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ELECTRONIC CORRELATIVE SPECKLE-INTERFEROMETER FOR LARGE-SCALE VIBRATION CHARACTERISTICS ANALYSIS OF AERO-ENGINE ELEMENTS

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System for recording parts resonance vibrations and consisting of electronic correlative speckle-interferometer, unique device for parts and vibration excitation, units for videoinformation input, storage and processing is developed. Interferometer optical scheme and unit structure are given.

Keywords: Speckle-Interferometer; Vibration Analysis.

Methods of holographic interferometry are mainly used for experimental investigation of aircraft engine parts natural frequencies and vibration modes, particularly turbine and compressor blades. Posessing significant advantages in comparison with other experimental methods holographic ones have one main drawback related to the need of photographic processing or using specific reversible medium. From this point of view electronic speckle-interferometry method allowing to get fringe patterns of vibration modes in real-time directly on the video monitor is more operative /1/.

In measuring systems where this method is used for vibration

modes analysis a block is used for videosignal filtering and rectification in order to transform hard to discriminate variations of speckle-structure contrast of vibrating object characterizing vibration mode to variations of intensity.Such transformation efficiency depends on the quality of a resultant image speckle-structure that puts in rather strict claims for correlative speckle-interferometers and applied video system.

Original methods proposed by one of the authors /2/ enabled to significantly simplify visualization of vibration modes and to realize speckle-interferograms recording with special purpose computer system.Engine parts resonance vibration recording system is developed having all advantages of holographic interferometry but without its drawbacks.The system consists of correlative speckle-interferometer,unique device for a part fixture and vibrations excitation,a unit for videoinformation input,storage and processing.

Correlative speckle-interferometer with uniform reference beam is assembled of standard optic-mechanical units and mounted on holographic table.It has He-Ne laser,electrooptic modulator and reference beam phase control system.

Videosystem applied is "Joyce-Loebl" M2A image analysis system with additional specialized program modules or personal computer IBM PC/AT with additional specific block for image input/output developed by CDI UI RAS.

Speckle-interferograms are formed on display where two video signals are input with high resolution TV camera:one signal is directly from vibrating object the other signal is the one input earlier after special processing in video system. Video system provides video signals processing in such a way that fringe pattern can be described with a function correspon-

ding any chosen holographic interferometry method.Fringe patterns can be undergone further processing in order to get quantitative information about values of surface vibrodisplacement or to get rid of redundant information if the aim of measurement is to get data on nodal lines location on part surface.

Combination of interferometer and the developed unique device for turbine and compressor blade fixture and contactless excitation permits its use for extensive measurement of details vibrational characteristics.

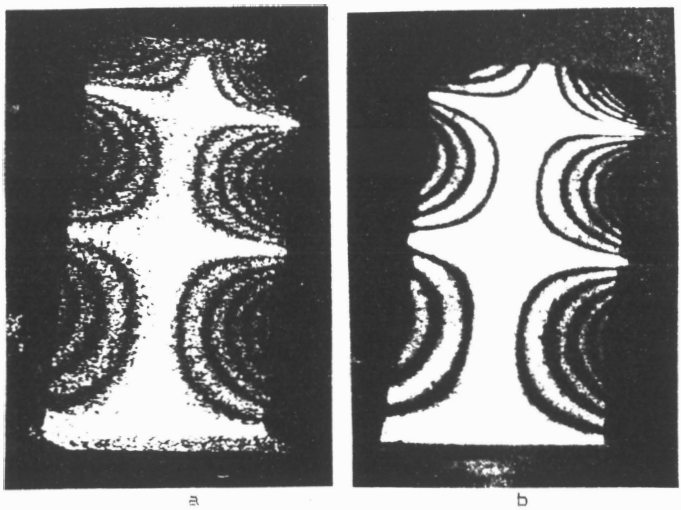

Fig.1.Speckle (a) and holographic (b) interferograms

Fig.1 shows speckle-interferogram of aircraft engine turbine blade vibration mode for resonance frequency F=3649Hz available in vibrational strength tests with the use of this system.

This system enables reliable isolation of all detail resonance frequencies,tracking dynamics of its vibration modes with changing frequency of exciting signal,recording of time-

averaged speckle-interferograms of vibrations with the quality equal to holographic interferograms.

References

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