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Determing Method Of Microtremors Wave Field

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SUMMARY

The history and development process of determining microtremors wave field characteristic are reviewed. Three new methods of determining the characteristics of microtremors are proposed, which are wave pattern recognition, motion track and spectrum ratio of horizontal to vertical component on rock surface. Finally, some examples of applications of the methods are illustrated and it is shown that the suggested methods are effective.

INTRODUCTION

A clear evidence for a major control of seismic damage by local geology was found very early in Japan (after the 1923 Koto earthquake). Recent earthquakes, such as Mexico 1985, Spitak 1988,Loma Prieta 1989 and Kobe 1995 make this evidence stronger. Researchers in engineering seismology have long been to look for the convenient, simple, low cost and efficient methods for the estimation of local geology effect. Several methods are used for this purpose, which include the theoretical transfer function, strong ground motion analysis and microtremors techniques. The theoretical transfer function needs detailed geotechnical survey, so it is a cost, trouble and wasting time analysis method. Strong ground motion analysis need enough earthquake records, while there are not enough earthquakes available in most of analyzed sites. However, the use of microtremors for the site effect estimation is somewhat simple, convenient and low cost. But the use of this technique is limited, for the microtremors wave field is very complicated and the sources of microtremors are unknown. The process methods using microtremors go through from the absolute spectra to spectral ratio with respect to reference site and H/V spectral ratio (Nakamura method). In the past decade, Nakamura method became a "hot" topic in the site effect estimation. Some researchers have discussed that Nakamura method had no precise theoretical grounding (Bard, 1994;Kudo, 1995; Konno,k. and Ohmachi 1998). On the other hand, this method does give the relative accurate fundamental resonance frequency of analyzed site than traditional techniques (absolute spectra, spectra ratio relative to reference site in microtremors analysis and coda waves analysis in the use of earthquake records). Many researchers (Hough, 1992; Bard, 1994, 1999; Field 1992; Lermo, 1994; Konno and Ohmachi, 1998; Malte, 1999) give some examples for the actual site effect estimation by Nakamura method and show that Nakamura method is a preferable method. But other researchers proposed the opposite opinions. The microtremors wave field is the key factor producing disagreement in microtremors measurements. Two methods are proposed deciding the characteristic of microtremors wave field in the paper.

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2 method of deciding the characteristic of microtremors wave field

2.1 track method of the microtremors

From seismology, we know that when the damping exist in layered model, the track of free surface of Rayleigh waves is ellipse and the axes of them are declining. However, when the track of motion is inline it should be body waves. Figure 1 through figure 4 is the tracks of microtremors measured in Lijiang Basin of YUN NAN province of china. Microtremors are measured at the same site in different time. Figure 1 and Figure 2 are mainly surface waves for their motion tracks are ellipse. Figure 3 and Figure 4 are mainly body waves for their motion tracks are lines. Arrow show the direction of particle motion

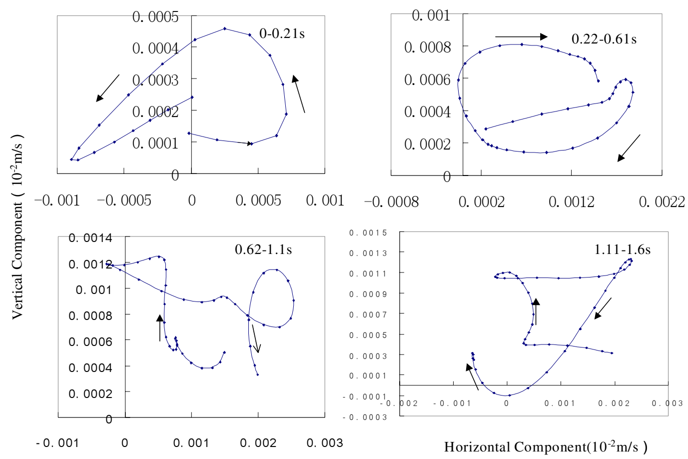

Figure 1 tracks of microtremors . Abscissa is the microtremors speed in east-west direction. Ordinate is the microtremors speed in vertical direction.

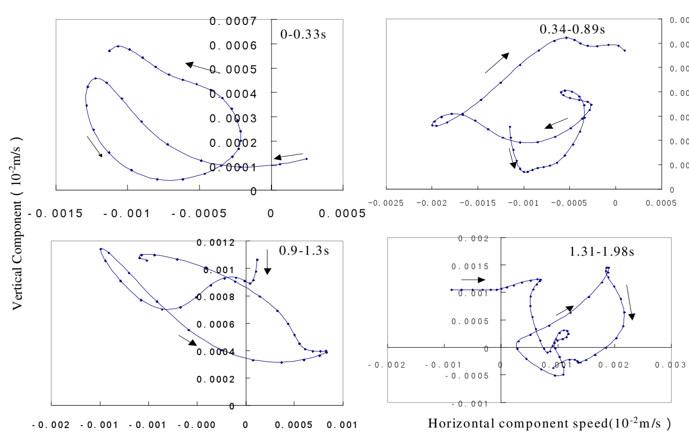

Figure 2 tracks of microtremors . Abscissa is the microtremors speed in north-south direction. Ordinate is the microtremors speed in vertical direction.

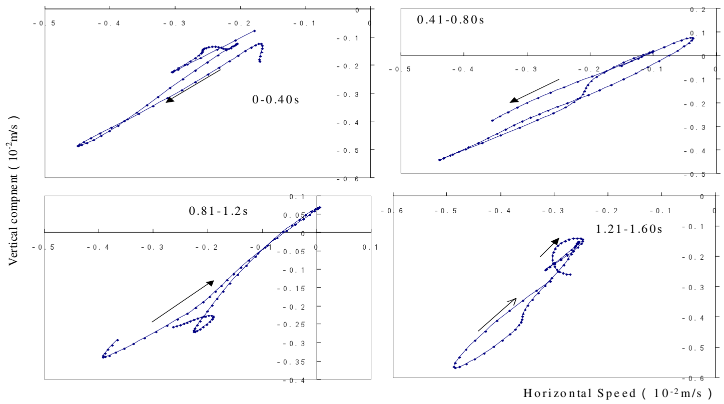

Figure 3 tracks of microtremors . Abscissa is the microtremors speed in east-west direction. Ordinate is the microtremors speed in vertical direction.

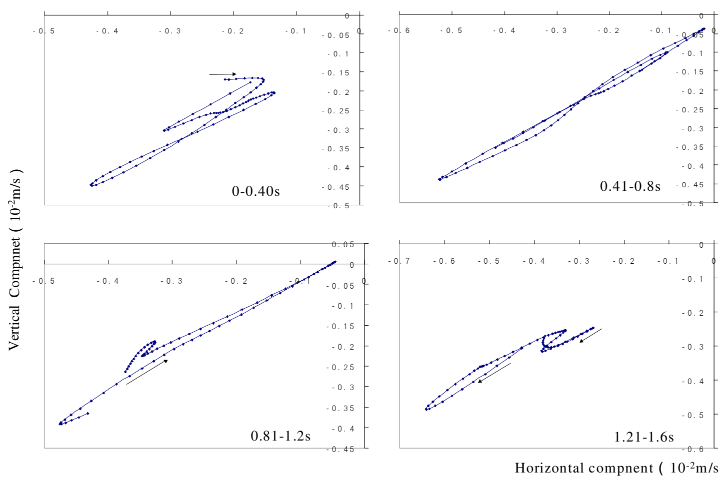

Figure 4 tracks of microtremors . Abscissa is the microtremors speed in north-south direction. Ordinate is the microtremors speed in vertical direction.

2.2 method of spectra ratio of horizontal to vertical direction on surface rock

It is shown that the H/V is close to unity for body microtremors and 0.68 for surface waves microtremors on the Possion rock surface approximately [1]. When the Possion ratio changes from 0 to 0.50, the ratio varies from 0.54 to 0.79. Figure 5 and figure 6 are the spectra ratio of microtremors on the rock in Lijiang Basin of China during different time.

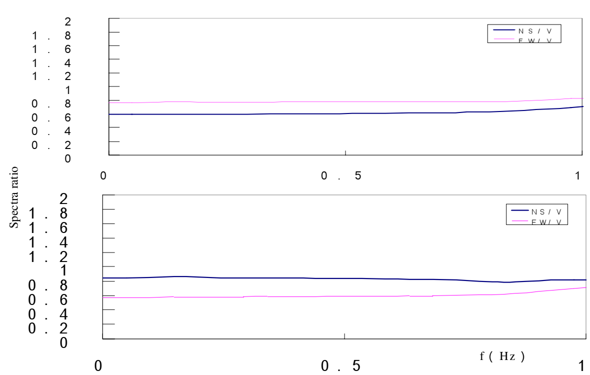

Fig5 Spectra ratio of horizontal to vertical component microtremors

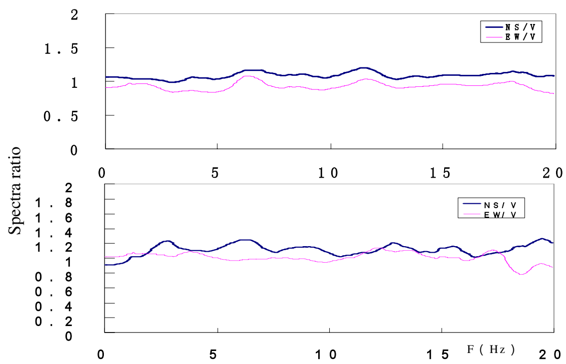

Fig.6 Spectra ratio of horizontal to vertical component microtremors

3 Discussion

Two methods are induced for discrimination the microtremors characteristic. It is show that the track method of the microtremors motion and method of spectra ratio of horizontal to vertical direction on surface rock is effective.

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