AN EXPERIMENT OF HIGH RESOLUTION SAR IMAGE IN DYNAMIC MONITORING THE CHANGE OF CONSTRUCTION LAND

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ABSTRACT:

This paper adopts high resolution SAR images and optical multispectral images of two dates to detect land use changes. Firstly, different speckle filtering methods are applied on SAR images, and different speckle noise suppression effects are analyzed and compared. It is indicated that the GAMMA speckle filtering method can get the best result. Secondly, in order to automatically detect new-added construction land change information, some methods such as data fusion technology and false color composite based on Principal Component Analysis (PCA) are put forward. Finally, change information is extracted.

1. INTRODUCTION

It's the key technology of land resource and ecology environment dynamic monitoring to acquire land use and land cover change space time distribution information speedily and correctly through advanced remote sensing image processing technology based on different times images[1]. Recently, the key objective of land use dynamic monitoring project is to monitor the new-added construction land. Its aim is to acquire the concrete position, boundary and attribution of new-added construction land within monitoring area timely and efficiently, and then provide beneficial technical support and guarantee. Synthetic Aperture Radar (SAR) is independent of solar with the characteristic of all weather, all time and penetrating cloud and fog. Due to the geometry shape of building on SAR images, its signal is more outstanding like the effects of corner reflector[2]. Then it benefits the recognition of construction land. And it makes SAR images be the more valuable data source of dynamic monitoring during the special time[3].

The application experiment on dynamic monitoring through SAR images is already carried out in several years, but the data source is mainly based on spaceborne SAR data. And it is rarely reported on high resolution airborne SAR data. This paper introduces the experiment data sources based on airborne SAR data in 2002 and 2004 and SPOT5 multispectral image in 2002. And then new added construction land change information is extracted through the combination between automatically and artificial interpretation. The resolution of SAR data is about 2m, and the band is Ku, and the resolution of multispectral image is 10m.

2. PROPRECESSING

2.1 Data correction

The test area locates in the conjunction between city and village. It is even, and the topography fluctuation is small. So the polynomial correction methods are put forward on SAR data. The topography map is the reference base map as selecting control points, and the mean square error is no more than 1 pixel. The result meets the correction accuracy requirement.

Then regarding the corrected SAR image as the reference data, other image matches it correctly. Image registration is the base of change information extraction. And if the error is too large, it will bring more false change information, and reduce the accuracy ratio of change monitoring.

2.2 Speckle filtering

Objects accept the coherence electronic waves emitted by radar, and it includes many pulse scatter points, then electromagnetic waves reflected are the coherence overlay of each scatter waves, so it produces many speckle noises in the SAR images. The existence of speckle noises reduces SAR image correction and interpretation precision[4]. Therefore, in the practical application, speckle filtering is the fundamental work of edge detection, object classification, and target detection and recognition etc.[5]. Recently, the research on speckle filtering is the hot topic of microwave remote sensing. The aim of speckle filtering is to reduce speckle noises and keep the texture detail information. At the stage of speckle noises, there are different methods according to different application purpose. The common speckle filtering mainly includes: Gamma-MAP, Lee filtering, SIGMA filtering, mean filtering, Frost filtering.

In the test, different filtering methods are carried out. Through the contrast and analysis of filtering results on the speckle reduction and detail preserve, the Gamma-MAP is finally selected. Gamma-MAP filtering is built on noise model. The following figure 1 is the contrast images between the original image and filtering image. a is the original image, and b is the filtering image through 3×3 window Gamma-MAP.

3. CONSTRUCTION LAND RECOGNITION ON SAR IMAGE

In the SAR images, construction land reflection energy is high, so it's brighter than surrounding other objects. Otherwise, due to residential building's orderly generally arrangement, it

possesses higher texture and special direction, then it benefits the recognition of this kind of land type.

Figure 1 Contrast images through Gamma filter

4. CHANGE INFORMATION DETECTION

Automatic recognition and change information extraction are the hot topic on the research of remote sensing. In the related literature, there are many kinds of research methods such as image interpolation, ratio method, PCA, spectrum feature variance, K-T etc.[6]. Different monitoring contents possess different methods. For example, according to urban extended area, fusion technology, difference value method, false color composite etc. are adopted[7]. The key contents of land use dynamic monitoring is to find the boundary, contour and attribution of land use types change in the new and old times. The methods on change information recognition depart into computer automatically recognition and artificial interpretation on the processing pattern. As the domain of research, it's independent between automatically recognition and artificial interpretation. But in practice, the relation between them is very close. Automatically recognition method could improve the efficient of searching change polygon, and artificial interpretation method could guarantee the accuracy of searching change and improve the accuracy ratio.

4.1 Change Information Detection Based on Fusion Technology

Change information detection based on fusion technology is to find spectral feature variance through merged image in different times. Change area on spectral feature of merged image could detect change. In the test, firstly, SAR data and multispectral image are merged into new fusion image. And then inconsistent area of spectral feature is searched in the fusion image. Finally, whether change or not is confirmed through comparing images of two dates. In figure 2, a is the multispectral image in 2002, b is the SAR data in 2004, and c is the fusion image in which bright green color denotes that image spectrum changed, namely new-added construction.

Figure 2 construction land change detection image based on fusion technology

4.2 False Color Composite Based on PCA

False color composite is to put the same band from different (2 or 3) times into red, green and blue image processing panel separately. And the composite image could denote high bright change information. In the test, PCA and false color composite are integrated into use. Firstly, multispectral image carries on PCA,. the first principal component extracted and SAR image are composited. SAR image is put into red band.Images through PCA are put into green and blue band separately. At last, it produced a new color image.

In figure 3, a is the multispectral image in 2002, b is the SAR data in 2004, and c is the composite image in which red color area is construction change information.
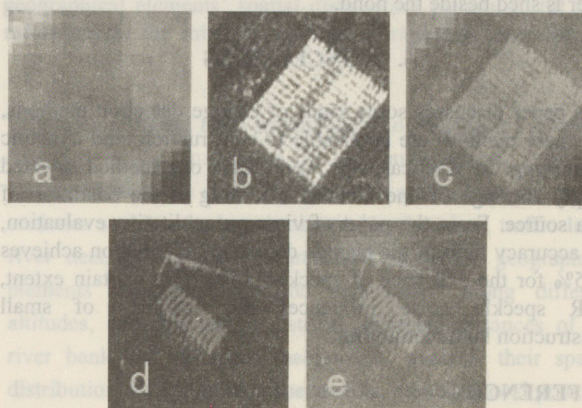
Figure 3 construction land change detection image based on PCA and false color composite

4.3 Difference value method

Difference value operation is applied in the two registrated images in different times. So the new difference value image denotes the spectral change between two images. Difference value image focuses on mostly change information and removes the same parts[8].

In the practical application, change detection method is selected according to the type of data source. The different change information stands out according to the characteristic of each method; moreover special change may be unfit for this kind of arithmetic. So if only one method is selected as the detection basis, it maybe results in omitting the change information. In order to reduce the omitting of change information, more than two kinds of methods selected may be better. And it's supplement each other to composite different change detection methods. Fig d and e in fig 3 is the different change results with different change detection methods. Fig d denotes the consistency between the tone of new-added residential area and the tone of surrounding residential area, but if only this change detection map would omit this type of change polygon. However, fig e denotes the change of the polygon. So two kinds of methods are integrated into use, and then reduce the omitting.

5. CHANGE INFORMATION EXTRACTION ANALYSIS

Whether of change information detection methods is selected, and the purpose is to extract change information. It comprises

drawing the outline of the boundary of change polygon, and judging the attribute of change information. The above detection results is to supply reference templates to extract change polygon, and the operation platform is GIS software, and through artificial analysis and intervene, the boundary of change polygon is extracted. Altogether 54 change polygons are extracted within this experiment area: 15 change polygons less than 1 mu, 10 change polygons between 1 and 3 mu, 20 change polygons between 3 and 10 mu, and 9 change polygons more than 10 mu. In order to evaluate this result, SPOT5 2.5m fusion image is provided to compare and analyze. On the view, 4 change polygons aren't the new-added construction land: 1 block is pond, while data acceptance, there's no water in it. So the reflectance of the pond bottom is similar with that of construction; 2 blocks of false change is speckle noise, and the other is shed beside the pond.

6. CONCLUSIONS

This paper discusses some kinds of change detection methods, and these methods are applicable to construction land dynamic monitoring. In practical work, more than one method selected supply shortage of one method according to the condition of data source. From the point of view on qualitative evaluation, the accuracy ratio of the change detection information achieves 92.5% for the existence of speckle noise. To a certain extent, SAR speckle noise influences the accuracy of small construction land monitoring.

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Figure 1 Contrast images through Gamma filter

4. CHANGE INFORMATION DETECTION

Automatic recognition and change information extraction are the hot topics in the research of remote sensing. In the related literature, there are many kinds of research's methods, such as mean intensity ratio method, PCA component, features detection method, etc. Different monitoring purposes possess different methods. For example, according to urban extended area, fusion technology, difference value method, false color composite etc. are adopted. The key contents of land use dynamic monitoring is to find the boundary contour and attribution of land use types change in the new and old times. The methods on change information recognition depart into computer automatically recognition and artificial interpretation on the processing pattern. And in the domain of research, it is independent between automatically recognition and artificial interpretation. But in practice, the relation between them is very close. Automatically recognition method could improve the efficient of searching change polygon, and artificial interpretation method could guarantee the accuracy of searching change and improve the accuracy ratio.

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Change information detection based on fusion technology is to find spectral radiant variance through merged image in different times. Change area on spectral feature of merged image could detect obvious. In the first, EnVisat SAR data and multispectral image are merged into new fusion image. And then more obvious area of spectral difference is acquired in the fusion image. Finally, whether change or not is confirmed through interpreting images of two times. In Figure 2, a-c is the multispectral image in 2005, d is the SAR data in 2004, and e is the fusion image; in which bright areas, color denotes that image represents changed, namely new-added construction. After filtering, mean filtering is adopted.
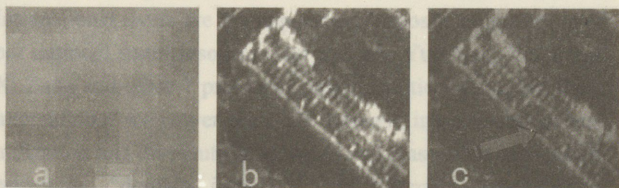
Figure 2 construction land change detection image based on fusion technology

5. CONSTRUCTION LAND RECOGNITION ON IMAGE

SAR's signal amplitude had volumetric respect SAR set of sub surrounding other objects. Otherwise, the reflectance building's orderly generally arrangement is...