A Pattern Allocation for Color Upsampling

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Abstract. In this paper, an issue of the Bayer pattern color filter array (CFA) demosaicking method is explained. As most digital cameras capture only one color component at each spatial position, the rest components must be restored by interpolation approach. Therefore, our goal is to propose an algorithm to restore each color component with satisfactory subjective performance while consuming minimal computational complexity.

Keywords: Bayer pattern CFA, color interpolation, pattern configuration

1 Introduction

Images captured by digital camera require filters to be shown on the sensors such as CCD or CMOS [1-3]. These required filters are allocated in preconcert way along the location of the sensors [4,5]. The Bayer pattern color filter array (CFA) is one of the most well used CFA. Normally, RGGB pattern is widely used but there can be few other configurations of CFA filters are possible.

In color image, each pixel has three colors: red (R), green (G) and blue (B). During the mosaicking process, CFA images may lose two color components (out of three), and this information must be restored by interpolation approaches such as NN (nearest-neighbor), BI (bilinear), or BC (bicubic) methods [6-10]. In general, these methods provide severe aliasing in color planes [11-13]. Therefore it can be concluded that individual plane-based approach is not effective. Some methods use filters. These methods perform demosaicking in frequency domain [14,15] and all filters are pre-designed and image aliasing is less shown than the spatial domain methods.

In this paper, we study and analysis performance of three possible Bayer CFA which has three combinations: RRGB, RGGB and RGBB. The article is arranged as follows. Section 2 explains the proposed method. Section 3 shows simulation results in terms of subjective performance. Finally, Section 4 describes conclusion remarks.
2 Proposed Method

An example of diagonal pattern CFA is shown in Fig. 1. Figure 2 shows how RRGB, RGGB, and RGBB Bayer pattern CFA are acquired. In diagonal pattern CFA, the red, green, and blue components are allocated in diagonal direction. In Fig. 1, the figure which is located in the first column is the diagonal pattern CFA. The three images located in the second row display original color components in each color plane. Next, the three images located in the third row are restored images after demosaicking. The unwanted color artifacts are introduced in this stage. Finally, the figure in the last column is reconstructed image. It is noted that R (or G, B) and r (or g, b) are original and restored color information, respectively.

Fig.1. A CFA example: diagonal pattern CFA and its restoration.

Fig.2. Bayer pattern CFA acquisition: RRGB, RGGB, and RGBB.
3 Simulation results

In this section, we use two images, #23 and #24 LC dataset. In particular, we assumed RRGB case for comparison. Figure 3(a) shows the CFA image. Figures 3(b) and 3(c) show green and blue components of the Fig. 3(a). Figure 3(c) shows the red component restored image. Figure 3(e) shows demosaicking image, which is similar to the original image (Fig. 3f).

![Simulation results on #23 LC image](image1)

Fig. 3. Simulation results on #23 LC image: (a) CFA image, (b) green channel, (c) blue channel, (d) restored red component, (e) restored color image, and (f) original image.

A similar simulation was conducted by using #24 LC image. Figure 4(a) displays the CFA image. Figures 4(b) and 4(c) display green and blue components of the CFA image. The demosaicked red component is shown in Fig. 4(d). Finally, the restored image is compared with the original #24 image, which are shown in Fig. 4(e) and Fig. 4(f).
Fig. 4. Simulation results on #24 LC image: (a) CFA image, (b) green channel, (c) blue channel, (d) restored red component, (e) restored color image, and (f) original image.

4 Conclusion

In this paper, we studied a demosaicking method in Bayer CFA. Our goal was to propose a restoration method in each color component. The method should require less computations while provide satisfactory objective and subjective performances. Simulation results used two images for the comparison.
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References