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Book review

Holographic Interferometry in Experimental Mechanics

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[pp. i–ix+248, with 167 Figures]

The book reviewed is one of a wide and popular series of publications under the common title *Optical Sciences*. The aim of the series seems to be popularization of achievements of the contemporary optics taking special account of its application to the other fields of science and technology.

The experimental methods play an essential role in developing the mechanics of the deformed solid body. In some cases, they are used to confirm some theoretical solutions or to improve the accepted mathematical models but frequently they offer a unique way of solving the given problem.

The book discussed contains the fundamentals of holography and holographic interferometry, both in reflected and transmitted light, used in practical applications to experimental mechanics. In particular, the authors present various applications of holographic interferometry in experimental examinations of the deformable solid body. The authors discuss the essential conditions under which the holographic interferometry may be applied to the experimental analysis of displacements. The characteristics of three components of the displacement vector are given for the bodies of different structure and shape of their surface.

The book contains 8 chapters.

Chapter 1. *Introduction to Optical Holography*

In this chapter, a historical outline of the holography development as well as the theoretical fundamentals of creation and reconstruction of images are presented. Also, a review of technical indications of how to realize the suitable holographic setups is given. The authors present also the technical data for some component elements of the equipment, such as: holographic setups, lasers, and recording materials.

Chapter 2. *Holographic Interferometry*

This chapter is particularly important since it contains the discussion of basic techniques used in holographic interferometry. The authors pay special attention to the technical conditions under which the discussed methods may be applied. The theoretical fundamentals and physical realizability of such measurement methods as: the two-exposure method, the sandwich holography, the real time method, the multi-exposure method, and the time-averaged method are described. In this chapter, the principles of fringe formation of diffusion-reflecting objects are considered. The interference fringes represent the phase differences of the given object and may be used to determine the deformation and displacement of its surface. Therefore, the authors analyse different techniques of fringe interpretation as well as the ways in which the quantitative analysis of the obtained measurement results may be performed. Also, technically important cases of fringe interpretation referring to analysis of the state of stress and deformation are discussed for different conditions of load and applied measurement techniques. From the practical point of view, an important case is represented by the methods of holographic interferogram interpretation including determination of both the number of fringes and their signs.

Chapter 3. *Optimization of Holographic Interferometry*

When determining the displacement vector of a point on the surface of the deformed body by the method of holographic interferometry, a question arises how to choose the basic parameters of the interferometer to enable the determination of the displacement components with possibly minimal inaccuracies. The authors in their discussion formulate the criteria and the principles of selection of the interferometer scheme in the context of the whole task of planning the experiment. One of the more serious shortcomings in this case is a possibility of making errors due to improperly chosen scheme of the interferometer.

Chapter 4. *Determination of the Displacement-Vector Components*

The authors consider the methods of holographic interferogram interpretation allowing us to determine all three components of the displacement vector of an arbitrary point on the surface of the deformed body. Different methods enabling us to determine separately the normal and tangential components of the displacement are presented including holographic and moire-type ones.

Chapter 5. *Determination of Strain and Stress in an Elastic Body by Holographic Interferometry*

In this chapter, the authors discuss the methodics of stress and strain determination on the basis of measurement results by using the methods of holographic interferometry. Here, the relation between the basic dependences of the elasticity theory and technical interpretation of the interference patterns is presented. The problems considered above are illustrated by concrete examples of solving some technical examples, such as the bended bar or plate or unaxial tension of a plate with a hole.

Chapter 6. *Displacement Measurements on Objects under Elasto-Plastic Deformation*

The existence of residual deformations in a given construction is an important factor as far as the desired functions, or durability, are concerned. Hence, the possibility of determination of such deformations has pervaded the designers and researchers for may years. The holographic interferometry offers a new measurement tool. In this chapter, the authors discuss the holographic methods of strain and stress determination in constructions under elastoplastic deformation. A possibility of determination of residual elastoplastic deformation is indicated. The methods mentioned above are illustrated by concrete examples of technical realization in the form of determined stress and strain distribution. The authors suggest the methods of surface-etching or hole-drilling to determine the residual stresses. A separate class of problems considered in this chapter is that connected with mechanical contact.

Chapter 7. *Holographic Contour Mapping*

Here, the application of holographic method to exact imaging of a surface shape is considered. The methods and the applicability of holography in measurements of this type are discussed. Obviously, the touchless way of measuring combined with high sensitivity is worth emphasizing. The authors discuss such methods of surface shape determination as: two-wavelength, two-source and immersion methods. In this chapter, also holographic methods of surface roughness determination are presented.

Chapter 8. *Holographic Studies of Vibrations*

Here, the authors describe the technical principles of strain determination under periodically changing load (vibrations). The methods and examples of examinations of the vibration mode of the object surface are given. The authors discuss also such the methods as time-averaging and stroboscopic phase modulation of the reflected wave. A separate issue brought out in this chapter is devoted to examinations of vibrations of rotating bodies.

The authors are known for an excellent knowledge of both theoretical basis and practical applications of holographic interferometry which resulted in a very simple and clear way of presentation in spite of the fact that rather difficult problems are dealt with.

The book reviewed may be especially useful for scientific workers and engineers working in the experimental analysis of the solid body deformation as well as for the students of mechanical, civil and also electrical engineering. The great clearness of reasoning widens considerably the circle of potential readers.

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