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Region Growing Thresholding Based Object-Oriented Shadow Detection and Removal from Urban High-Resolution Remote Sensing Images

[1]M.Nagamani, [2]Ms. N.Suchitra

[1]PG Scholar, Dept of ECE, Gokula Krishna College of Engineering, JNTUA, Sullurpet, AP, India.
nagamanihepsi@gmail.com

[2]Associate Prof, Dept of ECE, Gokula Krishna College of Engineering, JNTUA, Sullurpet, AP,India.
ns.suchitra326@gmail.com

Abstract: *This paper mainly focus to get the high resolution color remote sensing image, and also undertaken to remove the shaded region in the both urban and rural area. Some of the existing projects are involved to detect the shaded region and then eliminate that region, but it has some drawbacks. The detection of the edges will be affected mostly by the application of the external parameters. The edge detection process can be more helpful in the detection of the objects so that the objects can be used for further processing. In this process we have implement the region growing thresholding algorithm is used to detect the shadow region and extract the feature from the shadow region. Region growing is simplest in region-base image segmentation methods. The concept of region growing algorithm is checking the neighboring pixels of the initial seed points. Then determine whether those neighboring pixels are added to the seed points or not. In the region growing threshold algorithm Pixels are placed in the region based on their properties or the properties of the nearby pixel values. Then the pixel containing the similar properties is grouped together and then the large numbers of pixels are distributed throughout the image.*

Keywords: *Inner-outer outline profile line(IOOPL),object oriented ,relative radiometric correction ,shadow detection*

1. Introduction

Now a day the man survive the large area of the world, so to monitor the land area satellite imaging is used to detect the earth locality. The shadow is occurred by the interfacing of building[1] and the sun. In this process some of the problems occurred, due to the shadow area of an urban and rural area. So this project mainly focus to get the high resolution color remote sensing image, and also undertaken to remove the shaded region in the both urban and rural area[5]. Because of the ambient light, the ratios of the two pixels are not same in all three color channels. These two pixels will be different not only in intensity, but also in hue and saturation[6]. Thus, correcting just the intensity of the shadowed pixels does not remove the shadow, and we need to correct the chromaticity values as well. Using the shadow density, the shadow area is segmented into sunshine, penumbra and umbra regions. Since the lighting color of the umbra region is not always the same as that of the sunshine region, the color adjustment is performed between them. Then, the color average and variance of the umbra region are adjusted to be the same as those of the sunshine region. In the penumbra, color and brightness adjustments for small Deb et al.: Shadow Detection[2] and Removal Based on regions are performed the same as they are for the umbra region. Finally, all boundaries between shadowed regions and neighboring lit regions are smoothed by convolving them with a Gaussian mask.

1.1. Image Segmentation Considering Shadow Features

Images with higher resolution contain richer spatial information. The spectral differences of neighbouring 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. Traditional image segmentation methods are likely to result in insufficient segmentation, which makes it difficult to separate shadows from dark objects. The CM constraints can improve the situation to a certain degree. To make a further distinction between shadows and dark objects, color factor and shape factor have been added to the segmentation criteria. The parameters of each object have been recorded, including grayscale average, variance, area, and perimeter[14]. The segmentation scale could be set empirically for better and less time-consuming results, or it could be adaptively estimated according to data such as resolution.

1.2 Detection of Suspected Shadow Areas

For shadow detection[11], a properly set threshold can separate shadow from non shadow without toomanypixelsbeingmisclassified[3].Researchersha 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[3]. 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 grayscale average of each object obtained in segmentation. In addition, atmospheric molecules scatter the blue wavelength most among the visible rays (Rayleigh scattering). So for the same object, when in shadow and non shadow, its grayscale difference at the red and green wavebands is more noticeable than at the blue waveband. Thus, we retrieve a suspected shadow with the threshold method[11] at the red and green wavebands. Specifically, an object is determined to be a suspected shadow if its grayscale average is less than the thresholds in both red and green wavebands.

$$G_q=1/2\ (G_m+G_s)$$

1.3 Elimination of False Shadows

Dark objects may be included in the suspected shadows, so more accurate shadow detection results are needed to eliminate these dark objects. Rayleigh scattering results in a smaller grayscale difference between a shadow area and a non shadow area in the blue (B) waveband than in the red (R) and green (G) wavebands. Consequently, for the majority of shadows, the grayscale average at the blue waveband *Gb* is slightly larger than the grayscale average at the green waveband *Gg*. Also, the properties of green vegetation itself make *Gg* significantly larger than *Gb*, so false shadows from vegetation can be ruled out by comparing the *Gb* and *Gg* of all suspected shadows.

Namely, for the object *i*, when $Gb + Ga < Gg$, *i* can be defined to be vegetation and be ruled out. *Ga* is the correction parameter determined by the image type. After the elimination of false shadows from vegetation, spatial information of objects, i.e., geometrical characteristics and the spatial relationship between objects, is used to rule out other dark objects from the suspected shadows. Lakes, ponds, and rivers all have specific areas, shapes, and other geometrical characteristics. Most bodies of water can be ruled out due to the area and shape of the suspected shadows of the object that they produce. However, the aforementioned method still cannot separate shadows from some other dark objects. Spatial relationship features are used to rule out dark objects in the suspected shadows. Dark objects are substantive objects, while shadows are created by taller objects which block the light sources and may be linked together with the objects that result in the shadows. An obscured area (i.e., a shadow) forms a darker area in an image. The object blocking the light forms a lighter area in an image. At the same time, the sun has a definite altitude angle, and a shadow boundary reflects the boundary of a building and the position of a light source. Buildings, trees, and telegraph poles are the main objects creating shadows in urban remote sensing images[3]. Their shadow boundaries usually have a certain direction. To retrieve shadows using spatial relationships, the linear boundaries of suspected shadows are first analyzed to predict the probable trend of a shadow, according to which the approximate position of a large object is predicted. To determine whether it is a shadow, the proximity of a dark object to a light object within this azimuth is measured. An average spectral difference can be used to decide whether there are light objects linked around a shadow.

2. MODULES

- **Pre-processing**
- **Feature Extraction**
- **Segmentation**
- **IOOPL Matching**

2.1 Pre-processing

In this preprocessing, the input image is under going to convert the RGB image into the gray scale image. The converted gray scale image is resized into the specific resolution, hence the resolution is maintained till the further process.If the noise is occurred in the image, then the accuracy of the image is affect, so the filter is use to eliminate the noise present in the image. Then the noise free image is used for the further process.

2.2 Feature Extraction

Feature extraction is the process of extracting the required data's from the region of interest. In this method, the shadow feature is extracted by detected with the region growing threshold method. Then the object properties such as spectral features and geometric features are combined with a spatial relationship, in which the false shadows are detected and eliminated. In this technique, the feature extraction is carried to extract the features of the 5 major categories. The Average grayscale value of the image is extracted from the image. The peak value of the histogram which is obtained by the shadow peak histogram is extracted. Then the threshold value of the image is extracted. At the same time, the frequency of the image is also extracted from the image. At last the nearby pixel values are extracted from the same image from which the above features are extracted.

2.3Segmentation

Segmentation is the process of separating the required part from the cluster of unwanted background. On the other words, the segmentation is the process of elimination of the background region. To segment the required object, the shape factor and the color factor is considered to remove the shadow, but the dark region of the image should not be eliminate. The parameter of the each image is recorded and then the variation in the shadow and the dark area is noted.

2.4 IOOPL Matching

IOOPL matching is a process of obtaining homogeneous sections by conducting similarity matching to the IOOPL section by section. If the correlation coefficient is small, then there is some abnormal parts representing some different types of objects exist in this section.During the process, Gaussian smoothing is performed to simplify the view of IOOP. To rule out the nonhomogeneous sections, the IOOPL is divided into average sections with the same standard, and then, the similarity of each line pair is calculated section by section. If the correlation coefficient is large, it means that the shade and light fluctuation features of the IOOPL line pair at this section are consistent. If consistent, then this line pair belongs to the same type of object, with different illuminations, and thus is considered to be matching. If the correlation coefficient is small, then some abnormal parts representing some different types of objects exist in this section. Therefore, these parts should be ruled out. This sections that have failed the matching are indicated in red. If more accurate matching is needed, the two sections adjacent to the section with the smallest correlation coefficient can be segmented for matching again.

3. ALGORITHM

3.1Region Growing Thresholding

In the region growing threshold algorithm Pixels are placed in the region based on their properties or the properties of the nearby pixel values. Then the pixel containing the similar properties is grouped together and then the large number of pixels is distributed throughout the image. We are proposed the future enhancement based on the Region growing thresholding segmentation method. The aim of region detection is to provide the possibility to characterize the detected object by parameter analysis (shape, position, size...) Edge-based segmentation: borders between regions. Region-based segmentation: direct construction of regions. It is an easy way to construct regions from their borders and it is also easy to detect borders of existing regions. Segmentations resulting from edge-based methods and region growing methods are not usually exactly the same. Region growing is simplest in region-base image segmentation methods. The concept of region growing algorithm is check the neighboring pixels of the initial seed points, then determine whether those neighboring pixels are added to the seed points or not

3.2 flow diagram

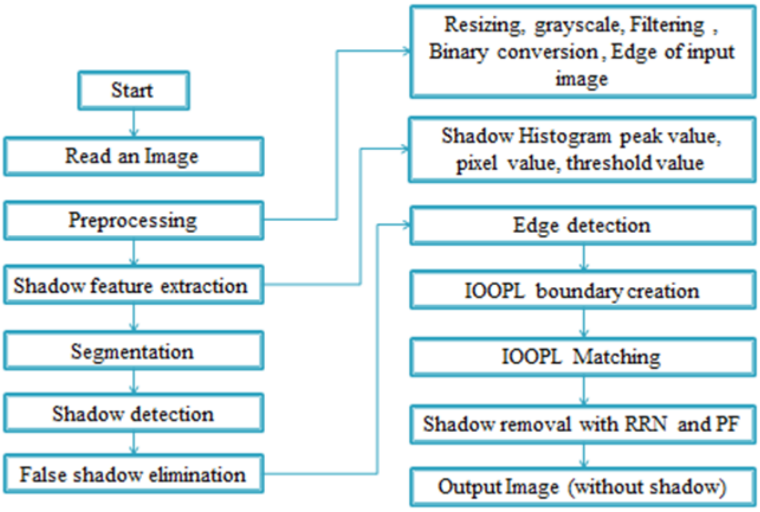


Fig 1. *Flow chart of Proposed Method*

3. 3 Implementation of Shadow Removal

Shadows are removed by using the homogeneous[10] sections obtained by line pair matching. There are two approaches for shadow removal. One approach calculates the radiation parameter[20] according to the homogeneous points of each object and then applies the relative radiation correction to each object.The other approach collects and analyzes all the homogeneous sections for polynomial fitting (PF)[19] and retrieves all shadows directly with the obtained fitting parameters.

Relative Radiometric Correction

In the same urban image, if objects in a shadow area and a non shadow area belong roughly to the same category, and they are in different lighting conditions, relative radiation correction can be used for shadow removal. To avoid the influence of scattering light from the environment, each single object has been taken as a unit for which the shadow removal process is conducted for that object. This enhances reliability. Commonly used relative radiation correction generally assumes that a linear relationship exists between the grayscale value digital number (DN) of the image to be corrected and the DN of the reference image,

DNref = *a* × DNrect + *b*.

DNref is the DN of the object in the reference image, DNrect is the DN of the object in the image to be corrected, and *a* and *b* are the gain and offset, respectively. By applying IOOPL matching to each shadow, homogeneous sections that represent objects of the same category in different lighting conditions are obtained. radiation value correction of the shadow can be realized through the obtained gain and offset values. Our experiments show that a straightforward and simple relative radiation correction, the mean variance method, for shadow removal can be applied as follows.

The concept of the mean variance method is that, after radiation correction, the homogeneous points on a line pair of the shadow have the same mean and variance at each waveband. The radiation correction coefficients of the mean and variance method are

$$a_k = \frac{S_{y_k}}{S_{x_k}}; b_k - \overline{y_k} - a_k \cdot \overline{x_k}$$

where *xk* is the grayscale average of the inner homogeneous sections at the waveband *k*, *yk* is the grayscale average of the outer homogeneous sections at the waveband *k*, *Sxk* is the standard deviation of the inner homogeneous sections at the corresponding waveband, and *Syk* is the standard deviation of the outer homogeneous sections at the corresponding waveband. We assume that the inner homogeneous sections reflect the overall radiation of the single shadow. After obtaining the correction coefficient, all points of the shadow are corrected according to

DNnon shadow = *ak* × DNshadow + *bk*

where *DN* non shadow stands for the pixel gray scale of the shadow after correction, *DN* shadow stands for the pixel gray scale of the shadow before correction, and *ak* and *bk* are the coefficients of the minimum and maximum method or mean variance method calculated with the homogeneous points of the object, respectively.

PF (POLYNOMIAL FITTING)

As mentioned previously, in high-resolution remote sensing images, the inner and outer homologous points represent the grayscale level of the same type of object of both sides of the shadow boundary in shadow and under normal illumination. It has been found that shadows and the corresponding non shadows exhibit a linear relationship. However, in this study, according to goodness of fit, the relationship of the inner and outer homologous points is best described by the polynomial model (Fig. 5). Consequently, we adopt PF, and the grayscale value of the shadow area is directly obtained with the fitting parameters, as shown in

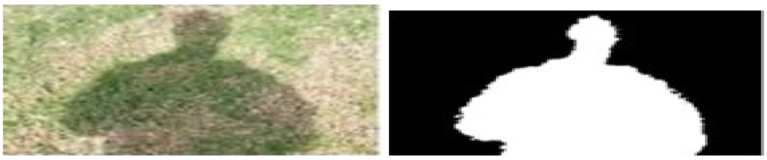
$$f(x) = ax3 + bx2 + cx + d.$$

After transforming the gray scale of the shadow area through f(x), the shadow removal result can be obtained. It is not appropriate to perform PF at greater than the third degree. One reason is to avoid the overly complex calculation; the otherreason is that higher fitting to degrees greater than three does not significantly improve accuracy. The next step assumes that the illumination model of the entire image is consistent. To ensure that enough statistical subjects are obtained, the grayscale values of all matching points on the inner and outer outline lines of all shadows in the entire image are determined. These provide the fitting parameters for shadow removal. This method has solved the problem of not being able to obtain the inner and outer outlines of the minor shadows and the lack of availability of enough IOOPL matching points.

4. Comparison of Existing and Proposed Methods

In proposed method we can remove the shadowed region as well as to attain the original picture quality. In existing method, there is no elimination of shadow region. In existing method, the original picture quality is less as compared to proposed method. The accurate area of the image is identified in proposed method. The proposed technique is more suitable for the both urban and the rural area. Hence the shadow is removed in both the urban and rural area.

In existing method, it is difficult to find the accurate area of image. In existing method this method some of the drawbacks like, there is no image calibration for the intensity and, the illumination adjustments. We get high resolution image (spectral and spatial) in proposed method. The proposed method: (a) depicts the original image, and (b) depicts the detected shadow regions



(a) (b)

5. Results and Discussion

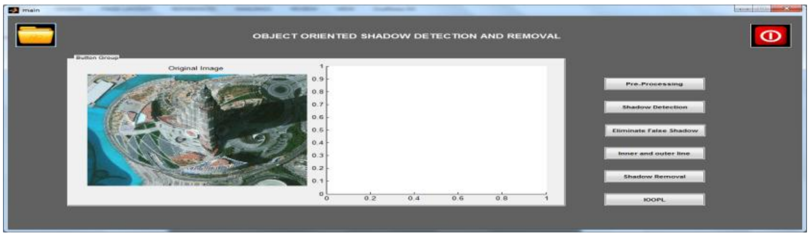


Fig 2: *Input image*

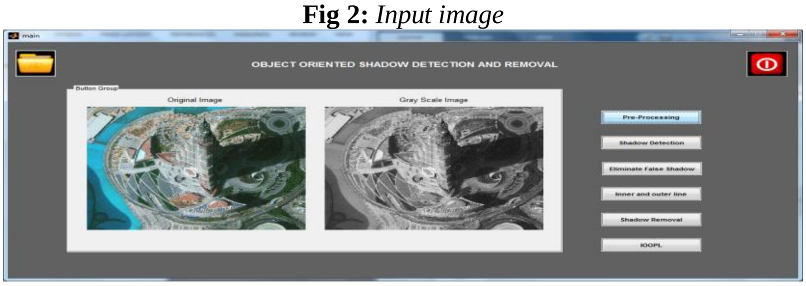


Fig 3: *Preprocessing*

Fig 4: *Shadow detection*

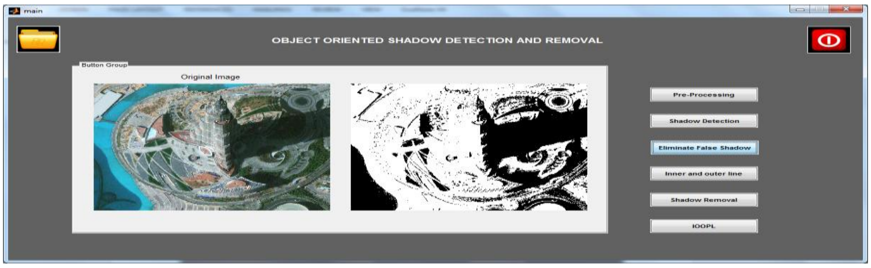


Fig 5: *Elimination of False Shadow*

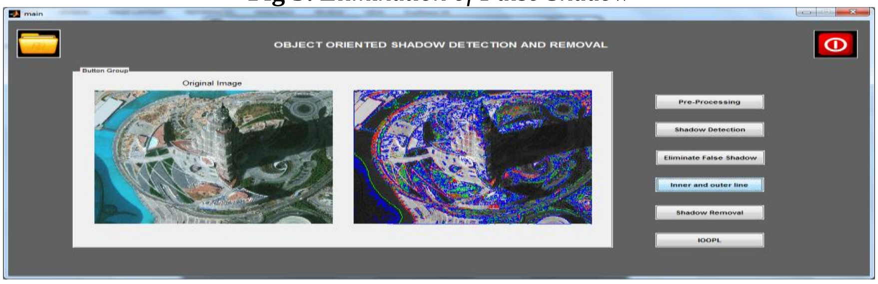


Fig 6: *Inner and outer line*

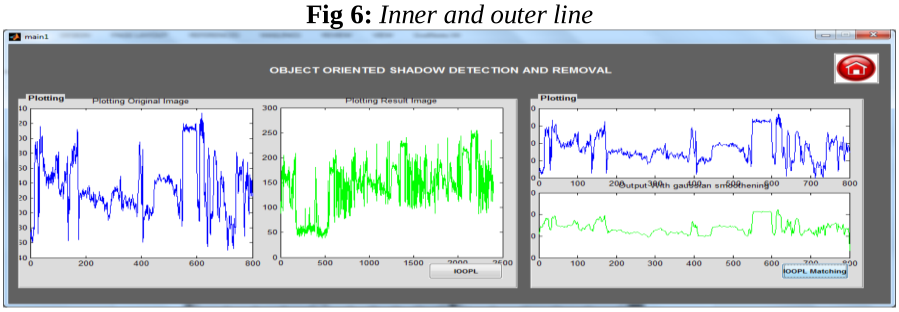


Fig 7: *IOOPL Matching*

Fig 8: *Output image*

6. Conclusion and Future Scope

The shadow detection method proposed in this paper can stably and accurately identify shadows. Threshold selection and false shadow removal can be conducted in simple but effective ways to ensure shadow detection accuracy. The shadow removal method based on IOOPL matching can effectively restore the information in a shadow area. The parameters calculated by using the radiation difference between inner and outer homogeneous sections can retrieve a shadow very effectively.

Because of the filming environment or some other reasons, obvious color cast can be seen in some parts of a shadow area. IOOPL matching could relieve this case to a certain extent but not completely resolve the problem.

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AUTHORS’ BIOGRAPHY

M.Nagamani, received the B.Tech degree in Electonics and communication Engineering from Priyadarshini college of Engineering , Sullurpet. Pursuing M.Tech DECS in Gokula Krishna College of Engineering.

Ms. N.Suchitra, working as an Associate Professor in the Department of ECE at Gokula Krishna College of Engineering, Sullurpet, SPSR Nellore (Dt).