ing the stability and reproducibility of a laser frequency to within $10^{-13}$–$10^{-14}$ with the aid of narrow molecular resonances, and also consider the use of lasers for measuring small changes in optical lengths with a sensitivity $\Delta l/l$ of up to $10^{-15}$.


[1] V. S. Letokhov, ZhETF Pis. Red. 6, 597 (1967) [JETP Lett. 6, 101 (1967)].

[2] V. N. Lisitsyn and V. P. Chebotaev, Zh. Eksp. Teor. Fiz. 54, 419 (1968) [Sov. Phys.-JETP 27, 227 (1968)].

[3] R. L. Barger and J. L. Hall, Phys. Rev. Lett. 22, 4 (1969).

[4] V. S. Letokhov and V. P. Chebotaev, ZhETF Pis. Red. 9, 364 (1969) [JETP Lett. 9, 215 (1969)].

[5] N. G. Basov, O. N. Kompanets, V. S. Letokhov, and V. V. Nikitin, Zh. Eksp. Teor. Fiz. 59, 394 (1970) [Sov. Phys.-JETP 32, 214 (1971)].

[6] O. N. Lompanets and V. S. Letokhov, Zh. Eksp. Teor. Fiz. 62, 1302 (1972).


**V. A. Zverev and E. F. Orlov.** Optical Methods of Information Processing in Radiophysics and Medicine.

Optical methods of information processing possess a number of advantages over electronic methods when performing multichannel integral transformations (measurement of spectra, correlation functions, and probability distributions). These operations can be carried out simultaneously in many parallel channels with the aid of optical systems. In connection with the appearance of lasers and the advances made in the field of holography, considerable attention is being given to the development of the optical methods of information processing based on the properties of coherent light. However, the requirement of coherence of light, which is the basis of the calculating machine, is difficult to fulfil when the signal under investigation is introduced into the processing scheme. Optical calculators are known which allow the use of noncoherent light, but the comparative ease with which information can be fed into them reduces considerably the accuracy of the computations. The decrease in the computational accuracy occurs owing to the fact that the result of the computations is observed in a strong interfering background, which is absent when coherent light is used.

We describe in the report a new principle of construction of optical calculators which allows us to simply feed the information in question into the machines and at the same time maintain a high computational accuracy. The principal idea of the proposed method consists in the application of a matched spatial and time modulation of the luminous flux. One type of modulation is used for computations: either spatial or time modulation, and the other type is used for raising the computational accuracy by means of spatial or time filtering of the useful signal. Experimental investigations of the principles considered showed that it is possible to construct the corresponding apparatus for optical information processing (the OSA system)[1], which will not be inferior in respect of computational accuracy to the apparatus using coherent light. At the same time the OSA systems utilize better the region of low spatial frequencies and, therefore, less accurate optical elements can be used in them[1].

The application of the OSA methods for solving concrete problems led to the development of an effective method for preliminary information processing—the method of generalized two-dimensional holograms[2]. A generalized two-dimensional hologram is obtained by representing the initial information $f(t)$ in the form $f(t)f(t-\tau)$, i.e., as functions of two coordinates $t$ and $\tau$. By inverting the generalized hologram with respect to $\tau$ and averaging over $t$, we can measure the spectral parameters of the process $f(t)$ with a high resolution and with a simultaneous simplification of its structure, which is necessary for the solution of a number of problems. The method has been successfully applied for the measurement of the technical width of the line of the quartz generator[3], for the measurement of spatial correlation functions of wave fields with a long averaging time[4], to some problems of stereophonic audio reproduction[2], and in operational interference spectroscopy[5].

The application of the method for the solution of a number of problems of medical diagnosis proved to be fruitful[6,7]. The recording of a phonocardiogram signal in the form of a generalized hologram in the frequency-time plane allows us to efficiently use the surplus information in the signal and to get rid of it when it is fed into the calculating machine; in a number of cases such a representation makes it possible to establish simple diagnostic symptons[6]:

A generalized hologram of a ballistic cardiogram permits an easy measurement of the absolute levels of the forces acting on the cardiovascular system[8]. The measurement of the relative levels of certain harmonic components of these forces allows objective estimates of the force of a heat muscle, the relative activity of operation of the right and left halves of the heat, and a number of other parameters of physiological and diagnostic importance[7].


[1] V. A. Zverev and E. F. Orlov, Opticheskie analizatory (Optical Analyzers), Sov. Radio, M., 1971.

[2] V. A. Zverev, Radiotekhnika 26, No. 6, 2 (1971).

[3] V. A. Zverev, E. F. Orlov et al., Izv. VUZov (Radiofizika) 12, 1169 (1969).

[4] V. A. Zverev and I. K. Spiridonova, Akust, Zh. 7, 428 (1961) [Sov. Phys.-Acoust. 7, 346 (1962)].

[5] S. M. Gorskiĭ and V. A. Zverev, Izv. VUZ. (Radiofizika) 11, 1205 (1968) [Radiophysics and Quantum Electronics 11, 687 (1968)].

[6] V. A. Zverev et al., Pediatriya No. 8, 21 (1970).

[7] V. A. Zverev et al., Med. Tekh. No. 6, 28 (1971).

[8] K. V. Zvereva, V. A. Zverev, and I. K. Spiridonova, Vrachebnoe Delo No. 1, 10 (1970).


Translated by A. K. Agyei