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Imaging near-surface inhomogeneities using seismic diffracted waves

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Detecting and mapping localized near-surface inhomogeneities is an important problem in a variety of applications, such as engineering site investigation, environmental studies, archeology and others. Typical examples of such inhomogeneous objects are cavities, caves and tunnels.

Recently, Shtivelman and Keydar (2005) have proposed a method for detecting shallow subsurface objects utilizing seismic waves diffracted by these objects. The method suggests that every subsurface point is a possible location of a point diffractor. Imaging of the diffractors is performed by focusing seismic energy in 3D space using a multipath summation approach, where for every subsurface point the wavefield is stacked together along all possible diffraction time surfaces (defined by source-receiver geometry) having a common apex at a given time. Alternatively, the stacking can be performed with a fixed velocity value estimated from velocity analysis of the diffraction data. The result of the imaging is a 3D volume in which prominent diffraction anomalies appear at spatial locations close to the target objects.

The method has been tested on synthetic data and successfully applied at several sites for detecting various localized subsurface objects. At each investigated site, the data were acquired by a 3D survey involving a large number of source and receiver points. Results of the application show that the method can produce reliable results in various geological environments and for different depths of target objects.

References

Shtivelman, V. and Keydar, S., 2005. Imaging shallow subsurface inhomogeneities by 3D

multipath diffraction summation. *First Break*, **23** (January issue), 39-42.