

A new method for image fusion based on multi-resolution wavelet decomposition

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On the basis that the PCA transformation and additive wavelet transformation have their own advantages and disadvantages —higher spatial resolution can be acquired from the PCA transformation; however, more serious distortion of spectral characteristics can happen as well. While, the à trous wavelet transformation is able to preserve spatial information; however, the result is lack of high spatial resolution. A new technique, based on additive wavelet decomposition and PCA transformation was developed for the merging and data fusion of such images in this paper. The new method is capable of preserving its spectral content while enhancing the spatial quality of the multispectral image to a greater extent.

This approach can be done in the following way. Firstly a fusion image A was obtained by using the PCA transformation to merge the multiresolution image and high-resolution panchromatic image. Then authors got the new principle components from the new multispectral image A, with most image information contained in the first component of the fusion image. Finally, the à trous wavelet transformation was applied to merge the multispectral image A with the first component generated from the PCA transformation to substitute the original high-spatial resolution panchromatic band. In general, a good fusion approach should retain the maximum spatial and spectral information from the original images and should not damage the internal relationship among the original bands. First the fused images were evaluated visually. In this paper, compare with the fused result just only by the astrous wavlet or the PCA, the fused result by the PCA+astrous wavelet transform has a better visual effect in Quickbird image fusion

Then secondly, authors evaluate the performance of the fusion method based on PCA+astrous wavelet transform using image quality indexes. Based on these criteria, the indexes authors selected are average value, standard difference, entropy, average grads, fractal dimensions and correlation coefficients.

Based on the experimental results obtained from this study, the PCA+astrous-based image fusion method is very efficient for fusing Quickbird images. This new method has reached an optimum fusion result.

In this paper, an experimental study was conducted by applying the proposed method, and also other image fusion methods, for fusing Quickbird images. A comparison of the fused image from the astrous wavelet and PCA method was made. It is shown that proposed wavelet transform approach improves the spatial resolution of a multispectral image while it also preserves much portion of the spectral component of the image.

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