Compare Reflex-2D-dataanalysis with other programs in data processing

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Abstract--This study was carried out through four tracks after adjusting the parameter parameters of the GPR device suitable for the soil quality to obtain the deepest possible depth, Three track, using an antenna (500 MHz) and one track using an antenna (250 MHz) In order to know the ability of the ground penetrating radar to detect and identify the features located under the ground of the university and knowledge The thickness of the pavement layers and the limitations of the site. The aim of the study was to compare Reflex program with the RAD Explorer program, This study demonstrated the efficiency of the RAD program for the Reflex program in data processing, detection of distortions accurately and also the technical efficiency (GPR) in the detection of erosion and soil-covered impacts without drilling.

Keywords--Reflex, University of Kufa, GPS.

1. Introduction
The science of geophysics is a broad science that studies the physical properties of the earth and reveals the depths of the earth by studying the differences between physical properties such as differences between the strength and intensity of magnetic properties, resistivity, gravity, density and the speed of propagation of elastic waves. Depending on the physical properties, there are several geophysical methods for sub-surface exploration such as the magnetic, electric and gravitational methods [1]. The importance of geophysical exploration methods lies in areas in which layer detectors disappear, and it is very difficult to know subterranean structures, and through this science the inner contents of the earth, such as the nucleus, the scarf and the crust, were explored [2]. In the beginning, before any geophysical survey, the objective of the survey must be determined, and what we are looking for is the best geophysical tool to reach the target. Then we take a reconnaissance trip as an initial stage, which consists of collecting information about rock structures and rock quality as well as collecting any information that characterizes the study area and processing all the information of the area in general, geophysical studies, competition for the region, maps (topography, geology, geophysical and geophysical maps). And a preliminary visualization of the geophysical survey network. [3] Taking into account external factors such as electricity wires or iron pieces, and also the conditions of the survey that the atmosphere is not rainy, no measurements can be taken on that day. To conduct the survey, The target is under investigation in order to reduce the number of raster lines, and the degree of spacing of lines according to survey objectives[4]. The field measurements should be transferred from the field machine to the computer. The field measurements should be entered into geophysical programs where there are several geophysical
programs and each of the geophysical methods has its own program. In these programs, corrections and filtration of field measurements are carried out. A model for field measurements is used[5].

2. Materials and Methods

A. Basic Principles

The ground penetration radar (GPR) theory is based on the transmission of electromagnetic EM energy in the form of short pulses and at high frequencies (1000MHz-10MHz) to the earth through the transmitter antenna. When these impulses are sent underground, they encounter different materials in the electrical properties: Electrical conductivity (σ), electric permeability (ε) and magnetic permeability (μ)). These waves respond to the electrical changes of the medium in which they are spread, and depends on the spread based on the extent of the differences between the properties of these materials, which determine the speed of the wave EM and attenuation and energy reflection signal [6, 7,8].

When EM waves face different targets or layers (in terms of electrical properties), part of their energy undergoes a reflection while some energy continues to move through the material in the form of absorbed energy and some are dispersed. The receiving antenna then receives the reflected waves and stores them in the digital control unit to form a radargram. Shown in Figure (1). Since we know the speed of the radar wave and the time it is sent and received along the path it is possible to calculate the depth of the point at which the reflection occurs [9,10].

![Figure. 1 Antennas’ Direction](image_url)
Figure 2 Basic principle of GPR [11]

The back wave is recorded as a function of the trace, and the compilation and display of these recordings together form a record (distance-time) or a profile. These images are then analyzed and manipulated by the analysis software to obtain a picture of the medium in which these waves have passed, so that they appear in two-dimensional forms after many filters are applied. [12] The signal receiver moves at a constant speed to capture and record the reflected signal, What is the body that causes this anomaly [13].

B. Waves Propagation

Electromagnetic waves (EM) are spread across different circles, and the permeability of these waves varies from one center to another, depending on the nature of the medium. EM waves are exposed to a range of physical phenomena, the most important of which are dispersion and absorption, resulting in the intensification of these waves. There are three characteristics of the material that control the propagation of waves (EM) in the material namely electrical permittivity (ε), magnetic permeability (μ), electrical conductivity (σ) and table (1).

Table 1- Electromagnetic wave speed [15,16].
3. **GPR Software**

The Radware program, which is designed to handle and interpret GPR data, allows the entire process to be processed and interpreted by the GPR. Within the framework of a unified system. The RadExplorer program contains standard measures for digital GPRs that are used to improve the signal-to-noise ratio and increase the analysis capacity. Processing procedures are performed for the purpose of easily interpreting data, eliminating unwanted signals such as data noise. With a variety of techniques, the signals are properly processed so that unwanted waves are removed or at least identified on the radar section so as not to be considered during interpretation[17]. Raw data processing procedures enable high-resolution results If procedures are used well, treatment should not be essentially the kind that radically distorts information from those collected. [18]

4. **Study Area**

Surveys have been conducted within the University of Kufa and sites identified in the Faculty of Engineering garage. The archetypes of the garage are (N 32° 01.679′, E 44° 22.528′) Use a device GPR after adjusting the parameters. As shown in the table (2) And the number of sites surveyed were one sites as shown in the table (3).

| Parameter Setting | Antenna 500MHz | Antenna 250MHz |
|-------------------|----------------|----------------|
| Max. Time Window  | Short          | Short          |
| Speed(cm/ns)      | 83             | 83             |
| Time Window(ns)   | 22.4           | 189.6          |
| Point Interval(m) | 0.05           | 0.05           |
| Sampling Freq.    | 30712.76       | 2548.62        |
| Depth (m)         | 1              | 5.22           |
Table 3 - shows Profile number, Track length (m), Antenna, Track direction

| Profile number | Track length (m) | Antenna | Track direction   |
|----------------|------------------|---------|-------------------|
| 279            | 30               | 500     | South - North     |
| 280            | 19               | 500     | South - North     |
| 281            | 37               | 500     | South - North     |
| 254            | 18               | 250     | West - East       |

5. Data Processing

A. Processing and interpretation of profile number 279 by RADEXplorer program

![Figure 3 - Profile No. 279.](image)
applying a filter (Background Removal) to the profile (279) the difference appears Between the layers as well as the intervals or space spaces between the pieces of paving . Concrete for the purpose of thermal expansion

B. Processing and interpretation of profile number279 by Reflex program

From the profile note (280) and profile(281) after Processing with the filter (Background Removal), the layers of the dark-colored mat are shown to indicate their high reflectivity .
Figure 6 - Profile N0.280 After the apply Background Removal

C. Processing and interpretation of profile number 281 by RADERplorer program

Figure 7 - Profile No. 281.
D. Processing and interpretation of profile number 281 by Reflex program

Figure 8 - Profile No. 281 After the apply Background Removal

Figure 9 - Profile No. 281 without Processing


E. **Processing and interpretation of profile number 254 by RADExplorer program**

When applying a filter (Time-Zero) we notice that the dotted line appears in red, indicating the zero point of the wave emission from the transmitter antenna to show the true penetration depth of the waveform.

![Figure 10 - Profile N0.281 After the apply Background Removal](image)

![Figure 11 - Profile No. 254.](image)

When applying this filter to profile 254 we notice the addition of hyperbola distance 3.39m from the beginning of the path. When the curve is placed on this block, the extra cutting specification is shown.
(speed = 15.1 cm / ns and the insulation constant = 4.0) and depth 1.98m In Figure(15-a), And the appearance of air In Figure (15-b), And the appearance of limestone.
Figure 14 - Profile N0.254 After the apply Background Removal

F. Processing and interpretation of profile number 254 by Reflex program

Figure 15 - Profile No. 254 without Processing
6. Conclusions
After conducting four field surveys at the University of Kufa using ground penetrating radar, it shows the ability of the RadExplorer program to detect submerged underground material and determine the subsurface layers. The results of the radar survey were shown by a frequency antenna (500) and a depth of 1 meter To determine the layers of the knights and asphalt, figure 10. And it was also shown to the profile (254) after being processed by the filter (Background Removal) we found that in the middle of the track it appeared in an air hole which was at a depth of 76.5 meters, limestone depth of 0.64m, dry stand depth of 1.98m.

7. References
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