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Per-pixel adjustment of the afterglow effect EOC screen.

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Abstract. Information capacity of optoelectronic measuring systems significantly exceeds the volume of the others. The residual afterglow EOC creates additional uncertainty. There is a partial solution to the problem [1-2]. The work is dedicated to the enhancement of existing methods to fight the afterglow.

1. Introduction

The main achievements of modern science and technological processes are closely connected to improved methods of obtaining and processing of measurement information, diagnostics of parameters studied or controlled processes. Optoelectronic system distinguishes fast entry of registered images to the computer, processing, extraction of image quantitative characteristics of the process being studied, data analysis and visualization. In such systems used a photodiode array made by CMOS technology. The main indicator of the quality of the measuring device is obtained from him the amount of information about the value of the measured value The optoelectronic system has a large information capacity in comparison with other devices. The residual illumination of the electro-optical converter creates difficulties in measurement. The work is dedicated to the refinement of existing techniques to combat afterglow[1-2].

2. Experimental setup

We shall determine thermal characteristics of high-speed processes. For this camcorder VideoSprint with nanosecond electro-optical shutter it has been used. Experimental stand presented in figure 1.



Figure 1. Experimental stand.



Performance provides additional gate - pulse, which is carried out in the interval photocathode-MCP. Solid-state image detectors convert light into a two-dimensional image brightness. For information processing and has been selected ImageJ - a freely available program. ImageJ written in Java, so it is one of the world's fastest image processing programs. In ImageJ presented all the necessary tools for image analysis. ImageJ has the ability to segment automation actions by writing macros. Discovered the afterglow of the phosphor is forcing us to process the image data pixel by pixel.

3. The algorithm refines the technique

Let the amplitude of the observed signal exceeds in I_{nois} N times background. The signal can be represented as exhibitors:

$$I(N) = m \cdot I_{nois} \cdot \exp(-a \cdot N).$$

The signal decreases e times during 1/0.36. Therefore, the lifetime of the afterglow three frames. The main contribution to the afterglow of investing 3 frames. Figure 2 illustrates the luminous particle by 4 frames, N is 0 to 3.



Figure 2. The image of the glowing particles in 4 consecutive frames.

Accordingly, the frame number, the minimum residual glow corresponds to the third frame:

$$I_{PSmin} = m \cdot I_{nois} \cdot \exp(-0,36 \cdot 3).$$

It was established experimentally that the appearance of the attenuation law does not depend on the initial intensity of the signal. Let the amplitude of the new signal I_2 exceeds a background in k times:

$$I_2(N) = k \cdot I_{nois} \cdot \exp(-0,36 \cdot 0).$$

If the signal traces overlap, recorded the amount of:

$$I(N) = k \cdot I_{nois} \cdot \exp(-0,36 \cdot 0) + m \cdot I_{nois} \cdot \exp(-0,36 \cdot N).$$

Where the value N depends on the time from the start of the afterglow of the previous signal. The signal-to-noise:

$$SNR(dB) = 20 \cdot \lg \left(\frac{A_{signal}}{A_{nois}} \right).$$

The background adds afterglow. For simplicity, we assume that the amplitude across the region of signal are the same. Then the signal/noise:

$$SNR(dB) = 20 \cdot \lg \left(\frac{k \cdot I_{nois} \cdot \exp(-0,36 \cdot 0) + m \cdot I_{nois} \cdot \exp(-0,36 \cdot N)}{I_{nois} + m \cdot I_{nois} \cdot \exp(-0,36 \cdot N)} \right).$$

Calculation of signal-noise with minimal afterglow:

$$SNR(dB) = 20 \cdot \lg \left(\frac{k \cdot I_{nois} \cdot \exp(-0,36 \cdot 0) + m \cdot I_{nois} \cdot \exp(-0,36 \cdot 3)}{I_{nois} + m \cdot I_{nois} \cdot \exp(-0,36 \cdot 3)} \right),$$

$$SNR(dB) = 20 \cdot \lg \left(\frac{k + 0,34 \cdot m}{1 + 0,34 \cdot m} \right).$$

If the images of the objects do not overlap and are joined along the border:

$$SNR(dB) = 20 \cdot \lg k + 0,34 \cdot m .$$

If the new signal appeared earlier, for example N = 1:

$$SNR(dB) = 20 \cdot \lg k + 0,7 \cdot m .$$

Therefore, when using optoelectronic systems for the study of SHS is important to eliminate afterglow. If we study one moving object, we use the algorithm [1-2] and there is no problem. If during the observation appear and disappear a lot of new objects, the difficulties arise. Then it is not enough to apply for all image pixels the same algorithm. You must use feedback.

Any image can be described by a set $I_{nois}, I, I_{PS}(N)$. Feedback based on the estimation of the ratio of the amplitude of the signal I_n the pixel to the amplitude of the signal in the same pixel in the previous frame I_{n-1} . Based on the comparison of selected factor b residual glow.

$$I_{PS}(N) = I \cdot \exp(-a \cdot N) = I \cdot b.$$

The value of the amplitude of the signal of the next frame in the same pixel is calculated by the formula:

$$I(N) = I_n - b \cdot I_{n-1}.$$

Let the currently registered signal in the pixel with coordinates (x,y). If the ratio is greater than one, then this new signal. Then the coefficient is b=1, N=0. When you move to the next frame in the memory cell "0" signal is automatically reset into the cell "1". The ratio of the signals stored as "d".

Table 1. Part of the algorithm, pixel-by-pixel processing

The memory		Calculation in the pixel	Comparison		
			If	Then	
				b	N
RAM memory	«0» a readable signal	$\frac{I_i}{I_{i-1}}$	>1 (this is a new signal)	1	0
	«1» storage I_{n-1}		=0,7 (this afterglow)	0,7	1
	«2» storage $d = \frac{I_n}{I_{n-1}}$		=0,5 (this afterglow)	0,5	2
			=0,3 (this afterglow)	0,3	3
«3» (background)	<1 (this background)		1		

Sometimes a very weak signal. Then the ratio of the signal more than the previous, but less than 1. If you need high accuracy, supplemented by comparison algorithm. The resulting ratio should not exceed d.

4. The application of optoelectronic systems for studies of SHS

The use of optoelectronic systems to study the SHS can be measured: the time of heat generation and heat, the speed of propagation of the combustion front, etc. There is also an opportunity to assess the size and times of the phases. Figure 3 shows the SHS [3-5] combustion process.

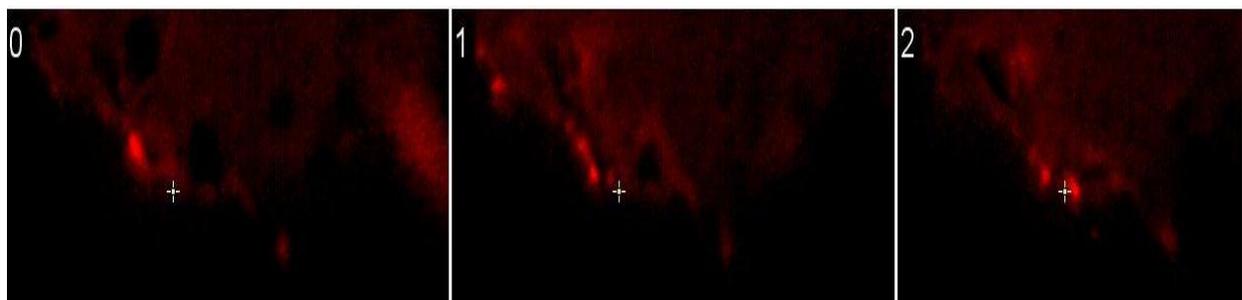


Figure 3. SHS obtain potassium - titanium bronze.

The frames obtained using the optoelectronic system. Pixel-by-pixel processing of data will make the results more accurate. The application of optoelectronic systems to measure the rate of heating will help to solve important tasks of nanotechnology.

5. Conclusions

The application of optoelectronic systems for research, very informative. However, existing methods of removing residual emission electron-optical converter contain flaws. In order to more accurately measure the need to: per-pixel processing and feedback. The proposed algorithm helps to select the correction factor for each pixel.

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