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UDC 004.8

THE DEFINITION OF ARTIFACTS OF THE TYPE OF BLOCKING ON RASTER IMAGES

ОПРЕДЕЛЕНИЕ АРТЕФАКТОВ ТИПА БЛОКИНГА НА РАСТРОВЫХ ИЗОБРАЖЕНИЯХ

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Abstract. Discusses how to define blocking artifacts in raster images. The proposed method is the development of NPBM method considered in [1]. Artifacts are analyzed for each component of the RGB color model of the image in question. As a metric of image quality is accepted value, the complementary probability of the presence of artifacts to one. Then the results are averaged and compared with the results of the expert evaluation of the image quality. Rank correlations are also calculated.

Аннотация. Рассматривает способ определения артефактов блокинга на растровых изображениях. Предлагаемый способ представляет собой развития метода NPBM, рассмотренного в [1]. Анализ артефактов производится по каждой компоненте цветовой модели RGB рассматриваемого изображения. В качестве метрик качества изображения принимается величина, дополняющая вероятность наличия артефактов до

единицы. Затем результаты усредняются и сравниваются с результатами экспертной оценки качества изображений. Вычисляются также ранговые корреляции.

Keywords: blocking artifacts, raster image, RGB color model, probabilistic metric.

Ключевые слова: артефакты блокинга, растровое изображение, цветовая модель RGB, вероятностная метрика.

This paper provides an extended solution to the issue of blocking artifacts that occur on raster images. The paper [1] presented the averaged results of probabilistic metrics for image quality assessment, which are presented on the basis of RGB color model.

The database [2] contains images with the presence of blocking artifacts and sufficiently high-quality images. Some full-color images from this database are shown in Fig. 1–6.

Figure 1. Img1.bmp

Figure 2. Img89.bmp

Figure 3. Img107.bmp

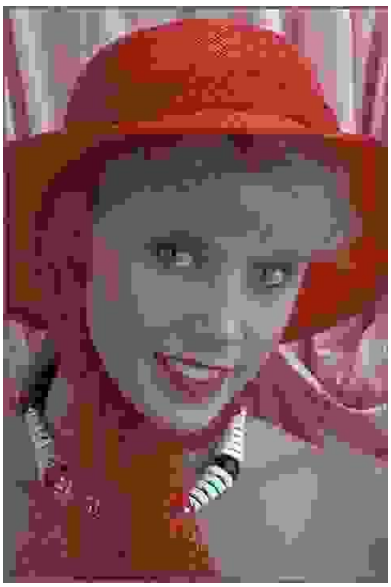

Figure 4. Img138.bmp

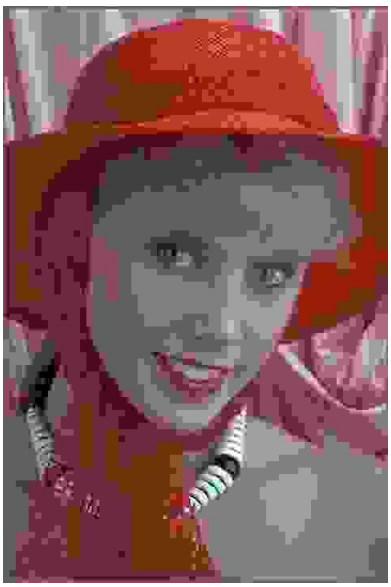

Figure 5. Img154.bmp

Figure 6. Img168.bmp

For the selected images there are estimates of experts, which will be called expert metrics. The metrics of experts on the images presented in Fig. 1-6 are given in Table 1.

Table 1 – The metric experts

№ п/п	Metric experts	Image File Name (*.bmp)					
		img1	img89	img107	img138	img154	img168
1.	Metrics	0.3263	0.45313	0.60102	0.15771	0.16225	1.4703

As can be seen from the table.1, the metrics of experts can be more than one. However, you can suggest a probabilistic approach in assessing the quality of images with blocking artifacts. Based on the method of evaluating the quality of full-color images from [3], it is proposed to modify it, including the consideration of individual layers (matrix) images, namely red, green, blue. The scheme of the generalized algorithm for determining the blocking artifacts in raster images is shown in Fig. 7.

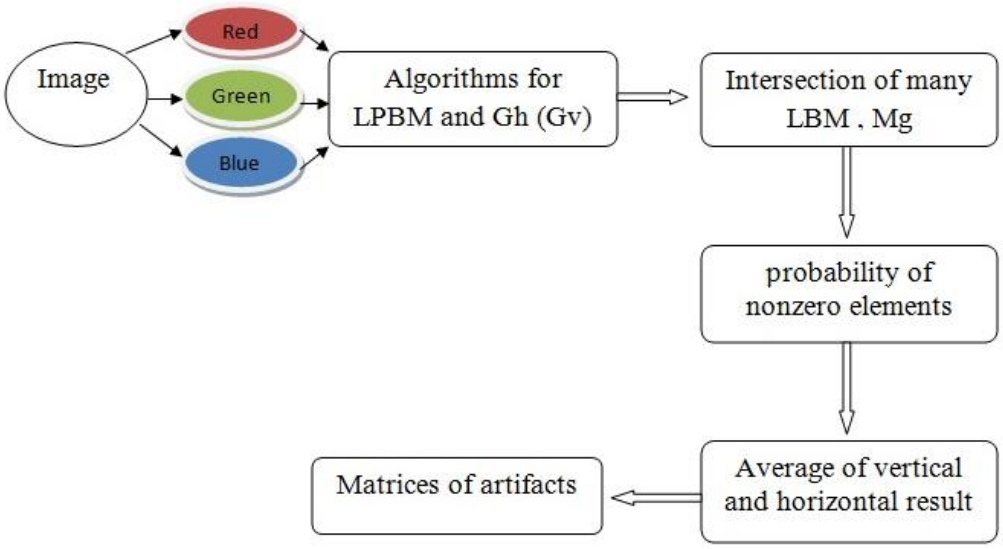

Figure 7. The basic scheme of the image quality assessment algorithm with blocking artifacts

In the diagram, Fig. 7 Image – three-dimensional array of RGB color model of the image. Red, Green, Blue – selected color channels that are analyzed separately from each other.

Numerical studies were carried out in the MATLAB (R2017a) system, which has effective means of image processing.

For Fig.7 the value of Mg is a grayscale image. In our case, a halftone image of Mg is defined for each of the three colors – red, green, blue. Further, the proposed algorithm corresponds to the algorithm considered in [3], before calculating the LPBMh (LPBMv) array. The proposed probabilistic approach assessment of the quality of the images is based on comparing arrays LPBMh (LPBMv) and the Gh (Gv), where h means the bypass horizontal, v – vertically appropriate two-dimensional arrays.This comparison was performed using the ismember function of MATLAB. For example, for one of the colors, the ismember function looks like this:

[LIA, LOCB] = ismember(A,B) also returns an array LOCB containing the lowest absolute index in B for each element in A which is a member of B and 0 if there is no such index.

The results of calculations are shown in the Table. 2.

Table 2 – Numerical metric estimates of test images

№ п/п	Experimental data	Image File Name (*.bmp)					
		img1	img89	img107	img138	img154	img168
1	Metric of quality	Red: 0.569241	Red: 0.694399	Red: 0.763325	Red: 0.101445	Red: 0.124096	Red: 0.859208
		Green: 0.569335	Green: 0.690435	Green: 0.759607	Green: 0.111951	Green: 0.134220	Green: 0.858458
		Blue: 0.545537	Blue: 0.678686	Blue: 0.751409	Blue: 0.089633	Blue: 0.112554	Blue: 0.858128
2	The mean value of the probabilistic metrics of the quality of the images	0.561371	0.687840	0.758114	0.101010	0.123624	0.858598
3	Probability of artifacts	Red: 0.430759	Red: 0.305602	Red: 0.236674	Red: 0.898554	Red: 0.875903	Red: 0.140791
		Green: 0.430665	Green: 0.309564	Green: 0.240392	Green: 0.888048	Green: 0.865779	Green: 0.141541
		Blue: 0.454462	Blue: 0.321313	Blue: 0.248590	Blue: 0.910366	Blue: 0.887445	Blue: 0.141871
4	The average value of the probability of artifacts in the images	0.438629	0.312160	0.241886	0.898990	0.876376	0.141402

From the analysis of the results given in the Table 2, you can see that the image is img138.bmp is the most substandard, and the image is img168.bmp is the highest quality. This is consistent with the visual analysis of the images shown in figure 1-6.

The values of probability metrics were compared with the corresponding values of expert metrics based on the rank correlations of Spearman, Kendall. The results are shown in Table 3. The calculations were carried out using the function of the corr system MATLAB (Release 2016b). An example of using the corr function is given below.

[Rho, pV] = corr(M, Expert, 'type', 'Spearman'); % and 'Kendall'

where Rho – determines correlation coefficient between each pair of the input *M* and *Expert*, *pV* – values for testing the hypothesis of no correlation against the alternative hypothesis of a nonzero correlation.In the example, Expert-array with values from Table 1,
M – array with values from Table 1 (string Metric of quality from Table 2).

Table 3 – Rankcorrelation

№ п/п	Name	Rs	pV	Confidence probability
1	Spearman	1.000 000	0.002 778	0.997 222
2	Kendall	1.000 000	0.002 778	0.997 222

As can be seen from the Table. 3, only with probability pV = 0.002 778 the hypothesis of linear functional dependence between the expert results and the proposed method can be discarded. This is quite a small probability. Therefore, the results are quite adequate. And they are enclosed in an interval [0; 1].

Findings

The obtained results provide a basis for using the proposed method to assess the quality of bitmaps with blocking artifacts. It should be admitted that this method does not provide guaranteed conclusions about images with artifacts of other types, such as spillage artifacts, strobe-effect artifacts, compression artifacts or artifacts of damage and contamination of magnetic heads. But, for detection of artifacts of blocking the considered method gives quite satisfactory results. In addition, the known image quality scores are enclosed from zero to some large numbers (more than 100). The proposed probabilistic metric is enclosed in the interval [0; 1], which determines its finiteness. It happens that some color component has a dominant role in the image. Therefore, this situation is taken into account in the proposed approach. It is possible to analyze the effect of each component of the RGB model on the resulting image quality, as well as the ability to identify blocking artifacts in images.

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ПРОГРАММНЫЙ КОМПЛЕКС МОДЕЛИРОВАНИЯ ТЕМПЕРАТУРНЫХ ПОЛЕЙ ТУРБУЛЕНТНЫХ ПОТОКОВ В СКВАЖИНЕ

PROGRAM COMPLEX OF MODELING OF TEMPERATURE FIELDS OF TURBULENT FLOWS IN THE WELL

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Аннотация. Поддержание в рабочем состоянии нефтяных и газовых скважин является одной из первостепенных задач нефтедобывающих предприятий, так как несвоевременное выявление неблагоприятных эффектов может привести к