A NEW APPROACH FOR DENOISING CFA IMAGE

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ABSTRACT

A CFA which is used in digital camera is a mosaic of selective filters, allows only one color component to respond at each pixel. The missing color has to be interpolated called color demosaicking (CDM). The traditional approach employ a separate denoising process after demosaicking but the drawback with this approach is that the untreated sensor noise before demosaicking can become the root of new color artifacts and this artifacts are difficult to remove. At the same time the author proposed methodology of providing denoising process before demosaicking using PCA which improves the image quality. This also shows visual quality and PSNR of original CFA image, image after denoising and final image after demosaicking.

INDEX TERMS

Color filter array (CFA), Demosaicking, Principal Component Analysis (PCA)

INTRODUCTION

Digital camera is one of the popular consumer electronic device. All electronic devices generate noise which become a common problem. The background hiss of a radio, the distorted sound of an over-amplified electric guitar, or the snow of interference on a badly-tuned television, some of it is internal noise generated by imperfection in the electronic components, all of these things are electronic noise, and so is the image noise in a digital photograph. Digital cameras work with a sensor. Sensors receive light and process it into electric charges, whose outputs are reflected as pixels in final digital image. These electrical charges tell the sensor what color each corresponding pixel is meant to be and other information which will create the digital image. This causes a degradation in quality of image. So denoising become a main concern by modifying image parameter like brightness, contrast, light luminance etc.

Single sensor camera uses only one sensor. Between the optical lens and pixel array in image sensor, there exists CFA, which makes each pixel produce only one color of the three primary colors. The most common pattern is Bayer pattern.

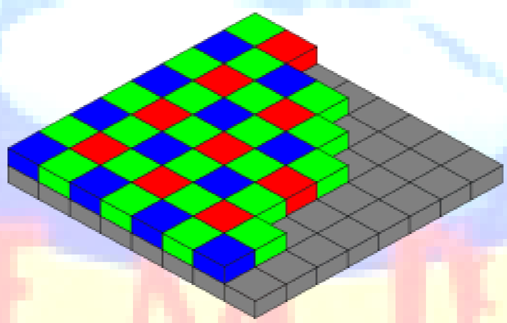

Fig 1 Bayer Pattern

The filter pattern is 50% green, 25% red and 25% blue, hence is also called RGBG, GRGB or RGGB. CFA allows allows only one color to be measured at each pixel. This means rest of the two color has to be interpolated or estimated. This estimation process is known as color demosaicking. This work is directly applicable to the CFA image.

METHODOLOGY

Previous algorithm assume the CFA data to be noise free, but practically it is impossible. To suppress the noise effect, three techniques are possible.

a) Denoising after demosaicking [1-4]

A convenient strategy to remove noise is to denoise the demosaicked images. The problem of this strategy is that noisy sensor readings are roots of many color artifacts in demosaicked images and those artifacts are difficult to remove by denoising the demosaicked full-color data. In this case noise has been introduced at CFA data also as well as after the demosaicking which does not produce better results

b) Joint demosaicking denoising [5-7]

In this, we estimate red, green and blue signals. LMMSE method is used to estimate the signals from the noisy environment. From the estimated signal we derive a full resolution green image, on which the original sensor noise is superimposed. The new wavelet based denoising method is used to remove the noise from the green channel. Anchored on the denoised green image, the green and blue channels are recovered.

c) Denoising before demosaicking

The third way to remove noise from CFA data is to implement denoising before demosaicking .The CFA image can be divided into several sub-images using the approach known from the CFA image compression literature .The desired CFA image is obtained by restoring it from the enhanced sub-images. The volume of CFA images is three times less than that of the demosaicked images, there is a demand to develop new denoising algorithms which can fully exploit the interchannel correlations and operate directly on CFA images, thus achieving higher processing rates.

EXPERIMENTAL RESULTS

The experiment is simulated on the test image. It is chosen for the experiment as the image has a significant amount of color texture, which can be used to determine the effectiveness of demosaicking method. The result are obtained in term of image quality and PSNR .

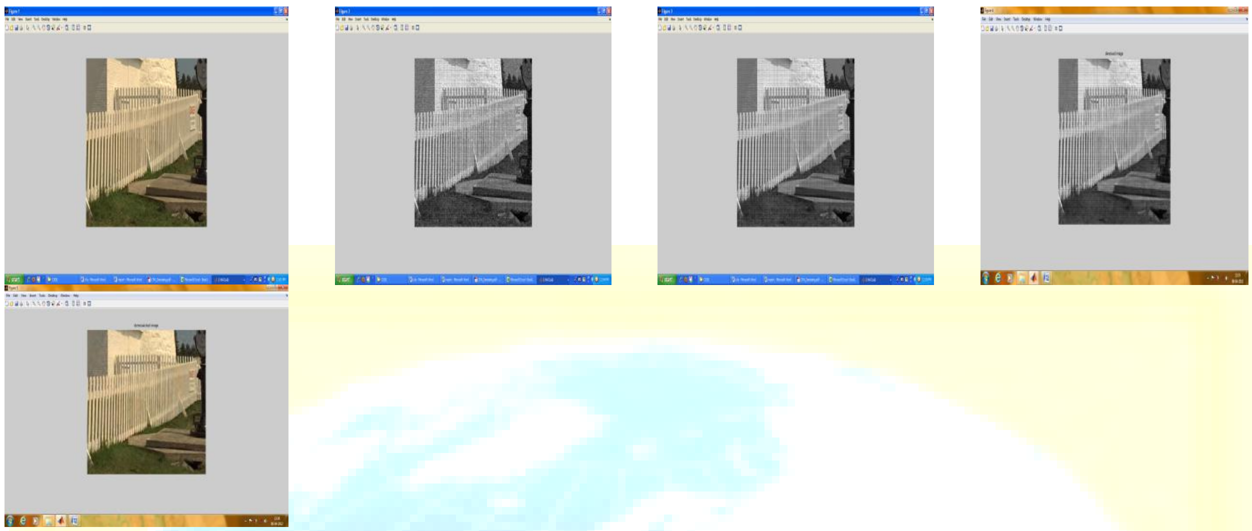

Fig 2. Test images numbered from left to right and top to bottom: (a) Original image; (b) CFA image; (c) Noisy CFA image; (d) CFA image after noise reduction; (e) Demosaicked image

The test image with the resolution of 512 x 768 pixels is used. To simulate CFA data, Gaussian noise was added separately to red, blue and green channels of mosaic images.

S.No.	STATUS	PSNR(dB)
1	Original Image (CFA)	26.6904
2	After Denoising (CFA)	31.3873
3	After Demosaicking (Full Image)	R=30.6746 G=31.3897 B=31.4496

Table 6.1 PSNR values for different image

The denoising results of CFA image by showing difference in image between the denoised CFA images and the original CFA image. This work finds that the proposed PCA based CFA denoising scheme achieves the highest PSNR value after denoising CFA and after demosaicking the full image, the PSNR values of red, green and blue has been achieved.

Conclusion

Performance of denoising algorithm is measured using quantitative performance measures such as peak signal to noise ratio as well as in term of visual quality of the images. This work provide an efficient new method of removing the noise in the CFA data by providing the denoising operation before the demosaicking.

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