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Imaging near surface anomalies by surface wave interferometry

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The detection of shallow objects such as tunnels, karsts, mines and other local heterogeneities is an important but difficult issue in subsurface studies. In general, their positions are not known, either because they are not recorded in a database or because location maps are not available. In such cases, geophysical methods can provide a cost-effective solution to detect them remotely from the surface. Surface wave imaging has shown great results for detecting caves, voids, old galleries, and bedrock surface. An extension of this imaging technique of lateral variations in subsurface S-velocity structure has required a unique approach incorporating the multichannel analysis of surface (MASW) and common receiver gather (CRG) cross-correlation analysis method.
The classical surface wave processing, seems similar to 2D seismic reflection survey data: the different shots are corrected for normal moveout to remove the offset effects. Then, the CRG gathers are stacked. However, the dynamic correction needed for surface waves differs from that used in seismic reflection, because dispersion phenomena must be taken into account. The dispersion curve i.e. the phase velocity variation versus frequency is calculated for each shot gather to establish a velocity model for dynamic correction.
In this work we propose a method for continuous 2D profiling of surface waves dispersion patterns without estimating the phase velocities. The method is based on the extraction of subsurface perturbations, i. e, scattering, by correlating, trace by trace, each shot gather on the seismic line with a pilot shot. Resultant correlation traces having a common receiver are gathered and stacked in the time domain. Finally, a 2D S-wave profile is reconstructed. Cross-correlation analysis from numerical modeling and field observations in karsts areas indicate that the new method could greatly improve the accuracy and resolution of subsurface structure, compared with conventional surface waves methods.