COLOR CORRECTION FOR ORTHOPHOTOS GENERATED FORM MULTI-VIEW IMAGES

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ABSTRACT: Orthoimagery has become a common data set in GIS applications. Many researches were focused on the geometric processing. To increase the application of orthoimages, it needs large coverage mosaicked with multi images. This is also valid for true-orthoimage composed by multi-view images, where hidden areas should be minimized. However, using multi-images produced orthophotoimages, especially for multi-temporal images, the color difference between images becomes an obstacle to cope with. Therefore, color balancing for multiple images is an important issue.This paper focuses on the color balancing for multi aerial images to produce orthoimages and true-orthoimages. The proposed scheme connects color for image patches globally and locally. The image control templates are obtained by back-projection from the object space for global color correction. We then get the color correction parameters with the gray value statistics for each template group. A local color correction is processed around seam lines for enhancing color continuity. Experimental results indicate that the proposed approach may reach quality results in radiometry.

1. INTRODUCTION

Orthoimagery has become a common data set in GIS applications. It is an important data source for urban planning and management. Conventional orthorectification corrects the relief displacements, which are caused by terrain relief (O'Neill and Dowman, 1988; Kim et al., 2001). True-orthorectification treats both terrain relief and the relief caused by man-made structures. True-orthoimages are more applicable than traditional orthophotos in terms of mapping quality. For rectification of true-orthoimage, geometric distortion by ground objects has to be considered as well. The ground object may include building, roads and trees. A possible way is to use simplified models for various objects. The building with the large height difference makes image deformation more serious than other objects (Rau et al., 2002; Albertz and Wolf, 2004; Zhou et al, 2005).

Traditionally, geometric processes may be used for orthoimage rectification and true-orthoimage rectification. Followed by more applications and developments of aerial digital imaging technology, multiple aerial images are used to generate orthoimages. In the process, hidden areas caused by above ground objects should be minized through the compensation of acquired with different angles. Thus, orthoimages generated from multiple aerial images has a problem in color uniformity, because images obtained at different times may have color dissimilarity, which may cause color discontinuity. Hence, the prior arts do not fulfill all users' requests on actual use. To achieve the above purposes, this paper proposed a method of orthoimage color correction using multiple aerial images.

2. THE PROPOSED METHOD

This paper focuses on the color balancing for multi aerial images to produce orthoimages and true-orthoimages. The proposed scheme comprising steps of: (1) processing a global color correction by using multiple aerial images coordinated with digital elevation models (DEM), where a gray value statistic is obtained for each aerial image individually and then orthoimages or true-orthoimages are processed through a global color correction according to the aerial images and the corresponding gray value statistics; and (2) processing a local color correction around seam lines between the orthoimages or true-orthoimages.

2.1 Global Color Correction

Aerial image are processed through a global color correction. A gray value statistic is generated for each aerial image individually and then a plurality of orthoimages or true-orthoimages is processed through a global correction according to the aerial images and the corresponding gray value statistics. Therein, the aerial images contain related parameters of relationships between object space and image spaces.

As shown in the figures 1, ground-point back-projection is employed to obtain conjugate image templates at the same ground position in different aerial images. Then we use the gray value statistics of multiple image templates. Figure 2 as an example, two black dash lines show the gray value statistics of two image templates and a red line shows a reference gray value statistic. A histogram matching is employed to gather statistics of gray values of the image templates for building the gray value statistics. Therein, each gray value statistic is corresponding to a center position of an image template. Gray value statistics are built at a fixed distance, as shown in the figure 3. In this way, the gray values of orthoimages or true-orthoimages are adjusted through interpolation according to the gray value statistics of the aerial images at corresponding positions.

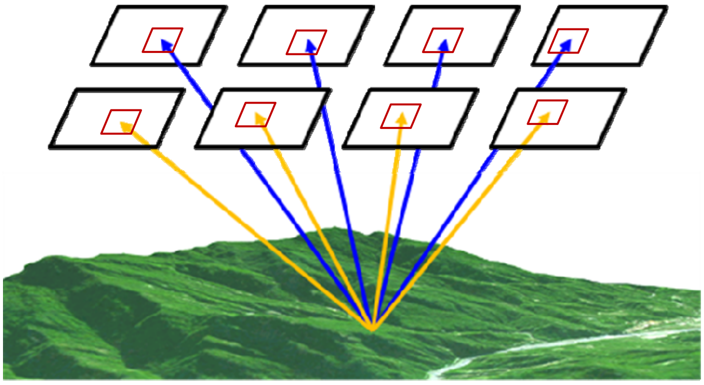


Figure 1. The Image Templates at the Same Position

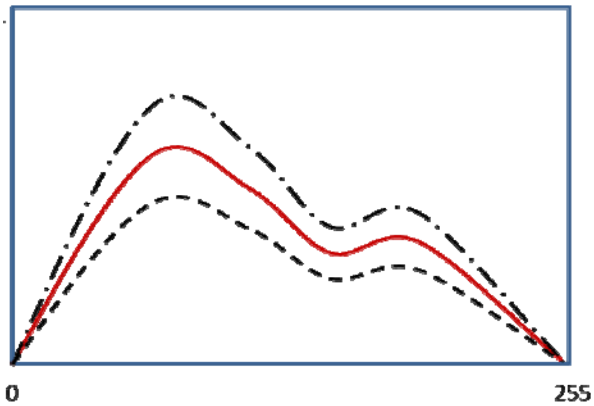


Figure 2. The Gray Value Statistic of a Template Group

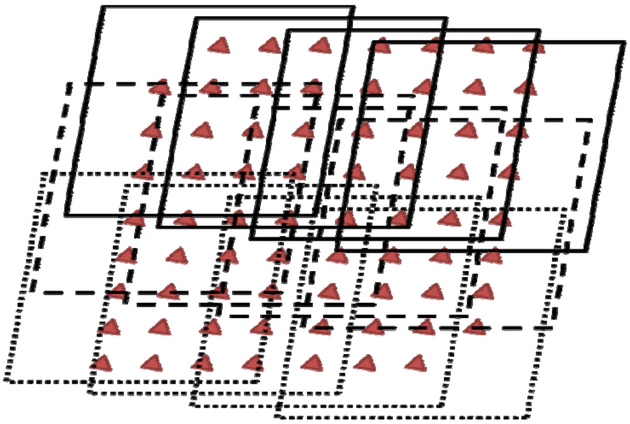


Figure 3. The Gray Value Statistic of Template Groups

2.2 Local Color Correction

A local color correction is processed around seam lines between the orthoimages or true-orthoimages in this stage. We generate a buffer around each seam line in the first step. The image information of the buffers are come from master images and slave images used in mosaicking or compensating through weighted averaging using reciprocals of distances to obtain final gray values. In Figure 4, for instance, a seam line is obviously found between blue and white parts in the beginning. The next step is to generate a buffer around the seam line. The color at the center of the buffer around the seam line is obtained by averaging the colors of the two parts beside the seam line. Then, the color is gradually changed toward two sides of the seam line according to the reciprocal of distance to the center.

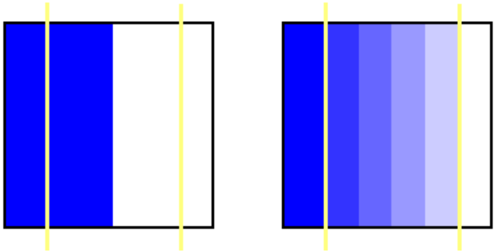


Figure 4. The Local Color Balancing

3. EXPERIMENTAL RESULTS

The test data include aerial images, DEM and a true-orthoimage produced with aerial images, DEM and building models, which are shown in Figure 5. The sensor of the employed aerial images is DMC with 16 cm resolutions, as shown in Figure 6. Total number of aerial images is 36 scenes. Figure 7 and Figure 8 display the DEM and the produced ture-orthoimage. The resolution of DEM and the true-orthoimage are 4 m and 0.1 m, respectively. Figure 9 to Figure 11 illustrate the comparison charts for before and after color correction. The areas with black borders mean the locations of seam lines. It's obvious that this proposed method effectively corrected color distinction between images.

Figure 5. The Buildings Models

Figure 6. The DMC Aerial Images

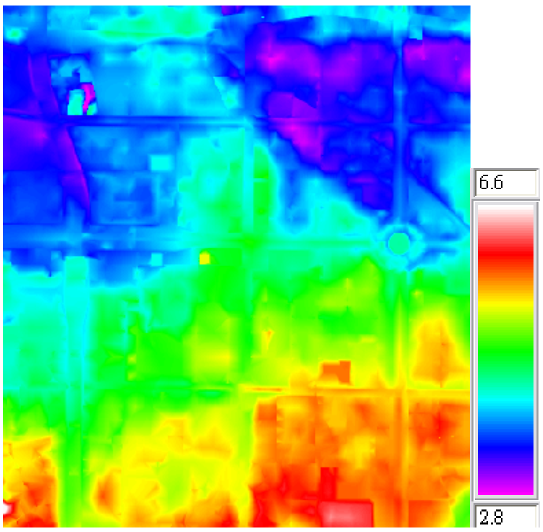
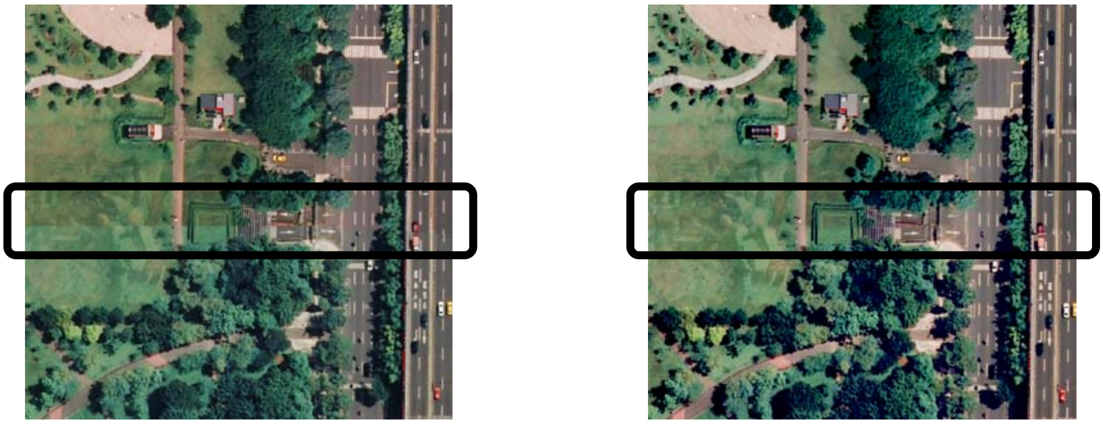


Figure 7. DEM

Figure 8. The Ture-orthoimages



(a) (b)

Figure 9. CASE I
(a) before color correction; (b) after color correction

(a) (b)

Figure 10. CASE II
(a) before color correction; (b) after color correction

(a) (b)

Figure 11. CASE III
(a) before color correction; (b) after color correction

4. CONCLUSIONS

This investigation proposed a method for true-orthoimage color correction. Aerial images and DEM are employed for balancing colors in orthoimages or true-orthoimages. Seam lines between images are also smoothed. Experimental results indicate that color distinction between images was rectified and orthoimage quality was greatly enhanced.

5. ACKONWLEDGMENTS

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