Advances in Computer, Signals and Systems (2022)
Clausius Scientific Press, Canada

DOI: 10.23977/acss.2022.060401
ISSN 2371-8838 Vol. 6 Num. 4

# *Information Entropy Algorithm for Image and Video Signal Processing*

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***Keywords:*** Information entropy, Image quality, Data fusion, Gray scale

***Abstract:*** In order to effectively improve the accuracy of image quality evaluation and analysis, an information entropy algorithm for images and videos is proposed. The algorithm completes the fusion calculation of the effective information of the image on the basis of calculating the image information entropy. In the experiment, the optimized image quality was analyzed by calculating and counting the proportion of each parameter in the image. The results show that the parameters such as gray level and smoothness of the image optimized by information entropy have been improved to a certain extent. The algorithm designed in this paper can improve the accuracy of image and video data fusion.

## 1. Introduction

Information entropy is an information-theoretic basis related to any random variable [1]. Information entropy can be understood as an average of the underlying information, surprise, joy and uncertainty of a variable. Claude put forward the idea of information entropy in 1947 [2,3]. In recent years, entropy has become an appropriate measure in the fields of video and images, as well as in signal processing [4].

As an important indicator, information entropy can reflect the state of the image. Hrzic et al. used the information entropy technology to test the edge of the X-ray image, and used the entropy operator to partially adjust the object shape and gray distribution of the image, which can well extract and display the boundary of the target area [5]. Hou Xinglin et al. obtained the exposure time required for the local information entropy value to reach the peak value through the relationship between the information entropy value of the image part and the exposure time, thus effectively overcoming the shortage of overexposure [6]. Ye et al. used discreteness, relative entropy and mutual information to measure the effect of contrast enhancement of real color images, thereby verifying that information entropy is more consistent with the real human eye observation in measuring true color images, and can be well adapted to the color range A true-color image with a wide range of textures and complex textures [7]. Chari et al. separated and combined the information entropy and the image critical value, and determined the optimal threshold according to the entropy value of each gray critical value point in the image, and its effect was better than the OTSU algorithm [8]. Dai Shengkui et al. proposed a dual histogram algorithm based on maximum entropy. The peak entropy point is used as the cut point of the histogram to divide the gray histogram into blocks, which realizes the segmentation of the image and optimizes the dynamic effect. By analyzing the existing research results, a method of image detail enhancement using information entropy is proposed. For high-brightness images, in order to improve the imaging details and prevent other enhancement methods such as poor brightness, grayscale "devouring", and unrealistic imaging results [9-11]. In this paper, the concept of discrete information sources is discussed by information entropy calculation and classification, and the advantages of many gray-level equalization methods are synthesized and applied to the information entropy domain to improve the overall state and details of the image.

## 2. Traditional Image or Video Fusion Method

At present, the most widely used fusion method is linear fusion. In order to make the overlapping part of the image more natural, the overlapping part is usually the place where the two images overlap and a simple addition is performed. In general, the point from the pixel point to the edge of the overlapping area is its weight. This method is easy to achieve and can be used in experiments with strong real-time fusion. But this also has many disadvantages. For example, if it cannot be aligned, it will lead to blurred images and ghosting, and there will be obvious seams and cracks on the edges of overlapping areas. Compared with linear fusion, mean fusion will lead to obvious boundaries of overlapping parts, and the fusion effect is not as good as linear fusion. The basic principle and method after weighting is to directly select the same value for the pixels in the original image, and then obtain the fused pixel value after weighted average. The basic idea after weighting is to take the coincident point of the pixels as the center, and the final pixel value is the value after the weighted average. This approach reduces computational bias. The algorithm is simple and convenient. However, if the data is incorrect or the image is inconsistent, it will affect the effect of the calculation. The weighted average method weakens the details of the overlapping parts, so that the overlapping parts have obvious artificial smear marks.

## 3. Design of Fusion Algorithm Based on Information Entropy

The Gaussian pyramid structure is used to describe the image in full range and multiple angles. The bottom is the original image, and the images three levels up are the second, third, and fourth levels in the Gaussian pyramid. The acquisition of each layer stems from the selection and filtering of lower-level images. All even and odd numbers after filtering are removed. The actual operation steps of multi-band fusion: First, use the Gaussian pyramid to construct a multi-layer representation of the source image, then use the Gaussian pyramid to obtain the pull-type pyramid; Then combine the sub-atlases that need to be analyzed by the same layer; Perform inverse Laplace transform to get a fused image, and its inverse formula is:

$$S_i = R_i + Expand\left(S_{i+1}\right) \tag{1}$$

In the formula, R is the resulting merged pyramid, S is the final fusion image, where the top layer of S is the top layer of R, S is calculated from the top layer to the bottom layer, and the bottom layer image of the final fusion pyramid is the final fusion image.

## 4. Experiments

This paper uses the VS platform to analyze the quality of multiple images with a resolution of 463*348, including the image data obtained in rainy weather, sunny weather and windy weather.

## 4.1. Subjective Evaluation

In Fig. 1, Fig. 1(a) is the original image under sunny conditions, and Fig. 1(b) is the image under cloudy and rainy weather. Through subjective determination, it can be seen that when linear fusion is used, the noise of the fusion image the point is very conspicuous. Although the weighted average method does not find seams, it has a strong sense of smearing in the overlapping parts of the images. The method chosen in this paper is the least traceable in the overlapping part of the image. Figure 1(c) is the fusion of outdoor dark light. At the joints of the picture, the linear fusion is very rough and the sense of fragmentation is obvious. Figure 2(a) is obtained by using the traditional weighted average optimization algorithm, while Figure 2(b) is obtained after using the information entropy optimization algorithm in this paper. Subjective naked eye evaluation, Figure 2(b) has a clearer boundary and a more natural image effect.

(a) Sunny weather (b) Cloudy and rainy weather (c) Dark environment

Figure 1: Original image

(a) Weighted average algorithm (b) Information entropy algorithm

Figure 2: Comparison of optimization effects

## 4.2. Objective Evaluation

From the dark light effect of rainy weather, it can be seen that the algorithm in this paper is better than the linear and weighted average methods in terms of differential information entropy, arithmetic mean and standard deviation; in terms of spatial frequency, the algorithm in this paper is also better than the other two. Slightly better; in terms of time, although the calculation speed of this paper is not the best, there is not much difference between the three methods, and the real-time performance of the algorithm in this paper meets the engineering requirements.

In the experiment of contrast between light and dark, the middle position is an accurate fusion map. With a difference of 10% light and dark as a gap, the light and dark levels are changed to 70% to obtain images of different brightness (15 images in total, the brightness range is -70%) to 70%). The information entropy and SSIM and the method in this paper are used to judge and evaluate the 15 images.

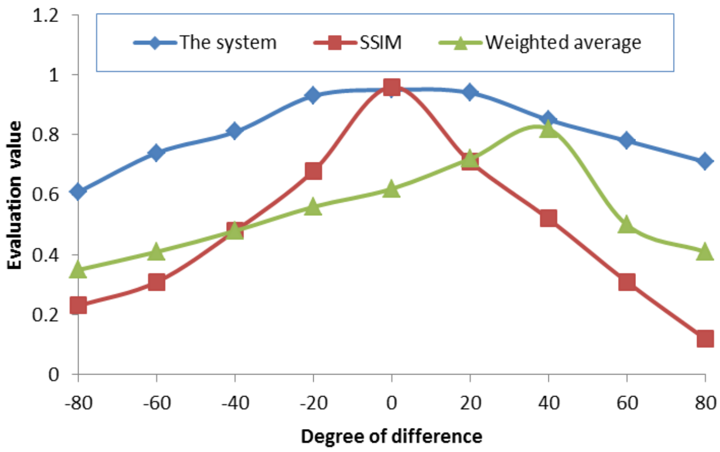



Figure 3: Comparison of evaluation differences under different light intensities

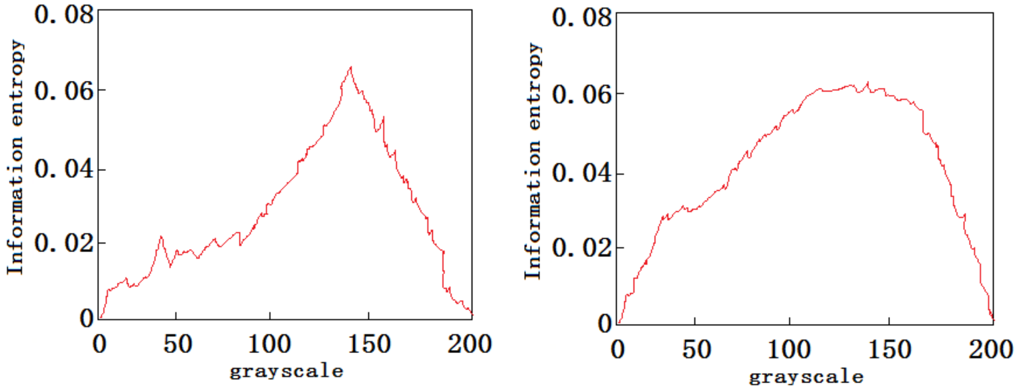
As shown in Figure 3, in the case of different light and dark degree differences, because the information entropy is not accurate enough to determine the Lena fusion map, when the difference is the smallest, the result is not the largest, and when the brightness difference reaches 30%, it achieves a peak value, which contradicts the reality and is not suitable for judging the quality of the image. The weighted average algorithm is not very sensitive to the difference of light and shade. When the difference of light and shade increases, the change of its evaluation value is not large, and the final evaluation results are biased towards the good side, which is inconsistent with the actual subjective feeling. The results of the assessment are not precise enough. Under the information entropy optimization algorithm in this paper, the evaluation value gradually decreases with the increase of the brightness difference, and gradually becomes stable. When the brightness difference exceeds 50%, the change of the evaluation value decreases smoothly with the increase of the brightness difference, and gradually becomes stable. Compared with the traditional weighted average algorithm, the information entropy-based optimization algorithm is more in line with human visual characteristics, closer to the subjective evaluation, and more accurate evaluation of images with different brightness.

Through the comparison of two groups of experiments with different degrees of deviation and light and shade, it is concluded that the evaluation method that uses information entropy to represent the image quality is not suitable for the judgment of the quality of the fusion image. It is more accurate, and it is more sensitive to detect the deviation degree and the degree of light and shade error, which can better reflect the deformation after fusion, and is closer to the subjective evaluation effect.

### 4.3. Image Quantitative Analysis

In order to better quantify the comparison, the image optimization results are analyzed using gray scale. The gray level distributions of the two algorithms are shown in Figure 4.

As shown in Figure 4, it can be seen that the gray level distribution data using this algorithm is better than the traditional weighted average optimization algorithm, which shows that this algorithm is more suitable for improving the image quality of the fusion image.



(a) Weighted average algorithm (b) Information entropy algorithm

Figure 4: Comparison of optimization effects

## 5. Conclusions

For the image fusion process, an image quality optimization algorithm based on information entropy is proposed, and the design ideas and evaluation criteria of the fusion algorithm are given. In the experiment, the difference between this algorithm and the weighted average algorithm is compared by the method of image gray level classification, and the advantages of this algorithm are verified.

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