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SIMULTANEOUS INTENSITY BIAS ESTIMATION AND STRIPE NOISE REMOVAL IN INFRARED IMAGES USING THE GLOBAL AND LOCAL SPARSITY CONSTRAINTS

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ABSTRACT:

Infrared (IR) images are often contaminated by obvious intensity bias and stripes, which severely affect the visual quality and subsequent applications. It is challenging to eliminate simultaneously the mixed nonuniformity noise without blurring the fine-image details in low-textured IR images. In this article, we present a new model for simultaneous intensity bias correction and destriping through introducing two sparsity constraints. One is that model fit on the intensity bias should be as accurate as possible. A bivariate polynomial model is built to characterize the global smoothness of the intensity bias. The other constraint is that the unidirectional variational sparse model can concisely represent the direction characteristic of stripe noise. A computationally efficient numerical algorithm based on split Bregman iteration is used to solve the complex optimization problem. The proposed method is fundamentally different from the existing denoising techniques and simultaneously estimates the sharp image, intensity bias, and stripe components. Significant improvement on image quality is achieved on both simulated and real studies. Both qualitative and quantitative comparisons with the state-of-the-art correction methods demonstrate its superiority.

INTRODUCTION

In this chapter we give the basic brief enquiry of core notions. We also show how the proposed work framework for studying of infrared noisy imagery. Digital images are prone to a variety of types of noise. Noise is the result of errors in the image acquisition process that result in pixel values and do not reflect the true intensities of the real scene.

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There are several ways that noise can be introduced intoan image, depending on how the image is created. For example if the image is scanned from a photograph made on film, the film grain is a source of noise. Noise can also be the result of damage to the film or introduced by the scanner itself. If the image is acquired directly in a digital format, the mechanism for gathering the data (such as a charge-coupled device (CCD) detector) can introduce noise. Electronic transmission of image data can introduce noise. Noise is considered to be any measurement that is not part of the phenomena of interest. Noise can be categorizedas image data independent noise and image data dependent noise. The remote Digital Image Processing is a promising area of research in the fields of electronics and communication engineering, consumer and entertainment electronics, control and instrumentation, biomedical instrumentation, infrared, robotics and computer vision and computer aided manufacturing (CAM). For a meaningful and useful processing such as image restoration, image segmentation and object recognition, and to have very good visual display in applications like television, photo-phone, etc. The acquired image signal must be deblurred and made noise free. The deblurring and noise suppression (filtering) come under a common class of image processing tasks known as image restoration.

LITERATURE REVIEW

Infrared is very useful tool and we can apply it in many fields, because they help to give a good view and provide a solution for the problem. At the initial stage of the present study, a collection of research work, related to Denoising satellite is examined extensively, so that proper guidelines and directions from their objectives, methodologies and findings may be sought to assist the various steps of the present study like depicting motivation, determination of objectives, selection of methodology and to get deep understanding of the subject. Following is the chronological ordered literature discussed related to the topic. It includes Infrared Journal, Image and Vision Computing, IEEE Transactions, ISPRS Annals of the Photogrammetry etc.

Denoising Infrared (IR) Images

In ecent years, several classes of denoising algorithms are used such as Total Variation (TV), wavelets means have all achieved much success. These algorithms are based on different theories and all show good performance in denoising [1] [2] [3]. When denoising an image, the TV method makes use of the geometric features of the image. The wavelet method makes use of the statistical features of the coefficients and the nonlocal means method makes use of the redundancy in the image texture features

[4]. However, the features that have been used by these methods all come from the noisy image itself. In fact, the image features acquired by other sensors from the same scene can also be used as priors in denoising.

Literature Review on Denoising IR Images

Sun and et al., [2008], provided an impulse noise image filter using fuzzy sets. The successful use of fuzzy set theory performance on many domains [10], together with the increasing requirement for processing digital images, have been the main intentions following the efforts concentrated on fuzzy sets. Fuzzy set hypothesis, contrasting with some other hypothesis, can offer us with knowledge based and robust means for image processing. By calculating the fuzziness of the pixels affected degree and taking equivalent filter parameters, a novel image filter for suppressing theimpulse noise is proposed. The proposed filter is more effective when compared to the median filter which is good for suppressing the impulse noise. Finally, the experimental result shows the feasibility of the proposed filtering technique .

Jung C. R, Scharcanski J. and et al., [2010], in the proposed a new method for image denoising with edge preservation, based on image multiresolution decomposition by a redundant wavelet transform. In this approach, edges are implicitly located and preserved in the wavelet domain, while noise is filtered out. At each resolution, the coefficients associated to noise and coefficients associated to edges are modeled by Gaussians and a shrinkage function is assembled. The shrinkage functions are combined in consecutive resolution, and geometric constraints are applied to preserve edges that are not isolated. Finally, the inverse wavelet transform is applied to the modified coefficients. This method is adaptive and performs well for images contaminated by natural and artificial noise. However, these parameters could be fine-tuned to each individual image to produce optimal results. Guo-shi Yang, Yun-xia Liu, [2010], they proposed new noise reduction method based on Wavelet modulus maximum for Chaotic signals and noise.

Xiang-Yang Wang and et al., [2013], this work is considered Denoising of images is one of the most basic tasks of image processing. It is a challenging work to design an edge-preserving image denoising scheme. Extended discrete Shearlet transform (extended DST) is an effective multiscale and multi-direction analysis method, it not only can exactly compute the shearlet coefficients based on a multiresolution analysis, but it also can provide nearly optimal approximation for a piecewise smooth function. Based on extended DST, an image denoising using fuzzy support vector machine (FSVM) is proposed. Firstly, the noisy image is decomposed into different subbands of frequency and orientation responses using the extended DST. Secondly, the feature vector for a pixel in a noisy image is formed by the spatial regularity in extended DST domain, and the FSVM model is obtained by training.

Arundhati Misra and et al., [2014], in this work they have study a real world signals which are affected by noise, in the communication signals for remote sensor signals, Wavelet transforms are now being adopted for a vast number of applications, often replacing the conventional Fourier Transform. Wavelet based denoising are being chosen in order to circumvent this problem .

EXISTING SYSTEM

In this work we are concerned with the filtering of a infrared image for additive noise when noise is statistically independent processes. In most of the recent work one or both of the following aspects of the problem are emphasized: the characterization of the filter belonging to some class and the determination of the filter of this class which is optimum in some sense. Our purpose here is slightly different, and with the ultimate goal of gaining some insight into the process of filtering noise infrared images, we study the performance of optimum and nonoptimum filters. We note that for a given noise and a specific error criterion the infrared image statistics determine formally the optimum filter and the resulting performance. Whether or not the performance is satisfactory will depend upon the message statistics, and we would like to know the characteristics of the infrared image and its type of sensor which lead to a good or poor separation from the noise. We study specifically linear filters and nonlinear as well as Wavelet Filters.

PROPOSED SYSTEM

This paper reviews recent advances in FPN correction, including traditional NUC methods and specific correction methods for single-frame image stripe nonuniformity. Traditional NUC algorithms are included within two major categories, namely calibration-based methods [18–20] and scene-based methods [21–24]. Algorithms within the first category are simple. They employ the two-point calibration method as a classic calibration algorithm. A surface source black body is used to provide a reference temperature to calibrate the detector response by measuring two different known radiations. However, this method increases the complexity and power consumption of the infrared imaging system, and cannot achieve real-time correction of the system. The second category encompasses several common strategies such as constant statistical methods, filtering estimation methods, and image registration methods. In general, these scene-based NUC methods perform stripe noise correction of the image by reasonably estimating the model parameters. However, the limitation of this scene algorithm is that it requires multiple frames of images to obtain a stable correction factor, which requires a large amount of hardware resources to be consumed in actual engineering. Furthermore, the scene-based NUC algorithm requires images to have sufficient scene motion. Otherwise, it will cause blurring of the edge of the target object in the image. In recent years, a large number of single-frame NUC algorithms have been proposed [25–27]. It can be divided into methods based on gray statistics [12, 13, 28], spatial filtering [4–6] and constrained optimization [29– 31]. The first assumes that the histograms between adjacent columns of the infrared image are essentially the same. Therefore, the new histogram for each column can be modified by the associated histogram of the adjacent columns. The second application of spatial filters to smooth the non-uniformity of the fringes usually requires setting thresholds to distinguish edge information and noise to achieve edge retention,the selection of the threshold has a greater impact on the de-striping effect of the algorithm. However, when the texture information of the image is weak, The algorithm may mistakenly delete the structural information as noise or retain the strong stripe noise as texture information, and the correction effect is not ideal. The third is to convert stripe noise into a problem of minimizing the energy function, and the horizontal gradient is as smooth as possible while the vertical gradient should be kept as much as possible. Proposed to consider the characteristics of strip noise and the spectral information of remote sensing images at the same time, and use the stripe noise problem as an image decomposition.

Fig.1. Input image.

However, in Figs. 6(c) and 7(d), both stripes and intensity bias are perfectly removed by the proposed method without introducing any noticeable artifacts. From the above-mentioned analysis, we can find that the proposed method is robust to both strong intensity bias and stripe, and performs much better than other correction methods in terms of image structure preserving, bias estimation, and stripe removal. This is mainly because the following holds. First, a significant advantage of the proposed model for estimating background bias is to adaptively determine the smoothness degree for the estimated bias. The intensity bias may be underestimated or overestimated if the smoothness degree cannot be guessed correctly by the user.

Fig.2. Output results.

CONCLUSION AND FUTURESCOPE

In this article, we have proposed a new NUC model to simultaneously estimate the stripe and intensity bias from low-textured IR noisy images. Different from previous NUC models, the salient characteristics of the stripe component, bias component, and image component have been considered. With the constraints of these properties, the proposed model can precisely separate the mixed noise component and maintain the fine structure of original IR data. In order to solve this nonconvex and nonsmooth optimization model, the SBIA has been applied due to its fast convergence and superior numerical stability. Several simulated and real data sets were tested in our experiments. Both the qualitative and quantitative assessments confirm that the proposed model can output better NUC results than other state-of-the-art techniques of UTV, ASSTV, LRID, and GF. Although the parametric model works well on various kinds of intensity bias, a great mount of matrix computations are needed in the process of solving the coefficients of parametric bias. To avoid this, a robust nonparametric model may be a better choice, which directs the update of the future work. In addition, horizontal or vertical stripes are removed well by our method, but there are still limitations for oblique stripes in the IR images. Thus, we focus on the higher efficiency and better performance of the optimization model in the future.

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