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Evaluation of GPR Responses for Buried Targets at Different Decomposition Stages: A Comparative Study Between 2021 and 2022

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Abstract

This study investigates the influence of forensic target decomposition stages on detection using Ground Penetrating Radar (GPR), comparing data collected under dry conditions in 2021 and 2022. Experimental burials with swine specimens were analyzed in a controlled environment simulating burial scenarios. The results demonstrate that advanced target decomposition in 2022 resulted in less distinct GPR signals due to reduced dielectric contrasts between decomposing tissues and soil. Soils with higher sand content (85%) maintained better target definition even with advanced decomposition. This work emphasizes the importance of considering decomposition time in the interpretation of forensic geophysical data.

Introduction

GPR is a valuable tool in forensic geophysics for the non-invasive location of buried bodies. However, its effectiveness is influenced by factors such as soil composition and the target's decomposition stage (Pringle et al., 2011). This study compares data collected during the dry season in two consecutive years (2021 and 2022) to evaluate how progressive target decomposition affects GPR signal quality. This study aims to: evaluate the impact of forensic target decomposition on GPR detection under dry conditions, analyzing how different decomposition stages affect signal quality; compare GPR signal clarity between 2021 (recently buried targets) and 2022 (targets in advanced decomposition stages), assessing resolution loss over time; and identify optimal soil sand/clay ratios to mitigate decomposition effects on detection, with a focus on optimizing long-term forensic investigations.

Materials and Methods

The experiment was conducted in a controlled area of approximately 100 m², where four experimental graves (SEPs) were prepared with swine specimens buried at depths of 0.50 m and 0.90 m. The soils were composed of different sand-clay ratios. Data acquisition was performed using a GPR system (GSSI SIR3000) with a 400 MHz antenna during the same dry season in both 2021 (fresh targets) and 2022 (advanced decomposition stage). The analysis included 2D radargrams.

Results and Conclusions

The results from 2021, when scanning fresh targets, showed GPR signals with better reflections across all burial depths. In contrast, the 2022 data collected from targets in advanced decomposition stages revealed significantly less defined GPR signals, particularly for those buried at 0.90 m depth. This degradation in signal quality resulted from mass loss and tissue homogenization during decomposition, which substantially reduced the dielectric contrast between the targets and surrounding soil matrix. When comparing both datasets, the impact of advanced decomposition became particularly evident through the less distinct GPR images, with clay-rich soils showing the most pronounced signal deterioration. These findings demonstrate how decomposition processes progressively diminish the dielectric contrast between organic remains and their burial environment, while simultaneously highlighting how specific soil compositions can help preserve detection capability over extended periods.