1.5.25. STUDY OF POSSIBILITIES OF TESTING SYSTEMS ON THE BASIS OF COHERENT OPTICAL METHODS UNDER DIGITAL RECORDING METHODS

Potapov I.A., Makhov V.E.,
North-West State Technical University, St.-Petersburg, Russia

Occurrence of coherent light sources (lasers) has led to to an opportunity to register and restore images of three-dimensional objects, and also to make comparison of their condition during the various moments of time. By virtue of high spatially time coherency laser radiation, any aperture restriction of a beam, in a plane of the registrar gives a casual picture of a chaotic interference (speckles). This phenomenon has led to to creation of adjacent methods: speckle-photography and speckle-interferometry (an interference speckles with a basic beam or another speckle structure). The characteristic size speckles depends on length of a wave λ, diameter of the limiting aperture D, distance of the aperture up to a plane of the registrar l_i:

$$b_s = 1.22\lambda \frac{l_i}{D}.$$

As against speckle-photography, speckle-interferometry, having the double size speckles, concerns to group of methods interferometry which allows to register dynamic processes (vibration) in real time. speckle- photo and interferometry reduce requirements to mechanical stability of object of the control and system of registration, resolution of the registrar that makes possible use of solid-state sensor controls.

Use of digital photoregistration in coherent light allows to approach to the decision of an actual problem of not destroying control – full automation of the control, including over real time. In case of digital registration disappears necessity of the subsequent decoding interferogramme in the optical way as local displacement speckle can be determined pictures algorithmically.

Occurrence of new generation of digital chambers of the high sanction (tab. 1) allows to consider a question on their practical use in monitoring systems on the basis of coherent optical methods.

Table 1. Characteristics of digital chambers

№	Model	The size of a sensor, mm × mm	Quantity pixels, million	The size of the image	The size of the pixel, μ × μ
1.	SIGMA SD14	FOVEON X3 20,7 × 13,8	14,06	2652 × 1768 × 3 Layer	7,8 × 7,8
2.	Canon EOS 50D	CMOS 22,3 × 14,9	15,1	4752 × 3168	4,7 × 4,7
3.	Nikon D300	CMOS 23,6 × 15,8	13,1	4288 × 2848	5,5 × 5,55
4.	Canon EOS 40D	CMOS 22,2 × 14,8	10,1	3888 × 2592	5,7 × 5,7

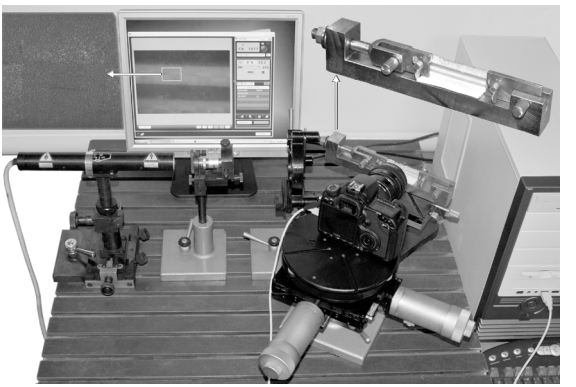

Fig. 1

Experimental researches (fig. 1) were carried out with use of the same lens: Sigma AF 15 mm F2.8 – 22 EX DIAGONAL Fisheye (the minimal size of a diaphragm – 0.68 mm), Sigma AF 20 mm F1.8 – 22 EX DG ASPHERICAL RF (0.91 mm) Sigma AF 30 mm F1.4 – 16 EX DC HSM (1.875 mm), Canon EF 50 mm f/1.4 – 22 USM (2.27 mm). For lengthening a tube rings KENKO were used: 12 mm, 20 mm, 36 mm, 12 + 20 mm, 12 + 36 mm, 20 + 36 mm, 12 + 20 + 36 mm.

Researches also have shown, that digital registration possesses high-grade opportunities to carry out the control over use of the phenomena of an interference: speckle-photography with mask the aperture (for example, a diaphragm as two small round apertures of 0.25 mm on distance of 2 mm).

The carried out researches have shown an opportunity of digital registration speckle pictures, an opportunity of its use for the control micro to deformation (accuracy of 0.5%).

References:

1. **Charels M.** Vest. Holographic Interferometry. John Wiley & Sons, New York – Chichester – Brisbane – Toronto (1979).