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Shadow Free Urban High Resolution Remote Sensing Images.

[1]D Srinath,[2]A Jerrin Simla* ,[3]S Panimalar,[4]SM Poonkuzhali.

Department of Computer Science and Engineering, Panimalar Institute of Technology,India

ABSTRACT

In this paper an object oriented shadow detection and removal method is used in high resolution remote sensing images.The shadow features are evalauted through image segmentation,where the features of the shadow are obtained with the spectral and spatial characteristics of the image. Histogram based threshold value method is used to detect the suspected shadows in which the false shadows are ruled out and the real shadows get detected.The inner outer outline profile line matching is used for shadow removal. The inner outer outline profile lines are generated along inner and outer outline lines in which those lines can be obtained by contracting the boundary of shadow inward and expanding it outward.The inner outer outline profile line matching is done section by section to obtain homogeneous sections by conducting similarity matching.The interference of noise and dark pixels are avoided in this method.Shadow trend information and spatial information are necessary to detect the shadows where in a high resolution remote sensing image a large amount of obvious shadow may lead to loss of information. Darker objects shadows are more concentrated in this paper to avoid the loss of object, in which the objects can be misatakenly taken as shadows and get eliminated.

Keywords: IKONOS, HSI space, IOOPL, PF

***Corresponding author**

INTRODUCTION

Shadow is an area where light from a light source is obstructed by an object.It occupy all of the space behind an opaque object in which a light infered on it[7].The cross section of a shadow is a two-dimensional silhouette are reverse projection of the object , blocking the light.There are three distinct parts of a shadow created by any non-point light source after impinging on an opaque object called the umbra,penunbra and antumbra.There are two types of shadow cast shadow and self shadow.The self shadow is shadow on the subject on a side that is not directly facing the light source.The cast shadow is shadow of a subject falling on the surface of another subject because the former subject has blocked the light source.Umbra and penumbra are the cast shadows .The umbra is created because of direct light is completely blocked.The penumbra is created by something partly blocking the direct light.Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object.The high resolution satellite such as IKONOS,quick bird,Geoeye 1,rapid eye etc are used to detect images from remote sensing area .The images are to be analysed for applications.In three dimensional reconstruction,estimating height where shadows are to be a useful information[13].

In the existing system model based method is used in which the prior information about the scene is required.It gives incorrect results during change detection.The shadows are need to be identified accurately. Shadow detection [1][15] and shadow removal are categorized in four steps as follows:

- Preprocessing
- Text stroke edges detection
- Segmentation
- Post Processing

In the preprocessing Adaptive Contrast Map is applied to the input image. In an Adaptive Contrast Map[, we combine the local image contrast with the local image gradient of the input image. It detects many non stroke edges from the background of degraded document that often contains certain image variations because of noise, unequal lighting, bleed-through, etc. To extract only the stroke edges properly, the image gradient needs to be normalized to compensate the image variation within the document background[15]. The purpose of the contrast image construction is to detect the stroke edge pixels of the document text properly. Detect the text stroke edge pixel candidate by using Otsu’s global thresholding method. The binary map can be further improved through the combination with the edges by Canny’s edge detector, because Canny’s edge detector has a good localization property that it can mark the edges close to real edge locations in the detecting image. In addition, canny edge detector uses two adaptive thresholds and is more tolerant to different imaging artifacts such as shading[7]. It should be noted that Canny’s edge detector by itself often extracts a large amount of non-stroke edges. The combination of Otsu’s global thresholding and canny edge map helps to extract the text stroke edge pixels accurately.

The text can then be extracted from the document background pixels once the high contrast stroke edge pixels are detected properly. We calculate the most frequently distance between two adjacent edge pixels in horizontal direction and use it as the estimated stroke width. The edge image is scanned horizontally row by row and the edge pixel candidates are selected. The histogram is constructed that the frequency of the distance between two adjacent candidate pixels. The stroke edge width can then be approximately estimated by using the most frequently occurring distances of the adjacent edge Pixels.

The Binarization result is further improved by post processing. The isolated foreground pixels that do not connect with other foreground pixels are filtered out to make the edge pixel set precisely [14]. The neighborhood pixel pair that lies on symmetric sides of a text stroke edge pixel should belong to different classes (i.e., either the document background or the foreground text). One pixel of the pixel pair is therefore labeled to the other category if both of the two pixels belong to the same class. Finally, some single-pixel artifacts along the text stroke boundaries are filtered out by using several logical operators.

Related Work

Shadows are created because the light source has been blocked by something. There are two types of shadows: the self-shadow and the cast shadow. A self-shadow is the shadow on a subject on the side that is not directly facing the light source. A cast shadow is the shadow of a subject falling on the surface of another subject because the former subject has blocked the light source. A cast shadow consists of two parts: the umbra and the penumbra. The umbra is created because the direct light has been completely blocked, while the penumbra is created by something partly blocking the direct light. Images with higher resolution contain richer spatial information [1]. Usually shadows will let to loss of information and provide corrupted results. For removing shadows the equatorial crossing time of 1030 of Ikons satellite was chosen to enable stable image conclusion.Satellite sensors are used to achieve high resolution images.The simplest algorithm such as biomedical histogram splitting is used.The results depends on spatial resolution and radiometric post processing. In the compensstion of color Aerial Image in Invariant color model approach is based on compensation of shadow regions [9]. It solves the problem which is occurred by digital image mapping. These methods are used in many invariant color spaces it decouples luminance. The false detection of shadow is obtained by false color tone, loss of feature information, fail of conjugate and shape distortion of objects. [2]. Remote sensed images with very high spatial resoluton are used to clearly identify the detailed features of the image.Shadows provide informatiom about the image their shape, geometricfeatures, brightness,luminance.The original image is converted from RGB based to HSV color space.Then the segmentation of the shadow area is obtained.Identify the shadow and non shadow region.Then the shadow region are compensated.Then the HSV image converted to RGB image and finally the result image is obtained.The shadow compensation is done by histogram based matching method by adjusting the HSV value [3].

In Efficient Shadow Detection of Color Aerial Images [4] based on Successive Thresholding Scheme where the shadow detection of gray scale image based on intensity value, geometric properties and light directions. The shadow detection accuracy can be improved by the intensity and color information. By low luminance and high saturation of blue or violet wavelength we can detect shadow. The segmentation process is applied for the saturation component and intensity component. Coarse shadow map are developed using global threshold process. Successive Thresholding scheme is used to detect shadows of color aerial images. Shadow determination process is used to differentiate the true shadow from user shadow [4].

Elimination of shadow problem occur in land cover classification of high spatial resolution images.Three methods are applied to achieve more efficiency because more accurate land cover information is obtained from land management, urban planning and urban landscape pattern analysis.This shadow detection and removal involves removal in high resolution imaginary using object based methods[5]. Due to complex interactions of geometry [6], some of the surface appears to be dark due to shades. Some local regions are appeared to be ambiguous. Due to orientation discontinuity the shadow and non-shadow region cannot be differentiated. Need to remove the false pairing between regions. Graph cut is used to solve shadow and non-shadow regions.

Self adaptive feature selection algorithm[8] is used which is more efficient and automation processing is reduced and it is wide prdectiablity adaptability algorithm.This method is widely applicable and is efficient and acuurate.

Shadow detection in color aerial images based on HSI space [9] and color attenuation relationship the shadows are separated from single color aerial image and candidate and non-shadow are differentiated by using an algorithm called Otsu’s Thresholding algorithm. Each color channel is obtained by law called Planck’s Blackbody Irradiation. To find the shadow area we split the segment smaller and smaller repeatedly. In digital images shadows provide dim distances in field of Image processing and recognition of patterns. Shadow causes unexpected problems while tracking the buildings and height estimation. The shadow detection is done using feature based and model based method. The feature based method uses chromaticity value, Intensity information and geometric characteristics to find the shadows.

Detection and Compensation of Shadows based on ICA Algorithm in Remote Sensing image [10] uses independent component analysis, grayscale histogram, RGB channels, HIS space transformation and multi-threshold retinex to achieve shadow detection and compensation. There are two methods of shadow detection. One is the shadow is calculated based on the geometry of the object data. The second is based on the image features such as texture, color gray and edge and all based on histogram. The method has high precision, simple operation and good compensation effect. The shadow detection and compensation method is appropriate and is not suitable for different type of shadow objects.

Object-based cloud and cloud shadow detection method is implemented to find the day time cloud and their cloud shadows. The missing data are labeled detected and it tells how to handle it. Pixel, ratio and maximum values are derived for all pair of reflectance band. To obtain the cloud and cloud shadow we split each segment and finding the average pixel value. To avoid false detection of cloud shadows we use an algorithm called simple cloud shape [11]. The spatial noise is reduced in this method. The image parts of cloud and cloud shadow are acquired by using the optical space sensors.

Object level change detection based on high-resolution remote-sensing images depends on the high-resolution remote sensing image is based on multifeature integration and property of different objects. This method splits the information into artificialo objects related change information and vegetation related. To analyse the objects we need the texutre of objects. Object level change detection method vectors of objects are prepared by radiation,texture and geometric features of an object.Tricolor Attenuation model enhanced with adaptive histogram Equalization segments the image and calculate Tricolor Attenuation model in each sub region and using threshold value from histogram Equalization. The image is converted into simple images the shadows obtained are removed. It is suitable only for simple images. The Tricolor Attenuation model is created and it is combined with intensity images to remove shadows efficiently. Adaptive histogram equalization improves the quality of an image. It requires only one threshold for detecting shadows. The method is easier to use and more robust
in many applications.

Proposed Solution

Binarization

Binarization is a process where each pixel in an image is converted into one bit and you assign the value as '1' or '0' depending upon the mean value of all the pixel. If greater then mean value then its '1' otherwise its '0'.

Image Binarization converts an image of up to 256 gray levels to a black and white image. Frequently, Binarization is used as a pre-processor before OCR. In fact, most OCR packages on the market work only on bi-level (black & white) images. Intensities, invariant color models and hue constant. This is also used for red green blue model. Shadow detection is done using hierarchical supervised classification scheme. Threshold estimator of space colored transformation technique is used. This improves the classification accuracy in images by using support vector machine.

The simplest way to use image Binarization is to choose a threshold value, and classify all pixels with values above this threshold as white, and all other pixels as black. The problem then is how to select the correct threshold. In many cases, finding one threshold compatible to the entire image is very difficult, and in many cases even impossible. Therefore, adaptive image Binarization is needed where an optimal threshold is chosen for each image area.

OTSU'S Method

- Separate the pixels into two clusters according to the threshold
- find the mean of each cluster
- square the difference between the means
- multiply by the number of pixels in one cluster times the number in the other
- compute histogram and probabilities of each intensity level
- set up initial $q_i(0)$ and $\mu_i(0)$
- step through all possible threshold maximum intensity
- update q_i and μ_i
- compute $\sigma_b^2(t)$
- desired threshold corresponds to the maximum

Canny Edge Map

The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images.

Canny edge detector has a good localization property that it can mark the edges close to real edge locations in the detecting image. In addition, canny edge detector uses two adaptive thresholds and is more tolerant to different imaging artifacts such as shading.

The Canny Edge detection algorithm runs in 4 separate steps:

Smoothing

Blurring of the image to remove noise.

Finding gradients

The edges should be marked where the gradients of the image has large magnitudes.

Non-maximum suppression

Only local maxima should be marked as edges.

Double thresholding

Potential edges are determined by thresholding. Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

IOOPL [Inner Outer Outline Profile Line]

IOOPL matching is a process of obtaining homogeneous sections by conducting similarity matching to the IOOPL section by section. During the process, Gaussian smoothing is performed to simplify the view of IOOPL. The Gaussian smoothing template parameters were $\sigma = 2$ and $n = 11$.To rule out the non homogeneous 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.

Shadows are removed by using the homogeneous sections obtained by line pair matching. There are two approaches for shadow removal. One approach calculates the radiation parameter 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) and retrieves all shadows directly with the obtained fitting parameters.

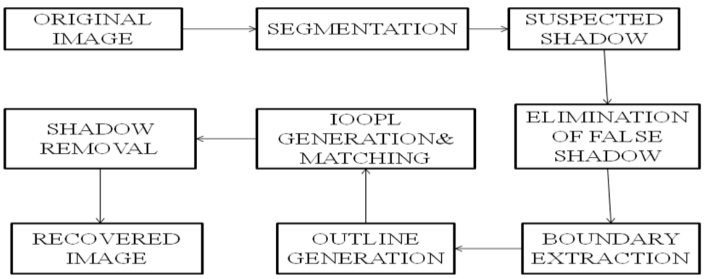

Figure 1: System Design

Experimental Analysis

Experiment Setup

In this experimental settings we are going to analyse the visual representation of the output for this paper. First,images are obtained from urban high-resolution remote sensing areas. Then the image segmentation takes place. The image is converted to grayscale image to identify the suspected shadows. Then it gets converted into binary image to eliminate the false shadows. Boundary extraction is done between shadow and non shadow region.The inner outer outline profile line matching is done for shadow removal where homogeneous sections are obtained through IOOPL similarity matching. Relative radiometric normalization (RRN) and Polynomial Fitting based on IOOPL matching could effectively remove the shadow. Finally shadow removed image is obtained.

Figure 2: Input Image

Figure 3: Segmented image

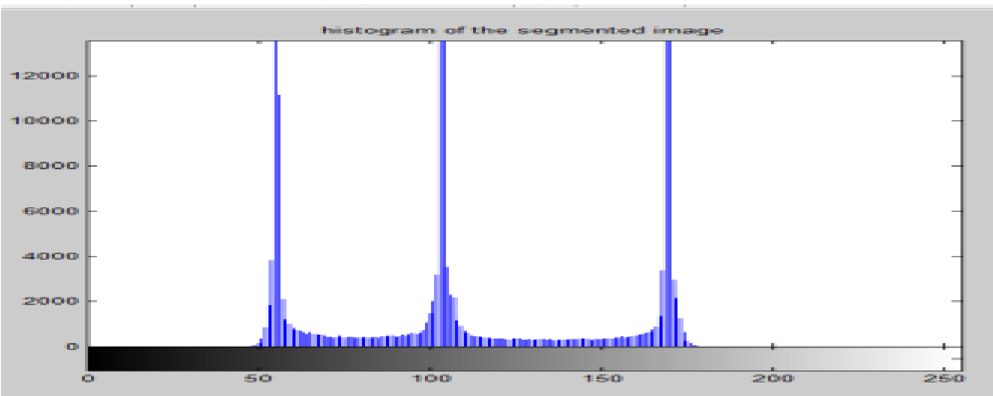

Figure 4: Histogram of the segmented image

Figure 5: Grayscale image

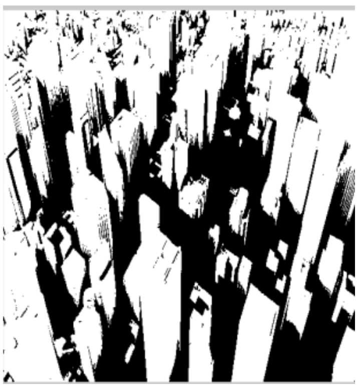

Figure 6: Shadow detection image

Figure 7: False shadow liminated image

Figure 8: Dark object removed from the shadow

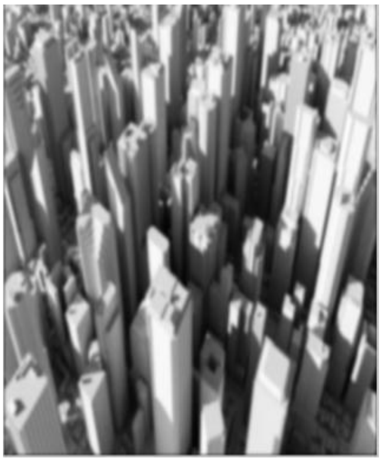

Figure 9: Gaussian smooth image

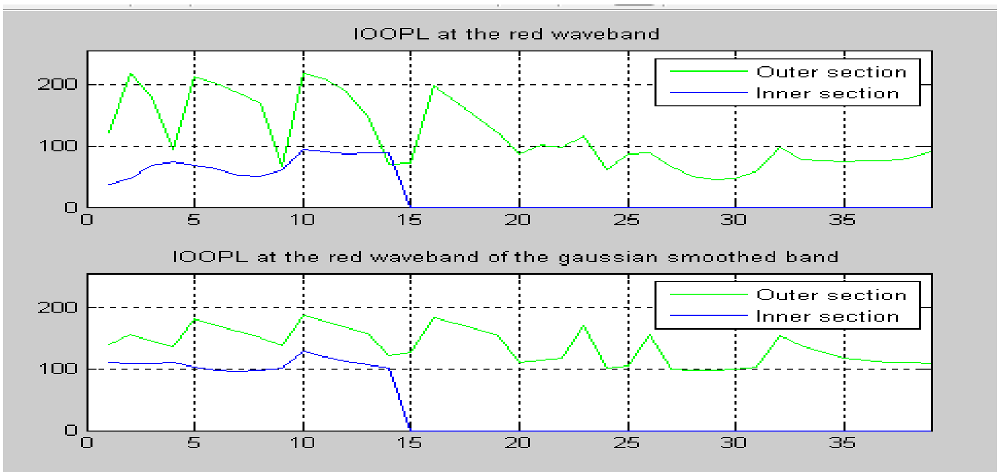

Figure 10: IOOPL graph generation

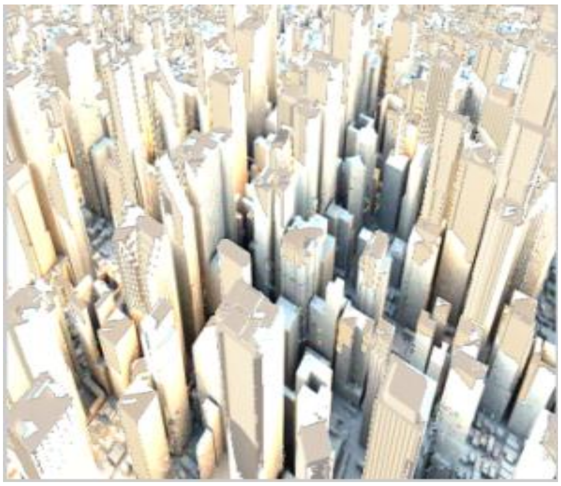

Figure 11: Shadow removed image

Evaluation Criteria

The grayscale value with the minimum frequency in the neighborhood of the mean of the two peaks as the threshold, as shown in

$$Gq = 1/2[(Gm + Gs)]$$
$$h(T) = \text{Min}\{h(Gq - \varepsilon), h(Gq + \varepsilon)\}. \qquad (2)$$

In the equations,

Gm is the average grayscale value of an image;

Gs stands for the left peak of the shadow in the histogram;

T is the threshold; ε represents the neighborhood of T, where $T \in [Gq - \varepsilon, Gq + \varepsilon]$; and $h(I)$ is the frequency of I, where $I = 0, 1, \ldots, 255$.

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

$$\text{DNref} = a \times \text{DNrect} + b.$$

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.

The gain and offset of the linear function can be estimated by the DN of the homogeneous sections. DNrect is the DN of the outer homogeneous sections, and DNrect is the DN of inner homogeneous sections. The radiation correction coefficients of the mean and variance method are

$$ak = Syk/Sxk;\ bk - yk' - ak \cdot xk'$$

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. All points of the shadow are corrected according to DNnonshadow = $ak \times$ DNshadow + bk ,where *DN*nonshadow 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.

In PF, 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

CONCLUSION

This paper presents an adaptive image contrast based document image Binarization technique that is tolerant to different types of document degradation such as uneven illumination and document smear. The proposed technique is simple and robust, only few parameters are involved. Moreover, it works for different kinds of degraded document images. The proposed technique makes use of the local image contrast that is evaluated based on the local maximum and minimum. The proposed method has been tested on the various datasets. Experiments show that the proposed method outperforms most reported document Binarization methods in term of the F-measure, PSNR, etc.

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Further improvement of this paper is applying Sauvola's Binarization method instead of Otsu's Binarization technique. Sauvola's works slightly better than Otsu's Binarization technique. Finally we measure the image quality performance. In Sauvola's Binarization color space conversion and morphological filtering are used.

REFERENCES

[1] PM Dare. Photogramm Eng Remote Sens 2005;71(2):169–177.
[2] VJD Tsai. IEEE Trans Geosci Remote Sens 2006;44(6):1661–1671.
[3] H Ma, Q Qin, and X Shen. Proc IEEE IGARSS 2008;2:1036–1039.
[4] K-L Chung, Y-R Lin, and Y-H Huang. IEEE Trans Geosci Remote Sens 2009;47(2):671–682.
[5] W Zhou, G Huang, A Troy, and ML Cadenasso. Remote Sens Env 2009;113(8):1769–1777.
[6] Ruiqi Guo, Qieyun Dai, and Derek Hoiem. Single-image Shadow detection and removal using Paired regions, An IEEE Conference Comput Vis Pattern Recog., pp.2033-2040, 2011.
[7] Aliaksei Makarau, Rudolf Richter, Rupert Muller, and Peter Reinartz. IEEE Trans Geosci Remote Sens 2011; 49(6):2049-2059.
[8] Jiahang Liu, Tao Fang, and Deren Li. IEEE Trans Geosci Remote Sens 2011.
[9] Wenxuan Shi, and Jie Li. Eurasip J Adv Signal Proc 2012.
[10] Chengfan LI, Jingyuan YIN, Junjuan ZHAO, and Feiyue YE. Int J Adv Comp Technol 2011;3(7):
[11] MacielZortea, Arnt-Børre Salberg, and Øivind Due Trier, "Object-based cloud and cloud shadow detection in landsat images for tropical forest monitoring," Proceedings of the 4th GEOBIA,2012.
[12] Sun Kaimin, Li Deren, Sui Haigang, Liu Junyi, and Ma Guorui. Object level change detection based on high-resolution remote-sensing images and its application in japanese earthquake in March 11,2011 ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume 1-7, 2012.
[13] Q Ye ,H Xie, and QX. Removing shadows from high-resolution urban aerial images based on color constancy. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume I-7, September 2012.
[14] Jyothisree V, and Smitha Dharan. Int J Comp Sci Inform Technol 2013;5(2).
[15] Amol D Dharmadhikari, and MS Deshpande. Int J Eng Res Technol 2014;3(4).