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A Review "Reconstruction of Shadow Areas in VHR Images"

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Abstract: Shadow reconstruction in VHR images is an interesting field. Most of the analysis for the shadow detection and shadow reconstruction is based on the image analysis. So far analysis of such kind of VHR images is very challenging. Reconstruction of shadow areas in VHR images are classified as shadow detection, shadow removal, shadow reconstruction. The resolution of reconstructed image is improved using bilateral filter. The reconstruction result is based on the parameter like PSNR. As we are comparing shadow areas with the non shadow areas, morphological analysis is necessary for the proper reconstruction. The different parameters of image is discussed and explained in this paper.

Keywords: VHR images, Morphological analysis, shadow detection, PSNR,

I. INTRODUCTION

The new era for the very high resolution (VHR) satellite images are discussing everywhere especially in the remote sensing field. VHR images give the detailed information about the little object like tress, roofs, and vehicle and building structures. In the other side VHR images having some drawbacks like the unwanted presence of shadow, variable and long shadows.

Usually shadows are affecting the images which will strongly affecting the information present in the shadow. Shadow may caused severe problem like false colour tone, wrong shape and size of object. This will create a major problem for the remote sensing image seller and user. As a presence of shadow even in the VHR images will lead to the loss of information which can turn the interpretation in negative direction. To overcome this drawback and to increase the accuracy, necessary steps are 1) shadow detection and shadow reconstruction. In this paper the following sections are classified.Problem Origination., Proposed Methods, Experimental result and Conclusion

II PROBLEM ORIGINATION

In VHR images specially in metropolitan areas, In the presence of shadow information present in those images may be completely destroy. Missing information in shadow areas directly affects the common processing and analysis operations such as generation of Google maps. Normally the shadow appears when the object comes in the direct contact with the lighting source (Sun). Though shadows are divided into two different classes. 1) Cast shadow. 2) Self shadow, shows in figure.1 when the projection of light source is in the direction of the object shadow is generated called Cast shadow; cast shadows are always having a vicious distinction to background. And the part of the object that is not illuminated directly by the light source is called the self shadow. Self shadows are unclear, indistinct shadows and do not have clear boundaries.

In this paper, the reason for which the detection of shadows is made through hierarchical supervised classification process are 1) a separation between shadow and non shadow areas in the given image and 2) To identify the differently non shadow classes as well as their corresponding shadow counterpart. Certainly denoting the shadow class as $X \sim N(\mu_s, \sigma_s^2)$ and the corresponding non shadow class as $Y \sim N(\mu\overline{s}, \sigma^2\,\overline{s})$, the reconstruction of shadow class will be reduced to a simple random variable transformation.

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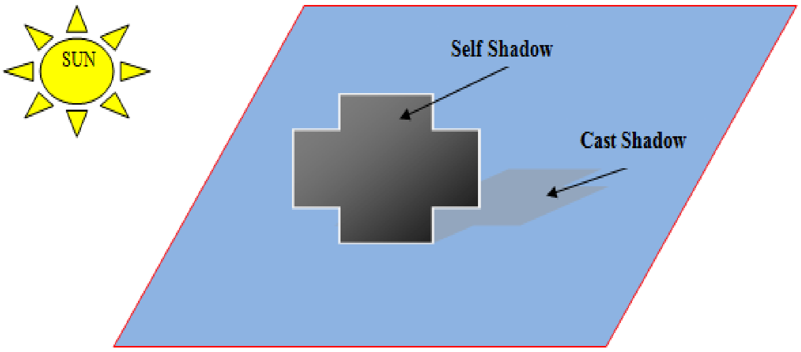

Fig. 1 Illustration of cast and self shadow

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III PROPOSED METHODOLOGY

Figure.2 shows a flowchart with the steps of the proposed methodology. In brief, let us consider a VHR image I of dimensions m × n, composed of N bands and characterized by the presence of shadow areas. The resulting image will allow performing first a binary classification in order to distinguish between shadow and non shadow regions. To deal with noise, which may result in the obtained binary mask M, two mathematical morphological operators are applied, namely, opening and closing by reconstruction [1] &[2]. After the morphological filtering one need to do the border creation for shadow portion and non shadow portion. Such classification allows the localization of the available couples of shadow and non shadow related to the same object and, thus, to define the spectral relationship between them as a means to perform the reconstruction of the shadow areas. In particular, the reconstruction is based on a linear regression method to compensate shadow regions where the intensities of the shaded pixels are adjusted according to the statistical characteristics of the corresponding nonshadow regions. Finally, the border between the reconstructed shadow and the nonshadow areas undergoes a linear interpolation operation to yield a smooth transition between them. In the following sections, a detailed description of all these steps is provided.

A Mask Creation

The non shadow verses shadow mask is constructed by two different methods namely 1) Binary Classification and 2) Postprocessing.

i *Binary Classification*:- Implementation of binary classification procedure in a supervised way by means of a support vector machine(SVM), which proves its effectiveness in the literature of remote sensing data classification [3]-[5].The features of the original image band is extracted by means of the wavelet transform. Wavelet coefficients are of high value on the presence of singularities [6]. For an original image I composed of B spectral bands, the resulting space thus consist of B × (1+4) dimension.

ii *Postprocessing* :-In postprocessing process basically morphological filtering is done to remove isolated shadow pixels in a non shadow area and to remove isolated non shadow pixels in shadow area. By applying proper choice of filter will attenuate this problem. An opening by reconstruction followed by closing by reconstruction i.e dilated and eroded is refer to opening and closing respectively.

B ***Border Creation***

The conversion between shadow and non shadow areas can caused problems such as boundary ambiguities, color invariation and illumination variation. The border portion is constructed by morphological operators. The mask c_impB2 is dilated (δ) and eroded (ε). Then the difference between these two images is computed to form the border image B.

B[X,Y]=δ(c_impB2[x,y])- ε(c_impB2[x,y]).

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C Shadow Removal

i *Multiclass Classification*:- The previously obtained mask is exploited to guide a further level of classification applied separately to the shadow and non shadow areas. The aim is to distinguish between the different predefined non shadow classes on the one side and the corresponding shadow classes on the other side. The result is a final classification map C, which is important to define the spectral relationship between the shadow and non shadow versions of the same object (class) and, thus, to perform customized reconstruction of shadow areas. For such purpose, two multiclass SVMs are trained in the feature space described earlier for the shadow and non shadow classifications, respectively. After the training phase, to generate C, both are applied to predict the label of each pixel of the corresponding areas, shadow and non shadows, respectively, defined in M_F.

ii *Postclassification*:- Improvementation of the classification map before exploring it for the reconstruction of shadow areas postclassification is applied by adopting a simple 3X3 majority filter for removing isolated labels and thus, smoothing the map.

iii *Shadow reconstruction* :- Image reconstruction is one of the most important steps in our methodology. As done in the literature [7]-[10] for the sake of getting a simple but satisfactory reconstruction model, we assume that the underlying relationship between the non shadow class (Y) and the corresponding shadow classes (X) is of the linear type. We have empirically observed that shadow classes and the corresponding non shadow classes reasonably exhibit a linear relationship. Regarding the statistical model of the classes, three estimation ways may be envisioned: 1) histogram estimation by box counting; 2) kernel density estimation; or 3) parametric estimation. In our case, we will adopt the last method by assuming that the classes follow a Gaussian distribution. This is motivated by the need to derive an analytically tractable and easy-to-implement reconstruction method. Under this assumption, $X \sim N(\mu S, \Sigma S)$ and $Y \sim N(\mu S, \Sigma S)$, where μ and Σ stand for the mean and covariance matrix, respectively. Since the two distributions are assumed linearly correlated, x and y may be linked by

$$y = Kx + c$$

$$\mu_{\bar{S}} = K\mu_S + c$$

$$\mu_{\bar{S}} = K\Sigma_S K^T$$

where K is a transformation matrix, K^T is its transpose, and c a bias vector. To estimate K and c, the Cholesky factorization is applied.

D Bilateral Filter

Bilateral filtering smoothes images while preserving edges, by means of a nonlinear combination of nearby image values. The method is noniterative, local, and simple. It combines gray levels or colors based on both their geometric closeness and their photometric similarity, and prefers near values to distant values in both domain and range. Oh et al. [11] describe a “texture-illuminance decoupling filter”, which uses the bilateral filter to decouple large and small-scale features thereby discounting the effect of illumination on uniformly textured areas. This method assumes that all large scale variations on such surfaces come from changes in illumination and does not handle detailed shadows of small objects correctly. Furthermore, the user is required to specify the texture feature size

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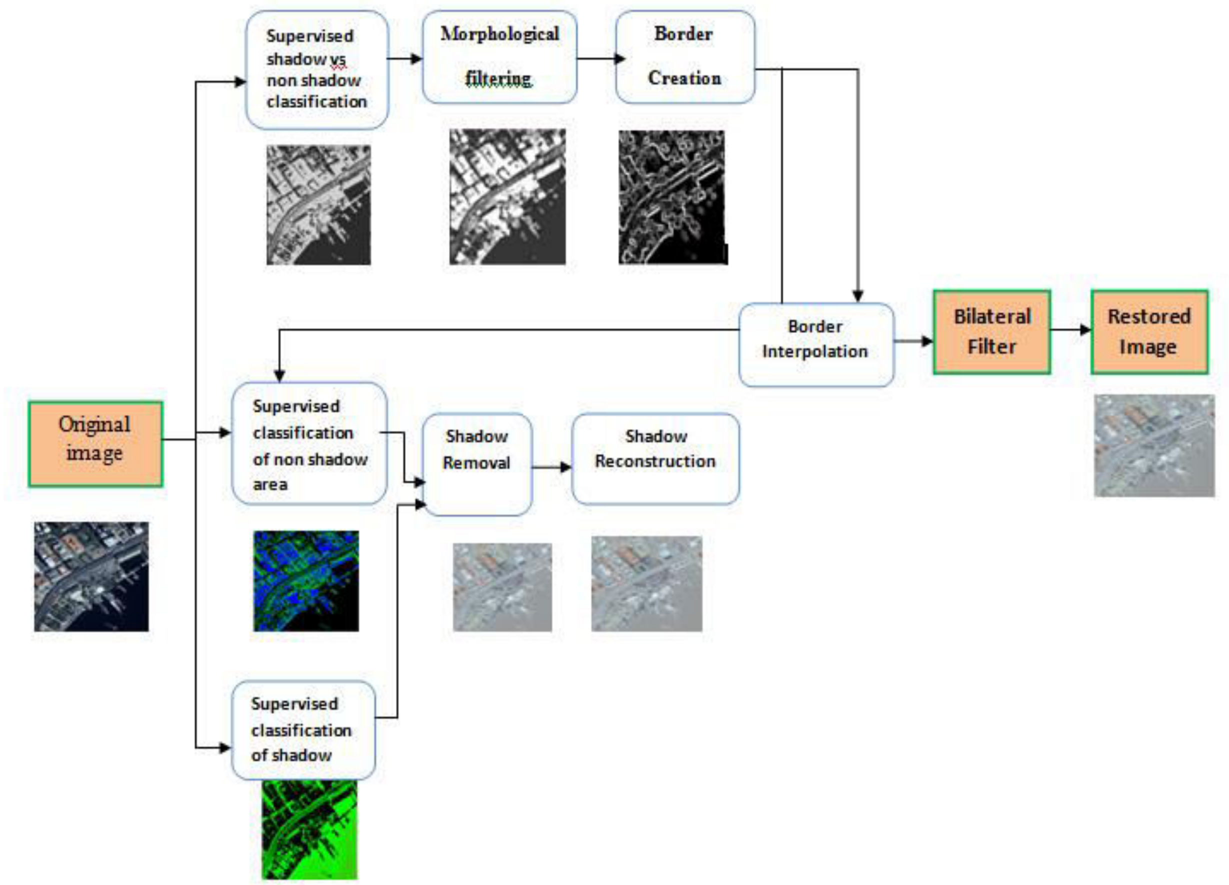

Fig. 2 Flowchart of the proposed Method

IV. EXPERIMENTAL RESULT

A) Experimental result:- To calculate the performance of the proposed method, a satellite VHR image is used for analysis.

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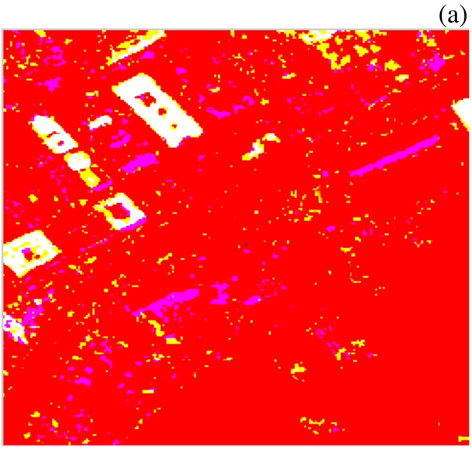
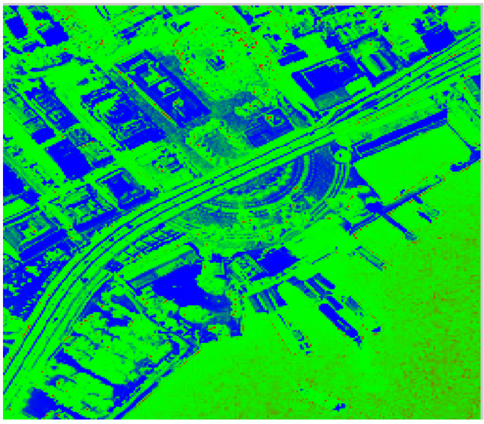
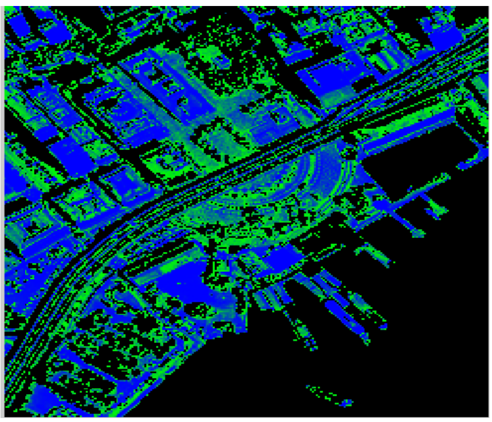
(a)



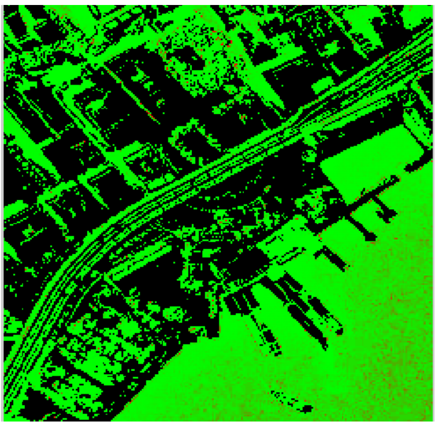
(b)



(c)



(d)



(e)

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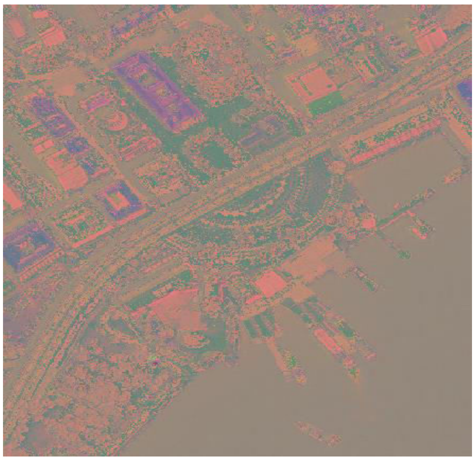
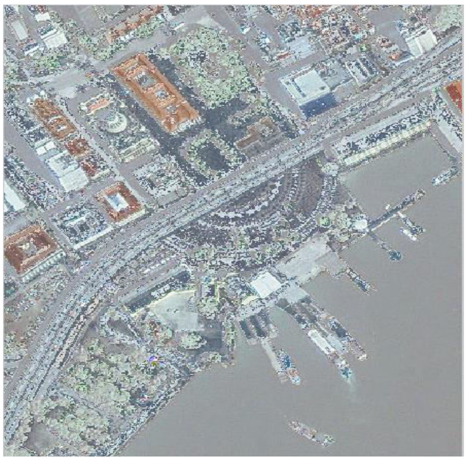


(f)



(g)

(h)

Fig. 3 Reconstruction results for VHR image.(a) Original image. (b) Color based clustering. (c) Shape modal output (d) Shadow classification. (e) Non shadow classification. (f) Shadow removed Ycbcr. (g) Reconstructed image. (h) Reconstructed filtered image

V CONCLUSION

Literature study reveals that all research were made for reconstruction of shadow image with poor resolutions. In current study we used same methodology with addition of bilateral filter to increase resolution of reconstructed image. Results were found to be good as compared to other techniques, in terms of increased resolutions.

REFERENCES

[1]. P. Soille, *Morphological Image Analysis*. New York: Springer-Verlag, 1999.

[2]. J. A. Benediktsson, M. Pesaresi, and K. Amason, "Classification andfeature extraction for remote sensing images from urban areas based on morphological transformations," *IEEE Trans. Geosci. Remote Sens.*,vol. 41, no. 9, pp. 1940–1949, Sep. 2003.

[3]. N. Ghoggali and F. Melgani, "Genetic SVM approach to semisupervised multitemporal classification," *IEEE Geosci. Remote Sens. Lett.*, vol. 5, no. 2, pp. 212–216, Apr. 2008.

[4]. E. Pasolli, F. Melgani, and M. Donelli, "Automatic analysis of GPRimages: A pattern recognition approach," *IEEE Trans. Geosci. RemoteSens.*, vol. 47, no. 7, pp. 2206–2217, Jul. 2009.

[5]. T. Habib, J. Inglada, G. Mercier, and J. Chanussot, "Support vector reductionin SVM algorithm for abrupt change detection in remote sensing,"*IEEE Geosci. Remote Sens. Lett.*, vol. 6, no. 3, pp. 606–610, Jul. 2009.

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[6]. R. Singh, R. E. Vasquez, and R. Singh, "Comparison of daubechies,coiflet, and symlet for edge detection," in *Proc. SPIE VI Process.*,Jul. 1997, vol. 3074, pp. 151–159

[7]. S. Wang and Y. Wang, "Shadow detection and compensation in highresolution satellite images based on retinex," in *Proc. 5th Int. Conf. ImageGraph.*, 2009, pp. 209–212

[8]. P. Sarabandi, F. Yamazaki, M. Matsuoka, and A. Kiremidjian, "Shadowdetection and radiometric restoration in satellite high resolution images,"in *Proc. IEEE IGARSS*, Sep. 2004, vol. 6, pp. 3744–3747

[9]. T. Nakajima, G. Tao, and Y. Yasuoka, "Simulated recovery of information in shadow areas on IKONOS image by combining ALS data," in *Proc. GIS Develop.*, 2002, pp. 1–7.

[10]. F. Yamazaki, W. Liu, and M. Takasaki, "Characteristic of shadow andremoval of its effects for remote sensing imagery," in *Proc. IEEE IGARSS*,Jul. 2009, vol. 4, pp. 426–429.

[11]. (OH B. M., CHEN M., DORSEY J., DURAND F.:Image-based modeling and photo editing. In Proc. SIGGRAPH2001 (2001), ACM Press, pp. 433–442.)

BIOGRAPHY

Ms. Supriya A. Hadke received the B. E. degree in Electronincs and telecommunication from the SRTMU, Nanded, India in 2007. Currently she is working toward the M. Tech degree in Electronics Communication. Her research interests include image processing and reconstruction techniques.