OPTIMIZATION OF LIGHT COLLECTION FROM FIBER PROBES AND SIGNAL TRANSMISSION VIA DISORDERED FIBER BUNDLES IN GAS DYNAMIC EXPERIMENTS

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Two types of optical recording can be used in studies of the properties of structural materials under extreme dynamic loads. In the first case, fiber sensors equipped with collimators are used. They are used to probe individual points of a moving surface using methods such as laser-heterodyne interferometry [1] and broadband laser probing. In the second case, an electron-optical image of the surface under study is recorded in the form of a two-dimensional brightness distribution (photographs, interferograms, holograms, etc.). Such a signal can be transmitted through free space or through a fiber bundle. In some cases, it is necessary to combine two methods with the simultaneous use of a fiber bundle and individual fiber sensors equipped with collimators [2]. The report describes various approaches to optimizing data transmission using the two methods described above and options for combining them in the framework of the experiments.

When probing the samples under study with laser radiation with the provision of light collection of the reflected signal through fiber collimators, a significant problem is the change in the reflective properties of the surface under shock-wave loading due to macro- and microdeformations. An important task here is to develop an optical system in which the probing beams are located so that optimal light collection is ensured at different stages of the sample movement. To optimize light collection, various types of surface deformation under the action of a shock wave were simulated, and the optical properties and efficiency of light collection for different states of the loaded surface were studied. Based on the results obtained, a number of technical solutions for optimizing light collection are proposed.

The possibility of using ordered and disordered fiber bundles for transmitting a frame image was studied. In the first type of bundles, the image is transmitted in its entirety from the input end to the output end. The second type of bundles is used to transmit illumination, in such fiber bundles the input and output ends are connected in a chaotic manner, and any image disintegrates and mixes. A method for calibrating disordered bundles, which allows using them to transmit images, is proposed. During calibration, the signal is input into the bundle from a micromonitor, whose pixel size is about 5 μm. The output signal is recorded by a digital matrix. Calibration is performed using sequential illumination of the fiber ends at the bundle input and by recording the output signal.

References

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