Abstract

The master's thesis contains 93 letters, 20 drawings, 28 tables, 19 sources in the list of references, 4 applications.

Topicality of research

Technological development has led to the improvement of traditional natural structural materials and the emergence of new ones. Industries such as mechanical engineering, metallurgy, automotive, aviation, etc. require the production of quality products that must meet high quality standards. Each of the materials has certain physical and mechanical characteristics that affect the control of products made of structural materials. In particular, in ultrasonic nondestructive testing, such a characteristic as the attenuation of the ultrasonic wave significantly affects the metrological characteristics of the measurements and controls. That is why the urgent task is to develop new research methods.

The thickness of the control objects is an important indicator, which primarily indicates the strength of the product in the further process of its operation. Ensuring the control of the thickness of products made of materials with high attenuation is based on the development of methods for precise determination of the time of propagation of ultrasonic signals in the objects of control.

The objective of this work is to improve the method of ultrasonic thickness measurement of products with material damping due to the use of methods of statistical processing of the results of phase measurements of signals of ultrasonic thickness measurement, which makes it possible to increase the reliability of control and accuracy of measurement of thickness.

Purpose and tasks of research

The purpose and objectives of the study. The purpose of the study is to improve the accuracy of determining the thickness of control objects made of materials with a high damping ratio. The method is based on the use of statistical processing of the phase characteristics of the ultrasonic thicknessmeter signals, which are pulses with a harmonic signal carrier.

To achieve this goal, the following **tasks**:

1) Development of a methodology for processing ultrasonic thickness gauges, which includes method, algorithm and software.

2) Simulation of information processing processes in systems of statistical phase ultrasonic thicknessmeter and justification of circular statistics for detection of thicknessmeter signals at low signal-to-noise ratio.

3) Carrying out model experiments of the process of detection of ultrasonic thickness meters developed by the method of statistical phasometry with the r-statistics obtained in a sliding mode.

4) Evaluation of the efficiency of detection of the thicknessmeter signals and the accuracy of measuring the time intervals between echoes proposed by the method of statistical phase ultrasonic thicknessmetry in products with materials with significant damping of ultrasound.

Object of research – process of determining the thickness of products made of materials with a significant damping effect of ultrasonic oscillations by the moon-pulse method.

Subject of research – method and software for statistical phase ultrasonic thickness measurement of products with materials with significant damping of the ultrasonic wave.

Methods of research: theoretical bases of ultrasonic nondestructive testing and based on the provisions of material science in the part of the theory of structural materials; mathematical statistics and probability theory of random phase shifts; methods of digital signal processing; signal and circuit theory; computer simulation methods.

Scientific novelty of research:

1. A method of determining the time intervals between echoes based on their r-statistics obtained in multi-window sliding mode is proposed, which allows measurement of signal-to-noise ratio greater than 1.

2. The effect of window aperture size and their number on the signal / noise ratio of the beneficial signal of the phase detectors of the UZT signals was

investigated, which makes it possible to substantiate these parameters for different UZT signals and information collection parameters.

Practical value dissertation results:

1. Software and algorithmic tools for the implementation of the proposed method of processing UST signals are developed, which are based on the receipt and analysis of r-statistics in the sliding polywindow mode of processing the phase characteristics of these signals.

2. The obtained results of modeling of processes of detection of signals of the UST and estimation of time intervals between echoes can be used for the design of new effective means of ultrasonic lunar-pulse thicknessometry.

3. The developed software statistics can be used in the tasks of UZT.

Key words

Ultrasonic thicknessmeter, phase signal processing methods, statistical method of ultrasonic phase thickness measurement, window signal processing, circular statistics.