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Pattern recognition of infrared images and pseudo-color image processing : Forest fire in himalaya

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ABSTRACT
Human growth in diversified fields has impacted atmosphere a lot. Every time Nature wants to balance and to tune with the universal effects. Resistance of human imbalances all of it's efforts, which results into disaster like Forest fire and a big reason of global warming. Early detection of fire has been much explored with available limited technology of satellite imaging in terms of spatial and temporal resolution. Sensors spectral coverage has enhanced data acquisition to a reliable degree in those EM spectrum bands. But in changing atmospheric conditions, shadowing of objects, fire spot finding in deep forests, difference finding in fire smoke and clouds are big challenges in remote sensing via satellite imaging. Our approach works on the pixels statistics of Red, green and blue intensities which are tested with infrared image of the same granule. Granule of forest cover (Longitude : 77.1185E, 79.4806 E and Latitude : 29.2672 N, 31.3583 N) by satellite images are used for this purpose. The selection criteria of forest cover are density and irregular geo-physical properties of forests in the Himalayan belt.
Keywords : Multispectral imagery, pseudo color images, pattern recognition, wildland fire detection, remote sensing.

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I. INTRODUCTION

Forest fire detection and recognition has been performed in many cases so far using MODIS sensors (Terra and acqua) with a spatial resolution of 1km. The contextual approach of fire detection is followed by the hybrid contextual approach using multispectral imagery[1][3]. In hybrid approach fire pixels are separated and background is suppressed using squared Mahalanobis distance.Thermal radiations are sensed by onboard sensor installations in satellites. Source of illumination is the sun in all passive satellite image acquisition modes whether in infrared images acquisition of objects is self actuating. Multispectral capability of onboard sensing devices helps in reliable collection of data, which after analysis becomes information. This information recognises boundaries of the objects in low light and in nocturnal duration[2][9].

Good temporal resolution image is essentially required in early fire detection cases. In dense forest cover of Mediterranean countries it is tough to be that much spontaneous with technical limitations[2]. In those cases anomaly detection could be performed with good spatial resolution infrared\thermal sensors. Fire flumes and thermal variations of surrounding and their imaging would help recognition to a great degree[9][10].

Satellite imagery has been enhanced from multispectral to hyper spectral and again moving towards ultra hyper-spectral era. These milestones are achieved because of precise atmospheric window analysis and accurate sensor designing.

Multispectral technology suites in the varied environmental conditions, it is because of the fine masses present in the atmosphere which absorbs the reflected radiations and makes window absent for a particular band. At the same time other spectral window may be present and sensor installed in satellite will have information of the same region of the earth. Technology has upgraded hardware devices with better resolution capabilities which results in hyper spectral bands imaging, now scientists and engineers are going to explore ultra hyper spectral bands to acquire fine features and hence better spectral resolution. VIIRS and RESOURCESAT-2 are capable enough and provides the information through hyper-spectral sensor media. LANDSAT satellite data is extansively used because of available wide time series data.

1.1electromagnetic Coverage :

High frequency blue band suffers maximum scattering which results into absorption in the atmosphere and less chances of fare color

image acquisition at satellite terminal [3][5]. Green colour responds to a great degree in infrared channel so it is used vegetation data acquisition of the ground. Information of forest density and availability of vegetation could be bitterly estimated with least error via electro-spectrum as media. Following graph shows different object's reflectance degree.

1.2 **Reflectance Of Green Vegetation:**

In passive remote sensing cases reflectance strength of green forest is maximum in infrared band. So infrared images could have better interpretation capability of forests. Anomaly with temporal resolution infrared image would be because of any surface change.

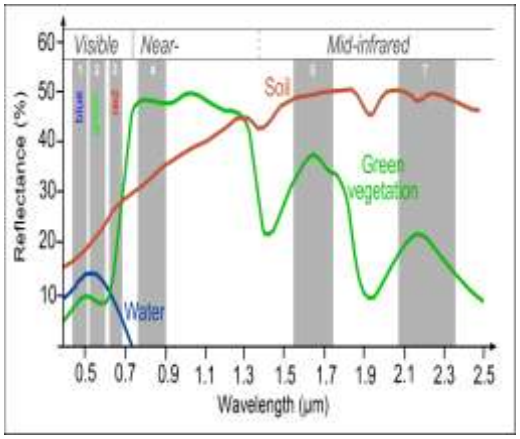


Figure 1 : Reflectance responses of green vegetation, soil and water

The response of reflectance of green forest vegetation is wide in the near infrared band of the electromagnetic spectrum around (50%) and ranges from 0.6μm to the 1.4 μm. Infrared region reflectance response of green vegetation is good, So the pseudo-color could be performed with infrared intensities.

II. METHOD OF OPERATION

In our experiment image of visible band has been converted into its infrared image. In Normal weather conditions infrared intensity would have better correlation with its infrared intensities. But in anomaly finding from the same granule gives varied correlation. That variation is a detection and this may be fire case or may be cloud. For confirmation of it we do linear analysis of the both cases using pixel neighbourhood analysis. This could be done by connectivity of pixels. In case of unconnected pixels which confirms the cloud. These anomaly infrared images are converted into pseudo-color for better interpretation.

III. RESULTS AND DISCUSSION

Primarily test has been performed with granule in clear weather condition.Degree of correlation with red, green and blue bands are measured here. All these measures are tested with respect to a MATLAB defined constant.

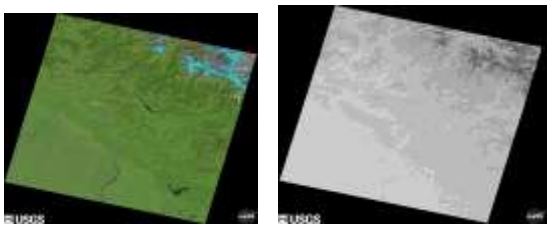


Image (a) Normal weather Granule
Image (b) Infrared of the granule

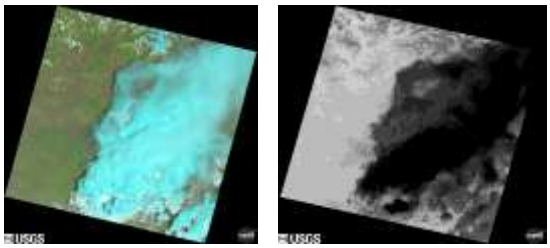
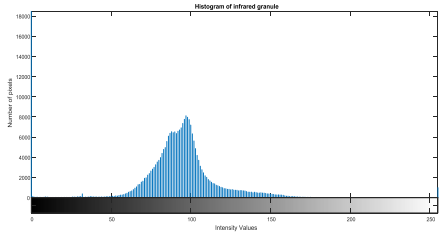


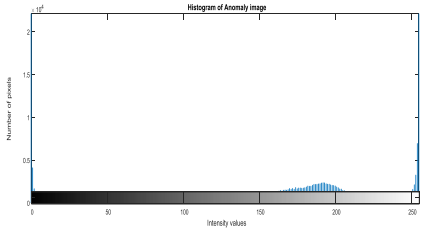
Image (c) Normal image in anomaly
Image (d) Infrared of the anomaly image

Figure 2 : Granule images(a,b,c,d) of the location(Longitude : 77.1185E, 79.4806 E and Latitude : 29.2672 N, 31.3583 N)

Histogram intensity distributions of the images(c) and (d) are following.



Histogram image a



Histogram image b

Figure 3 : Intensity distributions of IR normal weather and Anomaly images

Both the infrared images have very different intensity distributions for the same granule. From the time series data of satellite (say SENTINAL) in almost cases the intensity distribution would be like as in the histogram figure 3 image (a). But in case of histogram figure 3 image (b) the intensities are distributed drastically different. In case of anomaly we go for airbus imaging or UAV imaging and find out the edges using sobel and prewitt detectors. For this analysis we have following image of the forest fire. In this image fire fume is starting from ground and lifting up and making definite edges. For edge analysis we have opted sobel and prewitt edge detectors.

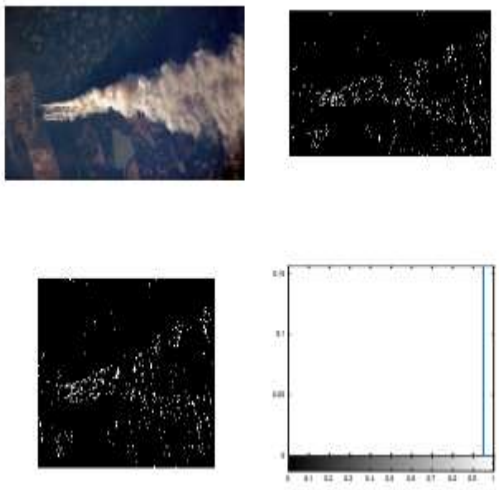


Figure 4 : (a) Original image (b) Sobel edges (c) Prewitt edges (d) Correlation degree = 0.9488

Here good correlation among the sobel and prewitt edge detectors shows greater connectivity and linearity of the image pixels. This again shows the directionality of similar intensity values. Similar intensities in a directions shows the image is of a fire case. Correlation value between (a) sobel and (b) prewitt edge detectors output cases is 0.9488.

Pseudo Coloring Of Uav Image :

In the following table the intensities of pixels are acquired along the traced line. The intensities be fitted on linearity scale. Statistical analysis of pixels intensities gives range of minimum and maximum value. This range helps in pseudo-coloring and validation of linearity which can be seen in the figure image 5 (b).

S.No.	X	Y	Intensity
1	112	337	44
2	156	336	246
3	184	336	237
4	219	336	206
5	247	336	246
6	312	337	184
7	348	336	204
8	387	336	219
9	429	334	154
10	445	333	127
11	466	331	122
12	487	337	98
13	528	336	137
14	552	334	149
15	582	336	138

Table : Coordinates & Intensity values of infrared intensity UAV image

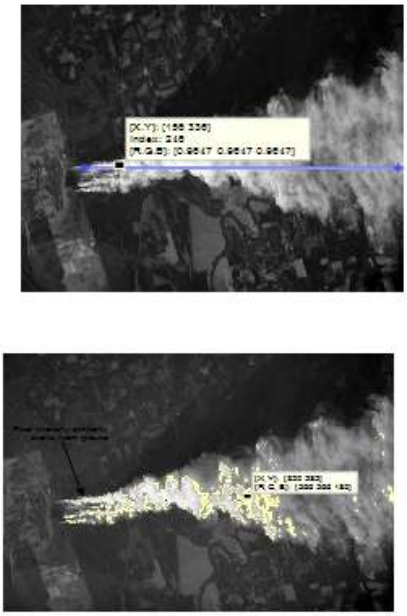


Figure 5 (a) Intensity distribution on linear scale (b) Pseudo color processed image

From table standard deviation of green color pixel intensities on linear scale is 59.1678, the average value of intensities is 167.4 (rounded 167) which is the basis of lower threshold in intensity slicing scales, maximum intensity here is 246 supposed to create band. The color image obtained after using threshold 167 to maximum intensity 246 is shown in figure (b). Here it is clearly visible that linearity starts from the surface of earth, which in matlab environment shows and separates clouds and forest fire smoke.

IV. CONCLUSION

In this work original satellite\UAV image is acquired from time series data of SENTINAL satellite. Reflectance response of green color is maximum in the infrared band, so the green colored object reflects fine as well as maximum details in this band of Electromagnetic spectrum. This property of thermal\infrared response of forest data is sensed by onboard thermal sensor and acquires the image of the location with temporal resolution of satellite. In case of anomaly or deviations of their IR images would be higher than normal day cases. .Good degree of correlation shows no variations and least anomaly, while least correlation shows anomaly present in the captured images. Again the testing has been performed with the UAV surveillance of same granule of satellite. For the differentiation purposes pseudo-coloring has been performed. All results are tested in the MATLAB environment shows similar characteristics with the UAV images. In future inter-band response of the objects would be checked and in maximum interference cases a separate analysis of the bands would help much for the object differentiation.

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