METHODS OF THE WAVELET TRANSFORM IN THE PROCESSING OF COLOR IMAGES

Abdumajidov Dostonbek Botir o`g`li [*]
[*] *Master, Faculty of Television Technology,*
Tashkent University of Information Technologies
named after Muhammad al-Khwarizmi, Uzbekistan

Abstract: *Many people use digital still cameras to take photographs in contemporary society. Significant amounts of digital information have led to the emergence of a digital era. Because of the small size and low cost of the product hardware, most image sensors use a color filter array to obtain image information. However, employing a color filter array results in the loss of image information; thus, a color interpolation technique must be employed to retrieve the original picture. Numerous researchers have developed interpolation algorithms in response to various image problems. The method proposed in this study involves integrating discrete wavelet transform (DWT) into the interpolation algorithm. The method was developed based on edge weight and partial gain characteristics and uses the basic wavelet function to enhance the edge performance and processes of the nearest or larger and smaller direction gradients. The experiment results were compared to those of other methods to verify that the proposed method can improve image quality.*

Keywords. *Wavelet, Image, CCD, DWT*

Introduction. The basic principles of digital still cameras and traditional cameras are analogous. Traditional cameras use sensitization negatives to sense the input image. Digital still cameras project the input image onto a charge-coupled device (CCD), where it is transformed into a digital signal. The digital signal is then stored in a memory component after compression. However, this signal indicates the light intensity and not the color variation. Therefore, a color filter array must be employed for digital sampling. Because of the high costs and large space required to use three color filter arrays with CCDs, only one color filter array with a CCD is employed. Consequently, each pixel possesses only one red, green, and blue color elements. The general color filter array in digital still cameras possesses a Bayer pattern, as shown in Figure 1. An interpolation algorithm must be employed to identify the two missing colors based on the surrounding pixels. The zipper effect or false colors are typically observed in images after interpolation. Numerous interpolation algorithms have been proposed to resolve these problems and obtain good image quality.

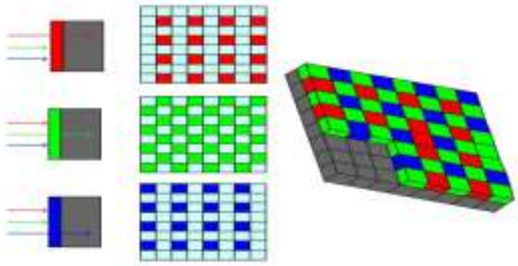


Figure 1. Bayer pattern color filter array.

Material. Image interpolation methods possess spatial and frequency characteristics. Edge direction and nonedge direction interpolation methods adopt spatial characteristics. The adjacent pixels selected by nonedge direction interpolation methods are constant. Examples of this method type include the bilinear interpolation method and color difference interpolation method. Because these methods do not detect edges, the edges of partial images are blurred following interpolation. The adjacent pixels selected by edge direction interpolation methods are nonconstant. These methods can detect and reduce blurred edges in the horizontal and vertical directions of an image. Examples of this method type include the edge sensing interpolation method and edge correlation sensing correction interpolation method. Frequency characteristic interpolation methods include the alternating projections interpolation method and novel frequency-domain interpolation method. Interpolation methods of this type use high- or low-frequency correlation to improve image aliasing and contrived phenomena and can provide high-quality images. A number of studies have employed a combination of the described methods or have proposed methods that use a wavelet algorithm for the edge or frequency domains. Common research techniques are based on the physical characteristics of interference. Furthermore, the method combines edge and frequency algorithms for interpolation. Good missing green samples were first obtained based on the variances of color differences along a correct edge direction. The red and blue components were then interpolated based on the interpolated green plane. The refinement scheme was employed to improve the interpolation performance. The method employed obtains luminance values at the green sample locations and preserves high-frequency information. An adaptive filter was used to estimate the luminance values of the red and blue samples. Then, the estimated full-resolution luminance was used to interpolate the red, green, and blue color components. These results indicate that many interpolation methods result in contrived colors or blurred edges because they cannot sensitively detect edges or perform appropriate color interpolation. Therefore, effective interpolation of the image edge cannot be achieved. In this study, the relationship between the surrounding interpolation pixel weights and discrete wavelet transform (DWT) was used to perform color interpolation and edge detection. The results were then compared with those reported by other studies using conventional methods.

Method. DWT can use the basic wavelet function and scaling function to conduct decomposition and reconstruction of sampling signals. The basic function is used to detect detailed variations. The scaling function is used to approximate original signals, which can be denoted as The basic wavelet function can be calculated from the scaling function. and are digital filter coefficients; their relationship is expressed as In wavelet transform, and are approximately equal to a high-pass filter and a low-pass filter. In, denotes the filter length. DWT has a similar function as a filter and can analyze the signal layer by layer. This filter comprises a high-pass filter and a low-pass filter. Figure 2 shows the operational manner and first-order wavelet transform decomposition of this filter. is an approximate coefficient. This indicates that the signal passes through a low-pass filter and undergoes downsampling. Approximate coefficients retain low-frequency information of the original signal and less high-frequency noise. is a detailed coefficient. This indicates that the signal passes through a high-pass filter and undergoes downsampling. Detailed coefficients retain high-frequency information of the original signal . Figure 2 is used in 2 to denote downsampling, which involves retaining half low-frequency and half high-frequency data. The method involves sampling odd and even terms.

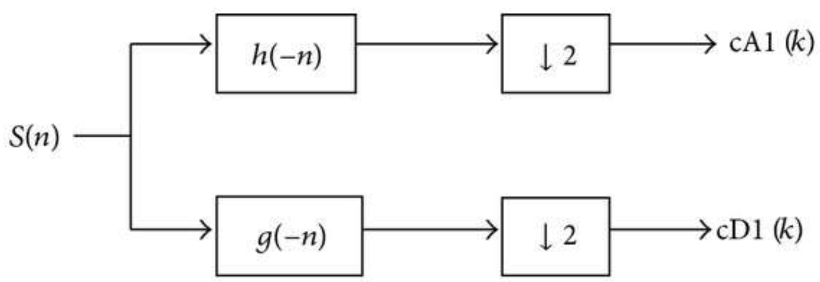
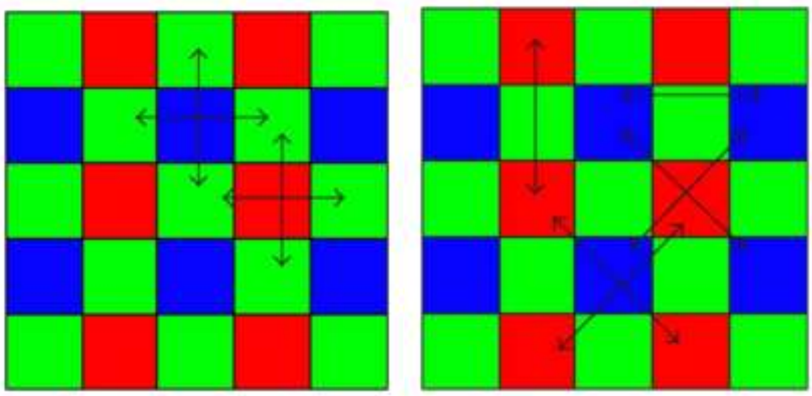


Figure 2 . First-order wavelet transform decomposition.

Image information is obtained after passing through a Bayer pattern color filter array. Horizontal and vertical direction information is used to interpolate the green portion. For the red and blue portions, only information in the horizontal, vertical, and diagonal directions can be employed, as shown in Figure 3. Therefore, in this study, the wavelet sensitivity and color correlation weight are used to identify the horizontal, vertical, and/or diagonal directions and interpolate missing pixels.



(b) (a)

Figure 3. (a) Green interpolation and (b) red or blue interpolation.

Result. Science and technology change every day. Although chip processing speeds continue to accelerate, their size and costs are increasingly decreasing. The proposed method does not employ frequency characteristics; instead, image quality is enhanced using spatial characteristics. Previous studies have discussed the importance of edges and interpolation pixels and calculated the frequency and spatial characteristics. This study exploited the sensitivity of wavelet algorithms and the correlation between colors to obtain good results regarding image edges and interpolation pixels. Comparing the simulation results to those of previous studies, the experimental images and data indicate that the proposed method can provide high-quality images.

Conclusion . In this article, wavelet-based image processing transforms and compares image quality according to wavelets with different levels of decomposition. This algorithm successfully reconstructs color images after image compression and also provides the best image quality. Significant improvements in the overall image compression process, dramatically increasing the PSNR of reconstructed images, but with minimal compression ratio. In the following, the scope of the work presented can be summarized as follows: An algorithm is proposed to further improve the high compression ratio. This algorithm can be used for any other image processing application to improve image quality.

REFERENCES.

1. B. E. Bayer, “Color imaging array,” U.S. Patent 3 971 065, 1976.
View at: Google Scholar
2. T. Sakamoto, C. Nakanishi, and T. Hase, “Software pixel interpolation for digital still cameras suitable for a 32-bit MCU,” IEEE Transactions on Consumer Electronics, vol. 44, no. 4, pp. 1342–1352, 1998.
View at: Google Scholar
3. S. C. Pei and I. K. Tam, “Effective color interpolation in CCD color filter arrays using signal correlation,” IEEE Transactions on Circuits and Systems for Video Technology, vol. 13, no. 6, pp. 503–513, 2003.
View at: Publisher Site | Google Scholar
4. J. E. Adams Jr., “Design of practical color filter array interpolation algorithms for digital cameras,” in 2nd Real-Time Imaging, vol. 3028 of Proceedings of SPIE, pp. 117–125, February 1997.
View at: Google Scholar
5. R. Lukac, K. N. Plataniotis, D. Hatzinakos, and M. Aleksic, “A new CFA interpolation framework,” Signal Processing, vol. 86, no. 7, pp. 1559–1579, 2006.
View at: Publisher Site | Google Scholar
6. B. K. Gunturk, Y. Altunbasak, and R. M. Mersereau, “Color plane interpolation using alternating projections,” IEEE Transactions on Image Processing, vol. 11, no. 9, pp. 997–1013, 2002.
View at: Publisher Site | Google Scholar