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Object-Oriented Shadow Detection and Removal from Satellite Images

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Abstract: ***I introduce an object oriented shadowdetection and removal method followed by an svm classification. In this technique, during image segmentation, shadow features are considered, suspected shadows are extracted with thresholding. Then, some dark objects which could be mistaken for shadows are ruled .Inner–outer outline profile line (IOOPL) matching is used for shadow removal. The inner and outer outline lines of the boundary of shadows are taken as the IOOPLs. Shadowremoval is performed using either Relative Radiometric Correction or polynomial fitting.Finally SVM classification is performed on input samples for improved accuracy.***

Keywords: Change detection, inner–outer outlineprofile line(IOOPL), object-oriented, relative radiometric correction, shadow detection, shadow removal, svm classification

1. Introduction

With the technological developments in aerospace in recent years, an increasing number of Earth observation commercial satellites with high-resolution sensors have been launched, such as QuickBird (QB), IKONOS. We will get images with very high spatial resolution (VHSR) from these satellites. So it is possible to identify small-scale features such as individual roads and buildings in urban environments. Therefore, these VHSR images are used for various remote sensing applications, such as object detection. Classification , object mapping , and change detection.

But, high spatial resolution causes some drawbacks like the presence of shadows, particularly in urban areas where there are larger changes in surface elevation (due to the presence of buildings, bridges, towers, etc.) and consequently longer shadows. These shadows may be utilized for inferring 3-D scene information based on their position and shape, for example, for building detection and building height estimation. Similarly, the shadows cause partial or total loss of radiometric information in the affected areas, and consequently, they make tasks like image interpretation, object detection and recognition, and change detection more difficult or even impossible. So due to this disadvantages, there is a need to remove this shadows. It is usually performed in two steps-shadow detection and shadow removal.

In this paper I propose an efficient method for Shadow detection and removal. Shadow detection is performed using an SVM classifier. Shadow removal is performed using an Object Oriented method.

2. Proposed Method

The Proposed method is shown in figure 1.Initially original image that containing shadows is segmented to obtain connected components or segments. Then suspected shadows are obtained through an SVM

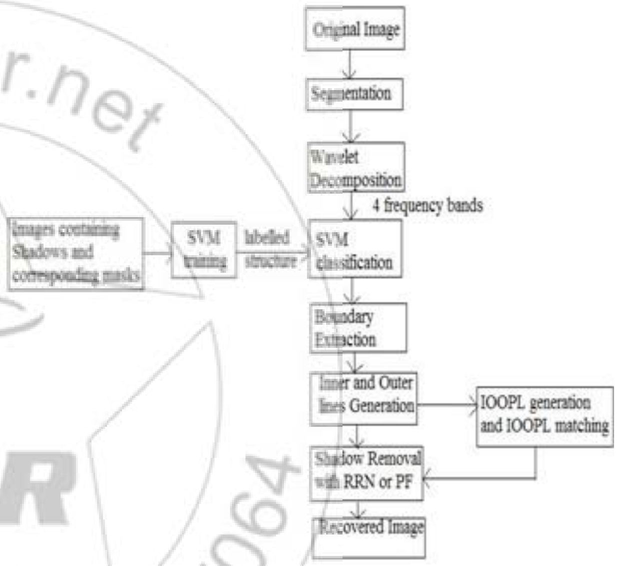

Figure1: Proposed method of shadow Detection and removal

3. Shadow Detection

Suspected shadows are obtained through an SVM classification method. For this an image set with shadows is trained already using its mask and shadow and non-shadow pixels are labelled correctly. Using this information, our input image is first decomposed into four wavebands namely HH,HL,LH and LL. Then data in each of these wavebands is classified as shadow or non shadow, using the previously obtained classifier. This technique is known as Support Vector Machine Classification(SVM).

Support vector machine, is a supervised learning technique that seeks an optimal hyper plane to separate classes. Kernel functions are used to map the input data into a higher dimension space where the data are assumed to have a better distribution, and then an optimal separating hyperplane in the high dimensional feature space is taken. The Support Vector Machine (SVM) technique is well suited to search for an optimal binary classifier. In Support vector machine method, we can calculate this for support vector classification and better ability to distinguish, and in support vector attachment is the position of the optimal hyperplane is the mid perpendicular direction. This hyperplane can maximize classification intervals to make sure the accuracy of classification and minimum classification error. Support vector machine as a new classification algorithm, was widely used in many fields.

It is feasible to decompose the training images using wavelet decomposition, and trainingeach waveband using the corresponding mask waveband to get shadow and non shadowpixel labels. The result can be stored in a structure. Then we can use this classification map to classify any images for shadow verses non shadow classification. For this, the image need to be classified is also decomposed into four wavebands-HH,HL,LH and LL and then apply the classification map or structure to data in these four bands.

4. Shadow Removal

Shadow removal method based on IOOPL matching is used to recover shadow areas. There is a large probability that both shadow and non shadow areas in close range on both sides of the shadow boundary belong to the same type of object. The inner outline can be and by contracting the shadow boundary inward and outer outline can be obtained by expanding it outward. As shown in Fig. 2, *R* is the vector line of the shadow boundary obtained from shadow detection, *R*_out is the outer outline in the non shadow area after expanding *R* outward, and *R*_in is the inner outline in the shadow area after contracting *R* inward. A one-to-one correspondence exists between nodes on *R*_out and *R*_in. When the correlation between *R*_out and *R*_in is close enough, there is a large chance that this location belongs to the same type of object. Grayscale values of the corresponding nodes along *R*_out and *R*_in at each waveband is collected to obtain the IOOPL. OPLs in the non shadow area are marked as outer OPLs and Outer profile lines (OPLs) in the shadow area are marked as inner OPLs. (Fig. 2).

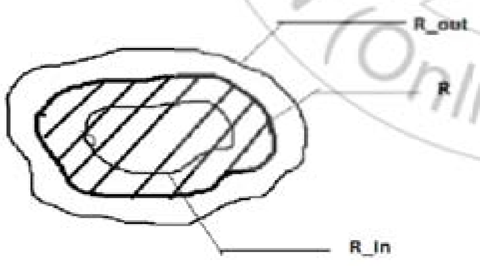

Figure 2: Diagram of shadow boundary, inner, and outer outline lines.

There are two approaches for shadow removal. Shadows are removed by using the homogeneous sections obtained by line pair matching. One approach of shadow removal calculates the radiation parameter with respect to the homogeneous points of each object and then applies the relative radiation correction to each object and is known as relative Radiometric Correction. The other approach, Polynomial Fitting collects and analyzes all the homogeneous sections for polynomial fitting (PF) and retrieves all shadows directly with the obtained fitting parameters.

5. Relative Radiometric Correction

In the same image, if objects in a shadow and a non-shadow areas belong to the same category, relative radiation correction can be applied for shadow removal. Each single object has been taken as a unit for which the process of shadow removal is conducted for that object to avoid the influence of scattering light from the environment. This is for the purpose of enhancing reliability. Relative radiation correction assumes that there is a linear relationship between the gray- scale value digital number (DN) of the image to be corrected and the grayscale value digital number(DN) of the reference image

$$DN_{refn} = a * DN_{corr} + b; \qquad (1)$$

In (4), DN_{refn} is the DN of the object in the reference image, DN_{corr} is the grayscale value digital number(DN) of the object in the image to be corrected, and a and b are the gain and offset. By applying IOOPL matching to each shadow, homogeneous sections that represent objects of the same category are obtained. According to (4), the gain and offset of the linear function can be found by the DN of the homogeneous sections. DN_{corr} is the DN of the outer homogeneous sections, and DN_{refn} is the DN of inner homogeneous sections. The radiation value correction of the shadow can be found using the obtained gain and offset values. Experiments show that relative radiation correction for shadow removal can be applied as follows.

The concept of the mean variance method is that, after relative radiation correction, the ho-mogeneous points on pair of lines of the shadow have the same mean and variance at each waveband.The relative radiation correction coeffcients of the mean and variance method are

$$a_j = SD_{yj} / SD_{xj};$$
$$b_j = y_j + a_j * x_j; \qquad (2)$$

where x_j is the grayscale average of the inner homogeneous sections at the waveband j, y_j is the grayscale average of the outer homogeneous sections at the waveband j, SD_{xj} is the standard deviation of the inner homogeneous sections at the corresponding waveband, and SD_{yj} is the standard deviation of the outer homogeneous sections at the corresponding waveband.

Making the assumption that the inner homogeneous sections reect the overall radiation of the single shadow. After obtaining the correction coeffcient, all points of the shadow are corrected according to

$$DNnonshadow = a_j * DNshadow + b_j \qquad (3)$$

where $DN_{nonshadow}$ is the pixel gray scale of the shadow after correction, DN_{shadow} is the pixel gray scale of the shadow before correction, and a_j and b_j are the coefficients of the mean variance method calculated with the homogeneous points of the object.

6. Polynomial Fitting(PF)

In high resolution remote sensing images, the inner and

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outer homogenious points represent the gray-scale level of the same type of object of both sides of the shadow boundary . Shadows and the corresponding non-shadows exhibit a linear relationship. The relationship of the inner and outer homologous points is best described by the polynomial model. By adopting PF, the gray-scale value of the shadow area is directly obtained with the fitting parameters, as shown in

$f(x) = ax^3 + bx^2 + cx + d;$

The results of shadow removal can be obtained after transforming the gray scale of the shadow area through f(x). It is not appropriate to perform PF at greater than the third degree so that to avoid the overly complex calculation and due to the reduced accuracy.

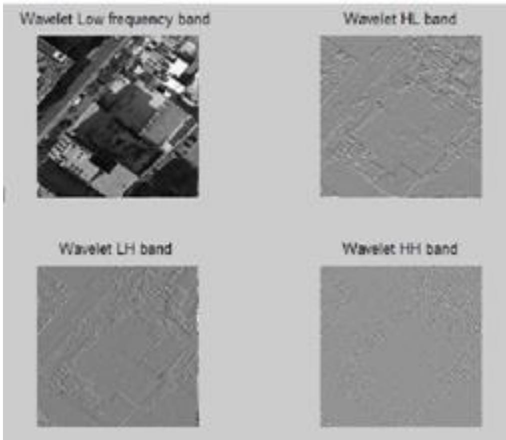
7. Experimental Results

The proposed method is evaluated on a set of images. The results of the entire process is shown here.

a) Original Image

b) Segmentation

c) Wavelet Decomposition



d) Detected Shadow Region

e) Ioopl Matching Region

f) Shadow Reconstructed Image

Shadow reconstructed image

8. Conclusion

A systematic and effective method for shadow detection and removal in urban high resolution remote sensing image is implemented. In order to get a shadow detection result, image segmentation considering shadows is applied first. After this,suspected shadows are selected through an SVM classification method.Some reliable image,mask pairs are used for SVM training.The trained data is used to detect shadow pixels in any input image using SVM classification.This results in better shadow detection results than previous methods..

For shadow removal, , two strategies are put forward after the homogeneous sections have been obtained by IOOPL matching- relative radiation correction for the objects one at a time,and shadows are removed directly after Polynomial Fitting(PF) is applied to all the homogeneous sections and correction parameters are obtained. The experimental

results revealed the following.

1) More shadow pixels are detected with SVM classification method than the previous methods, which helps in improving the reconstruction results too.
2) The shadow detection method proposed in this paper can stably and accurately identify shadows. Training of images and suitable masks can be conducted in simple but effective ways to ensure shadow detection accuracy.
3) The shadow removal method based on IOOPL matching can restore the information in a shadow area effectively. The homogeneous sections obtained by IOOPL matching can show the radiation gray scale of the same object in shadow areas and in non-shadow areas. The parameters calculated by using the radiation difference between inner and outer homogeneous sections can retrieve a shadow very effectively.
4) The two shadow removal methods (RRN and PF) are both suitable for high-resolution urban remote sensing images. Moreover, there are advantages to each strategy: RRN can restore the texture details well while PF has a more stable background radiance.

References

[1] Hongya Zhang, Kaimin Sun, and Wenzhuo Li `Object-Oriented Shadow Detection and Removal From Urban High-Resolution Remote Sensing Images', IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, VOL. 52, NO. 11, NOVEMBER 2014
[2] T. Kim, T. Javzandulam, and T.-Y. Lee `Semiautomatic reconstruction of building height and footprints from single satellite images', IGARSS, Jul. 2007, vol. 2, pp. 47374740.
[3] S. Ji and X. Yuan.`A method for shadow detection and change detection of man-made objects ', J. Remote Sens., vol. 11, no. 3, pp. 323329, 2007.
[4] P.M. Dare, `Shadow analysis in high-resolution satellite imagery of urban areas, '. Eng. Remote Sens., vol. 71, no. 2, pp. 169177, 2005
[5] Y. Li, P. Gong, and T. Sasagawaz, `Integrated shadow removal based on photogrammetry and image analysis 'Int. J. Remote Sens., vol. 26, no. 18, pp. 39113929, 2005.