New method to solve the wave field as a response function of isolated linear dynamic system II

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A new approach has been proposed for the computation of wave field in a generally anisotropic, dispersive and heterogeneous medium in order to provide a basic tool for the new active method in the underground exploration (Kumazawa et al., 2004). Trial works of developing the numerical code have been made so far (Nagai et al., 2004) on the basis of this theory; the wave equation constraining wave field is formulated as a linear dynamic system equation e = Dw with wave field w as an input and excitation e as an output. The D is a system function (wave equation operator) dependent on angular frequency, global wave number and physical property as a function of space. The inverse system equation w = Re with excitation e as an input and wave field w as an output is identified with the required representation of wave field in frequency and wavenumber domain. The R above is designated as frequency-wavenumber response function (FWR) which is a function of angular frequency and wavenumbers of both wave field and excitation. Our problem is to find out an appropriate method of computing the FWR.

There are two paths to derive FWR from D; (Path 1) D is Fourier transformed and matrix inverse is computed to give R and (Path 2) Inverse of each components of D is computed and then Fourier transformation is made to give R. Whereas numerical computation has shown the validity of Path 1, it demands a large number of inverse calculations of very large matrices, indicating that the path is not practical in the application to general 3D problems. Path 2 involves inverse operations of matrices of only 3 by 3 in size even for 3D problems, and is considered to be practically useful. In this report, the relevant developmental works on Path 2 are discussed and several numerical examples are shown to demonstrate how this approach works.