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XNSR – a software for a different approach to single-station spectral ratio

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The standard technique for single-station spectral ratio, or horizontal-to-vertical spectral ratio (HVSR) assumes that the maximum amplitude in presence of a resonant behaviour is on the horizontal plane with a minimum on the vertical direction.
This assumption is reasonable if one suppose that seismic noise is composed by surface waves and that HVSR are mainly related to Rayleigh waves ellipticity. If on the contrary one assumes that body waves can give a significant contribution or that a simple 1-d plane-parallel model is not reliable, then it may be that there is another plane in space on which the amplitude is the maximum and on the orthogonal direction there is an amplitude minimum.
In this case it is possible to explore the full set of combination azimuth-emersion angle to identify if such a non-horizontal plane exists, then having the ratio between the true maximum an minimum component (hence the acronym maX to miN Spectral Ratio, XNSR).
The implementation of this algorithm required a software that uses both parallel and vectorial techniques to reduce the computational time. A Matlab code was implemented, which is able to perform the XNSR calculation on a search grid of few degrees in less than five minutes.
The first application of the software show that while in most simple 1-d cases the maximum and minimum amplitudes coincide with horizontal and vertical direction, there is a percentage of sites where strong lateral discontinuities cause a deviation from HVSR expected results.