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A Random Subspace Algorithm based classification for change detection of satellite images

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Abstract - Change detection techniques are playing major role in order to know the changes in different situations. Using these methods, we can know the changes that are occurred or occurring on earth due to climatically changes or degradation of certain areas. Change detection will help us to observe the different areas on earth remotely. The correct changes can be obtained via proper classification methods. Generally a single classifier may not meet the current requirement. So that ensemble classifiers are required. Wrong classification results incorrect changes. In this paper, ensemble subspace classifier is discussed to get accurate classification thereby accurate changes can be obtained. The changed area is calculated based on the comparison of the number of pixels in each class of two temporal images. Here we have shown the changed pixels in each class and also changed areas in each and every class.

Keywords - *Classification; Change Detection; Satellite Image; Ensemble.*

I. INTRODUCTION

Recently, changed detection technology of remote sensing image is developing rapidly, and variety of change detection algorithms are proposed by some researchers. The changes occurring in our surroundings and environment need to be observed. It is possible with satellite images. It is one of the major branches of Remote Sensing image processing. To apply this there are several applications in our common life like, manmade target detection, urban planning, land-cover database updating, disaster management and the development of human civilization. So that there is a great need to detect the changes. With the help of sensor technology multi-temporal satellite image are available with low resolution and high resolution so that monitoring of earth surface time-to-time is possible [1-3].

Change detection will identify certain changes in the images of same area taken at different time instants. The under lying information can be extracted to know the changes easily over large areas on the earth surface. Change detection techniques are based on multiband, multi-temporal or single-phase images using Image processing methods. The analysis is carried out based on pixel level, feature level and target level. Classification can be supervised or unsupervised.

Generally the satellite images consists some complex backgrounds which will reduce the efficiency of change detection methods [4-5]. Still the research is going on different sophisticated kind of change detection models. The major procedure to find the changes are, obtaining difference image and following correct and exact classifiers. Two basic procedures to get difference image are, one is subtraction operation and another is ratio operation. The subtraction of the pixels in the bi-temporal images, the changes can be observed. The other methods are mean-filter, log-ratio and mean-ratio etc. Only one difference image is produced majorly in all change detection methods [6].

2. ENSEMBLE OF DIFFERENT CLASSIFIERS FOR CHANGE DETECTION

Change detection efficiency depends on the classifiers that are used for classification. Now-a-days majority of researchers are using ensemble classifiers than a single classifier because of their high accuracies. In ensemble classifier various base classifiers will combine together to produce high accuracy. All the benefits of individual base classifiers can be achieved by ensemble methods. Ensemble discriminant method is better .In this also Random Sunspace classifier is preferred because the data sets that are obtained are similar to original database. The procedure to get correct classification and to avoid the misclassification is shown in the figure 1.

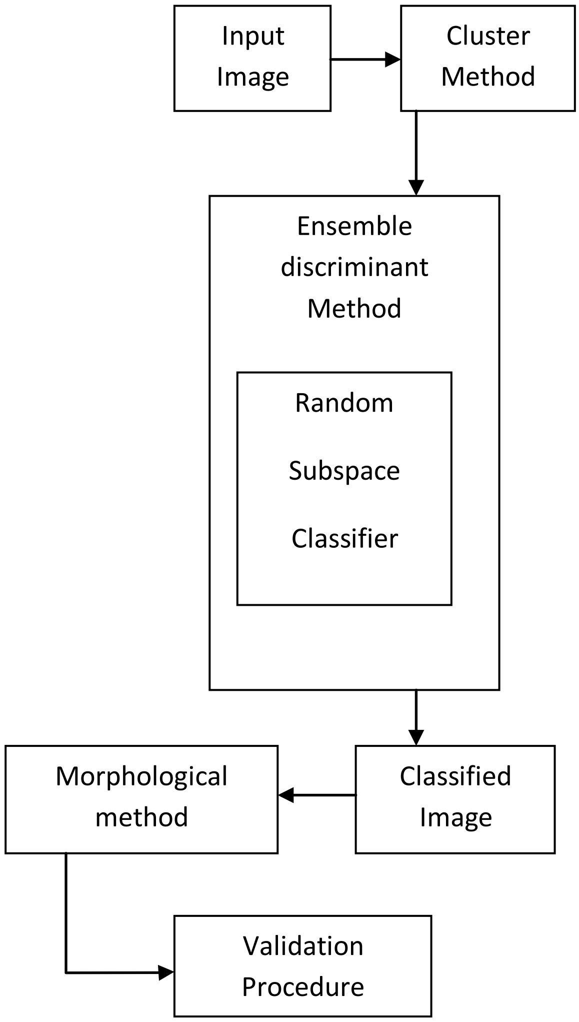


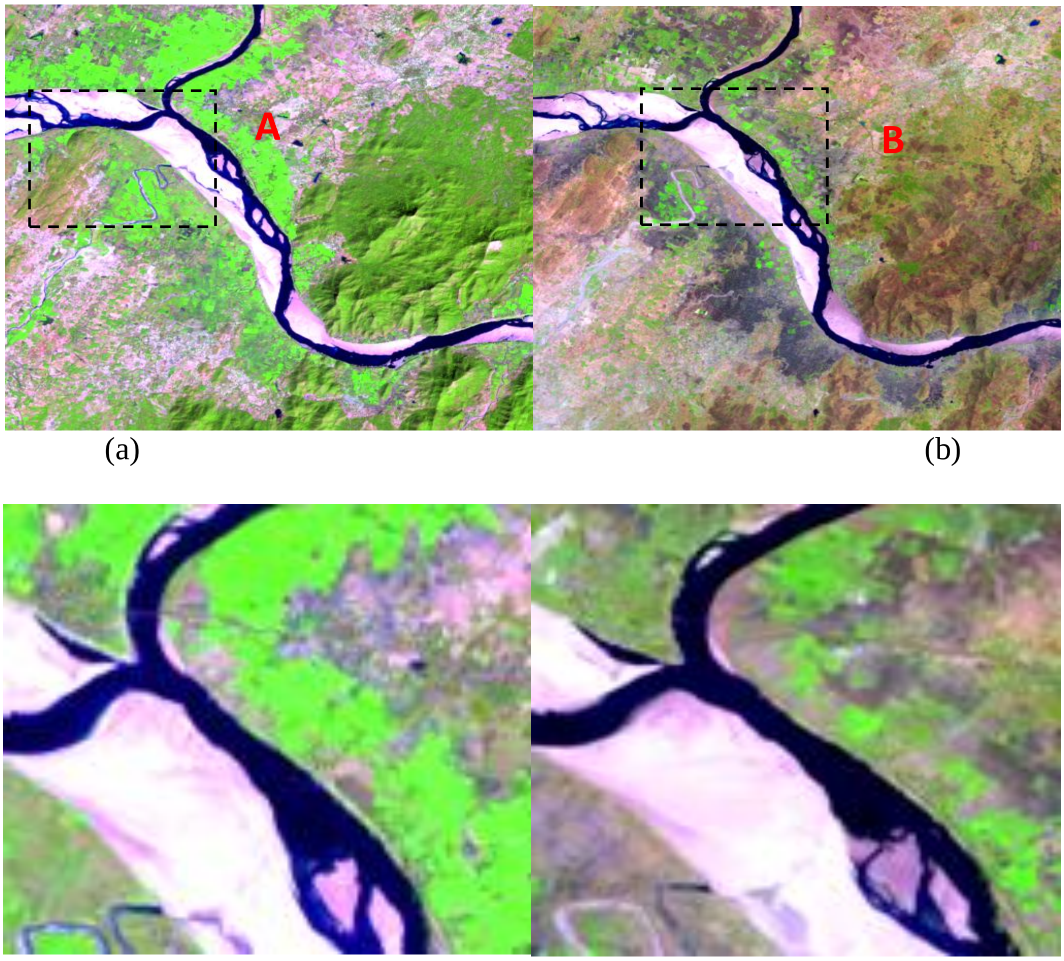
Figure 1: Classification Process

The input satellite image in which change we need to observe is first applied to a clustering algorithm to get clustered image which simplifies the classification processes. Here we followed Self Organizing Map kind of clustering is preferred. The clustered image is now applied to a efficient classifier i.e. Random Subspace classifier based on its advantages. Once the classified image is obtained we can validate it with the ground truth points. Based on the comparisons made in the two images pixels in different classes we can give the changed areas.

3. RESULTS AND DISCUSSIONS

The ensemble subspace technique has been used for classification of images. Ensemble technique is preferred because it results better in quality of classifier through which accurate change detection is possible. The classes defined here are: agriculture fields, water, green land and barren land as the reference fields. 200 points are considered for getting the accuracy measurement for better comparison. 200 points are not the small number for 512*512 pixels image. From these points both user's and producer's accuracies are calculated.Two sets of data have been considered for analysis.

Figure 2 shows classified first image, classified second image, Zoomed image of (a) and Zoomed image of (b). Table 1 gives the list of classes and corresponding pixels of first image. Table 2 gives list of classes and corresponding pixels of second image (First set). Table 3 contains change detection in pixels and area. Here both classified images pixels are compared and obtained the changed areas. The table shows the total number of pixels changed related to water are 627 and the area changed is 2,50,800sq-m (decreased); total number of pixels changed related to agriculture are 19,260 and the area changed is 77,04,000sq-m (decreased); total number of pixels changed related to barren land are 21,939 and the area changed is 87,75,600 sq-m (increased); total number of pixels changed related to green land are 2,052 and the area changed is 8,28,200 sq-m (decreased).



(a) (b)

(c) (d)

Figure 2: (a) First image (b) Second image (c) Zoomed image of (a) and (d) Zoomed image of (b)

Table1: List of classes and corresponding pixels of first image (First set)

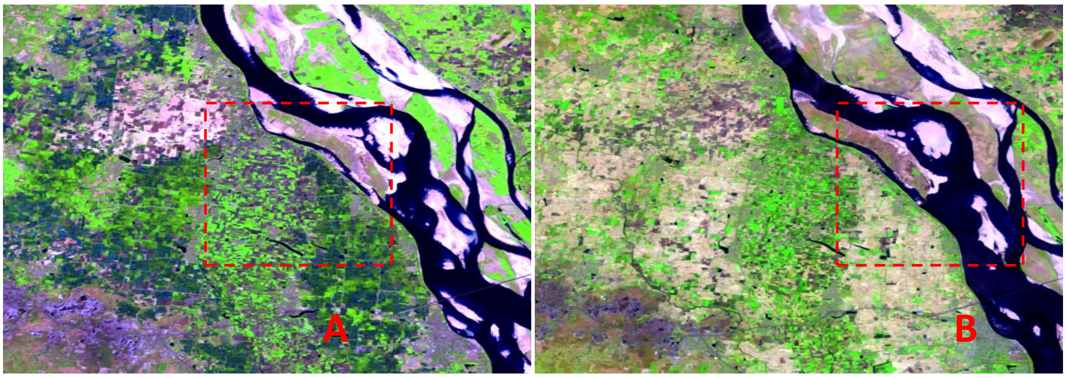
S.No	Class	Pixels in class after classification Proposed method
1	Class1	27,465
2	Class2	42,535
3	Class3	99,320
4	Class4	92,824
Total		2,62,144

Table 2 : List of classes and corresponding pixels of second image(First set)

S.No	Class	Pixels in class after classification Proposed method
1	Class1	26,838
2	Class2	23,275
3	Class3	1,21,259
4	Class4	90,772
Total		2,62,144

Table 3: Change detection in pixels and area(First set)

Class		First Image		Second Image		Change	
		No. of pixels in class	Total area (m^2)	No. of pixels in class	Total area (m^2)	No. of pixels in class	Total area (m^2)
Class1	Water	27,465	1,09,86,000	26,838	1,07,35,200	-627	-2,50,800
Class2	Agriculture	42,535	1,70,14,000	23,275	93,10,000	-19,260	-77,04,000
Class3	Barren Land	99,320	3,97,28,000	1,21,259	4,85,03,600	21,939	87,75,600
Class4	Green Land	92,824	3,71,29,600	90,772	3,63,08,800	-2,052	-8,20,800
		2,62,144		2,62,144			0



(a) (b)

(c) (d)

Figure 3: (a) First image (b) Second image (c) Zoomed image of (a) and (d) Zoomed image of (b) (First set)

Figure 3 shows, classified first image, classified second image, Zoomed image of (a) and Zoomed image of (b). Table 4 gives the list of classes and corresponding pixels of first image. Table 5 gives list of classes and corresponding pixels of second image (Second set).

Table 4: List of classes and corresponding pixels of first image (Second set)

S.No	Class	Pixels in class after classification Proposed method
1	Class1	29,450
2	Class2	69,535
3	Class3	63,410
4	Class4	99,749
Total		2,62,144

Table 5: List of classes and corresponding pixels of second image (Second set)

S.No	Class	Pixels in class after classification Proposed method
1	Class1	28,645
2	Class2	23,184
3	Class3	1,15,421
4	Class4	94,894
Total		2,62,144

4. CONCLUSION

In this paper the discussions are carried-out for two set of images on ensemble techniques for change detection. 200 points were considered with four classes: water, green land, barren land and agriculture for validation of output. Finally, pixels of each class were compared in the two images and also calculated the corresponding area. This analysis gave good change detection based on ensemble method. This can be used in disaster management. Even we have verified this procedure with support vector machine, k nearest neighbors, random forest and maximum likelihood procedures. This change detection can be useful in forest deformation, crop monitoring, urban area development, etc.

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