Diffuse Fields in Layered Media

Francisco J. Sánchez-Sesma

Instituto de Ingeniería,
Universidad Nacional Autónoma de México,
Cd.Universitaria, Coyoacán 04510, Mexico DF,
Mexico

ABSTRACT

Multiple wave scattering in the Earth´s crust give rise to both coda of earthquakes and microtremors, also called seismic noise. These motions are frequently referred to as diffuse wave fields because its intensities are governed by diffusion-like equations.

For an inhomogeneous, anisotropic elastic medium under diffuse seismic illumination (or, equivalently, with an uncorrelated uniform set of random forces) the average cross correlation of motions at pairs of receivers, in frequency domain, is proportional to the imaginary part of Green function.

The imaginary part of Green function at the loading point is proportional to the power injected into the medium by a unit harmonic load. Such power will vary if the motions change by waves reflected back to the source location. Therefore, it represents reflection events. This property of diffuse fields can be used to characterize the mechanical and geometrical characteristics of an elastic domain.

Microtremors are generated close to the free surface and we assume they constitute a diffuse seismic field. Thus, for a horizontally layered medium overlying a half space we may link energy densities with Green function, an intrinsic property of the medium. In principle this allows the medium inversion from the surface *H/V* spectral ratio, the well known Nakamura’s ratio.

On the other hand, deep earthquakes illuminate the site structure from below with predominance of body waves. Extending diffuse field concepts we assume that the autocorrelations, averaged for several earthquakes, represent directional energy densities associated to the site. These densities are proportional to the imaginary part of 1D Green function at the free surface which is proportional to the square of the absolute value of the corresponding transfer function for a plane, vertically incident wave with unit amplitude. This allows inversion of structure from the average *H/V* spectral ratio.