5.3.10. DETAILED ANALYSIS OF IMPACT-ECHO SIGNALS OF SPECIMENS WITH NONLINEAR EFFECTS

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The Impact Echo [I-E] is very good known method of NDT, e.g. [1] etc. It is used in two basic ways. First, it is evaluated echo time from the damage as classical ultrasound NDT. The second way uses impact pulse as a simple wide-spectrum excitation for spectral analysis. The obtained resonance frequency components correspond to dimensions of the tested body. Frequencies of these components are compared with standard forms and their deviations signalize non-idealities and defects. This NDT method is very cheap and effective especially for small bodies with expressive resonance properties.

On the other hand this method has a small sensitivity to relatively small cracks. But this method doesn't use the same principle as the good known crack detection by human hearing as this one needn't standard forms for comparison. The new method [4] consists in utilize of nonlinear acoustic properties of bodies with cracks (good known as SIMONRUS, RAS, [2], [3] etc.) when the resonance frequencies depend on excitation. Therefore the customary use of Fourier Transformation to whole recorded sound of I-E brings inconvenient averaging of this effect with the main part of the recording time when the intensity of excitation is low. The main idea of the new variant of the spectral I-E method consists on searching of time dependency of frequencies of the dominant resonance frequency components as dependence of excitation. Some aspects of time-frequency analysis of I-E signals are also shown in [4].

On the other hand, the complex analysis of full I-E signal is very complicated because there are tens of dominant harmonic components. Therefore the analysis of soft frequency deviations in time dependencies is very elaborate. Further our experiments show that there is more information about behavior of tested specimens as magnitude dependencies of individual harmonic components. For this reason we designed a program for detailed time-frequency analysis of I-E signals. It has these features:

- time-frequency spectral analysis with possibilities of setting of various parameters (as length of time segments, length of time shifts etc.);
- automatic detection of peaks (1st or 2nd derivation) and separation of individual dependencies;
- 3D image (2D+color) of detected dominant harmonic components and their time dependencies;
- possibility of separate zoomed displaying of time dependency of frequency and magnitude of each selected component.

By this way the detailed analysis of I-E signals of specimens with nonlinear effects can be advanced and more information about flaw of tested specimens can be acquired from I-E signal. The experimental findings will enable to prepare practical variant of the program in next step.

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