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RESEARCHING METHODS OF FILTERING DIGITAL IMAGES THAT CONTAIN MEASURING INFORMATION

One of the fundamental problems of our time is the problem of visual perception. Originating a long time ago, it is still relevant because the image is a natural means of communication between a man and machine in any processing, analysis and control systems.

Useful information from images can be obtained in many ways. In this research, this method is the image analysis measurement of objects that are of high quality. The solution of this problem is the choice of a specific method of filtration. To select a method, we need to analyze the most suitable methods for the automated system. The criterion for choosing a method of filtration can be anyone.

Modern methods of image filtering are of various kinds. They may differ in the basic principles of action, and have similar algorithms with some differences that improve each method. The task is to select the most effective one. The main methods are discussed in this report, which highlights the methodology of each of them, their advantages and disadvantages.

In this research, aerospace images are used. The sources of noise in these images may be different:

• non-ideal imaging equipment – camera, scanner, etc.;
• poor shooting conditions – such as heavy noises that occur at night video shooting;
• obstacles when transferring images by analog channels: electromagnetic fields, noise of active components (amplifiers) of transmission line;
• filtering errors in the allocation of brightness and color signals from analog composite signal and so on.

The most common types of noise:

• Gaussian noise;
• Rayleigh noise;
• noise Erlang (gamma noise);
• exponential noise;
• steady;
• pulse.

The following basic approaches can be distinguished for spatial noise suppression:

• linear averaging pixels;
• mathematical morphology;
• Gaussian blur;
• Wiener filter;
• methods based on wavelet transformation;
• the method of principal components;
• anisotropic diffusion;
• median filtering.

Linear averaging of pixels. A simple idea to remove noise is to average pixel values in the spatial field. For each pixel neighboring pixels that are arranged in a certain rectangular box around are analyzed.

Mathematical morphology. Noise reduction may also be carried out with the use of two basic morphological operations: constriction and expansion, as well as their combinations – closing and opening. Opening (first contraction, then expansion) removes edges at the boundaries of objects, and closing (first expansion, then contraction) fills the holes within and on the borders.

Gaussian blur. Gaussian blur is a convolution of the image with a Gaussian function which parameters set the degree of blur and rationing. In fact, it's the same averaging only pixel is blended with others on a particular law, according to the Gaussian function.

Wiener filter. Technically Wiener filter is implemented using a discrete Fourier transformation in the frequency domain. Conditions to choose the Wiener filter are its use for processing images with a fairly large size.

Methods based on wavelet transformation. Wavelet transformation is a tool for image analysis. In the field of noise suppression, it allows to remove noise from an image without affecting significantly the limits and detail. Also, it can effectively extinguish noises with spectra other than white.

The method of principal components. The method of principal components reveals the structure of multivariate data and is mainly used for recognition or image compression. In the field of noise suppression, this approach is relatively new and little explored. It works best for images with Gaussian white noise.

Anisotropic diffusion. The basic idea of this approach is that the brightness of each pixel value is interpreted as the temperature at a given point in the image, so all the images are presented as maps of temperature. Noise reduction is performed by alignment of pixels intensities by simulation of heat transfer process.

Median filter implements a non-linear noise removal procedure. Median filter is a window that moves across the image and includes an odd number of pixels. The central pixel is replaced by the median of all elements in the image window. The median filter is used to remove the additive and impulse noise in the image.

Notch filters. Notch filters remove or weaken the frequency band of the ring around the origin of Fourier transformation.

Band-pass filters transacts opposite to notch filters. The transfer function of the band-pass filter can be obtained from the transfer function corresponding to notch filter by using inverse expression.

There are some noises when receiving images from satellite and in aerospace shooting. When transferring images to Earth there is a switching noise. It is characterized by the replacement of pixel values in an image of a fixed or random variable. Rayleigh noise occurs, because the survey is conducted at a distance. Gaussian noise occurs, because of the poor conditions of signal reception. Since the survey takes a long time and there is exposure of sunlight, there is thermal noise .

Filtering can be performed in the frequency domain as well as in space (time domain). In spatial filtering pixel by pixel image processing occurs. Information about the contours of the object is in high frequency, so for their selection high pass filters are used. The rest of the image data contain in the low frequency, low pass filters are used for filtration.

Thus, the main sources of noise in digital images are the processes of obtaining and transmitting. Work of video sensors depends on various factors such as external conditions during shooting and quality of sensors. Also in the process of transferring images may be distorted by the obstacles that arise in the communication channels. Moreover, among the factors contributing to the digital noise on the video images both external and internal noise play an important role.