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Special section

GPR data imaging and interpretation — Introduction

Maksim Bano[1], Nikos Economou[2], John Bradford[3], Antonios Giannopoulos[4], Anja Klotzsche[5], Evert Slob[6], and George Tsoflias[7]

Ground-penetrating radar (GPR) is a well-established geophysical method that has found applications in a wide range of applied geophysics problems, from investigations at the earth's polar regions to infrastructure sensing at the hearts of our modern metropolises. Notwithstanding many advances in GPR practice, GPR data continue to pose challenges to interpreters. Due to the continuous improvement in data acquisition technologies, the community reaps the benefits of fast, multifrequency, and multichannel recordings. At the same time, imaging and interpretation algorithms are called upon to handle a rapidly growing amount of data, which often require adaptive and efficient batch processing. For both conventional and more advanced techniques, dedicated processing of the highly nonstationary GPR signal is required to overcome the difficulties in transitioning from data to imaging and interpretation. Interpretation may also require new techniques and tools for the visualization and quantification of subsurface structure.

In this special section of Geophysics, a collection of seven papers provides the GPR community with examples from the latest trends in this inherently challenging task and proposes some of the future directions for research in this area. We briefly present the summaries of the published papers.

Liu and Shi propose to utilize diffraction imaging of GPR data to assess water pipeline leakage. The laboratory and field experiments substantiate its viability and illustrate the potential of using GPR for such applications.

Ercoli and Ferguson demonstrate the performance of Gabor deconvolution on data with mixed-phase dominant wavelets, such as the GPR data, to compensate for attenuation and improve the temporal resolution. The authors test this technique on synthetic profiles and apply it on a 3D real GPR data set, improving the imaging of an important active fault in Central Italy as well as suggesting clear benefits in other applications.

Angelis et al. present a workflow for processing multioffset GPR data from systems with multiconcurrent receivers. These novel systems' data require an innovative and dedicated data processing workflow, combined with methods adapted from seismic data processing, to produce stacking velocity fields and zero-offset sections with increased signal-to-noise ratio.

Highlighting the growing popularity of drones in geophysical surveying, **Booth and Koylass** undertake a critical analysis of a drone-GPR platform for velocity analysis. The authors use synthetic and field data to show that refraction effects across the air-ground interface significantly distort the moveout of diffraction hyperbolae, introducing significant errors to GPR velocities estimation.

Allroggen et al. present an attribute classification-based interpretation approach of 3D GPR data collected across a breccia pipe on Svalbard. After comparing their results with a manual interpretation, the authors obtain insight into the pipe architecture and its internal structures.

Diamanti et al. explore the issue of "unusual" responses sometimes encountered in GPR sections that could cause misinterpretation of survey results. After developing a conceptual explanation, both numerical modeling and field data are used to demonstrate the concepts described, and the results lead to recommendations on key factors to consider in GPR field operations and in data interpretation.

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[1]University of Strasbourg, EOST/ITES (UMR 7063), Strasbourg, France. E-mail: maksim.bano@unistra.fr (corresponding author).
[2]Technical University of Crete, School of Mineral Resources Engineering, Applied Geophysics Laboratory, Chania, Greece and Sultan Qaboos University, College of Science, Earth Sciences Department, Muscat, Oman. E-mail: noikonomou@tuc.gr, n.oikonomoy@squ.edu.om.
[3]Colorado School of Mines, Golden, Colorado, USA. E-mail: jbradford@mines.edu.
[4]University of Edinburgh, School of Engineering, Edinburgh, UK. E-mail: a.giannopoulos@ed.ac.uk.
[5]Agrosphere (IBG-3), Institute of Bio and Geosciences, Forschungszentrum Jülich, Jülich, Germany. E-mail: a.klotzsche@fz-juelich.de.
[6]Delft University of Technology, Delft, The Netherlands. E-mail: E.C.Slob@tudelft.nl.
[7]The University of Kansas, Department of Geology, Lawrence, Kansas, USA. E-mail: tsoflias@ku.edu.

Alemdağ et al. combine GPR data obtained with different dominant frequency antennas on the same profile with simple and time-shifted balanced summation techniques. In addition, the authors demonstrate the usage of frequency-domain local mean notch filter, *f-x*, and automatic gain control filters for the improvement of these GPR sections' imaging quality.