COMPUTER SIMULATION OF ACOUSTO-OPTIC IMAGE PROCESSING

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The paper is devoted to theoretical and experimental study of regular trends of optical beams processing. New results on the image processing have been obtained due to the application of computer simulation methods based on the Fourier analysis.

Recently there has been an increasing interest in processing of images by various optical systems [1]. Additionally to the traditional schemes of the beams processing, new highly efficient methods have been developed during the last decade. It provided observation of the images characterized by higher quality and obtained in shorter time intervals. These systems of image processing seem promising for usage in medicine, laser optics, ecological monitoring and other areas of modern science and technology. At present, the acousto-optic processing of optical images belongs to the new branch of actively developed modern information technologies[2]. In particular, the present research is devoted to the problem of optical images processing executed by means of acousto-optic filters of spatial frequencies. It is known that light beams propagating in the acousto-optic cells are diffracted by acoustic waves. During the diffraction processes, information included in the incident optical beam so as in the acoustic waves is transformed into the diffracted beam [1]. As a result, a spectrum of an image in the diffracted light might be considered as a convolution of two spectra: one describing the incident optical ray and another one representing the transmission function of the cell. The transmission function of the acousto-optic device may be controlled electronically by a driving electric signal. Consequently, due to the electronic control, optical beams with a required distribution of light intensity over the incident and the diffracted beams cross section may be observed at the cell output.

From the practical point of view, variations of the optical wave amplitude related to the transmission function of the cell are of most interest. These changes may be analyzed, in the simplest way, in the case of application at the filter input of light fields represented by the well-known functions such as the Gaussian function, the single rectangular pulse or single triangular pulse function as well as by other functions. During the analysis, a complicated structure of an initial optical field was analyzed as a superposition of the above mentioned simple functions. Acousto-optic cell with a wide-angular geometry of light diffraction was investigated. Contrary to the traditional methods of light waves filtration, the proposed scheme of processing provides the spatial filtration of light simultaneously along two mutually orthogonal directions. Experiments have confirmed that the developed devices gave us a unique possibility to control spatial structure of optical beams in the real time. For example, it made it possible to execute edge enhancement of two dimensional images [2].

References

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