UNIVERSITI TEKNOLOGI MARA
College of Built Environment

Poster Book

IIIDBEEX 2023

20 JANUARY 2023

International Invention, Innovation & Design Exposition for Built Environment and Engineering 2023

College of Built Environment
UiTM Puncak Alam
20 January 2023 I Friday

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CONTENTS

QUALITY ASSESSMENT OF GROUND PENETRATING RADAR (GPR) DATASET WITH VARIOUS SOIL-BASED CONDITIONS

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INTRODUCTION

A vast sophisticated network of cables and pipelines runs beneath the surface of metropolitan regions and large cities all over the world, providing crucial utility services that support contemporary civilised life. A surge in demand for utility services in the city led to the burying of a large numbers of utility pipelines, including telecommunication lines, fibre optics, water and gas pipelines, and electrical cables. Many subterranean utilities have reached the end of their useful lives, necessitating their replacement or maintenance. As a result of urbanisation and the evolution of human living styles, such as enhanced communication technology, new utilities are being installed. Engineers, surveyors, utility owners, or contractors will require accurate data and information on these utilities as a reference for excavation work (Desai L. et al., 2016).

Underground utility detection is defined as the process of identifying, separating, and labelling public and private subsurface utilities that are buried beneath the ground surface such as electricity distribution cables, communication lines and pipelines.(Metwaly M., 2015). In the radargram, a cylindrical object like pipelines, would show as black and white streaks in the shape of a hyperbola (Jaw S. & Hashim M., 2013). This study is to assess the quality of radargram images for different soil types with different soil characteristics: fine sand, topsoil and silt soil.

ISSUES/ PROBLEM STATEMENT

GPR is the best approach for detecting and identifying underground utilities. This technology can precisely find a wide range of underground services, including both metallic and non-metallic pipelines and wires (Al-Nuaimy W., Al-Hab et el., 20).It analyses the ground by emitting a signal from an antenna at various frequencies of electromagnetic (EM) pulses. A radar trace is made up of these reflected signals. However, undesirable echoes created by heterogeneous substances such as sand, clay, rock, gravel, and utilities are always present in these reflected signals.

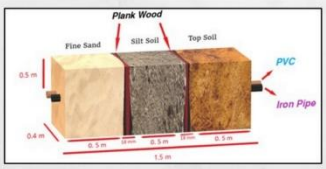
The composition of the soil on site will have a direct effect on how accurate the GPR reading will be. If high concentrations of minerals, salts, etc. exist, the GPR can be obstructed. This is because, for a good transmission to take place, magnetic and electrical waves must be unhindered as they interact with one another.

OBJECTIVES

- **To interpret the resolution of radargram images on different soil types due to different soil characteristics**
- **To determine the characteristic of different Soil-based condition with with high frequency scanned data (1GHz)**

METHODOLOGY

PRELIMINARY STUDIES
Project Planning
(Identify Site, Types of Pipes, Types of Soils)



DATA COLLECTION
GPR Measurement at three (3) distinct soil types: fine sand, topsoil, and silt soil.

DATA PROCESSING
ReflexW software - to filter the data image for a cleaner image in terms of brightness and contrast, by removing any noise in the radargram images.

RESULT & ANALYSIS
Radargram Images Interpretation

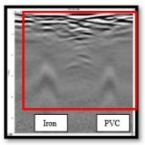
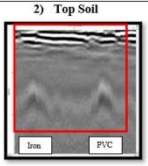
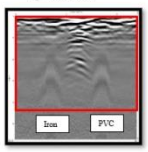
Qualitative Assessment on Different Soil-based Types with High Frequency

CONCLUSION & RECCOMENDATION

FINDINGS

To reveal which varieties of **soil** and **pipe material** are **easier** and more **accurate** to identify using **1GHz** GPR.

Radargram Image interpretation for fine sand, topsoil, and silt soil

Radargram Images	Radargram	Texture
1) Fine Sand 	The appearance of the parabolic Iron & PVC pipe is clear and easy to interpret after processing	The texture for the fine sand with small particle surface and has a bit void
2) Top Soil 	The appearance parabolic of the pipe is clear for Iron Pipe and PVC pipe and easy to interpret after processing	The texture for the topsoil is finer than the surrounding texture compared with silt soil and fine sand
3) Silt Soil 	The Iron and PVC Pipe parabolic more upward compared to others and there is void in the middle of image	The texture for the Silt Soil has the highest rough surface compared with fine sand and topsoil

NOVELTY

The expected outcome from this study is hoping that it opens many eyes about the difference in soil characteristics will affect the quality radargram images. Accurate positioning method with using Ground Penetrating Radar (GPR) is needed in which the principle on types of different soil-based characteristicas propose in this study is becomes relevant in ensuring reliability and high quality data in underground utility determination for mapping purpose, not only for surveyors from land survey industries (private firm), but also for Government agency. This is aligned with Goal number 9 in Sustainable Development Goals (SDG) which give benefit for industry, innovation and infrastructure.

The research study as proposed shows a big potential to assist many different agencies from private firm and Government department that related to underground utility survey and mapping.

CONCLUSION

Firstly, the **radargram** obtained shows **different texture** that giving **different presentation** for **each soil** on the radargram images. It can be concluded that each type of **soil** has its **own structure** that may **impacts** on how the **radargram appears**.

Secondly, the **different types of underground utilities** (Iron Pipe and PVC Pipe) also may **influence** in term of the **tendency of detection** by GPR. ***Iron Pipe is more accurate compared to PVC in term of accuracy with RMSE statistical model***. Furthermore, based on the soil properties structures (texture, moisture, and electrical conductivity), ***fine sand the is least suitable for soil in detection compared to topsoil and silt soil***.

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