Proceedings of Online International Conference on Innovative Solutions and Advanced Research
Organized by Novateur Publications, Pune, Maharashtra, India
JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN: 2581-4230, Website: journalnx.com, October 11th, 2020

METHODS FOR IMPROVING THE QUALITY OF VIDEO INFORMATION

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Abstract

The above methods for improving the quality and accuracy of video information preprocessing make it possible to expand the scope of using video information processing devices in various sectors of the national economy. Improving the quality of video processing creates the necessary prerequisites for increasing the reliability of image recognition and the accuracy of optical measurements.

Keywords: video surveillance, video information processing devices.

Introduction:

Adaptive preprocessing procedures [1] are associated with the optimization of the functioning of optoelectronic image conversion devices that provide the required signal-to-noise ratio in a minimized volume of information messages. The commonality is that regardless of the purpose of the information system, preprocessing procedures are based on identical principles and include similar stages [1, 2]. This allows us to formulate the principle of versatility of preprocessing, i.e. to highlight the stages of solving various problems of preprocessing, which can be performed by universal methods in devices for analog and digital converters of video information. There are three aspects of preprocessing:

1. Element-wise processing to correct the distorting factors of transforming spatial optical signals into electrical digital ones. This type of preprocessing should be implemented adaptively and combined with spatio-temporal sampling and digital transformation of the original spatial signal in image reading devices.
2. Processing to improve the quality of information display signals (increase in contrast, increase in signal-to-noise ratio, etc.).
3. Processing, ensuring the compactness of the description of the information signal (selection of contour, spectral preparations of images).

The preprocessing methods of analog and digital type, considered by the example of a device for adaptive transformations of spatial signals into a digital data array, are presented in Table 1. The sequence of preprocessing procedures corresponds to the stages of their

implementation in digital video information conversion devices. If the use of the number of processing stages in the given sequence is dictated by the needs of the applied problem, then each subsequent stage of preprocessing always requires the presence of the previous stages.

In preprocessing devices, optical (analog) processing is usually used in spatial-coordinate linear procedures that ensure the construction of optical images with the required quality. In a number of practical applications (biology, medicine, hydrology), it becomes necessary to carry out spatial-spectral linear procedures that provide photoelectric registration of low-contrast or phase-contrast information objects [3].

The quality of video information preprocessing is determined by the adaptation of devices to external and internal distorting factors of transformation of spatial information signals. From this point of view, the processing criterion becomes locally informational in the image space, considering the display of spatial information signals as a result of the interaction of three random processes: information, information carrier noise, and the noise of a converting device as a consequence of limitations and imperfection (imperfection) of the device element base. Therefore, in the adaptive digital video information preprocessing device, after optical preprocessing (stage I), stage II of preprocessing is sequentially carried out to correct the distorting conversion factors - noise and distortions of the converting devices.

Table 1. Methods and stages of video information processing

<table>
<tr><td>Stages</td><td colspan="2">Video processing methods</td></tr>
<tr><td>Stage I Analog (optical)</td><td>Spatial coordinate (scaling, apodization)</td><td>Spatial spectral (contrasting, phase contrast imaging, spatial noise elimination, matched filtering)</td></tr>
<tr><td>Stage II Digital</td><td colspan="2">Adaptive correction of distorting image conversion factors (CCD dark signal, uneven background, aperture, geometric distortion of the optical link, color distortion)</td></tr>
<tr><td rowspan="3">Stage III Digital signal processing methods</td><td>Coordinate</td><td>Spectral</td></tr>
<tr><td>Contrast modification (contrast reversal, scaling, contrast enhancement, bit slice, etc.)</td><td>Energy redistribution (discrete filtering in the basis)</td></tr>
<tr><td>Boundary detection (discrete filtering, discrete differentiation, static differentiation, nonlinear differentiation)</td><td>Compression range</td></tr>
</table>

The task of digital image processing at the output of real digital communication channels that implement the transmission of image data is always associated with the need to minimize the digital stream entering the communication channel. Known procedures for efficient coding of images are used to minimize image data. For this purpose, the procedures of the third stage of preprocessing are used, which ensure both the improvement of the displaying properties of information signals (for example, contrast processing), and the formation of

new minimized descriptions in the form of contour image preparations ("boundary detection") or spectral image preparations ("discrete filtration").

Let us single out the most important stages in solving image processing problems, which, on the one hand, have a certain content, and on the other hand, they reflect the peculiarities of the presentation and management of data, structures of machine algorithms, and the organization of computational processes.

1. Formation of digital representation of the image. This includes the procedures for entering images into a personal computer and primary data conversion for organizing the most effective forms of their presentation at various memory levels. The solutions used in this case should be considered primarily from the point of view of effective storage and further processing of data by a personal computer. At this stage, the main procedures are sampling and quantization, as well as placing digital images in the memory of a personal computer.

2. Pre-processing of images. The main feature of this stage is the preservation of the form and structure of the description of the original image. Transformations performed on an image generate new images that belong to the same class as the original images. For example, the original image, represented by a matrix of integers, in the preprocessing step can be transformed into some other image, but still represented by a matrix of numbers. The main operations of this stage are operations to restore and improve the visual quality of images.

3. Formation of a graphic preparation of the image. At this stage, the selection and formation of the line structure of the image is carried out. Representation of images in graphical (line) form greatly simplifies the processes of its analysis and description, carrying out measuring operations on the image. The main operations of this stage are the operations of segmentation, outline selection and skeletonization of images [1].

4. Analysis of images. At this stage, by measuring various parameters, determining the features of the entire image, its constituent parts, fragments, etc., descriptions of images and objects on them are compiled. The main operations of this stage are procedures for measuring spectral, topological, geometric, structural, statistical and other features [2].

5. Classification and recognition of images. Typically, this is the final stage of digital image processing. At this stage, based on the descriptions, the classification and recognition of images and objects on them is carried out using the methods of pattern recognition [4].

From the stages listed above, it can be seen that the video information processing procedures contained in the second stage are not very dependent on the type of the resulting image, and stages 2 and 3, on the contrary, are determined by the task set before the video information processing devices. Pre-processing of video information for subsequent high-quality television display or feature extraction in classification devices is a key task in control, monitoring and diagnostic and information-measuring systems.

One of the first stages of image preprocessing is to improve their quality, which consists in increasing the contrast, signal-to-noise ratio, and expanding the dynamic range.

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