H14 Ground Penetrating Radar: A New Tool in Crime Scene Examination?

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After attending this presentation, attendees will understand the search techniques employed to locate buried bodies or items within Queensland, Australia, and how new techiques are being evaluated.

This presentation will impact the forensic science community by illustrating the role that the Queensland Scientific Police serve and the equipment and techniques utilized to locate various buried items. These techniques are now being evaluated in Queensland in order to offer better service delivery to plain clothes investigators.

Recently the Queensland Police Service (QPS) considered the purchase of a ground penetrating radar (GPR) system. The current practice within the QPS with regards to GPR is to employ the services of a private operator and GPR system on a case-by-case basis. As the call for GPR services increases, it may be more cost effective for the QPS to acquire the GPR equipment and skill base as a service resource.

GPR operates by radiating short pulses of energy into a medium, usually soil, via a transmitter antenna and then receiving the energy reflected back from geological, or forensic, features with varying electromagnetic properties. By recording the propagation time delay between the transmitted and received signal, the distance to subsurface features such as rocks, tree roots, and objects of forensic interest can be determined.

GPR has many benefits compared with traditional search techniques. GPR is nondestructive, relatively portable, self-contained, and can readily provide high resolution data in real time on the radar display unit. The availability of real time data provides investigators with vital information about subsurface features while in the scene and greatly assists the forensic personnel by identifying specific areas of interest for excavation.

The use of GPR by law enforcement agencies is extensively documented in the forensic literature; however, most of this literature is derived from international experiences. It is not a tool routinely utilized within Australia for crime scene examinations. Prior to the purchase of any GPR unit, validation trials were required to be conducted.

Several burials sites were established based on simulated crime scene scenarios. These burial sites were positioned beside each other in a row. The scenarios represented included:

1. Non-disturbed soil (Control),
2. Disturbed soil to 300mm with no object,
3. Disturbed soil to 500mm with no object,
4. Disturbed soil to 300mm with mixture of plastic skeleton and bovine skeletal elements, and
5. Disturbed soil to 300mm with metal weapon.

The GPR unit utilized in the trials was the GSSI SIR-3000, loaned from the Commonwealth Scientific and Industrial Research Organization (CSIRO) Mining Automation. Two antennas were trailed in association with this system. These were the GSSI 900MHz and GSSI 400MHz antennas, both of which are interchangeable with the SIR-3000 system.

The various burial sites were contained within an area approximately 4m x 8m. During the first trial an X-Y grid was established for a survey pattern. A series of runs or scans were conducted at regular intervals along the X-axis and then along the Y-axis. A total of 27 scans were obtained for the study area. Each scan provided information on subsurface items on the display unit. Sites 2-5 were readily identified by the disturbances in the soil, represented on the display screen as hyperbola. The raw data displayed a significant difference between the reflection of the metal weapon (Site 5) and all the other sites, with the metal weapon displaying a stronger hyperbola. The raw data also displayed a difference between Site 2 and Site 3, with Site 3 exhibiting a disturbance further into the soil than Site 2. Interestingly the scans obtained during this trial could be refined at a later time during subsequent processing to provide 3-D images of the study area. These 3-D scans will be presented during the presentation.

A second trial was conducted using the same burials pits however 30mm cement pavers were placed on the soil surface above each burial site. The GPR was subsequently run over each burial site again using the same X-Y grid pattern. The results displayed during this trial were similar to the results of trial 1 in terms of the differences between Sites 1-5 discussed above. The concrete pavers over the soil surface simply added an additional feature within each scan. These pavers were reinforced with steel which is represented in each scan as regular spaced dots along the top of the images. The disturbed soil below the concrete pavers was still able to be observed as hyperbolas. The metal weapon in Site 5 again produced the strongest hyperbola.

The 400 MHz antenna provided the best resolution for the visualization of the subsurface features compared to the 900 MHz antenna. The 400 MHz antenna is commonly referred to in the literature as the antenna of choice for burial work. The results of the trial concurred with this observation.

Crime Scene, Recovery, Search Techniques

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