Editorial of Special Issue Modern Surveying and Geophysical Methods for Soil and Roc

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Editorial

Editorial of Special Issue "Modern Surveying and Geophysical Methods for Soil and Rock"

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Thanks to the rapid development of technology, the field of soil and rock investigation has made significant progress in recent decades. The advancement of near-surface non-destructive geophysical methods enabled the investigation of large volumes of soil and rock in a reliable manner. Additionally, the protocols for geophysical data acquisition, analysis, and interpretation significantly enhanced, which encouraged both practitioners and researchers to implement geophysical methods on a wide range of geological, hydrogeological, engineering-geological, geotechnical, civil engineering, infrastructure management, shallow geothermal, agronomy, and environmental tasks. Within the Special Issue "Modern Surveying and Geophysical Methods for Soil and Rock", several papers highlight the benefit of utilizing various geophysical methods.

Jug et al. [1] combined several surface non-destructive geophysical methods, including multichannel analysis of surface waves (MASW), shallow refraction seismic (SRS), electrical resistivity tomography (ERT), and ground-penetrating radar (GPR), to investigate dimension stone on the Island Brač in Croatia, where the methods are key tools to assess the quality of rock mass and classify its suitability for exploitation purposes. Finally, rock mass was classified into three categories according to its suitability for dimension stone exploitation, where each category is defined by compressional and shear seismic velocities as well as electrical resistivity. In addition, GPR was found to be a good tool for the visual determination of fissured systems. The ERT method was also used by Briški et al. [2], who combined it with monitoring spring discharge and hydrochemistry to characterize metamorphic aquifers on slopes of the Medvednica Mountain in Croatia. The implementation of these methods proved to be very effective as a first and relatively inexpensive methodology for the hydrogeological characterization of crystalline terrains, both in local and catchment scales. As the authors conclude, the ERT method successfully revealed the local subsurface structure of the alteration zone, in which aquifers can form, while discharge and hydrochemical monitoring revealed groundwater flow characteristics at the catchment scale.

The GPR is a geophysical method that can map soil and rock in a relatively rapid and reliable manner and can be used to detect series of features directly linked to the condition of infrastructure using a range of antennas that measure at different frequencies and depths. Kulich and Bleibinhaus [3] used GPR in combination with a cross-hole radar to successfully delineate the fault and karstification zones with higher water content due to their strong dielectric permittivity contrast compared to the surrounding geology, while Sokolov et al. [4] used the GPR to prospect and evaluate massive ice in a frozen rock mass, thus obtaining a set of criteria for identifying massive ice according to GPR measurements. As the authors note, the developed criteria will allow the use of GPR for a detailed study of permafrost rock's structure to prevent the development of dangerous cryogenic processes in undisturbed and urban areas of the Arctic. Iwasaki et al. [5] successfully implemented GPR in combination with the Penetrometer–Moisture Probe (CPMP) to evaluate the spatial distribution of soil moisture and hardness in coastal and inland windbreaks, which is a

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challenging task considering that tree windbreaks often decline due to inappropriate soil moisture conditions and soil compaction. The CPMP was useful for interpreting GPR profiles, and the GPR was useful for interpolating the information about the horizontal distribution of soil moisture and soil hardness between survey points made with the CPMP.

Seismic geophysical methods are significant not just for geological prospecting but also for geotechnical engineers as a tool used to determine soil and rock physical–mechanical parameters. Bačić et al. [6] demonstrate the versatile applications of seismic geophysical methods for geotechnical engineering in karst, from mapping near-surface karstic features to the application of elastic wave velocities in the determination of small to large strain stiffness of karst, by highlighting several practical examples that offer a step forward from the traditional interpretation of seismic surveys, making them a prosperous tool in the geotechnical engineering investigation works, design, and quality control campaign.

Further, recent developments of innovative surveying and monitoring techniques boosts up practitioners' and researchers' confidence in using these methods for soil and rock investigation efforts. Tripaldi et al. [7] combined both geophysical and geodetic investigations, along with geochemical observations, to explore the relations between ground deformations, seismicity, and geochemical time series (from 2004 to 2016) on the location of a reawakening volcano at Campi Flegrei caldera (Southern Italy). The investigation topic received a great deal of attention due to the issues related to the volcanic risk management in a densely populated area. The data are analyzed via a purely statistical approach, and the authors conclude that the proposed analysis is not in competition with the methods traditionally used to study volcanic environments. Ðapo et al. [8] described the long-standing interdisciplinary geodynamic research for the wider Zagreb area, the most seismically active area of the continental part of the Republic of Croatia, where authors use geodetic and geological field measurements to develop a unique interdisciplinary movement model of the surface layers of the Earth's crust for the project area. Within this study, it is concluded that by using precise geodetically determined movements of the geodynamic network's points, a detailed analysis of the tectonic activity in the area of research can be conducted.

Considerable progress is also made in applying various methods to assess soil quality. Alshammary et al. [9] developed a novel digital electromechanical system (DES) to obtain information about important parameters for the assessment of soil quality and health with a direct application for agronomists. The evaluation of the DES performance is particularly appropriate for different tillage methods, mulching systems, and fertilizers used to increase soil fertility and productivity. Authors note that the results of the study represent the data of a specific area, and it is necessary to ascertain the extent to which the results apply to other areas and the use of different soil solarization practices. Ivonin et al. [10] present a methodology for a numerical analysis of three-dimensional tomographic images to quantitatively assess the pore space structure in dry and wet soil by integral geometry methods. The quantitative changes of the proposed parameters of pore space tomographic images prove the possibility and progressiveness of their usage for the pore space transformation estimate.

Conflicts of Interest: The authors declare no conflict of interest.

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