



Interactive Segmentation for Change Detection Using Fuzzy-Clustering Method in Multispectral Remote Sensing Images

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ABSTRACT:

Image change detection is a technique that analyzes images of the same scene taken at different times in order to identify changes that have occurred between the considered acquisition dates. With the development of remote sensing, change detection in remote sensing images becomes more and more important. Among them, change detection in synthetic aperture radar (SAR) images exhibits some more difficulties than optical ones due to the fact that SAR images suffer from the presence of the speckle noise, so that's why we proposed an unsupervised distribution free change detection approach for synthetic aperture radar (SAR) images based on an image fusion strategy and a novel fuzzy clustering algorithm. The image fusion technique is introduced to generate a difference image by using complementary information from a mean-ratio image and a log ratio image. In order to restrain the background information and enhance the information of changed regions in the fused difference image, wavelet fusion rules based on an average operator and minimum local area energy are chosen to fuse the wavelet coefficients for a low-frequency band and a high frequency band, respectively.

Keywords: SAR, Image Fusion, Fuzzy Clustering, Multispectral Remote Sensing

1. Introduction:

The term digital image refers to processing of a two dimensional picture by a digital computer. In a broader context, it implies digital processing of any two dimensional data. A digital image is an array of real or complex numbers represented by a finite number of bits. An image given in the form of a transparency, slide, Photograph or an X-ray is first digitized and stored as a matrix of binary digits in computer memory. This digitized image can then be processed and/or displayed on a high resolution television monitor. For display, the image is stored in a rapid-access buffer memory, which refreshes the monitor at a rate of 25 frames per second to produce a visually continuous display A digitizer converts an image into a numerical representation suitable for input into a digital computer. Some common digitizers are Microdensitometer, Flying spot scanner, Image dissector, Videocon camera, photosensitive solid- state arrays. An image processor does the functions of image acquisition, storage, preprocessing, segmentation, representation, recognition and interpretation and finally



displays or records the resulting image. The following block diagram gives the fundamental sequence involved in an image processing system. Mathematical processing of the digitized image such as convolution, averaging, addition, subtraction, etc. are done by the computer. The secondary storage devices normally used are floppy disks, CD ROMs etc. The hard copy device is used to produce a permanent copy of the image and for the storage of the software involved. The operator console consists of equipment and arrangements for verification of intermediate results and for alterations in the software as and when require. The operator is also capable of checking for any resulting errors and for the entry of requisite data.

2.Change Detection in Synthetic Aperture Radar Images Based on Image Fusion and Fuzzy Clustering :

In this project first we perform mean ratio and log ratio on two original images and performing DWT based fusion image using fusion rules and apply RFLCM and FLICM techniques on DWT based fusion image and finally compare the results of PCC and kappa values of both techniques. Image change detection is a process that analyzes images of the same scene taken at different times in order to identify changes that may have occurred between the considered acquisition dates. In the last decades, it has attracted widespread interest due to a large number of applications in diverse disciplines such as remote sensing, medical diagnosis and video surveillance. With the development of remote sensing technology, change detection in remote sensing images becomes more and more important. Among them, change detection in synthetic aperture radar (SAR) images exhibits some more difficulties than optical ones due to the fact that SAR images suffer from the presence of the speckle noise. However, SAR sensors are independent of atmospheric and sunlight conditions, which make the change detection in SAR images still attractive.

2.1.Change Detection Techniques :

Data clustering is the process of dividing data elements into classes or clusters so that items in the same class are as similar as possible, and items in different classes are as dissimilar as possible. Depending on the nature of the data and the purpose for which clustering is being used, different measures of similarity may be used to place items into classes, where the similarity measure controls how the clusters are formed. Some examples of measures that can be used as in clustering include distance, connectivity, and intensity. In hard clustering, data is divided into distinct clusters, where each data element belongs to exactly one cluster. In fuzzy clustering (also referred to as soft clustering), data elements can belong to more than one cluster, and associated with each element is a set of membership levels. These indicate the strength of the association between that data element and a particular cluster. Fuzzy clustering is a process of assigning these membership levels, and then using them to assign data elements to one or more clusters.

2.2. Fuzzy C means Clustering (FCM) :

Fuzzy c-means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. This algorithm works by assigning membership to each data point corresponding to each cluster center on the basis of distance between the cluster center and the data point. More the data is near to the cluster center more is its membership towards the particular cluster center. Clearly, summation of membership of each data point should be equal to one.

Fuzzy c-means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. This method (developed by Dunn in 1973 and improved by Bezdek in 1981) is frequently used in pattern recognition. It is based on minimization of the following objective function:

$$J_m = \sum_{i=1}^N \sum_{j=1}^C u_{ij}^m \|x_i - c_j\|^2, \quad 1 \leq m < \infty$$

where m is any real number greater than 1, u_{ij} is the degree of membership of x_i in the cluster j , x_i is the i th of d -dimensional measured data, c_j is the d -dimension center of the cluster, and $\|*\|$ is any norm expressing the similarity between any measured data and the center. Fuzzy partitioning is carried out through an iterative optimization of the objective function shown above, with the update of membership u_{ij} and the cluster centers c_j by:

$$u_{ij} = \frac{1}{\sum_{k=1}^C \left(\frac{\|x_i - c_j\|}{\|x_i - c_k\|} \right)^{\frac{2}{m-1}}}, \quad c_j = \frac{\sum_{i=1}^N u_{ij}^m \cdot x_i}{\sum_{i=1}^N u_{ij}^m}$$

This iteration will stop when $\max_{ij} \left\{ \left| u_{ij}^{(k+1)} - u_{ij}^{(k)} \right| \right\} < \epsilon$, where ϵ is a termination criterion between 0 and 1, whereas k are the iteration steps. This procedure converges to a local minimum or a saddle point of J_m .

Advantages:

- 1) Gives best result for overlapped data set and comparatively better than k-means algorithm.
- 2) Unlike k-means where data point must exclusively belong to one cluster center here data point is assigned membership to each cluster center as a result of which data point may belong to more than one cluster center.

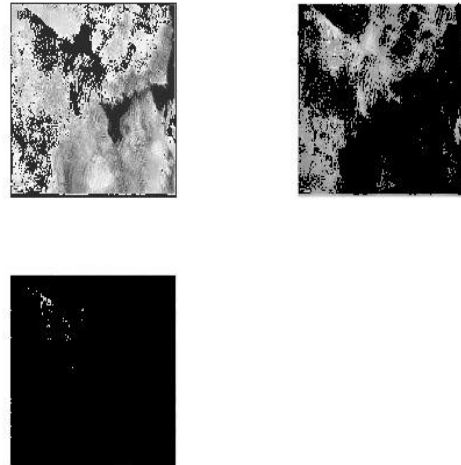
Disadvantages:

- 1) A priori specification of the number of clusters.

2) With lower value of β we get the better result but at the expense of more number of iteration.

3) Euclidean distance measures can unequally weight underlying factors.

3.Experimental Results



Application

- i. Remote Sensing
- ii. Medical Diagnosis
- iii. Video Surveillance, etc.

4. Conclusions:

In this project, we have presented a novel SAR-image change detection approach based on image fusion and an improved fuzzy clustering algorithm, which is quite different from the existing methods. First, for the wavelet fusion approach that we proposed, the key idea is to restrain the background (unchanged areas) information and to enhance the information of changed regions in the greatest extent. Here, the RFLICM algorithm that incorporates both local spatial and gray information is proposed, which

is relatively insensitive to probability statistics model. The RFLICM algorithm introduces the reformulated factor as a local similarity measure to make a tradeoff between image detail and noise. Compared with the original algorithms, RFLICM is able to incorporate the local information more exactly. The experiment results show that the proposed wavelet fusion strategy can integrate the advantages of the log-ratio operator and the mean-ratio operator and gain a better performance. The change detection results obtained by the RFLICM exhibited less spots than its preexistence (i.e., FLICM) since it is able to incorporate the local information more exactly.

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