METHODOLOGICAL NOTES

Holography workshop

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The need for acquainting physics majors with the principles of optical holography became essential in the middle Sixties. Obviously, it is simplest to accomplish this in the optics course which is part of the general physics program, and we started to do so in 1965. During the first years, this material could be illustrated only with the aid of suitable photographs from the scientific journals.

This was followed by organization of lecture demonstrations on holography[1-3], in which, of course, only various images obtained with previously prepared holograms could be shown.

The first experimental work by students on the production of holograms was organized in 1969 by Yu. A. Il'inskiĭ in the Division of Wave Processes of the Physics Department of the Moscow State University[4].

In 1972, at the optical laboratory of the general Physics Workshop, the present authors have constructed facilities for individual viewing, on the part of all students, of images produced by an assembly of various holograms of the Fresnel, Fourier, and Denisyuk-Lippman type[5]. The holograms needed for this purpose were obtained with the kind collaboration of V. K. Kozlova and V. I. Bobrinev.

The description of a students' workshop on coherent optics was published in 1973 and contained a number of holography projects[8].

Starting with September 1974, a general-departmental workshop on holography has been in operation in the Solid State Division of the Physics Department of the Moscow State University. The first section of the workshop consists of five experimental projects performed on modern interferometer stages equipped with pneumatic shock absorbers to protect against vibration.

The following laboratory projects were organized:

1. Holography of three-dimensional opaque objects and the investigation of their images.

By independently recording the holograms, the students are able to observe and photograph the virtual and real images obtained by transmitting light through these holograms, and to become acquainted with the principles involved in obtaining magnified real images.

2. Production and investigation of plane-wave holograms.

The laboratory work results in one-dimensional, two-dimensional, and three-dimensional interference "sinusoidal" gratings, makes it possible to examine their structure and to observe the diffraction of light by them. Three-dimensional diffraction gratings make it possible to illustrate the Bragg condition in an optical experiment.

3. Production of holograms by the opposing-beam method, and their investigation.

4. Holographic interferometry with separated exposure time.

The method reduces to double holography of an arbitrary three-dimensional object in the natural and deformed state. The interference pattern that overlaps the reconstructed image of the holographic objects makes it possible to find the distribution of small deformations on the surface of the object.

5. Holographic interferometry of phase objects. In this project, the students use a new method, developed by the authors of this note, of measuring the diffusion coefficient in a transparent medium with the aid of holographic interferometry. The gist of the new method is described in[7].

The preparation of the student for the workshop is based on a textbook[8] and on detailed descriptions of the laboratory projects that are undertaken in the workshop.

A 20-hour lecture course "Physical Fundamentals of Holography" was developed for those attending the courses given by the Division for Advancement of the Teaching of Physics at the Moscow State University.

[1] O. A. Shustin, Usp. Fiz. Nauk 105, 361 (1971) [Sov. Phys.-Usp. 14, 668 (1972)].
[2] Lektsionnye demonstratsii po fizike (Physics Lecture Demonstrations), V. I. Iveronova, ed., Nauka, 1972.
[3] T. G. Chernevich, V. V. Korchazhkin, O. A. Shustin, and I. A. Yakovlev, Usp. Fiz. Nauk 113, 184 (1974) [Sov. Phys.-Usp. 17, 439 (1974)].
[4] Golografiya (Holography), Lab. of General Physics Workshop, Moscow State University, 1970 (Description).
[5] Ustanovki dlya nablyudeniya golograficheskikh izobrazheniĭ (Installations for the Observation of Holographic Images), Lab. of Gen. Phys. Workshop, Moscow State Univ., 1973 (description).
[6] F. T. S. Yu and E. Y. Wang, Am. J. Phys. 41, 1160 (1973).
[7] O. A. Shustin, T. S. Velichkina, T. G. Chernevich, and I. A. Yakovlev, ZhETF Pis. Red. 21, 52 (1975) [JETP Lett. 21, 24 (1975)].
[8] T. G. Chernevich, K. N. Baranskii, T. S. Velichkina, O. A. Shustin, and I. Ya. Yakovlev. Metodicheskoe rukovodstvo po golografii (Methodological Manual of Holography), Lab. of Gen. Phys. Workshop, Moscow State University, 1974.

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