for classification and in homogeneity contour model is developed for segmentation of the saliency object in satellite images which can acquire accurate results in all conditions and with lower computational complexity. Both quantitatively and qualitatively the results show accurate results by comparing with the state of art methods.

VI. REFERENCES

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