USE OF COMPLEX ANALYSIS OF GPR SIGNAL FOR THE DELINEATION OF SUBSURFACE SUBTLE FEATURES

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Introduction

Extraction of detail and optimum information from ground penetrating radar (GPR) over the subsurface media through which its signal propagates is so vital for objective interpretation processes that are reliable.
However, random noise influence may in some cases obliterate subtle but very important information that are contained in the measured data. Thus, interpretation of raw field signal response may not show all the details information of the media through which the signal traverse.
In this paper, complex signal analyses of GPR field data over a farmland in part of Krakow were interpreted alongside the basic filtered field data. The farmland was simulated with varying degrees of soil compaction induced by tractor movement which was aimed to represent farming activity. The focus of the study was to determine the possibility of identification of more characteristics of the propagating media through which the electromagnetic energy travelled than as revealed in the raw field data.

Materials and method

Field data measurements were carried out using 800MHz central frequency antennae GPR system (ProEx) manufactured by Mala Geoscience incorporation. The choice of the antenna frequency was based on target depth and resolution. Data collection was done in the common offset mode. A total of 14 profiles were acquired. Three of the profiles have length of 70 meters while the remaining profiles of about 10 meters long are perpendicular to the 70 meters-long profiles.
The field data were subjected to pre and post processing before the actual data presentation and interpretation. Some of these processing include data editing, profile merging, DC-shift, de-wow and time gain. Subsequently advance signal analysis such as instantaneous amplitude (envelope), instantaneous phase and instantaneous frequency were performed on the processed data. The analyzed data were interpreted and inferences were made.

Results

Advance analysis operations on the field data such as event frequency depict more about the effects of the compaction on the soil than as revealed in the basic filtered field data. The analysis also revealed better the subsurface layer boundary and lateral variation in the physical properties of the traversing media were well elucidated. Degradations of the soil to a certain depth by the tractor movement were shown properly in the signal transformation. Furthermore, the horizons of the subsurface layers are better delineated in the analysed data. Processed data obtained as a result of GPR measurements and exemplary signal attributes determined for them are shown on Fig 1.

Conclusions

Important information concealed in the field data that may have been obliterated by random noise, human and equipment errors are better revealed from the fragmentation of the various components of the signal via its analysis. This assertion is adjudged from the results of this study which have demonstrated that detail signal processing such as using complex signal transformation has ability to provide hidden or subtle characteristics of the propagating media.

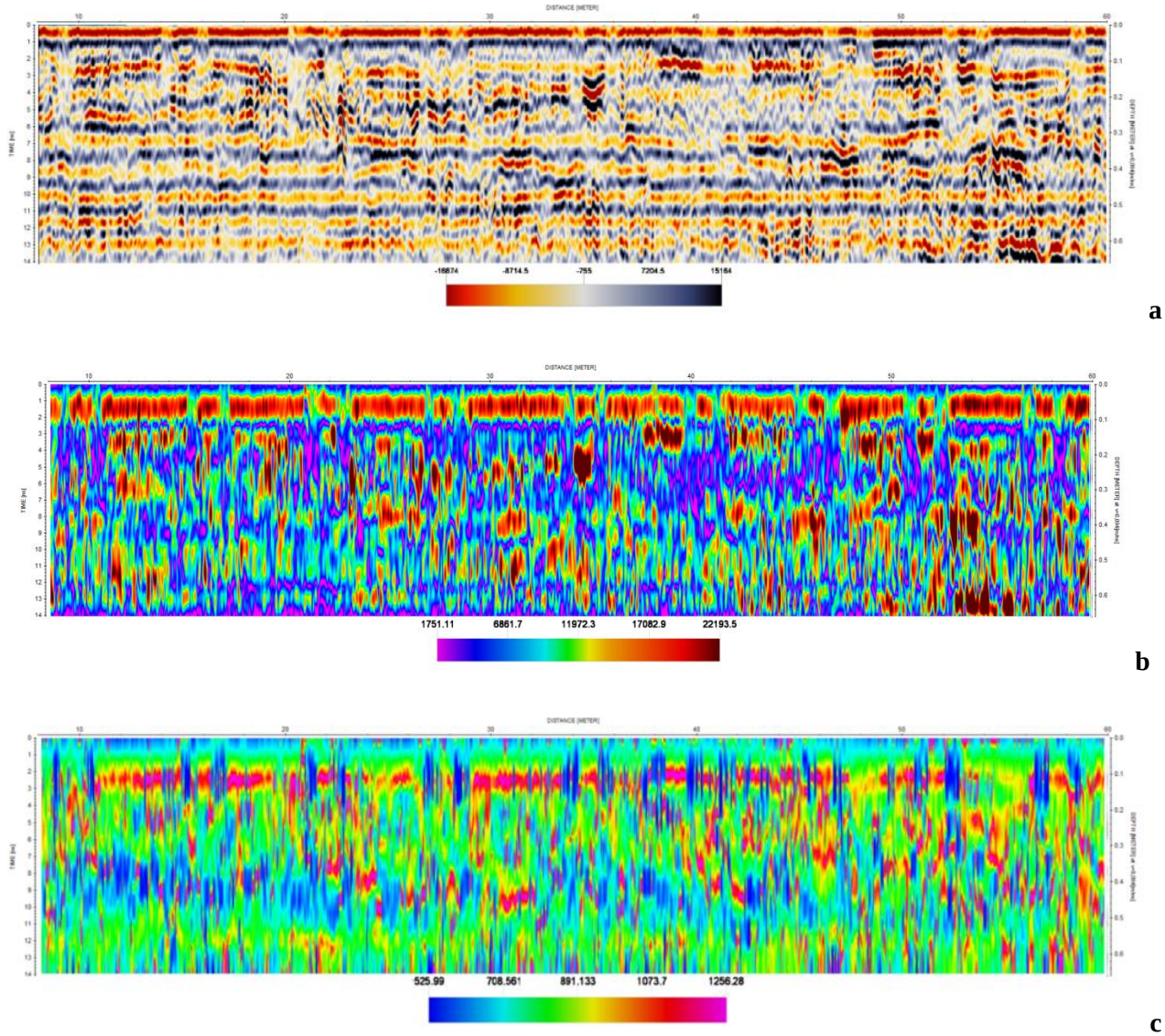

Figure. 1. *Comparison of a) processed GPR data b) instantaneous amplitude image and c) event frequency attribute results.*

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