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Acousto-optic filters using multi-phonon Bragg diffraction

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Image edge enhancement is of great importance in optical image processing. This approach allows to reduce the information data array but at the same time to preserve such essential characteristics for the recognition of the object as its shape, size, peculiarities of motion, etc. The simplest and widely used in practice method of the edge enhancement is Fourier processing using spatial filters with specified characteristics. Acousto-optic (AO) cells are attractive filters because they allow very simple change of the filter characteristics (period and depth of acoustic grating). However, in the majority of cases the AO interaction is one-dimensional process. Therefore, conventional AO cells don't allow performing the 2D image processing. To process such images, it is necessary to develop special AO filters.

In [1-5] AO filters are described which make it possible to obtain a two-dimensional image contour on the basis of the two- and three-phonon Bragg diffraction.

In our report we are giving a common approach to AO filters using the multi-phonon Bragg diffraction process.

We present theoretical and experimental investigations of image edge enhancement. Theoretical models of AO interactions and calculation results of transfer functions will be described and discussed. The experimental setup and experimental results will be presented as well. We will discuss also the types of AO interaction of "two-mode" optical radiation with a single acoustic wave. It will be shown that AO filters based on these types can be used for 2D processing as well.

It is assumed that diffraction occurs in a uniaxial gyrotropic crystal tellurium dioxide. A model of a gyro-

tropic crystal which takes into account both the curvature of the wave vectors and the ellipticity of the intrinsic waves of the crystal is developed.

At that the curvature of the surfaces affects especially strongly when the light propagates near the optic axis. It will be shown that each diffraction order can be used for the 2-D image processing. The peculiarities of different orders will be discussed.

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