INPUT INFLUENCES ON AN OPTICAL-ELECTRONIC DEVICE WHEN MEASURING ANGULAR COORDINATES OF DISTANT OBJECTS

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ABSTRACT: *An attempt for specifying the concept of input effects has been made in the article in order more data to be systematized about them, to be specified the composition and their effect over the planning and functioning of electro-optical device.*

An analysis has been made, showing the impact of the input effects over the functionality of the electronic-optical device for measuring the position of distant objects according to angular coordinates.

KEY WORDS: *electronic-optical device*

The design of complicated measuring systems, electronic-optical devices (OEDs) being one of them, which ensure measuring coordinates of distant objects, either of natural or artificial origin, include analysis of the input influences which helps the optimization of the system.

The article aims to research the input influences, the information about them is systemized, their content is determined, as well as their impact on the design and functioning of an optical-electronic device.

Fig. 1 shows a scheme which presents the structure of the environment, which is divided into physical and technical spheres, and structure of a spectrophotometer as a sequence of functional systems. The influence of the physical sphere is presented by multiple input signals (M), which enter the input hole of the OED and exploitation influences (W), attached directly to the construction elements of the device.

The input influences ($M' \subset M$) include the input signals which greatly impact the entrance of the system and its functioning. The multiple composition (M')

which has to be analysed at the design is defined by the device's function. In fact, the input signals ($M' \subset M$) don't influence the device's functioning. The input influences consist of useful signal $м_1 \in M_1$ whose informative perimeter is directly or functionally connected with the measuring value and the noises $y' \in Y$, which deform this parameter until its entrance into the input hole of the device and it is the reason for errors in the calculations [3, 4, 5]. Thus:

$$M' = P' \ (M_1 Y').$$

$$M' = F' \ (M_1),$$

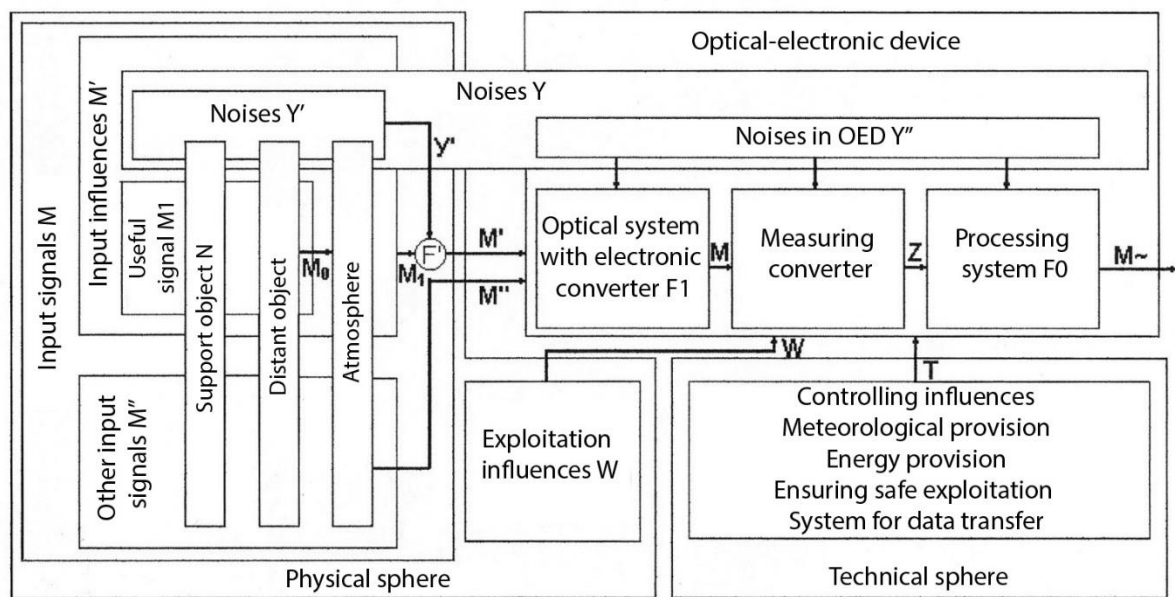in the conditions of maximizing the ratio signal/noise.

Fig. 1. Structural scheme of environment and optoelectronic device

The first functional part of the OED is an optical system, being an optoelectronic transformer, which performs reception and release of the influences of multiple input signals.

$$M' = F'(M_1)$$

at the condition of maximizing the ratio signal/noise.

The measuring transformer performs the major function of OED–measuring, i.e. it provides output signal (Z)

$$Z' = F_i(M').$$

The system of data processing, which contains a model of the input environment and OED (θ), performs transformation of the input signals and evaluation of the angular coordinates of the distant object ($\bar{M}$) [1]:

$$\bar{M} = F_0(Z, \theta)$$

The technical sphere also shows some certain influences T (fig. 1), as well as noises in the OED Y''.

The system for data processing which contains a model of the input environment and OED *(θ)* performs transformation of the input signals and evaluation of the angular coordinates of the distant object ($\bar{M}$) [1].

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A useful signal in the OED when measuring the angular coordinates of distant objects is the radiation of the distant object and information parameters – direction, which is defined into a standard system of coordinates and the speed of its position change.

The energy characteristics of the radiation of the distant object are defining values and not informative parameters of the useful signal [1, 2] and they are subject to analysis when designing the OED for measuring angular coordinates.

When using relative methods for measuring angular coordinates of distant objects, a useful signal is the radiation of a distant support object (N).

According to the character of the relation of the noises with the level of the useful signal, they are adaptive and multiplicative and according to their statistical features – random and determinative. The random noises cause random errors which determine the measurement accuracy and the determinative noises cause systematic errors which are usually corrected algorithmically with the help of the device.

The short analysis of the input influences and the affecting values considers not only the function of the OED but also the differences in the used measurement methods.

The methods for measuring the angular coordinates of a distant object are divided into absolute and relative, depending on the choice of the start of taking reports from the measured values.

It is characteristic for the mobile (astronomical, distant) objects to have determinative parameters of movement which are regulated by the laws of space mechanics. This allows the optimization of the method choice and certain construction elements of the OED [3, 4, 5].

The movement of the astronomical object causes determinative nose – planet aberration: visible change of the location of the astronomical object, its trajectory, reaching a few angular seconds. Another determinative noise is the diffraction parallax – it appears because of the end position of the topocentric distance of the astronomical object and the diffraction properties of the atmosphere.

The atmospheric noises and refraction phenomena influence greatly the results from measuring the angular coordinates of astronomical objects from ground OEDs.

The analysis of the above mentioned factors when designing OED needs to be supported with considering the specific device structure, its technical

realization and the parts choice. The influencing values can activate the noises $y_1 \in Y_1$, generated by the device elements if the technical and algorithmic devices are not designed properly.

The level of the useful signal, which depends on the distant objects, is for many photoreceivers defined by the image size of the distant object, which can influence the measuring accuracy of the position of the image centre. The optimality of the algorithm depends on the correct calculation of the function of energy distribution in the focal field of the lens. Besides this, it is characteristic for some types of photoreceivers to displace the image field which depends on the level of the input signal. This fact is the reason for the appearance of determinative noises in the optical-electronic device.

The influence of the background radiation from the own light of the atmosphere and ground sources of light, and the integral radiation of the stars are part of the parameters which determine the ratio signal/noise in the system [3]. The ratio signal/noise is an important factor and the accuracy of the measuring transformer in the OED can depend on it.

The spectral density from the radiation of the distant object depends primarily on the radiation spectre of the Sun an on the properties of the reflecting surfaces of the distant object. As a result of the atmospheric dispersion and the chromatic aberration of the optical system of OED, the image of the radiation source is stretched in the spectre and its energy centre is dislocated according to the difference in the wave lengths in the maximum of the radiation from the light source and the maximum of the spectral sensitivity of the photoreceiver. The reading of these determinative noises is possible when there is information about the spectral characteristics of the radiation source.

The conducted analysis visually shows the impact of the input influences and other factors on the quality of the functioning of OED when measuring the angular coordinated of distant objects.

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