MULTIRESOLUTION FUSION OF PAN AND MS IMAGES BASED ON THE CURVELET TRANSFORM

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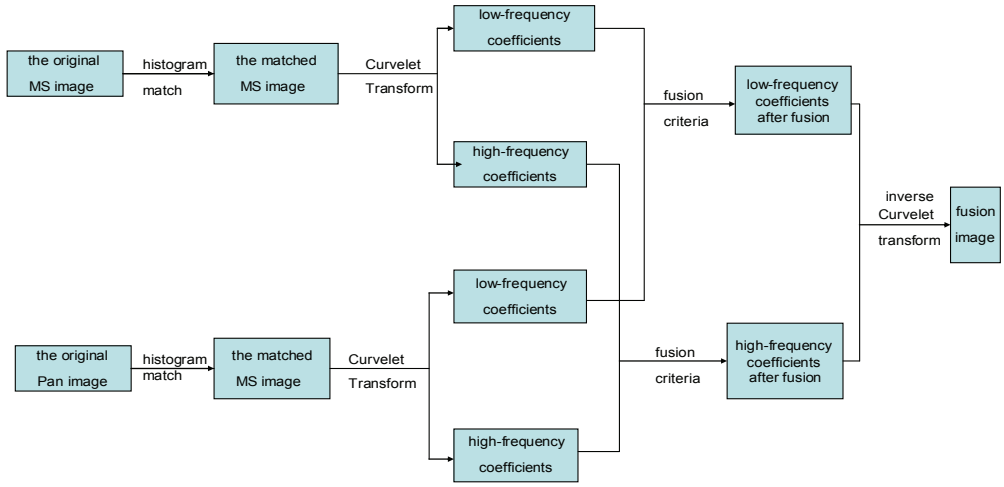
Image fusion can enhance remote sensing image data information so that the image is well used in feature extraction, classification and target identification and so on. Therefore, the fusion technology of remote sensing images is more and more focused on.

How to fuse the multispectral (MS) satellite images with a high spectral but low spatial resolution and the panchromatic (Pan) satellite image with a high spatial but low spectral resolution making the fused multispectral satellite images with a high spectral as well as a high spatial resolution is recently thought to be especially important in remote sensing image study. Image fusion only based on the wavelet transform is not ideal for describing the signals with high dimensional singularities.

This paper proposed a new image fusion method using the Curvelet transform, which represents the contour of image better and is anisotropy. The algorithm procedure of remote sensing image fusion based on the Curvelet transform is as follows.



the image fusion procedure based on the Curvelet transform

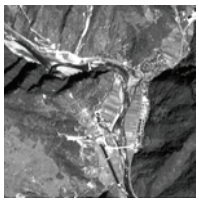
First of all, perform histogram match of panchromatic image and multispectral images;

Secondly, take the Curvelet transform of multi-spectral images and the matched panchromatic image;

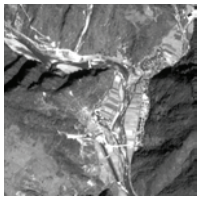
Thirdly, use different fusion criteria for coefficients of the Curvelet transform, such as weighted average for low-frequency coefficients and region energy for high-frequency coefficients, and then obtain the fusion image Curvelet coefficients;

Finally, make the received image Curvelet coefficients in the inverse Curvelet transform, and thus obtain fusion images.

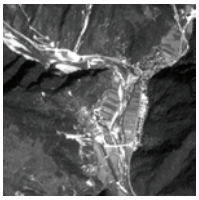
Image fusion based on the Curvelet transform has been used to fuse both IKONOS Pan and MS images of Wenchuan in Sichuan province after the 5.12 earthquake and a group of resource satellite images. The fusion result is given in Fig1 and Fig 2. From (c)、(d) and (e),it is improved that the fusion based on the Curvelet transform is better in both the spatial and the spectral domains than the conventional approach, such as the Intensity-Hue-Saturation and the discrete Wavelet transform.



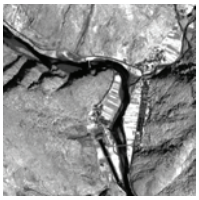
(a)



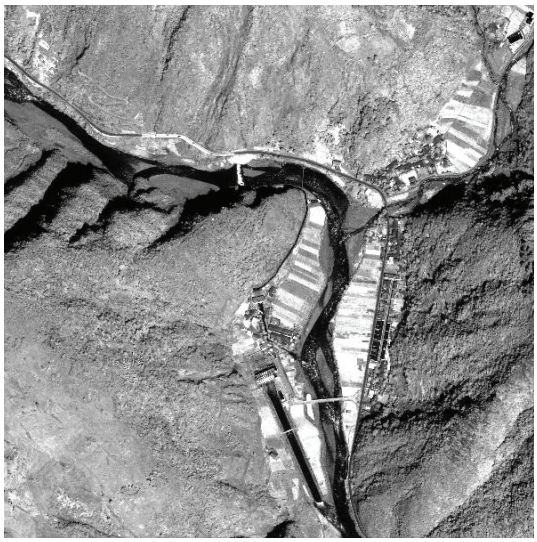
(b)



(c)



(d)

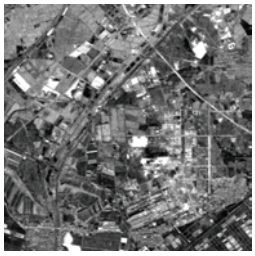


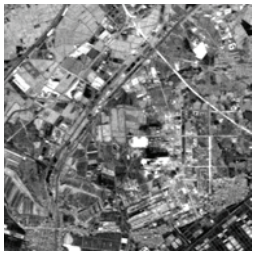
(e)

(f)

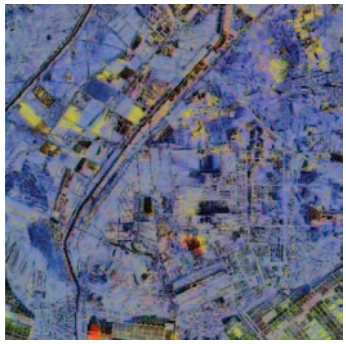
(g) (h)

Fig1. (a) R-band of the original IKONOS MS image. (b) G-band of the original IKONOS MS image. (c) B-band of the original IKONOS MS image. (d) Nir-band of the original IKONOS MS image. (e) The original IKONOS Pan image. (f) The fusion based on the IHS transform. (g) The fusion image based on the discrete Wavelet transform. (h) The fusion image based on the Curvelet transform.

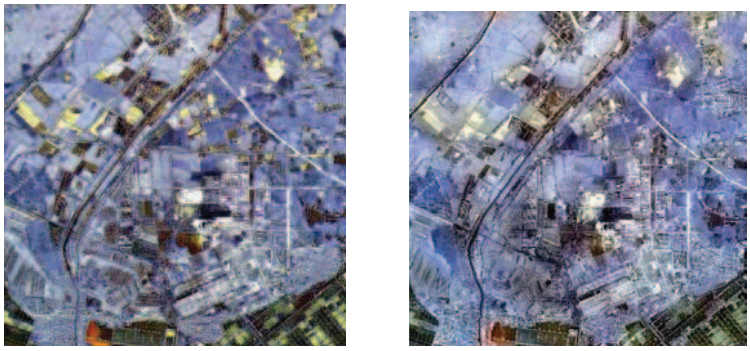




(a) (b) (c) (d)



(e) (f)



(g) (h)

Fig2. (a) R-band of the original resource satellite MS image. (b) G-band of the original resource satellite MS image. (c) B-band of the original resource satellite MS image. (d) Nir-band of the original resource satellite MS image. (e) The original resource satellite Pan Image. (f) The fusion based on the IHS transforms. (g) The fusion image based on the discrete Wavelet transform. (h) The fusion image based on the Curvelet transforms.

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