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Importance of three-dimensional ground penetrating radar surveys in accurate display of the images of subsurface installations, Case study: Shahrood University of Technology

Masoud Hosseini[1], Abolghasem Kamkar Rouhani[2], Mahdi Mohammadi Vizheh[3] and Saeed Parnow[3*]

1- M.Sc. Graduated, School of Mining, Petroleum and Geophysics, Shahrood University of Technology, Shahrood, Iran
2- Associate Professor, School of Mining, Petroleum and Geophysics, Shahrood University of Technology, Shahrood, Iran
3- Ph.D. Student, Institute of Geophysics, University of Tehran, Tehran, Iran

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Corresponding author: saeed.parnow@ut.ac.ir

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Shahrood University of Technology

Extended Abstract

Summary

Geophysical methods can effectively be used for delineation and maintenance of man-made subsurface installations. These installations are suitable targets for detection by ground penetrating radar (GPR) method. In this non-invasive method, high frequency electromagnetic (EM) waves in the frequency range 10 to 1000 MHz are used for detection, demonstration and investigation of shallow subsurface structures. The most important advantage of this method over other geophysical methods its high resolution, high speed of survey and non-destructiveness. In urban areas where the ground surface is covered by asphalt and also noise level is high, it not possible to use other geophysical methods while obtain high resolution data without destruction of the asphalt. However, the GPR method with shielded antenna acts well in urban areas. This method can present a three-dimensional (3-D) picture from the subsurface in which an accurate estimation of the subsurface structures can be made. In this method, EM waves, generated by the GPR transmitter, are sent into the ground and the reflections from the subsurface structures are received by the GPR receiver. The GPR waves are intensively attenuated in high conductive subsurface media and hence, the depth of penetration of GPR waves in this method is limited. In this research work, the depth of penetration of the GPR waves in the study area decreases to less than 2 meters. In this research, an urban survey area where various metallic and non-metallic pipes have been buried is selected, and then, GPR survey is performed on a grid in the area. As a result of processing and interpretation of the acquired GPR data, the subsurface targets at different depths are detected with relatively good accuracy and resolution.

Introduction

Nowadays, transmission of fuels, water and other energy resources by buried pipes, tanks and cables in urban areas is a substantial necessity for human beings. This leads to creation of huge and costly underground networks. Following creation of such networks, a very important matter is the maintenance of these man-made installations to prevent them from possible destructions. These destructions to the installations are not normally observable at the ground surface as the installations are located in the subsurface areas. These destructions that can occur due to different reasons can cause considerable financial losses and also irreparable environmental contaminations. In this regard, geophysical methods can be used for delineation and maintenance of these installations. Often there is a sufficient physical contrast between these installations and their surrounding media. Thus, these installations are suitable targets for detection by GPR method. In this method, high frequency EM waves in the frequency range 10 to 1000 MHz are used for detection, demonstration and investigation of shallow subsurface structures.

Methodology and Approaches

In this research work, GPR method has been used in an urban survey area where various metallic and non-metallic pipes have been buried. The GPR survey has been performed on a grid in the area, and then, the GPR data have been acquired using 250 MHz Noggin Plus GPR system with shielded antenna. Following processing and interpretation of the GPR acquired data, two-dimensional (2-D) and 3-D maps and depth cross-sections are obtained. As a result of this GPR survey, the subsurface targets at different depths in the 3-D maps have been detected with relatively good accuracy

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and resolution. These 3-D maps can considerably help the interpreter to interpret the GPR data reliably and accurately. Moreover, significant and relatively comprehensive information from these 3-D maps is obtained. 3-D presentation of the GPR data is very useful in the 3-D visualization of the subsurface, and thus, can indicate the targets more precisely.

Results and Conclusions

In this research work, the depth of penetration of the GPR waves in the study area was less than 2 meters. 2-D and 3-D GPR maps and depth cross-sections were obtained as a result of processing and interpretation of the GPR acquired data. Moreover, the subsurface targets at different depths in the 3-D maps were well detected with relatively good accuracy and resolution. 3-D presentation of the GPR data is very useful in the 3-D visualization of the subsurface, and thus, can indicate the targets more precisely. The results of this research indicate that non-invasive, fast and cheap GPR method has considerable advantages over other geophysical methods in civil engineering applications.

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