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SHADOW DETECTION AND REMOVAL FROM SATELLITE CAPTURE IMAGES USING SUCCESSIVE THRESHOLDING ALGORITHM

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ABSTRACT

Recently, Tsai presented an efficient algorithm which uses the ratio value of the hue over the intensity to construct the ratio map for detecting shadows of colour aerial images. Instead of only using the global thresholding process in Tsai's algorithm, this paper presents a novel successive thresholding scheme (STS) to detect shadows more accurately. In our proposed STS, the modified ratio map, which is obtained by applying the exponential function to the ratio map proposed by Tsai, is presented to stretch the gap between the ratio values of shadow and non-shadow pixels. By performing the global thresholding process on the modified ratio map, a coarse-shadow map is constructed to classify the input colour aerial image into the candidate shadow pixels and the non-shadow pixels.

Key word: color model, de-shadowing, shadow compensation, shadow dectection, thresholding, shadow segmentation, HSV color model.

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1. INTRODUCTION

In urban aerial images, shadows usually result in information loss or distortion of objects thus; it is an important research issue to detect shadows for urban aerial images. Based on the three features, which are intensity values, geometrical properties, and light directions, several efficient algorithms have been presented to detect shadows for gray aerial images. Since, gray aerial images only provide the intensity information, some nonshadow regions may be identified as shadows even if the aforementioned three features have been considered.

Because the chromaticity information is not affected by the change of illumination for some cases, a shadow region can be detected by selecting the region which is darker than its neighbouring regions but has similar chromaticity information. According to this illumination invariant property of chromaticity, several efficient methods have been developed to detect shadows for color images efficiently. However, they may not work well for color aerial images since some shadow properties in color aerial images have not been considered. To detect shadows of color aerial images. According to the two shadow properties, the red, green, and blue (*RGB*) color aerial image is first transformed into the

hue, saturation, and intensity (*HSI*) color model, and then, a segmentation process is applied to the saturation component and the intensity component to identify shadows. Observed that the pixels in a shadow region usually have large hue value, low blue color value, and small difference between green and blue color values. Following this observation, three experimental thresholds are determined to detect shadows in the *HSI* color model. Recently, Tsai presented an efficient algorithm to detect shadows for color aerial images, too. The input image can be first transformed into the *HSI*; hue, saturation, and value (*HSV*); luma, blue-difference chroma, and red-difference chroma (*Y CbCr*); hue, chroma, and value (*HCV*); or luminance, hue, and saturation (*YIQ*) color models.

1.1. Thresholding

Thresholding is simplest methods replace each pixel in an image with a black pixel if the image intensity $I_{i,j}$is less than some fixed constant T (that is $I_{i,j} < T$), or a white pixel if the image intensity is greater than that constant. In the example image on the right, this results in the dark tree becoming completely black, and the white snow becoming complete white. The simplest method of image segmentation is called the thresholding method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image.

1.2. Clustering Method

The K-means algorithm is an iterative technique that is used to partition an image into K clusters. In this case, distance is the squared or absolute difference between a pixel and a cluster center. The difference is typically based on pixel color, intensity, texture, and location, or a weighted combination of these factors. K can be selected manually, randomly, or by a heuristic. This algorithm is guaranteed to converge, but it may not return the optimal solution. The quality of the solution depends on the initial set of clusters and the value of K.

1.3. Compression-Based Method

Compression based methods postulate that the optimal segmentation is the one that minimizes, over all possible segmentations, the coding length of the data. The connection between these two concepts is that segmentation tries to find patterns in an image and any regularity in the image can be used to compress it. The method describes each segment by its texture and boundary shape.

1.4. Histogram-Based Method

Histogram-based methods are very efficient compared to other image segmentation methods because they typically require only one pass through the pixels. In this technique, a histogram is computed from all of the pixels in the image, and the peaks and valleys in the histogram are used to locate the clusters in the image. Color or intensity can be used as the measure. A refinement of this technique is to recursively apply the histogram-seeking method to clusters in the image in order to divide them into smaller clusters. This operation is repeated with smaller and smaller clusters until no more clusters are formed. One disadvantage of the histogram-seeking method is that it may be difficult to identify significant peaks and valleys in the image. Histogram-based approaches can also be quickly adapted to apply to multiple frames, while maintaining their single pass efficiency. The histogram can be done in multiple fashions when multiple frames are considered.

2. SYSTEM HISTORY

Many effective algorithms have been proposed for shadow detection. Existing shadow detection methods can be roughly categorized into two groups: model-based methods and shadow-feature-based methods. The first group uses prior in- formation such as scene, moving targets, and camera altitude to construct shadow models. This group of methods is often used in some specific scene conditions such as aerial image analysis and video monitoring. The second group of methods identifies shadow areas with information such as gray scale, brightness, saturation, and texture. An improved algorithm exists that combines the two methods. First, the shadow areas are estimated according to the space coordinates of buildings calculated from digital surface models and the altitude and azimuth of the sun. Then, to accurately identify a shadow, the threshold value is obtained from the estimated gray-scale value of the shadow areas.

- Shadow Detection by Tsai´s Algorithm

The flowchart of Tsai's algorithm is To detect shadows in the RSI, Tsai transforms the input

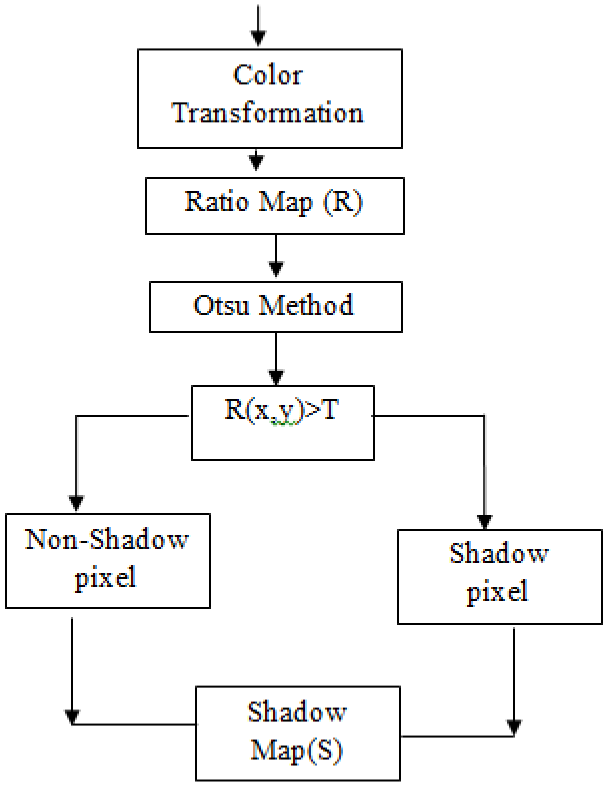

Figure 1 Tsai's algorithm flowchart

RGB image I into an invariant color model, i.e., HSI, HSV, HCV, YIQ, or Y CbCr color models. For each pixel, the ratio of the hue over the intensity is used to determine whether the pixel is a shadow pixel or not. For easy exposition, the HSI color model is used as the representative. Tsai's algorithm has the best shadow detection performance for the HSI model. Tsai presented a shape preservation process to preserve shape information of objects casting shadows. It first performs the Sobel operator on Ie(x,y) to obtain the gradient map, and then, a shape map Sh can be constructed by applying Otsu's thresholding method to the gradient map. In the shape map Sh, the value of each pixel is determined. For each pixel Sh(x, y), it is a boundary pixel of the casting object when Sh(x,y) = 1. After performing the logical AND operation on the shape map Sh and the shadow map S, the shape information of objects can be preserved. Finally, from the result of the shape preservation process, the shadow compensation process compensates shadows by adjusting the intensity values of shadow pixels. Since this paper focuses on the detection of shadows for RSIs, the shadow compensation process is ignored.

3. PROPOSED SYSTEM

Shadow removal employs a series of steps. We extract the inner and outer outline lines of the boundary of shadows. The gray-scale values of the corresponding points on the inner and outer outline lines are indicated by the inner–outer outline profile lines (IOOPLs). Homogeneous sections are obtained through IOOPL sectional matching. Finally, using the homogeneous sections, the relative radiation calibration parameters between the shadow and non-shadow regions are obtained, and shadow removal is performed.

- Image Segmentation Considering Shadow Features

Images with higher resolution contain richer spatial information. The spectral differences of neighboring pixels within an object increase gradually. Pixel-based methods may pay too much attention to the details of an object when processing high- resolution images, making it difficult to obtain overall structural information about the object. In order to use spatial information to detect shadows, image segmentation is needed. We adopt convexity model (CM) constraints for segmentation.

- Detection of Suspected Shadow Areas

For shadow detection, a properly set threshold can separate shadow from non-shadow without too many pixels being misclassified. Researchers have used several different methods to find the threshold to accurately separate shadow and non-shadow areas. Bimodal histogram splitting provides a feasible way to find the threshold for shadow detection, and the mean of the two peaks is adopted as the threshold. In our work, we attain the threshold according to the histogram of the original image and then find the suspected shadow objects by comparing the threshold and gray-scale average of each object obtained in segmentation.

We chose the gray-scale value with the minimum frequency in the neighborhood of the mean of the two peaks as the threshold.Inaddition, atmospheric molecules scatter the bluewavelength most among the visible rays (Rayleigh scattering).

Here, our proposed STS-based algorithm is presented to detect shadows for remote sensing images (RSI). Instead of using the ratio map obtained by Tsai's algorithm, we present the modified ratio map to distinguish the candidate shadow pixels from non-shadow pixels. From the modified ratio map, the global thresholding process is first performed to obtain the coarse-shadow map, which separates all the pixels of the input image into candidate shadow pixels and non-shadow pixels.

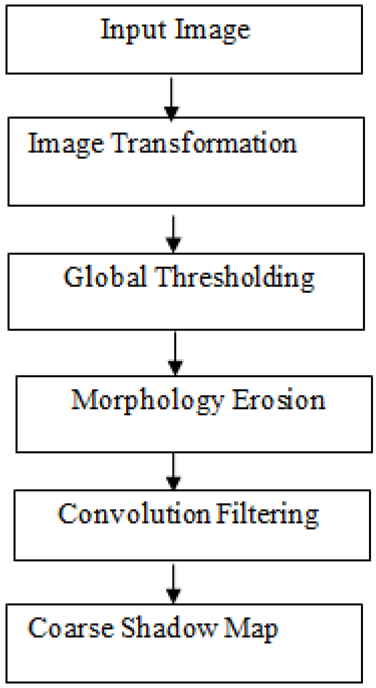

Figure 2 Our new analysis based algorithm flowchart

4. CONCLUSION

We have put forward our new algorithm for shadow detection and removal .our new algorithm gives better result for three type of accuracy (producer’s, user’s and overall) than tsai’s algorithm. That means accuracy of shadow detection using our new algorithm is better than tsai’s algorithm. When shadow detection properly take place or more accurate then shadow remove correctly, which is given in our method.

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