



## Simultaneous body and surface wave retrieval from the seismic ambient field and discrimination from unavoidably arising spurious artifacts

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We simultaneously extract both, direct P-waves and Rayleigh waves, from the seismic ambient noise field recorded by a dense seismic network in Iran. With synthetics, we show that the simultaneous retrieval of body and surface waves from seismic ambient noise leads to the unavoidable appearance of spurious arrivals that could lead to misinterpretations.

We work with 2 months of seismic ambient noise records from a dense deployment of 119 sensors with interstation distances of 2 km in Iran. To retrieve body and surface waves, we calculate the cross-coherency in low-frequency ranges, i.e. frequencies up to 1.2 Hz, to provide the empirical Green's functions between each pair of stations. To separate the P and Rayleigh waves, we use the polarization method that also enhances the small amplitude body waves.

We observe both P and Rayleigh waves with an apparent velocity of  $4.9 \pm 0.3$  and  $1.8 \pm 0.1$  km/s in the studied area, respectively, as well as S or higher mode of Rayleigh waves, with an apparent velocity of  $4.1 \pm 0.1$  km/s. Besides these physical arrivals, we also observe two spurious arrivals with similar amplitudes before/after the P and/or Rayleigh waves that render the discrimination challenging.

To better understanding these arrivals, we perform synthetic tests. We show that simultaneously retrieving the body and surface waves from seismic ambient noise sources will unavoidably lead to the appearance of spurious arrivals in the calculation of empirical Green's functions.