Similarity between Patented Algorithm (CA2491794A1) and Contextual Clustering for Segmentation of Vegetation in Satellite Image

Dr.T.Suganthi

Abstract- This paper presents the similarity between the patented algorithm (CA2491794A1) and contextual clustering for segmentation of vegetation in satellite image. Patented algorithm used for segmenting vegetation image by adjusting different colors present in the image. Contextual clustering used to extract the features of the satellite image which is used for segmenting the vegetation area. Comparatively the segmentation performance of contextual clustering is more than patented algorithm.

Keywords- Satellite Image, Vegetation, Patented Algorithm (CA2491794A1), Contextual Clustering.

I. INTRODUCTION

Remote sensing of vegetation helps the government and private people to know the status of vegetation in different areas. This is used to monitor and control the overall specific vegetation product and to provide information for the government to compensate farmers when planted crops are damaged by disasters such as floods. In this paper patented algorithm and contextual clustering technique used for identify the vegetation area.

II. PROPOSED ALGORITHM

A. Patented Algorithm (CA2491794A1)-

A method for improving the color of a natural color image is presented. The steps for implementing greenness generation band from a multispectral image including blue, green, red and near infrared bands and method for adjusting the green band using the greenness band are presented.
The greenness band is generated using the equation (1).

$$GN = (NIR_{orig} - R_{orig} - \lambda)/ s \qquad (1)$$

Where GN is a greenness band, NIR_{orig} is an original near infrared band, R_{orig} is an original red band, λ is a threshold and s is a scale factor.

In vegetation, reflectance is very high in near infrared range and very low in red range. Vegetation covers have very high grey values in near infrared (NIR) band and low grey values in red (R) band. The subtraction of NIR band by R band ($NIR_{Orig} - R_{Orig}$) results in a subtraction band with high grey values in vegetation areas. This is because of large grey value difference between the NIR and R bands, low grey values in soil areas, and negative grey values in water areas. A threshold λ is introduced for proper color adjustment and to segment non-vegetation areas in the subtraction band from vegetation areas. Then the non-vegetation area is assigned with a grey value of zero.

The vegetation areas in the subtraction band contain grey values larger than zero. The other areas are all set to zero. This results in a greenness band. The threshold can be identified manually and automatically. To control the magnitude of the greenness, a scale factor is introduced. Adjusting the green band using the greenness band is done using the equation (2).

$$G_{Adj} = G_{Orig} + GN \qquad (2)$$

Where G_{Adj} is an adjusted green band, G_{Orig} is an original green band and GN is a greenness band.

A greenness band is also generated from pan-sharpened image bands including blue, green, and red and near infrared bands and subsequently adjusting the pan-sharpened green band using the greenness band using the equation (3).

$$GN_H = (NIR_{PS} - R_{PS} - \lambda)/s \qquad (3)$$

Where GN_H is a high resolution greenness band, NIR_{PS} is a pan-sharpened near infrared band, R_{PS} is a pan-sharpened red band, λ is a threshold.

The color of a pan-sharpened natural color image is improved by generating a greenness band from a panchromatic image and a pan-sharpened red band; and adjusting the pan-sharpened green band using the greenness band using equation (4).

$$GN_H=(Pan_{Orig}-R_{PS}-\lambda)/s \qquad (4)$$

Table-1 Results of lambda and scaling factors in segmentation of vegetation image			
scale	**Lambda=0.4**	**Lambda=0.1**	**Lambda=0**

Where Pan_{Orig} is an original panchromatic band. The subtraction of Pan_{Orig} band by R_{PS} band ($Pan_{Orig}-R_{PS}$) results in high grey values in vegetation areas. A threshold λ is also needed to segment non-vegetation areas from vegetation areas to set the grey values of non-vegetation areas to zero. After this segmentation, only vegetation areas of the subtraction band contain grey values higher than zero, while other areas are zero, resulting in a high resolution greenness band (GN_H). A scale factor s is introduced to adjust the magnitude of the greenness.

Subtraction of near infrared band by green band or blue band and subtraction of green band by blue or red band will generate greenness bands. For high resolution greenness bands, pan-sharpened bands need to be involved. The subtraction of original panchromatic band by pan-sharpened green or blue band results in a high resolution greenness band. The pan-sharpened green band is adjusted using the equation (5).

$$G_{HAdj}=G_{PS}+GN_H \qquad (5)$$

Where G_{HAdj} is an adjusted high resolution green band and, G_{PS} is a pan-sharpened green band.

B. Contextual Clustering Algorithm-

Contextual clustering algorithm segments a data into category 1 (ω_0) and category 2 (ω_1). The data is assumed to be drawn from standard normal distribution. The following steps are adopted for implementing contextual clustering.

1. A decision parameter T_{cc} (positive) is defined and weight of neighborhood information β (positive). Let N_n be the total number of data in the neighborhood. Let Z_i be the data itself, 'I'.
2. Data is classified with $z_i > T_\alpha$ to ω_1 and data to ω_0. The classification is stored to C_0 and C_1.
3. For each data 'i', the number of data u_i is counted, belonging to class ω_1 in the neighborhood of data 'I'. It is assumed that the data outside the range belong to ω_0.
4. Data is classified with the following equation (6) to ω_1 and other data to ω_0. The classification is stored to variable C_2.

$$z_i + \frac{\beta}{T_\infty}\left(u_i - \frac{N_n}{2}\right) > T_\alpha \qquad (6)$$

5. If $C_2 \neq C_1$ and $C_2 \neq C_0$, then C_1 is copied to C_0, and C_2 is copied to C_1 and returned to step 3, otherwise returned to C_2.

The implementation of the CC is given as follows:

Step 1: A landsat image is read and split into 3X3 windows.

Step 2: The values of the windows are sorted to form Patterns.

Step 3: The median of the pattern C_m is found.

Step 4: The number of values greater than the median values, U_m are identified.

Step 5: CC is calculated using the following equation (7).

$$C_m + (beta/Tcc) * (U_m - (bs/2)). \qquad (7)$$

Step 6: CC is assigned the segmented values.

III.RESULTS

The proposed technique patented algorithm and contextual clustering is used for segmentation of vegetation in satellite image .These algorithm has been implemented in MATLAB for segmentation of the vegetation area.

A. Patented Algorithm (CA2491794A1) Results-

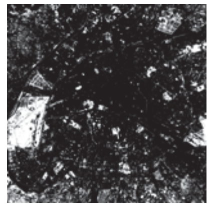
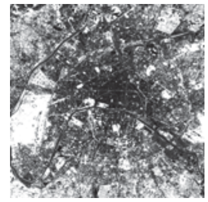
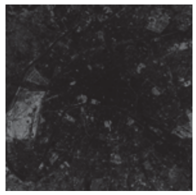
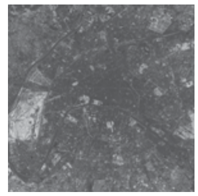
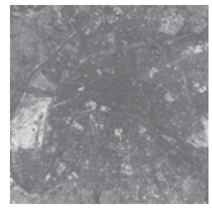
0.1			
0.5			

Table-1 presents the segmentation outputs of the patented algorithm for different values of lambda and scales. The outputs of the patented algorithm is good when $\lambda \approx 0$ and scale=0.1.

B. Contextual Clustering Algorithm Results-

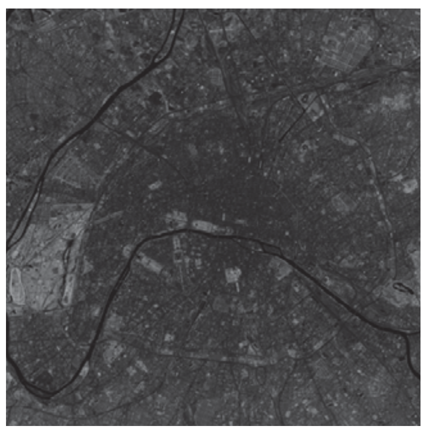


Figure.1. NIR image (4^{th} band).

Figure.1. is the original NIR image. The bright portion on the left top is the area is vegetation. This can be detected by normalized vegetation index (NVI). The identification of vegetation is carried out by proposed algorithms.

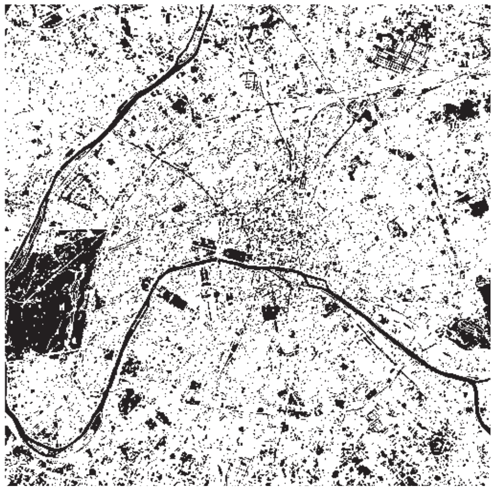


Figure.2. CC segmentation output (bright).

Figure.2. the output of the contextual clustering with two thresholds is used. The lower threshold is 40 and the upper threshold is 80. The segmented images shows vegetation highlighted on the left middle lower side**.**

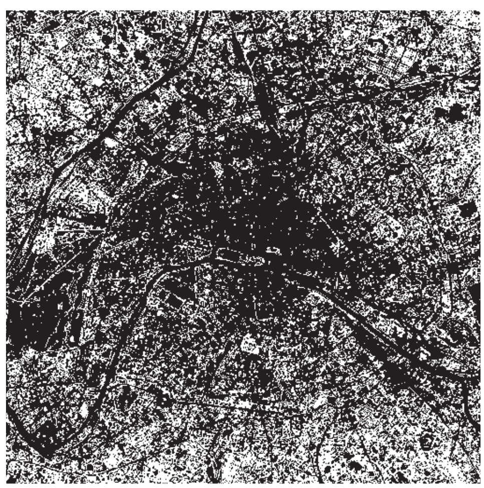


Figure.3. CC output (less contrast).

Figure.3. shows the output of CC. The segmented image is less contrast and not clears. The lower threshold is 60 and the upper threshold is 80. The segmented images show many areas black and hence vegetation could not be identified clearly.

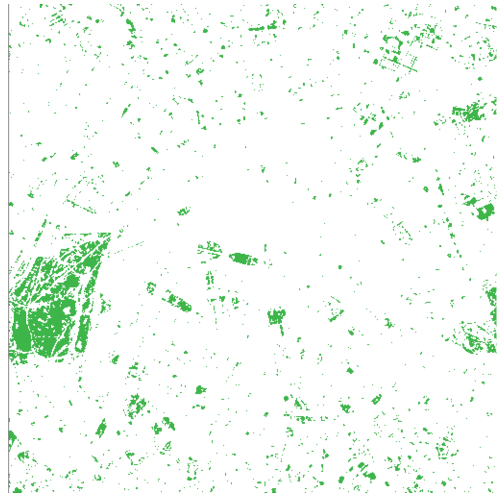


Figure.4. Color segmented output of vegetation.

Figure.4. shows the segmented landsat image. The green color indicated the presence of vegetation.

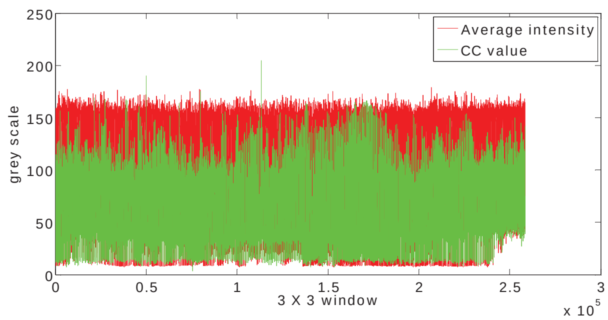


Figure.5. Outputs of CC for each 3X3 window.

Figure.5. shows the outputs of CC for each window. The green color gives the outputs of CC. The red color is the average value of each window. When the output of CC is close to the average of the window, then the segmentation is meaningful. Form the plot, it can made clear that, due to closeness of the CC output with the average of the window, CC is best suitable for segmentation of vegetation image.

IV.CONCLUSION

This paper presents the existing algorithm to identify the vegetation in satellite image. The patented algorithm used for segmenting vegetation image by adjusting the colors present in image. The supervised contextual clustering used to extract the feature of the image which is used for segmenting the vegetation area. It involves least computation in the segmentation. How ever it is very much suitable to segment the satellite image.

REFERENCES

[1] Addink E.A., de Jong S.M., and Pebesma E.J., 2007, “The Importance of Scale in Object-based Mapping of Vegetation Parameters with Hyper spectral Imagery, Photogrammetric Engineering and Remote Sensing”, Vol.72, No.8, pp.905-912.

[2] Andreasen C., Rudemo M., and Sevestre S., 1997, “Assessment of weed density at an early stage by use of image processing, Weed Research”, Vol.37, pp.5-18.

[3] Arnon Karnieli, 2003, “Natural vegetation phenology assessment by ground spectral measurements in two semi-arid environments”, International Journal of Biometeorology, Vol.47, No. 4, pp.179-187.
[4] Bandyopadhyay S., 2005, “Satellite image classification using genetically guided fuzzy clustering with spatial information”. International Journal of Remote sensing, Vol.26, Issue.3, pp.579-593.
[5] Baret F., and Guyot G, 1991, “potentials and limits of vegetation indices for LAI and APAR assessments”. Remote Sensing Environment, Vol.35, pp.161-173.
[6] Brandt Tso, and Richard C., Olsen, 2005, “A contextual classification scheme based on MRF model with improved parameter estimation and multiscale fuzzy line process”, Remote Sensing of Environment, Vol.97, pp.127–136.
[7] Chen Z., Zhao Z., Gong P., and Zeng B., 2006, “A new process for the segmentation of high resolution remote sensing imagery”, International Journal of Remote Sensing, Vol.27, No.22, pp.4991-5001.
[8] Chengfan Li, Jingyuan Yin, Junjuan Zhao, 2010, “Extraction of urban vegetation from high resolution remote sensing image”, Computer Design and Applications (ICCDA), pp.V4-403-V4-406.
[9] Coppin P., Jonckheere I., Nackaerts K., Muys B., and Lambin E., 2004, “Digital Change Detection in Ecosystem Monitoring: A Review”, International Journal of Remote Sensing, Vol.25, No.9, pp.565-596.
[10] Coppin P.R., and Bauer M.E., 1996, “Digital change detection in forest ecosystems with remotely sensed imagery, Remote Sensing Reviews”, Vol.13, pp.207-234.
[11] Crippen R.E., 1990, “Calculating the vegetation index faster, Remote Sensing of Environment”, Vol.34, pp.71–73.
[12] Crippen Robert E., and Blom Ronald G., 2001, “Unveiling the Lithology of Vegetated Terrains in Remotely Sensed Imagery”, Photogrammetric Engineering and Remote Sensing, Vol.67, No.8, pp.935-943.
[13] Huete A.R., and Warrick A.W., 1990, “Assessment of vegetation and soil water regimes in partial canopies with optical remotely sensed data: Remote Sens, Environ”, Vol.32, pp.155-167.
[14] Huete A.R., and Jackson R.D., 1987, “Suitability of spectral indices for evaluating vegetation characteristics on arid rangelands: Remote Sens. Environ”., Vol.23, pp.213-232.