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High Dynamic Range Image Tone Mapping Based on Asymmetric Model of Retinal Adaptation

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Abstract

Global tone mapping operators using the symmetrical retinal response model to light tend to produce a low dynamic range (LDR) image that exhibits loss of details of its corresponding high dynamic range (HDR) image in a bright or dark area. In this paper, we introduce a new asymmetric sigmoid curve (ASC) based on the model of retinal adaptation encompassing symmetrical S-shaped curve, and present two global tone mapping operators by using the ASC. In the proposed method, an ASC-based tone mapping function is obtained by using a well-known classic photography technique, called zone system. In addition, a contrast-enhancing tone mapping function is introduced by formulating a bi-criteria optimization problem with the luminance histogram of an input HDR image and the ASC-based mapping function. Experimental results demonstrate that the proposed method enhances the global contrast while preserving image details in the tone-mapped LDR image. Moreover, the objective assessment results using an image quality metric indicate that the proposed method shows a high performance to state-of-the-art global tone mapping operators.

Keywords: High dynamic range image, tone mapping operator, retina response model, perceptual image processing

1. Introduction

With the rapid development of high dynamic range (HDR) technology, HDR images can provide far more lightness and color information than 24-bit RGB images [1]. However, since most display devices still have a low dynamic range (LDR), various types of tone mapping operator have been proposed to represent an HDR image on LDR devices. These methods can be broadly classified into two parts: global [2]-[10] and local [11]-[19] operators.

The global tone mapping operator applies a spatially invariant compression function to each pixel to compress the dynamic range of an HDR image. For

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