principles and professional norms and launching an international planning competition in 2010 to reach the best possible solutions, in addition to community dialogue

Figure (1-3) Shanghai city development

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Dr. Martin Sagradian, Sydney, Australia

Department of Mathematics and Statistics, Macquarie University.

ACOUSTIC AXISYMMETRIC VIBRATIONS IN ROAD PIPES DURING SOUNDING USING GEORADAR

As a result of georadar survey on the section of the highway it is possible to restore with high accuracy the thickness of layers of pavement, to identify areas of undercompression of discrete materials, to install reinforced construction layers and to determine the location and parameters of culverts. The results of the inspections are confirmed by the reproducibility and accuracy of the methods of interpretation of the measurement results under the condition of determining the electrophysical characteristics of the materials.

Probing of the asphalt concrete layer is performed in the longitudinal direction (road axis) and transverse directions with simultaneous fixing of obstacles, areas of visible defects, etc.

The radar scan obtained by probing results is analyzed and processed. During the initial processing of the radar image, fault signals are removed and averaging is performed in order to reduce the impact of noise and interference, as well as signal smoothing.

The scattering of acoustic and electromagnetic waves by bodies of revolution (BOR) has long been the subject of numerous studies. One of the reasons for the long-term interest in this problem is the practical need to improve the reliability of the georadar target recognition (for example, a pavement structure). In addition to wave scattering on solid BOR’s, the solution of wave scattering problems for open thin-walled shells (cavities) is of great importance for modeling georadar targets (pavement structure, pipes, cracks in the pavement).

For a rigorous solution of the mixed boundary value problem for the Helmholtz equation describing the diffraction of scalar waves on acoustically soft doubly connected surfaces of revolution of arbitrary shape, a special version of the Method of Analytical Regularization (MAR) is being developed.

The foundations of the MAR approach allow us to transform an initially poorly posed problem of the first kind into a rapidly converging system of algebraic equations of the second kind. We investigate the transmission of plane sound waves through finite-size cylindrical tubes, focusing on the resonant behavior of the circular tube and two modifications that can be described as “multi-piece” finite tubes. Both modifications can be considered as "variable" section pipes.

The first is a combination of round tubes of different diameters; the second is a combination of a round tube and a spherical cavity. The study covers two complementary issues. The first task is to find complex eigenvalues for axisymmetric vibrations that can be excited in each of the three configurations.

A rigorous MAR-based approach to the determination of complex eigenvalues of two-dimensional open cavities was demonstrated by professor Vinogradova, where an elliptical cylinder with a variable slot was investigated in detail. We are extending this approach to open 3D cavities. Complex vibrations in a pipe with a constant circular cross-section are calculated for various aspect ratios

L/a = 1, 2, 5, 10, where a is the radius and L is half the length (half the height) of the cylinder. Tubes with a sharply varying cross section represent a multiparameter system of coupled resonators.

Let us investigate the influence of specially selected parameter values on the coupling strength of these resonators. The second problem is the study of resonant backscattering based on the calculation of the frequency dependence of the monostatic georadar cross section:

$$\sigma_B(k),\ k = 2\pi / \lambda, \quad (1)$$

where $\sigma_B(k)$ – is a frequency dependence of the monostatic georadar cross section;

λ – is a wave length.

The exact determination of the complex eigenvalues makes it possible to predict the resonant behavior observed in the cross section of a monostatic georadar cross section. The calculation $\sigma_B(k)$, focused on resonant excitation, was performed for a circular tube of finite length, as well as for tubes with a sharply varying cross-section.