Some Spectral Problems of Porous Media Acoustics

A. S. Shamaev, A. A. Gavrikov, D. U. Knyazkov

The current talk concerns problems of finding natural frequency spectrum of media consisting of two fast alternating phases with different mechanical properties (e.g. elastic frame with channels filled with compressible or incompressible viscous fluid, mixture of two liquids with various viscosities and compressibilities etc). In a quite a number of cases macroscopic models of such media (they are usually called homogenized or effective models) are models of materials with dynamics described by integrodifferential equations with integral terms of convolution product by time coordinate type. In the talk (a) there are exact statements on proximity between solutions of original boundary problems for two-phase models and solutions of corresponding boundary problems for the above integrodifferential equations. In addition, (b) various natural oscillations spectra qualitative properties for the mentioned homogenized models are analyzed. It is shown that homogenized problem spectrum consists of two parts: real and complex. Complex part is a union of two complex conjugated sequences of complex numbers where real parts have a limit and imaginary parts tend to infinity or have finite limits. Real part of investigated spectrum is a union of a finite or countable number of limited sequences (lying on nonoverlapping intervals of the real axis), each having a limit. Under some conditions it is possible for some interval to contain continuous spectrum.

Analysis shows, that qualitative properties similar to described above are also valid for a number of other problems with different physical or mechanical origin: dynamics problem for viscoelastic materials with "memory", nonstandard models of heat conductivity with memory, well-known in filtration theory "double-porosity" problem.

Here we are stating a hypothesis of existence of a general operator model, with use of witch it could be possible to prove the existence of spectra of described above structure in all cases.