An Experiment to Color EROS Panchromatic Image

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KEY WORDS: Color Transformation, Unsupervised Classification, Image Fusion

ABSTRACT: Traditionally, the color transformation method such as IHS transformation is usually used as a fusion technique to color higher spatial resolution panchromatic image from lower spatial resolution multi-spectral image. However, the analysis indicates that the success of this image fusion technique depends heavily on a small proportion of spatial resolution between multi-spectral and panchromatic images. For example, a relatively high proportion of spatial resolution will over-resample the image, and consequently smooth down the color variation and feature sharpness of the resultant image. In this study, we develop a segmentation technique to color high spatial resolution panchromatic image. The experiment shows that the proposed approach is able to color EROS panchromatic image (2m resolution) from SPOT multi-spectral composite image (10m resolution) with color and sharpness preserved in the final product.

1. INTRODUCTION

ImageSat EROS A1, built by Israel Aircraft Industry MBT Division, was successfully launched on December 5, 2000. This satellite supports panchromatic image acquisition in either 1.8-meter standard or 1-meter over-sampled mode. The high spatial resolution images likes EROS A1 definitely will provide lots of information for detail-thirsty remote sensing users. It appears that the remote sensing community will continually put a lot of effort into the development of automated extraction and recognition techniques for high spatial resolution images. However, there is still of basic needs for many users to obtain visual information through the manual image interpretation. From a practical point of view, if the panchromatic mode of the high spatial resolution images can be enhanced with color, it will generate value-added effect for manual interpretation and image visualization. The main aim of this study is to propose a new approach to color EROS panchromatic image. In the past, the color transformation method such as IHS transformation is commonly used to color higher spatial resolution panchromatic image from lower spatial resolution multi-spectral image (Chavez and Bowell 1988, Carper *et al*. 1990). One key point to make a success of this transformation is that the spatial resolution gap between multi-spectral and panchromatic images has to be relatively undersized, because the oversized gap will over-resample the lower spatial resolution images, and consequently smooth the color variation and degrade the feature sharpness. Since this study attempts to color EROS panchromatic image using SPOT multi-spectral composite image, if the traditional color transformation is adopted, the considerably different spatial resolution between both images obviously will fail to generate the appropriate EROS color image. In this study, we develop a segmentation technique to produce a region-preserved image to avoid over-resampling the lower spatial resolution image. By doing so, the color transformations will be able to color EROS image with a reasonable visual effect.

2. METHODOLOGY

The flow chart of the proposed method can be found in Figure 1. First of all, we use ISODATA to classify high-resolution panchromatic image into pieces of patches according to its gray level variations. Secondly, an image clumping technique is used to label every patch. Then, each labeled patch is colored by averaging the pixel values of its corresponding region covered by resampled low-resolution multi-spectral image. By doing so, it will generate an additional region-preserved multi-spectral image. After that, the traditional LAB color transformation method (Wyszecki, 1982) is used to perform image fusion for high-resolution panchromatic image and the additional region-preserved multi-spectral image. As a result, it will add color to the high-resolution panchromatic image.

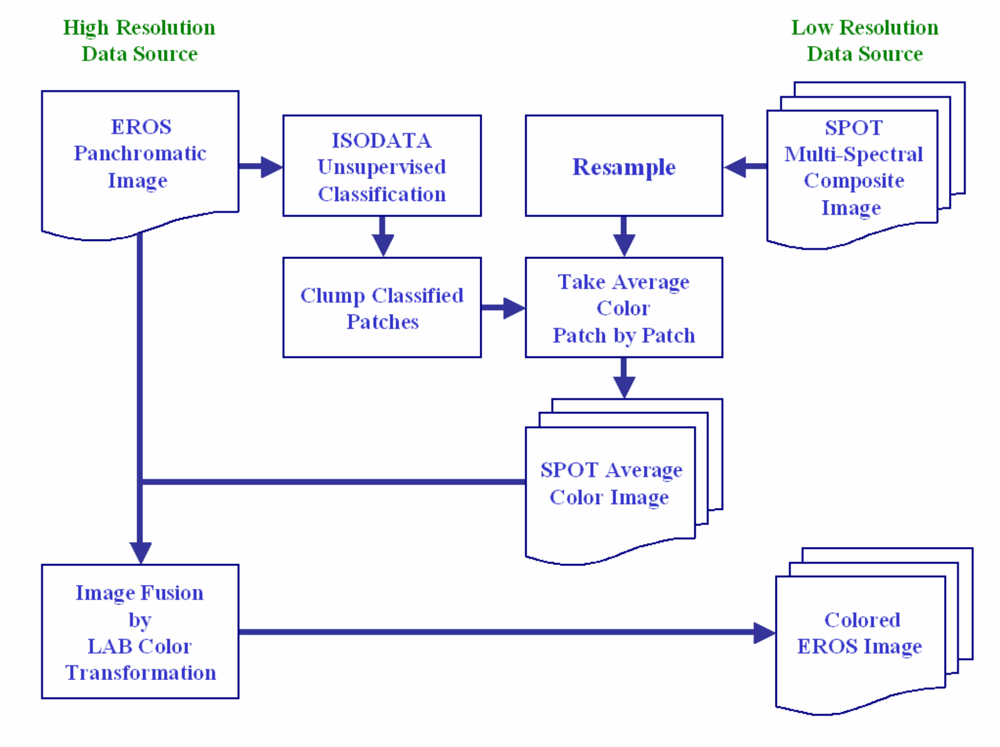

Figure 1: The flow chart to color high-resolution panchromatic image.

3. EXPERIMENT RESULT

The experiment contains two parts. In the first part, we apply the proposed scheme to a series of simulated images to describe the functionality of proposed procedure. The second part includes the test for the real satellite images of EROS and SPOT to demonstrate the practicability of the scheme.

Figure 2 shows the simulated images (image (a) to image (d)) and the results from the traditional image fusion technique (image (e)) and proposed scheme (image (f)). From images (e) and (f), it is obviously that color variation and feature sharpness in image (f) is more preserved than (e).

The second part of experiment is illustrated in Figure 3. The similar results to the previous experiment can be found for satellite images. The careful observation indicates that the image generated by the proposed method (image (e)) indeed produces much sharper image than the traditional method (image (d)). It is also worth noting that the image (d) basically remains all color and features of SPOT image, however, in this test, some land features have changed due to different acquisition time of EROS and SPOT. Therefore, it is not surprised to find out some disagreement between color and feature in EROS image. The proposed method basically produces the additional region-preserved multi-spectral image form EROS, the effect of disagreement between color and feature can be reduced as least as possible.

4. CONCLUSION

In this paper, we proposed a scheme to color the high-resolution panchromatic image from the low-resolution multi-spectral image. The proposed method can overcome the problem of blurred appearance in the image normally caused by the traditional image fusion method when the resolution gap between panchromatic and multi-spectral image is relatively large. The experimental result shows that the proposed approach is able to color EROS panchromatic image from SPOT multi-spectral image with color variation and feature sharpness preserved in the final product.

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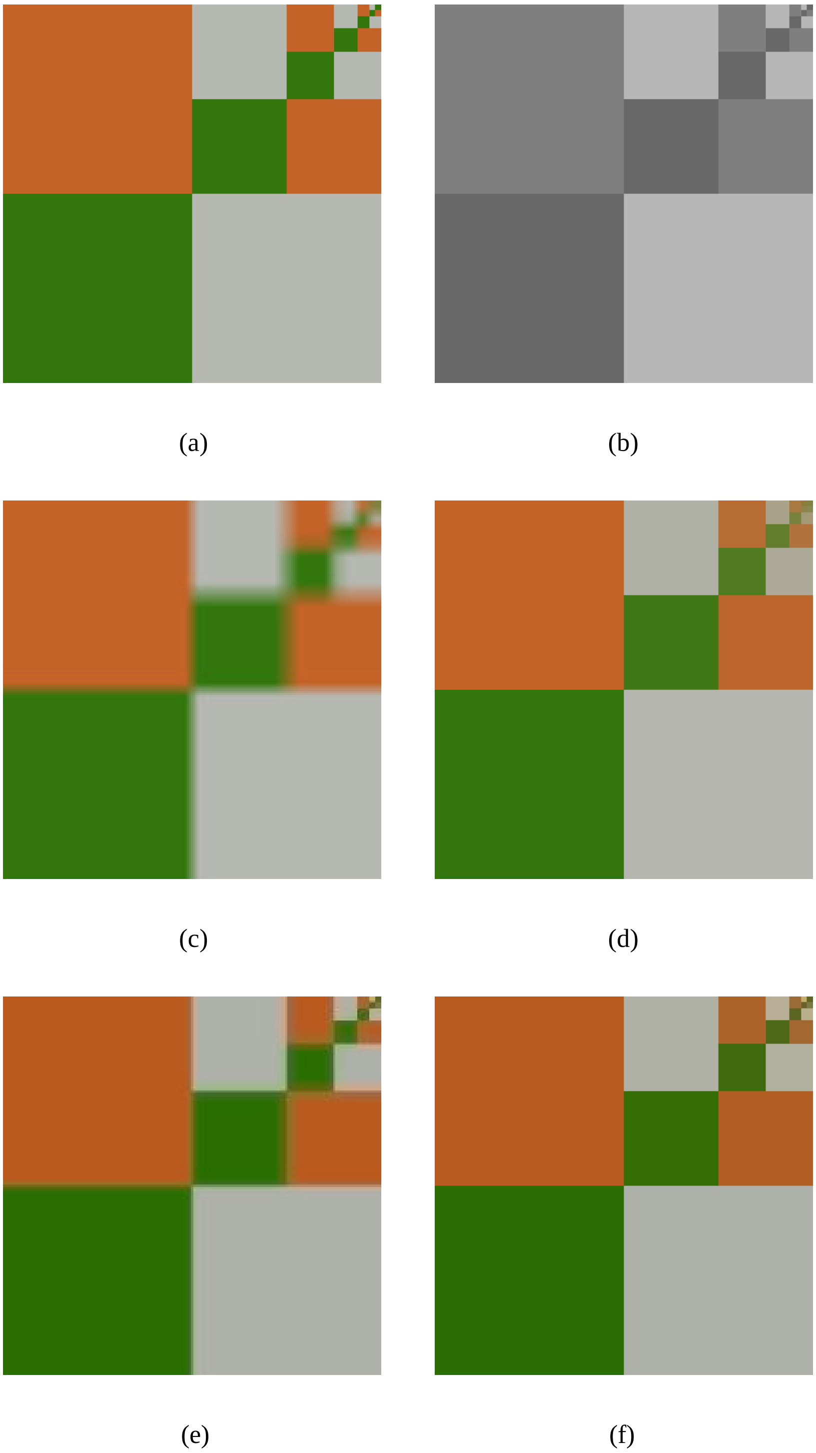

Figure2: The simulation image used in experiment.

(a) Simulated color image. (b) Panchromatic image from averaging all multi-spectral bands of simu lated image. (c) Multi-spectral image generated by reducing image (a) 5 times. (d) Spatially average the color of image (c) according to the clumped patches of classified panchromatic image. (e) The result by using LAB color transformation method to fuse images (b) and (c). (f) The result by using LAB color transformation method to fuse images (b) and (d).

(a)

(b)

(c)

(d)

(e)

Figure 3: The Satellite images used in experiment.

(a) Nature color composition from SPOT images acquired on year 2000 with 10-meter resolution. (b) Original EROS satellite image acquired on year 2001 with 2-meter resolution. (c) Spatially average the color of image (a) according to the clumped patches of classified EROS panchromatic image. (d) The result by using LAB color transformation method to fuse images (a) and (b). (e) The result by using LAB color transformation method to fuse images (b) and (c).