

COLOR CONTRAST ENHANCEMENT USING AUTOMATIC WEIGHTING MEAN-SEPARATED HISTOGRAM EQUALIZATION WITH SPHERICAL COLOR MODEL

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ABSTRACT. *Histogram equalization (HE) is one of the most effective technique for image contrast enhancement. However, it is not suitable to be implemented directly in consumer electronics (digital TV, camera, etc.) because this method tends to produce an output with saturation effects. Therefore, Automatic Weighting Mean-separated Histogram Equalization (AWMHE) was proposed to overcome this weakness for gray-scale images in our recent work. Although AWMHE method performs well in the gray-scale images, it cannot be applied to most consumer electronic products that produce color images. This article proposes a novel enhancement scheme by using the spherical color model and the AWMHE method to improve the quality of color images. The effectiveness of the spherical color model for color contrast enhancement is verified by comparing with other state-of-the-art color models with HE and AWMHE methods. Furthermore, experimental results show that the proposed enhancement scheme can generate better enhancement images than those using the state-of-the-art enhancement schemes.*

Keywords: Color contrast enhancement, Histogram equalization, Spherical color space

1. Introduction. Over the last few decades, contrast enhancement techniques have been actively developed to improve the image quality. This can facilitate the performance of image processing systems, such as video surveillance systems [1, 2], digital photography [3, 4], medical imaging systems [5, 6] and low power display systems [7]. Moreover, contrast enhancement has become widely available to improve the representation of digital images with software and hardware environments, including Adobe Photoshop, mobile devices, digital TVs, digital cameras, and so on [8, 9, 10, 11, 12, 13, 14, 15].

Contrast enhancement methods can be broadly categorized into two major classes: direct and indirect methods [16]. Direct methods [17, 18] try to improve the image quality using the definition of a contrast measure. Indirect methods [19, 20] exploit the under-utilized dynamic range of digital images to improve the contrast without defining a specific contrast term. According to the related literature [16], the most popular contrast enhancement methods almost fall into the second class.

One of the most popular indirect methods is histogram equalization (HE) due to its simplicity and effectiveness [21]. The basic idea of HE method is to re-map the gray levels of the input image using a transformation function with the cumulative distribution of the input image. HE method stretches the dynamic range of the image histogram to improve the overall contrast of the original image. However, HE method is unsuitable for the consumer electronic applications because the calculated transformation function may extremely change the original brightness of the input image.