Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 89 (2016) 700 – 709

Procedia Computer Science

Twelfth International Multi-Conference on Information Processing-2016 (IMCIP-2016)

Performance Assessment of TMOs

N. Neelima[a,*] and Y. Ravi Kumar[b]

[a] *Malla Reddy Institute of Technology & Science, Hyderabad 500 100, India*
[b] *Defence Electronics Research Laboratory, Hyderabad, India*

Abstract

High dynamic range (HDR) imaging has gained momentum with the growth in digital photography technology. In this paper, performance assessment of various tone mapping techniques has been presented. HDR images were used and Tone Mapping Operators (TMOs) such as Gamma Correction, Reinhard, Drago, Ashkmin were applied to generate Low Dynamic Range (LDR) images. After that, LDR images are rated using objective assessment parameters such as luminance, mean, MSE and mPSNR. A new modified Ashikmin TMO is reported in this work. The results have shown that modified Ashikhmin has generated better LDR image than other TMOs. In addition, the profiles of objective performance assessment were also included to compare the usability of TMOs for generating better LDR images.

Peer-review under responsibility of organizing committee of the Organizing Committee of IMCIP-2016

Keywords: High Dynamic Range; Low Dynamic Range; mPSNR; TMO; Tone Mapping.

1. Introduction

The ever evolving technological advancements in the field of imaging are responsible for greater availability of High Dynamic Range (HDR) images. The HDR images exhibit a special characteristic with a high dynamic ratio between the darkest and the lightest light intensity in the image[1]. High dynamic range images are produced by capturing Low Dynamic Range (LDR) images having different strike times using special cameras. Many standard display devices are suitable only for showing LDR images. Tone Mapping operators (TMOs) have been developed to convert HDR to LDR images. TMOs mostly operate on the luminance channel intensities of the image. They can be divided into global TMOs that process each pixel intensity in the same way and local TMOs that process the pixel intensities depending on their surrounding area. The optimal parametric values of TMOs are in general depends on quality of image and in most common cases their determination requires human intervention. To evaluate the subjective performance of the converted images, the objective parameters are to be reasonably correlated. For the original HDR image and the tone mapped LDR image, the objective assessment parameters such as Luminance, mean, MSE, mPSNR are correlated to grade the quality of TMO. The major contribution of this paper is the improvement of existing TMOs by using an alternative Ashikhmin TMO.

Figure 1 shows the block diagram for performing the operation of tone mapping along with the real world scene. It can be read from Fig. 1 that the real-world scene is observed in two different environments. In one environment,

*Corresponding author. Tel.: +91 9502751880.
E-mail address: nnrani2729@gmail.com

Peer-review under responsibility of organizing committee of the Organizing Committee of IMCIP-2016
doi:10.1016/j.procs.2016.06.039

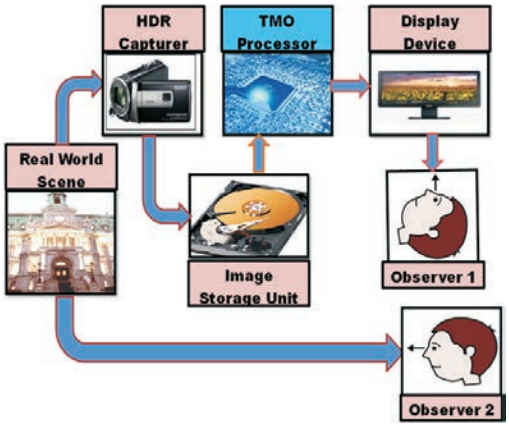

Fig. 1. Block Diagram Showing Tone-mapped and Real-world Scenes.

it had been viewed directly by Viewer 2. In the second environment, it has been observed by viewer 1 after processing using tone mapping technique. The objective is to have similarity in the scene viewed by viewer 1 and viewer 2.

The paper is organized as follows: The evolution and types of TMOs have been presented in section 2. In Section 3, the objective assessment parameters are defined. In section 4, the tone mapped images after applying TMOs under consideration along with the profiles of objective assessment parameters have been presented and discussed. In Section 5. the conclusions are presented.

2. Tone Mapping

Tone mapping is a technique applied in image processing to develop similarity between one set of colors to another set. The TMO also approximates the visibility of HDR images in a medium that has a low dynamic range. Tone mapping is useful for correcting strong contrast related problems of the scene. The process of Tone mapping has the capability of retaining the details of the image as well as color particulars which are important to identify the original scene. In realistic applications, the goal is to get a non-cognitive similarity between a real image and a processed image.

The tone mapping operators developed can be divided in two categories. They are (i) Global and (ii) Local operators. The Global operators will process the image under test using non-linear functions which are spatially uniform by including the luminance as the parameter. Once the necessary function is estimated for a given image, individual pixels in the image are processed in the same way irrespective of the value of neighbouring pixels in the image. Global techniques are simple and fast, but they can cause a loss of contrast. The local operators are also treated as spatially varying operators developed using the key factors of the non-linear function based on the changes in individual pixels. Local operators are complicated compared to the global operators. The local operators can show effects such as ringing and halo. However, the output of Local operators looks unrealistic, but provides the best performance.

The global operators are limited in their capacity to compress HDR images. This drawback can be overcome by using local operators. A local operator processes each pixel according to their luminance values, as compared to the luminance values of a set of surrounding pixels. Thus, instead of performing the estimation is adjusted using a globally derived quantity, the computation is adjusted according to an average over a local neighbourhood of pixels.

2.1 Tone mapped operators

In this paper, the performances of 5 types of prominent Tone mapped operators are compared. They are Gamma correction, Reinhard, Drago, Raman and Ashikhmin and are described below.