FUNSION METHOD OF MULTI-SOURCE REMOTELY SENSED IMAGES FOR AVOIDING REGIONAL DIFFERENCES

Xiaodong Hu, Zhanfeng Shen, Jiancheng Luo

(Institute of Remote Sensing Applications, Chinese Academy of Sciences, Beijing, 100101, PRC,
E-mail Address: mydonne@gmail.com)

1. INTRODUCTION

For a series of multi-source remotely sensed images of the same area, the sensors' types and the shooting time will be different. Therefore, there will be varying kinds of distortion or noise in the images, especially the features information will be different, resulting incompletely matching in the process of fusion[1]. Most of the existing methods of fusion are unable to achieve a balance between the spatial and spectral resolution. However, Li[2] and Ehlers[3] have done relatively well, but they did not solve the issue of fusing the regional differences of spatial information between multi-spectral(MS) and panchromatic(Pan) images. Thus, there will be inconsistence in spatial information, serious distortion in color and blur in regional features.

The Fusion Method of Adding Different Coefficients on Multi-source Images(FMADCMI) was proposed in this paper. The experiment and analysis proves the method's ability of preserving spectral characteristics, improving spatial resolution and solving the issue of fusing the regional differences of spatial information.

2. FUSION METHOD FOR AVOIDING REGIONAL DIFFERENCES

We borrow ideas from "Ehlers Fusion"[3] to balance the spectral and spatial resolution of the fused image, and study on a number of principles of regional analysis considering the fact of regional differences of spatial information. Based on these, we design the work flow of FMADCMI as Figure 1.

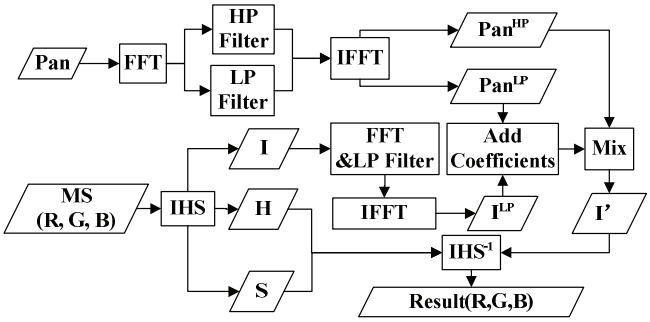


Fig.1 The Work Flow of FMADCMI

$$AvgAB(x,y)=\frac{\sum_{i=x-5}^{x+5}\sum_{j=y-5}^{y+5}\left|A(i,j)-B(i,j)\right|}{11\times 11} \tag{1}$$

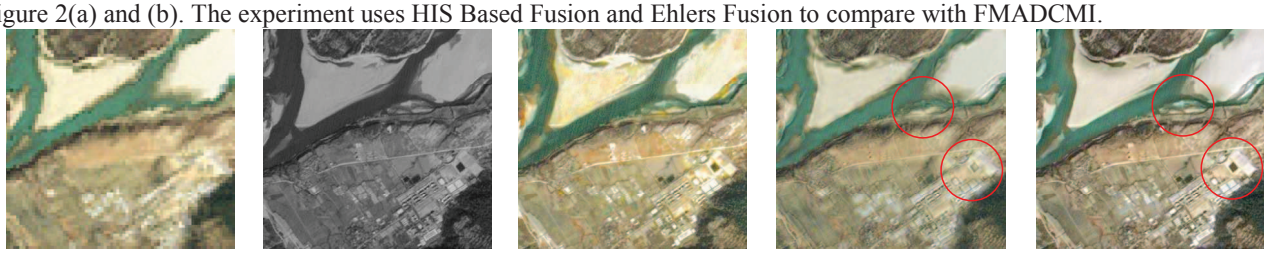
$$I'(x,y)=\alpha\times(a\times I^{LP}(x,y)+b\times Pan^{LP}(x,y))+\beta \tag{2}$$

According to Figure 1, the difference between Pan's low passed image(Pan^{LP}) and I's low passed image(I^{LP}) based on FFT is calculated by Formula (1). Then different coefficients are added on Pan^{LP} and I^{LP} respectively as Formula (2). To explain the coefficients shortly, we call "α" reliability value which denotes the reliabilities of the result; "β" is a global compensation for

the bright value; “a” and “b” are the coefficients added on the two images which are determined by the value calculated in Formula (1). Because the result retains Pan^{HP}, it’s more effective when “b” lager than “a”.

3. EXPERIMENT OF THE FUSION METHOD

Here, a 28.5m resolution of ETM+ image and a 5m resolution of IRS image of the same area are selected for experiment. Band1, band2 and band3 of ETM+ for MS image, which was obtained in 2001, and the IRS Pan image’s time is 2005, seeing Figure 2(a) and (b). The experiment uses HIS Based Fusion and Ehlers Fusion to compare with FMADCMI.



(a)MS image (b)Pan image (c)IHS Fusion (d)Ehlers Fusion (e)FMADCMI

Fig.2 Comparison of Three Kinds of Fusion Methods

According to Figure 2, the result of IHS Fusion has caused serious distortion, and Ehlers Fusion’s result seems has blur in some regional areas. Relatively, FMADCMI’s result has fused regional difference successfully.

Table 1 Coefficient comparison of three kinds of fusion method

		MS images	Fused Results		
			IHS	Ehlers	FMADCMI
Standard Deviation	R	43.544	48.650	47.399	47.686
	G	44.897	47.583	47.816	47.947
	B	37.738	34.622	39.962	39.556
Entropy	R	4.236	4.976	4.942	4.923
	G	4.120	4.919	4.843	4.855
	B	4.042	4.870	4.679	4.803
Relative Coefficient (To MS)	R	1.000	0.8853	0.9378	0.9133
	G	1.000	0.8148	0.9174	0.9065
	B	1.000	0.7912	0.8898	0.8485

In order to analyze them in quantity, we calculated the Standard Deviation(STD), Entropy(EN) and Relative Coefficient(RC) values as shown in Table 1. STD and EN indicate that FMADCMI’s effect on spatial resolution is similar to the other two, while Ehlers and FMADCMI perform definitely better than HIS in the performance of RC. As a conclusion, the effect of FMADCMI and Ehlers are similar, but the former avoided the problem of regional difference.

4. CONCLUSIONS

This paper presents a new idea of fusing two images, which can not only balance the spectral and spatial resolution, but also can avoid the contradiction of regional difference between two images. This idea can also be used in the fusion of other kinds of images with the similar effect.

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