Noise suppression algorithm in the process of high dynamic range image fusion

Chen Yeyao[1], Jiang Gangyi[1,2], Shao Hua[1], Jiang Hao[1], Yu Mei[1,2*]

[1]College of Information Science and Engineering, Ningbo University, Ningbo, Zhejiang 315211, China;
[2]National Key Lab of Software New Technology, Nanjing University, Nanjing, Jiangsu 210093, China

The experiment results of cafe sequence

Overview: High dynamic range (HDR) images can accurately represent the dynamic range of real scenes and are therefore receiving widespread attention. At present, the methods for obtaining HDR images are mainly divided into two categories. The first type is to map the original low dynamic range (LDR) images to the irradiation field by estimating the camera response function, and perform fusion in the irradiation field to obtain a wide dynamic range image. The second is to fuse a multiple exposure image sequence directly in the pixel domain to produce an LDR image with HDR effect. However, these fusion methods do not consider the effect of noise in the images. When shooting a multi-exposure image sequence in an actual low light environment, the camera sets high sensitivity to prevent images blurring, which generates noise. After the fusion, the image noise will be further amplified, resulting in a severe degradation in the visual quality of the final HDR image. To solve this problem, according to the noise characteristics of multi-exposure images, this paper proposes a noise suppression algorithm in the high dynamic range image fusion process based on luminance partition and noise level estimation. Firstly, according to the luminance information of the images, each LDR image is decomposed into three areas of low-luminance, middle-luminance, and high-luminance. Noise levels are estimated by using overlapping blocks in three luminance areas. Since the noise mainly exists in the dark areas of the image, therefore, for the low-luminance area, "winner-take-all" strategy is used to process the overlapping blocks to obtain the noise level. For the middle-luminance and high-luminance areas, an average strategy is used to obtain the noise level. Then the noise level is used to guide the sparse denoising of the image. The denoised images of the three different luminance regions are combined into a single complete LDR image. Finally, the processed multiple exposure LDR images are fused into a single high-quality HDR image. Experimental results show that the proposed algorithm not only can effectively suppress the noise of the image, but also processes the image according to the noise level without blurring the details of the image and preserves the texture information of the original image well. In addition, using the existing objective metrics to evaluate the fusion images, the results show that the image quality obtained by this method is higher, and image detail information is retained while suppressing image noise.

Citation: Chen Y Y, Jiang G Y, Shao H, *et al*. Noise suppression algorithm in the process of high dynamic range image fusion[J]. *Opto-Electronic Engineering*, 2018, **45**(7): 180083

Supported by National Natural Science Fundation of China (61671258) and Zhejiang Natural Science Fundation of Zhejiang Province (LY15F010005)

* E-mail: yumei2@126.com