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Using median filtering for efficient image processing

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Abstract

The article shows the principles of image processing using median filters. Showing methods for cleaning images of impulse noise. A comparative analysis of median filters with different weights of mask coefficients was carried out.

Keywords: image processing, different weights, mask coefficients.

الملخص

توضح المقالة مبادئ معالجة الصور باستخدام المرشحات المتوسطة. عرض طرق تنظيف صور ضوضاء الاندفاع. تم إجراء تحليل مقارن للفلاتر المتوسطة بأوزان مختلفة لمعاملات القناع.

الكلمات المفتاحية: معالجة الصور ، الأوزان المختلفة ، معاملات القناع.

Introduction

Digital image processing is an intensively developing scientific area, which is becoming more and more widely used in various information systems: radar, communications, medical and technical diagnostics, and many others. Currently, many branches of technology related to receiving, processing, storing and transmitting information are largely focused on the development of systems in which information has the nature of images [1]. When digital noise is detected in a digital image, the question arises of the qualitative improvement of the image. The main goal of the improvement is to process the image so that the result is more appropriate from a particular application. The word concrete is important because it from the very beginning establishes that the methods that will be used in the processing of a noisy image are to a large extent problem-oriented. For example, a method that is very useful for improving X-ray images will not necessarily be the best for processing images of Mars transmitted by a spacecraft. Image enhancement is one of the most interesting and attractive from the standpoint of visual analysis of image processing areas [2]. We

consider the effect of median filtering as a way to efficiently process images from noise.

Filters based on ordinal statistics

Filters based on ordinal statistics belong to the class of nonlinear spatial filters. The response of such a filter is determined by the preliminary ordering of the pixel values that are covered by the filter mask and the subsequent selection of values that are at a certain position of the ordered sequence, that is, they have a certain rank. The filtering process is reduced to replacing the original pixel value with the obtained filter response value [3]. The most famous is the median filter, which replaces the pixel value with the value of the median of the brightness distribution of all pixels in the neighborhood. Median filters for certain noises show excellent noise reduction capabilities with a significantly smaller defocusing effect than linear smoothing filters with similar sizes. In particular, median filters are effective at cleaning impulse noises, sometimes called "salt and pepper" noises, which are an overlay on an image of random black and white dots [4].he median of a set of numbers is such a number η that half of the numbers from the set are less than or equal to η, the other half are greater than or equal to η. To perform median filtering for an image element, you must first order in ascending pixel values inside the neighborhood, then find the median value and, after all, assign the resulting value to be processed. So for a neighborhood of 3 × 3 elements, the median is the fifth largest value [1]. For a neighborhood of 5 × 5, the thirteenth value and so on. If several elements in a neighborhood have the same values, these values will be grouped [5]. For example, suppose that in a neighborhood of 3 × 3 the elements have the following meanings:
(10, 20, 20, 20,15, 20, 20, 25,100). After ordering, they will be located as follows: (10,15, 20, 20, 20, 20, 20, 25,100; consequently, the median will be 20. The main function of median filtering is to replace a pixel value that is different from the background by another one closer to its neighbors. Isolated dark or light clusters that have an area of not more than $n^2 2$ will be removed by a median mask filter with dimensions $n \times n$. In this case, “deleted” means that the pixel values at the corresponding points will be replaced with median values in the neighborhoods. Large-sized clusters are distorted much less [5].

Simulation of digital image processing in MATLAB

In the simulation, a “rabbit” image of 256 размером 256 in shades of gray was used (Fig. 1a). All calculations were carried out in the Matlab R2013b software environment.
The image “rabbit” was spoiled by the impulse noise “salt and pepper”; this noise appears on the image as black and white dots. To suppress impulse noise, a median filter of 3 × 3, 5 × 5, 7 × 7 was used. The processing result is shown in Figure 1.

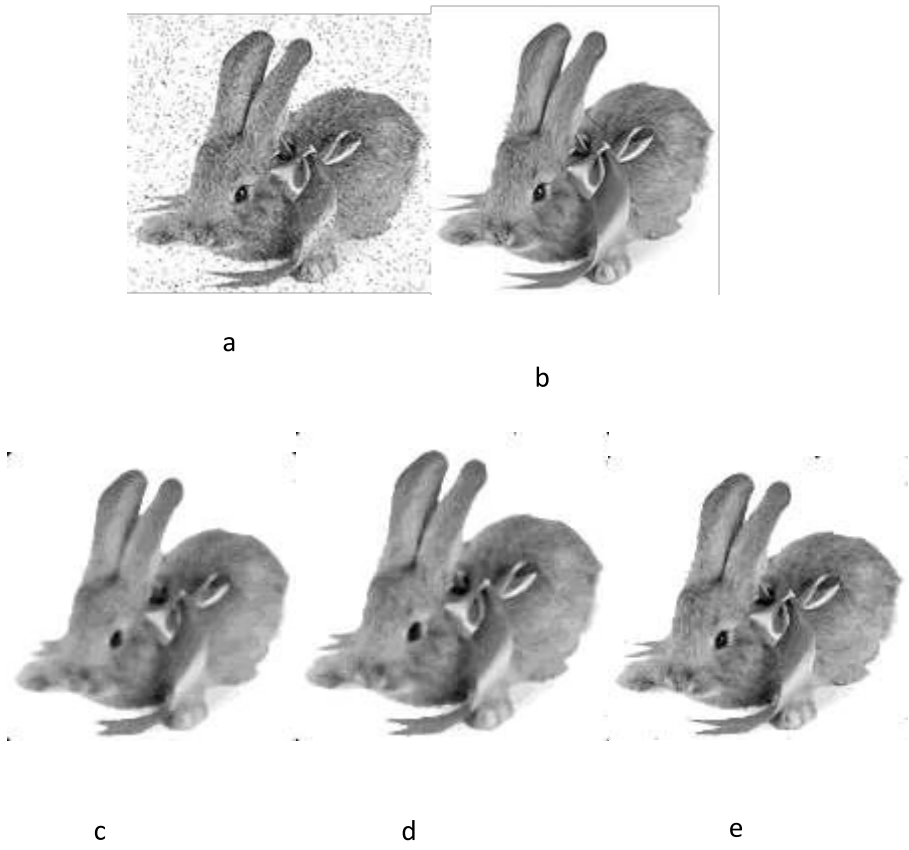

Fig 1. a) image in grayscale "rabbit"; b) image spoiled by noise "salt and pepper"; c) image processed by a median filter with a mask of size 3×3; d) image processed by a median filter with a mask of size 5x5; e) image processed by a median filter with a mask of size 7x7

The generalization of the considered median filter is a weighted median filter. In a simple median filter, all elements of the image within the mask are the same effect the result of finding the median. Sometimes it is desirable to give a lot of weight to points that are located close to the center of the mask. The basic idea of a weighted median filter is to change the number of elements in the mask by repeating each element a given number of times and finding the median of the resulting stretched sequence. The result of processing the median filtering with weighted coefficients is shown in Fig.2

Fig. 2. Images processed by weighted median filter

Conclusion

The paper demonstrated the use of a median filter in cleaning images of impulse “salt and pepper” noise. A comparative analysis of median filters with different weights of mask coefficients showed that using a median filter with weighted coefficients allows reducing the noise level in the image compared to the known median filter.

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