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Modal analysis of 2-D sedimentary basin from frequency domain decomposition of ambient vibration array recordings

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The frequency domain decomposition is a well-established spectral technique used in civil engineering to analyze and monitor the modal response of buildings and structures. The method is based on singular value decomposition of the cross-power spectral density matrix from simultaneous array recordings of ambient vibration. This method is advantageous to retrieve not only the resonance frequencies of the investigated structure, but also the corresponding modal shapes without using an absolute reference. This is an important piece of information, which can be used to identify areas of minimum and maximum ground motion on the structure.

We apply this approach to evaluate the SH and P-SV resonance characteristics of 2D Alpine sedimentary valleys through decomposition of ambient vibration recordings from linear seismic arrays deployed perpendicularly to the valley axis. Results are presented for a set of synthetic models, initially used to validate the method, and for a real acquisition survey performed in the Rhone valley (Switzerland). For the real case, up to six separate resonant frequencies, together with their corresponding modal shapes, were retrieved for the SH case using the frequency domain decomposition method. We then compare these mode shapes with results from classical site-to-reference spectral ratios and solutions from analytical and numerical modal analysis.