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A Study on the Performance of GPR for Detection of Different Types of Buried Objects

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Abstract

The objective of this research is to evaluate the applicability of Ground Penetrating Radar (GPR) method to detect burried objects in the shallow depths using 250 MHz and 800 MHz center frequency antennas. For this purpose, different objects were burried in several places of a certain test site. GPR data were collected along six paralel profiles using 250 MHz and 800 MHz antennas which are compatible with RAMAC CU II system. The reflections profile data were processed using the computer program ReflexW. After the processing of data, the reflected /scattered reflections on the processed radargrams were examined and the radargrams were interpreted to determine the depths and positions of the objects from the surface. Also, the data obtained from 250 and 800 MHz antennas were compared and the differences between them in terms of resolution were discussed.

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Keywords: Ground penetrating radar; burried objects; test site; data; resolution;

1. Introduction

Geoscientists use a variety of techniques on the subsurface of the earth that can either be invasive or noninvasive [1, 2]. Invasive methods include any techniques that disturb the ground, and these techniques also have a higher likelihood of destroying evidence [2, 3, 4]). Such techniques include probing, shoveling, or using any earth-moving

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equipment to displace soil. Conversely, noninvasive techniques do not disturb soil and allow researchers to investigate the subsurface with much less risk of destroying evidence [4, 5]. Geophysical techniques such as GPR are an excellent method of detecting buried objects without disturbing the ground and associated evidence.

Ground Penetrating Radar (GPR) is a high resolution electromagnetic technique that is used to investigations in the shallow subsurface of the earth. A ground radar system consists of a control unit, an impulse generator, two antennas for the transmission and the receiving of the signals and a memory [1]. The impulse generator sends short electric pulses (~ 1 ns) to the transmitting antenna. The transmitter radiates the EM waves into the ground. When the waves which spread into the ground come across with any objects or discontinuities, the waves are diffracted, refracted, and reflected. The reflected waves which are sent back to the surface are measured by the receiving antenna, amplified and displayed by the control unit as a function of time; this is called “radar trace”. Data collection is performed on the profiles deployed at regular intervals with certain measurement intervals. The traces at each measurement point are adjoined and two dimensional (2B) radar sections called as “radargram” are obtained.

2. Methodology

In the present study, GPR method was used to reveal determinability of depths and positions of different objects which is buried in several places of a certain field. The size of test site is 20.6 m x 3.57 m. In the test site, a metal plate, plastic pipes which have different diameter, a metal cylindrical object and a wooden object were buried underground (Fig. 1). To detect these object from the surface, the 250 and 800 MHz center frequency antennas which are compatible with RAMAC CU II system were used. The radargrams obtained from the measurements were processed using ReflexW software, version 6.0.7. After the processing of data, the reflected /scattered reflections on the processed radargrams were examined and the radargrams were interpreted to determine the depths and positions of the objects from the surface. Also, the data obtained from 250 MHz and 800 MHz center frequency antennas were compared and the differences between them in terms of resolution were discussed.

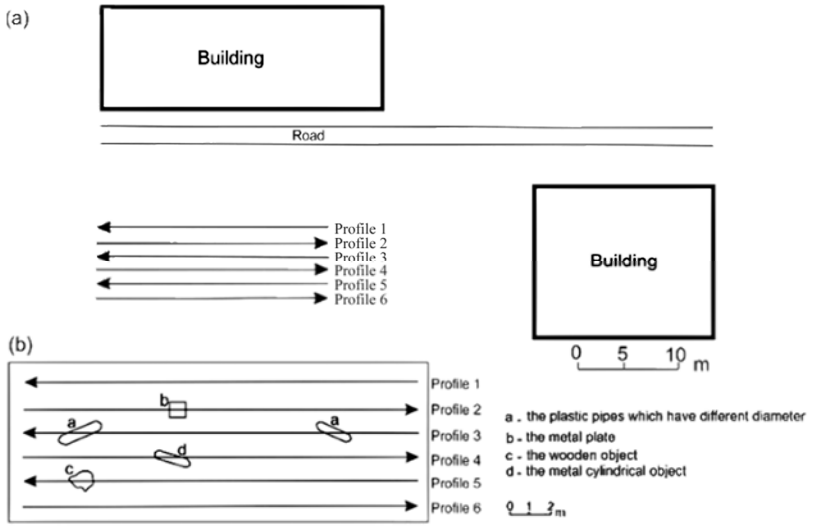

Fig. 1. (a) The plan of the test site, (b) Location of objects.

2.1. Data Collection

In the test area, parallel six profiles (Fig. 1), 20 m in long, were created at 60 cm intervals. Along each profile, data were collected by using RAMAC CU II radar system and 250 MHz and 800 MHz center frequency antennas which are compatible with this system.