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A new method for soil-structure interaction estimation by the deconvolution of vertical array data

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The deconvolution approach is a well-known method for studying wave propagation in buildings, and from this, to identify their dynamic characteristics (i.e. the shear wave velocity through the building and damping). Furthermore, this approach is also applied in the field of structural health monitoring for the detection and localization of possible earthquake-induced damage. Moreover, deconvolution interferometry provides insights into wave propagation through shallow geological layers when applied to borehole strong motion recordings.

In this study, first, the methodology for the joint analysis of earthquake recordings of sensors installed in buildings and nearby boreholes is developed, with the objective of obtaining insights into wave propagation through the building-soil-structure. In addition to the univocal identification of the different wave phases and the better understanding of wave propagation through building-soil layers, a technique for the estimation of the energy radiated back from a building to the soil is proposed. It is based on the separation of the real seismic input and the down-going waves reflected at the top of the building and radiated back to the soil by making use of the constrained deconvolution approach.

The method is validated by the analysis of a synthetic data set, and results from its application to a real case from Bishkek, Kyrgyzstan, are presented.