I-630

PRELIMINARY SURFACE SCATTERER INVERSION

Masahiro IIDA* and Paul SPUDICH**
* Member of JSCE, Earthquake Res. Ins., Univ. of Tokyo, Tokyo, Japan
** U.S. Geological Survey, Menlo Park, California, USA

1. LOCAL HETEROGENEITIES, SCATTERING AND CODA

Body waves are dominant in near-source high-frequency strong motion seismograms. The weakest link in the strong motion prediction might be poor knowledge of structural information. Two important factors for body wave propagation are attenuation and scattering (the phenomenon that a ray is reflected by a local heterogeneity). Because evaluation of scattering effects is more difficult, we restrict ourselves to scattering.

There are two types of approaches for scattering. The statistical approach is based upon the concept that coda parts of seismograms (later phases after S wave arrivals; See Fig. 1) at a station have common characteristics because they comprise many rays which experience different pathes. In contrast, the deterministic approach comes from the idea that the coda parts have some distinct differences, providing valuable information on the ray pathes. The former approach has been superior in numbers.

2. PURPOSES AND PRINCIPLE METHODS

We are developing a deterministic waveform scatterer inversion on the basis of Spudich and Miller's work (1990, BSSA). Deterministic approaches are more directly applicable to prediction problems, and the results may be verified using other information. Our twofold purposes are to locate the local heterogeneities (fault, basin, etc.) that are responsible for scattering energy to the site of interest, and to characterize the seismic response of these heterogeneities. Our methods are a first practical approach available for shallow structure.

The image of our methods is shown in Fig. 2. In our approach, we use a set of seismograms from widely distributed local microearthquakes observed at a single station. In the reciprocal geometry, a point force is applied at the station. It radiates some waves, and they are incident upon scatterers assumed at certain locations, ξ_1, ξ_2, ..., etc. The incident waves make the scatterers radiate like equivalent 3 forces and 6 moment tensors, Fi(ξ,t) and Mjk(ξ,t). The radiation from the nonisotropic scatterers propagates to an earthquake, q_i. We use the observed waveform seismograms to solve for Fi(ξ,t) and Mjk(ξ,t) at each scatterer. Thus, the scattering problem can be turned into a radiation problem, forming an inverse problem. Assuming layered structure, ray theory is used. We express the power of each scatterer by a single parameter.

3. CONSISTENCY OF RESULTS WITH GEOLOGICAL INFORMATION

We apply this technique to the North Palm Springs, California, region. It is interesting to note different geologies at the stations as well as the fact that every station lies next to a fault except the station, AIR (Fig. 3(a)). As our first step, we perform surface scatterer inversion because most scatterers are expected to concentrate near the ground surface. We set a grid of scatterers with an interval of 2 km on the ground surface.

Low-pass filtered 0 to 4 Hz velocity records at the station, SMC are used. We recognize strong scatterers, A, B and C, where the power is larger than that in the surrounding areas (Fig. 3(b)). The scatterers A and C are located near the fault trace in the boundary regions of rocks and deposits/alluvium while the scatterer B is in the center of the alluvium region.

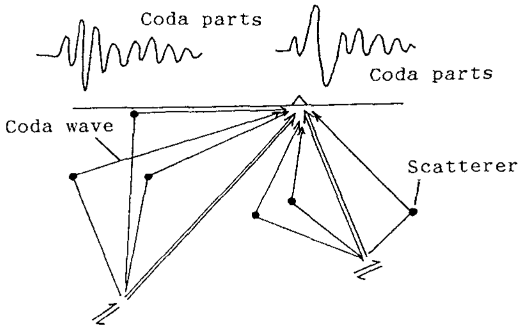


Fig. 1 Schematic explanation of coda parts of seismograms at a station.

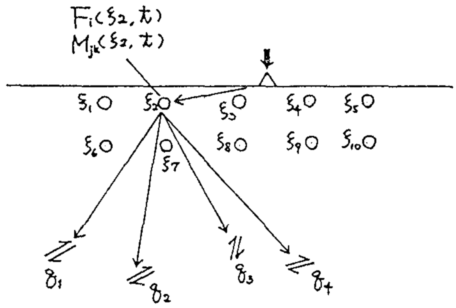
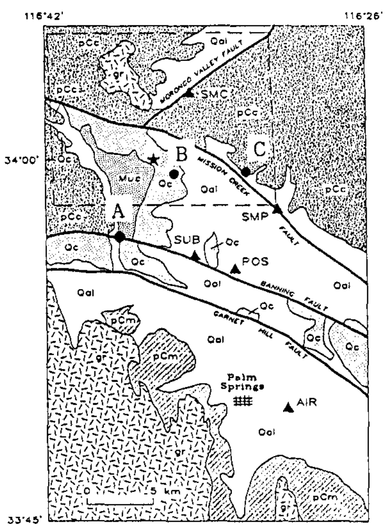
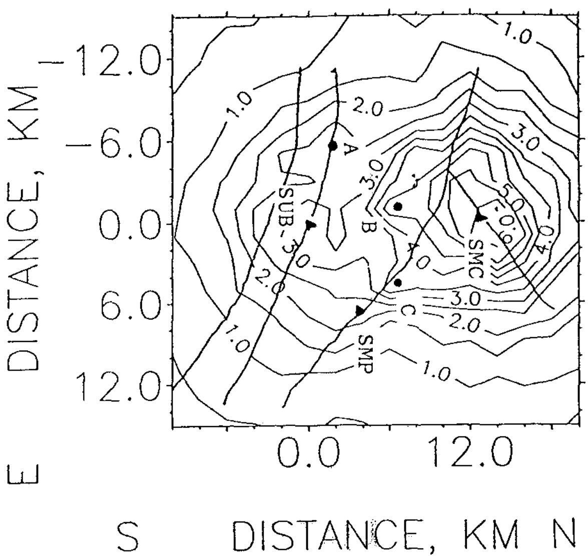


Fig. 2 Schematic display of our idea based upon reciprocal geometry.



(a)



(b)

Fig. 3 (a) Simplified geologic map of the North Palm Springs, California, region and 5 seismic stations (solid triangles). The geologic units are as follows: (Qal) alluvium, (Qc) sedimentary deposits, (ms)(Muc)(gr) rocks, and (pCm)(pCc) complex. A, B and C indicate strong scatterers. (b) The average coda power of all three components at the station, SMC.