Study of Color Interpolation Techniques for Color Filter Array Demosaicking

張珮毓、陳文儉

E-mail: 9707255@mail.dyu.edu.tw

ABSTRACT

Under the influence of digitization, digital still cameras (DSC) are becoming prevalent in recent years. The image capturing and file storing process of a digital still camera involves multiple image processing and precise corrective calculations. In order to reduce cost and volume, a digital still camera usually utilizes only one sensor and color filter array (CFA) for capturing images, and reconstructs a corresponding full-color image using a color interpolation method. Demosaicking is the first step of image processing of digital still cameras and has been integrated into the design of a variety of digital still cameras. If noise and blurred edges exist from the onset of image reconstruction, a post-processing can do little to improve the quality of the reconstructed image. A demosaicking method is proposed in this paper to prevent the occurrence of color artifacts. By detecting the edge characteristics of a digital image, accurate weights can be obtained for image interpolation, before refinement is made in post-processing. After comparing the experiment results of this paper with those of previously proposed methods, it is found that the proposed method can effectively reduce color artifacts and enhance image quality.

Keywords : Color Filter Array ; Demosaicking ; CFA Interpolation

Table of Contents

REFERENCES

[1] R. G. Keys,“ Cubic convolution interpolation for digital image processing,” IEEE Transactions on Acoustic, Speech and Signal Processing, vol. 29, no. 6, pp 1153-1160, 1981.

[2] W. T. Freeman,“ Median Filter for Reconstructing Missing Color Samples,” United States Patent, 4724395, 1988.

[3] D. R. Cok,“ Signal Processing Method and Apparatus for Producing Interpolated Chrominance Values in A Sampled Color Image Signal,” United States Patent, 4642678, 1986.

[4] R. H. Hibbard,“ Apparatus and Method for Adaptively Interpolating A Full Color Image Utilizing Luminance Gradients,” United States Patent, 5382976, 1995.

[5] J. E. Adams,“ Interactions between color plane interpolation and other image processing functions in electronic photography,” in Proc. SPIE. Cameras and Systems for Electronic Photography and Scientific Imaging, Mar. 1995, vol. 2416, pp. 144-151.

[6] S. C. Pei and I. K. Tam,“ Effective Color Interpolation in CCD Color Filter Arrays Using Signal Correlation,” IEEE Trans. Circuits and Systems for Video Technology, vol. 13, no. 6, pp. 503-513, Jun. 2003.

[7] Hamilton, J. F. Jr. and J. E. Adams, Adaptive Color Plane Interpolation in Single Sensor Color Electronic Camera, United States Patent, 5629734, 1997.

[8] Chang, E., S. Cheung, and D. Pan,“ Color filter array recovery using a threshold-based variable number of gradients,” in Proc. SPIE. Sensors, Cameras, and Applications for Digital Photography, Mar. 1999, vol. 3650, pp. 36-43.

[9] Li, X. and M. T. Orchard,“ New edge directed interpolation,” IEEE Trans. Image Processing, vol. 10, no. 10, pp. 1521-1527, 2001.

[10] R. Kimmel,“ Demosaicing: image reconstruction from CCD samples,” IEEE Trans. Image Processing, vol. 8, pp. 1221 – 1228, 1999.

[11] W. Lu, and Y. Tan,“ Color filter array demosaicing: New method and performance measeure,” IEEE Trans. Image Processing, vol. 12, no. 10, pp. 1194-1210, Oct. 2003.

[12] X. Li,“ Demosaicing by Successive Approximation,” IEEE Transactions on Image Processing, vol. 14, no. 3, March 2005.

[13] B. E. Bayer,“ Color imaging array”, U.S. Patent 3 971 065, July 1976.

[14] L. Chang and Y. P. Tam, “ Effective use of Spatial and Spectral Correlations for Color Filter Array Demosaicing ” , IEEE Trans. Consumer Electronics, vol. 50, no. 1, pp 355-365, Feb. 2004.
[15] K. Hirakawa and T.W. Parks, “ Adaptive homogeneity-directed demosaicing algorithm ” , IEEE Trans. Image Processing, vol. 14, no. 3, pp 360-369, Mar. 2005.
[16] C. Y. Tsai and K. T. Song, “ A new edge-adaptive demosaicking algorithm for color filter arrays, ” Journal of image and vision computing, vol. 25, pp 1495~1508, Sept. 2007.
[17] X. Wu and N. Zhang, “ Primary-consistent soft-decision color demosaicing for digital cameras ” , IEEE Trans. Image Processing, vol. 13, no. 9, pp 1263-1274, Sept. 2004.
[18] B. K. Gunturk, Y. Altunbasak and R. M. Mersereau, “ Color plane interpolation using alternating projections, ” IEEE Transactions on Image Processing, vol.11, no.9, 2002.
[19] http://r0k.us/graphics/kodak/