VELOCITY STRUCTURE IMAGING BY INVERSIONS OF RAYLEIGH WAVE ELLIPTICITY APPLICATION TO THE ARAK CITY, IRAN

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More than 140 single station ambient noise measurements manipulated in the city of Arak in the framework of seismic microzonation of this city. The standard H/V (horizontal/vertical) spectral ratio calculated for these measurements shown a clear amplification for low frequencies (0.8 -1 1Hz) for a great parts of the city especially at the northern parts of the city Haghshenas, (2013). The thick alluvial deposits or deficiency of energy of Rayleigh wave on the vertical components (due to far distance of the city to the oceans) can be proposed as the reasons for these unexpected observed results.

Comparison of the results with geological and geophysical and earthquake data proposed the first idea, for the northern and eastern parts of the city. To verify more precisely this hypothesis in the present study we try to retrieve the 1D S-wave velocity profile based on the relation of H/Vand ellipticity of the fundamental mode of Rayleigh waves. Two new methods; the HVTFA technique (Poggi and Fah, 2010) and the RayDec method Hobiger et al., 2009 were applied to extract the ellipticity curve for these 148 ambient noise measurements.

The HVTFA method tries to reduce the SH-wave influence; this is possible by identifying P-SV wavelets along the signal and computing the spectral ratio from these wavelets only. Using this technique we assume that this maximum is related to a single Rayleigh wave wavelet for which the H/V ratio is computed. The average over all wavelets defines the H/V spectral ratio.

At the second method it has been proposed to apply the random decrement technique (Assmussen, 1997) to three component records of seismic noise. By using the vertical component as a master trigger and stacking a large number of horizontal and vertical signals, Rayleigh waves will be emphasized with respect to Love and body waves.

Some numerical studies shown that the right flank of the ellipticity is the most reliable part of ellipticity measurement, therefore this part of the extracted ellipticity curves are used in inversion for the present study. The Ellipticity curves for 148 measured points are classified into 11 categories (Figure 1), based on their right flank similarity and peak resonance frequencies from Classic H/V and the distribution of these 11 categories are mapped. (Figure 2). The average of all curves in each category of ellipticity are calculated and then are cut for the selection of reliable frequency band of right flank as a input in inversion processes.

The Vs, profiles for each zones of the city prepared by inversion based on neighborhood algorithm (Wathlet, 2008) in GEOPSY package software. Figure 3 shows one example for category 8 of Ellipticity and the result of its inversion, confirming the existence of a deep Impedance contract for this zone.

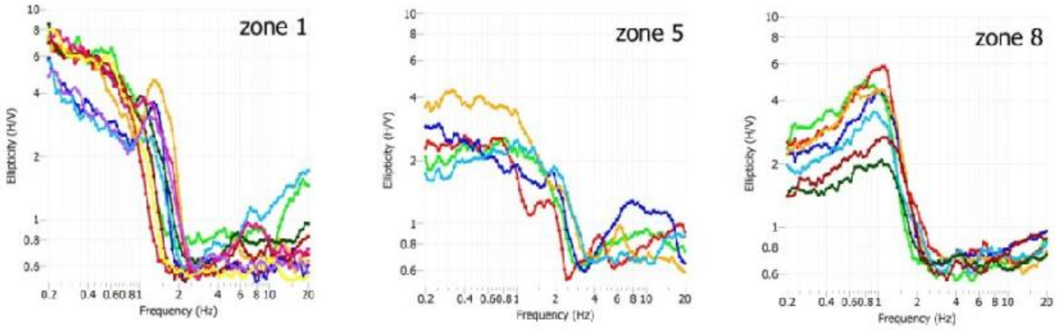

Figure 1. Ellipticity categories (zone 1, 5 & 8) that are averaged for inversion processes

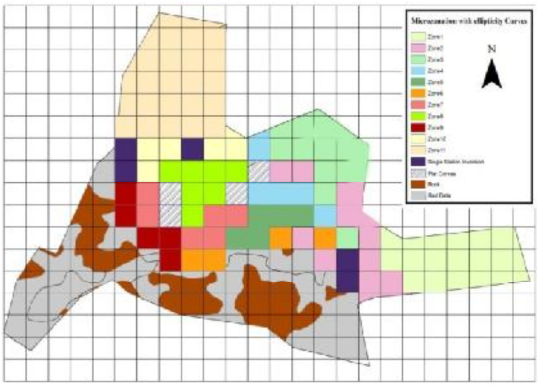

Figure 2. The zonation map based on similarity of ellipticity

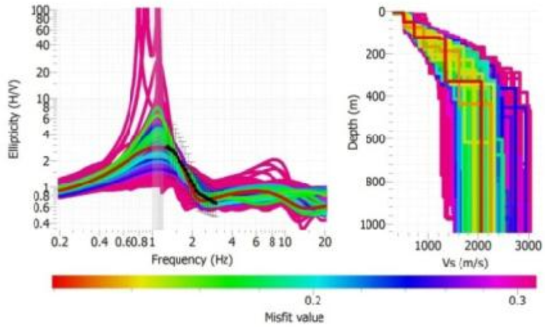

Figure 3. The average ellipticity and Vs profile for zone 8

REFERENCES

Asmussen J C (1997) Modal Analysis Based on The Random Decrement Technique, Ph.D. Thesis, Univ. of Aalborg, Aalborg, Denmark

Haghshenas E (2013) Arak seismic microzonation, single station ambient noise reports, IIEES Professional report (In Persion)

Hobiger M, Bard P-Y, Cornou C and Le Bihan N (2009) Single Station Determination of Rayleigh Wave Ellipticity by Using the Random Decrement Technique (RayDec), *Geophysical Research Letters*, 36, L14303

Poggi V and Fäh D (2010) Estimating Rayleigh wave particle motion from three-component array analysis of ambient vibrations, *Geophys. J. Int.*, 180, 251–267

Wathelet M (2005) Array Recordings of Ambient Vibrations: Surface-Wave Inversion, Ph.D. Thesis, Universite de Liege, Belgium