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EVALUATION OF AERIAL PHOTOGRAPHS MASKING METHODS EFFECTIVENESS

Abstract: Discusses comparative evaluation of the most common methods of masking. Demonstrates the use of previously sound measures quantify the quality of detection and localization of paths to compare methods. The results of the experiment the of masking by different methods.

Keywords: masking, masking assessment, detection and localization quality, aerial photographs

EWALUACJA SKUTECZNOŚCI METODY MASKOWANIA DLA ZDJĘĆ LOTNICZYCH

Streszczenie: W artykule przeprowadzono porównawczą ocenę najbardziej znanych metod maskowania. Ponadto, w pracy przedstawiono środki i sposoby oceny jakości detekcji (wykrywania) oraz lokalizacji obiektów. Przedstawiono rezultaty działań eksperymentalnych polegających na dokonywaniu maskowania różnymi metodami.

Słowa kluczowe: maskowanie, ocean maskowania, jakość detekcji oraz lokalizacji, zdjęcia lotnicze

1. Introduction

In different application areas related to image processing, particulary in the field of aerial photographs processing, you must take into account the semantic component

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images. Borders of the objects are the most semantically meaningful information. One of the basic components of semantic processing are methods of masking. Such technologies allow you to allocate informative information about the structural characteristics of the objects in the images. The process of selecting contours in an image consists of several steps:

- image noise filtering - removal of image distortions due to the impairment of the photographic equipment;
- selection of contours in the image - the selection of areas of the image that can be considered as contours;
- binarization of the image - the final allocation of significant contours with the screening of those contours that do not meet the criteria for binarization.

For detection of contours there is a big variety of technologies and methods of masking of images. One of effective approaches for creation of methods of masking are methods on the basis of creation of a gradient. Gradient (differential) methods, are based on definition in each point of space of approximate values of a gradient of brightness and the directions of their greatest change. Way of search of contours is processing of the image by means of the sliding mask called also by the filter (a kernel, a window or a template). Respectively operating by such mask (matrix structure) and performance of the corresponding transformations for the purpose of definition of contours is called masking or spatial filtration. There are no universal methods of masking for various types of images. It leads to the fact that the existing methods are effective only within a narrow class of images. Therefore, the lack of the reliable device of assessment of methods of masking leads to restriction of increase in their efficiency. In most cases assessment of quality of a method of masking is limited only to value judgment. It means, that the problem of quantitative assessment of quality of methods of masking in the systems of automatic processing of realistic images is **relevant scientifically – applied task**.

Therefore, **the purpose of researches** of article consists in quantitative assessment of quality of methods of masking.

2. Method of masking quality assessment

To assess the quality of the methods of detecting the boundaries we test sample images, which will consist of aerial photographs and reference images. Reference image is the picture, in which the researcher is manually selected edges are all important parts of the image.

The following is a list of quality criteria of edge detection:

- type I error a - the ratio of correctly selected boundary pixels to total pixels that are not boundary:

$$a(A,B)=\frac{n(B\setminus A)}{n(X\setminus A)} \tag{1}$$

- type II error b - the ratio of unselected boundary pixels to the total number of edge pixels:

$$b(A,B)=\frac{n(A\setminus B)}{n(A)} \tag{2}$$

- in practice, often there are options such as sensitivity – the ratio of correctly selected boundary pixels to the total number of edge pixels in reference image:

$$Sp=\frac{n(X\ /\ B\cup A)}{n(X\ /A)}=1-a \tag{3}$$

- specificity - the ratio of allocation not of non-edged pixels to the total number not of non-edged pixels of the reference image:

$$Se=\frac{n(B\cap A)}{n(A)}=1-b \tag{4}$$

As additional parameter it is offered to carry out the assessment of time of processing of the image t. Let's hold testing of the methods of masking applied in the systems of automatic processing of images. Testing is understood as visualization of results of processing and quantitative assessment of quality of a method of masking (calculation of the offered metrics on formulas (1) – (4)). At assessment of quality of work of methods of masking as entrance were used: realistic grayscale images of the identical sizes and bitmaps as references images for these realistic images. At calculation of metrics were compared the image – result of a method of masking and binary reference image for the processed image. For testing the most widespread methods using an image gradient – Roberts, Pruitt, Sobel's operators, Sharru and Hryashcheva were considered.

3. Result of research

The article presents estimate of the quality of masking methods (input image, processing result, calculated metric values) for the following images: realistic halftone images from an unmanned aircraft vehicle with a natural background, 10000x10000 pixels in size with low, medium and high intensity of details, and the corresponding ground truth (GT) image.

Test results are presented in tabular and graphical form. Table 1 presents the calculated values of the quality metrics of the masking methods for images (the corresponding minimum and maximum values of the metrics are highlighted in bold). As a result of the research conducted on the common methods of masking, the following conclusions can be made:

- the best quality indicators in terms of non-missing of real contours and edge gaps in the Sharru method (the lowest values of type II error in all cases).

- the best quality indicators in terms of not adding false contours in the Prewitt method in two cases and Hryashchev in the case of images with high saturation of details (values of the type I error are minimal in the Prewitt method in images with low and medium details saturation, with a lag of 2.2 % and 1.4% of the Khryashchev method respectively, and the advantages of the Khryashchev method in the case of image processing with high details saturation).

- The lowest selectivity in image processing is a large lag in the Sharru`s method.

There is a more than twofold advantage in the speed of image processing for the Hryashchev method due to the absence of the need to pre-filter the image from noise due to the fact that a function is used to build a mask for this method, which is also a low-pass filter

Table 1. Result Of Research

Metrics	Masking methods				
	Roberts	***Prewitt***	***Sobel***	***Sharru***	***Hryashchev***
	Image with low-detail density				
Type I error	0.1269	**0.0736**	0.0825	0.4046	0.095
Type II error	0.4738	0.2515	0.2454	**0.0485**	0.2700
Sensitivity	0.5261	0.7484	0.7545	**0.9514**	0.7299
Selectivity	0.9766	**0.9813**	0.9711	0.6060	0.9637
Time	6.8457	7.3629	6.7385	5.8075	**2.4566**
	Image with medium-detail density				
Type I error	0.0521	**0.0375**	0.0540	0.3846	0.0517
Type II error	0.4889	0.2172	0.1779	**0.0237**	0.2065
Sensitivity	0.5110	0.7827	0.8220	**0.9762**	0.7934
Selectivity	1.000	**0.9858**	0.9651	0.6178	0.9705
Time	6.3688	6.2396	5.6955	6.2837	**2.4360**
	Image with high-detail density				
Type I error	0.0228	0.0354	0.0529	0.2726	**0.0326**
Type II error	0.6322	0.2501	0.1962	**0.0486**	0.2909
Sensitivity	0.3677	0.7498	0.8037	**0.9513**	0.7090
Selectivity	1.0290	0.9851	0.9631	0.7312	**0.9912**
Time	6.2276	6.1382	6.2673	5.8600	2.4302

4. Conclusion

As a result of testing masking methods with a quantitative assessment of the quality of image processing, it is justified that there is no universal masking method with equally high metrics for images with different filling with objects (contours). It is proved that existing methods are effective only within a narrow class of images. In most cases, the assessment of the quality of the concealment method is limited only by the subjective assessment (visual assessment of the quality of work). Experimental assessments of the quality of masking techniques have revealed the following:

- the best values of the quality of contour detection in the Prewitt method (by the value of type I error kind and selectivity metrics);

- Sharru's low selectivity compared to other methods under the same initial conditions, which prevents the use of this method in an aerial photo image masking system;

- more than twofold advantage of the Khryashchev method for processing time and at the same time high performance of all metrics compared to other methods, which defines this method of masking as promising in the field of processing of aerial photographs (since processing time is a key parameter in aerial photographic processing systems).

It is proposed to carry out a preliminary analysis of the image according to the degree of saturation with their contours, followed by classification: weakly, moderately and strongly saturated with contours, followed by detection and selection of contours in images taking into account the degree of saturation by their contours.

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