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Rayleigh wave ellipticity in seismic noise studies based on vector random decrement technique (VRD)

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In seismic hazard assessment studies, the estimation of site effects plays an important role. In recent years, using seismic noise has become increasingly popular because of their simplicity, low cost, and non-destructively. Seismic ambient noise wavefield investigation can be fulfilled by both single-station and array methods. The RayDec single station method is used to estimate ellipticity curve of Rayleigh wave based on Random Decrement (RD) technique by putting more emphasis on Rayleigh waves in compare to other participant waves in the seismic noise wavefield. In this study, to assess measuring the ellipticity of Rayleigh waves in an array of stations, Vector Random Decrement (VRD) technique is applied. The main idea is applying vector triggering condition on vertical components in an array of stations and selecting common triggering points. Those parts of signals where common points of all stations are detected would be included in further processing. It may lead to a lower number of obtained triggering points and insufficient convergence. To control the convergence, the vector of triggering conditions could be divided into some subsets. The maximum number of subsets can be estimated as the lowest integer of N/2 in which N is the number of stations in the array. Wherever, the common triggering points are detected on three components of the stations, the time windows with the same length are extracted. In the following, the signals in the mentioned windows are stacked and the ellipticity ratio is estimated by analyzing the energy content of the horizontal and vertical signals. In order to verify the method, synthetic circular array data are simulated using the FD code including five stations regularly placed on the circumference and a station in the center. Furthemore, the real array data recorded in Ramsar site (North of Iran) are used to study the method. The data included six Nanometrics trillium 40 seismic stations in which five stations placed on the circumference as well as a station at the center regarding to array aperture of about 15m. The retrieved ellipticity curves are evaluated and compared with the results of high resolution Rayleigh three component beam-forming (RTBF) method. The RTBF and VRD methods show good performance in recognizing the right flank of peak frequency while, the peak frequency and the left flank are better retrived using VRD method. Finally, the retrieved ellipticity curve from VRD alongside with the dispersion curves obtained from RTBF for both synthetic and real array data are used as targets in a joint inversion process to validate the shear wave velocity profile.