AN EFFECTIVE SHARPNESS ASSESSMENT METHOD FOR SHALLOW DEPTH-OF-FIELD IMAGES

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Introduction

The sharpness of an image determines the amount of detail that an imaging system can present, and it is one of the most significant factors affecting the quality of an image. Many objective NR sharpness assessment metrics which are often intended to be strongly associated with the human visual system (HVS) have been proposed. However, recent studies show that common sharpness assessment indicators may misjudge the degree of blurring for images with shallow depth of field that are often used to highlight the main subject in the view.

Fig 1.illustrates two types of photos for the same subject, in which picture (a) and (c) are two depth-of-field pictures taken by photographers to highlight the subject, and picture (b) and (d) are two global blur pictures (the blur degree of the distant view is not as good as that in picture(a) and (c)). Most people will think that picture (a) and (c) are clearer. However, the classic sharpness assessment algorithms may get the opposite result of HVS.

Fig. 1. (a) and (c) are pictures with shallow depth of field to highlight the subject. (b) and (d) are overall blurred pictures (the blur degree of the distant view is not as good as that in picture(a) and (c)).

Proposed Metric

Scientific research shows that the highest visual acuity in the human visual system is limited by the size of the foveal area. The large changes in pixel intensity can indicate sharpness more than the small changes. The foveal region is composed of an image block of approximately 64 × 64, which covers a view angle of about α = 2, and is covered with cone cells for detecting brightness and color. In this area, smooth blocks will be excluded because they contribute little to the sharpness of the object. If the images with blurred background and clear foreground are considered, the clear foreground such as human faces attract people's visual attention, and then the correlation between the classic no-referenced sharpness indicators and the subjective scores will decrease.

Based on the above characteristics, we propose a new no-referenced objective image sharpness assessment algorithm based on the square of block energy difference product, which can assess the sharpness of shallow depth-of-field images. We first extract the local change characteristics of each pixel, divide the tested image into blocks, find the local characteristics of the pixels in each block and the local characteristics of the block, and use the square sum of the block characteristics as the final sharpness metric. The two local extraction features enlarge the contribution of the high-variation area to the sharpness evaluation metric and enable the calculation results to better fit the HVS.

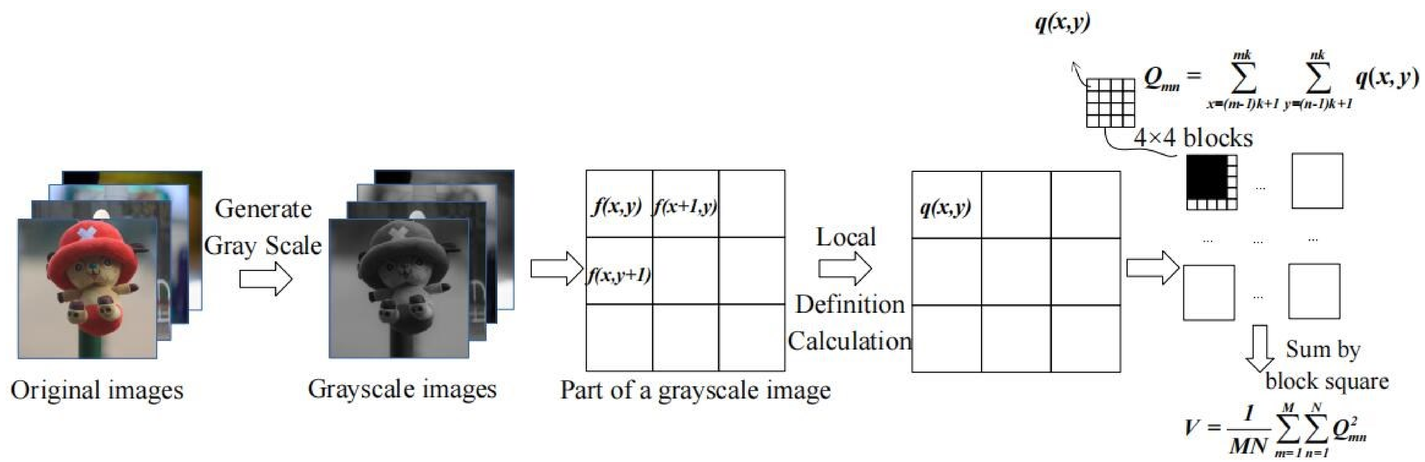

Fig. 2. Algorithm framework proposed

Contributions

(1) The sharpness of shallow depth-of-field images can be accurately evaluated with the proposed algorithm when traditional methods do not work well.

(2) Experimental results on three public datasets demonstrate competitiveness and effectiveness of the proposed algorithm when compared with several state-of-the-art methods.

Experimental Results

(1) In experiment A, 15 sets of shallow depth-of -field pictures taken with a telephoto lens are tested, which shows the sharpness of shallow depth-of-field images can be accurately evaluated with the proposed algorithm while other algorithms fail.

(2) In experiment B, various blur types of image subsets are used from three large-size LIVE, TID2008 and TID2013 dataset are tested, which shows how the proposed algorithm outperforms the state-of-art algorithms on the three public dataset with respect to universality and accuracy.