An Evaluation of the Combined Application of Ground-Penetrating Radar and 3D Laser Scanning in the Location and Rapid Recording of Skeletal Human Remains

James L. Fenn[1], Paul N. Cheetham[2], & Jeremy Pile[3]

Centre for Forensic Sciences
School of Conservation Sciences
Bournemouth University
Bournemouth, UK
BH12 5BB
[1] *email: jamesfenn1@gmail.com*
[2] *email pcheetham@bmth.ac.uk*
[3] *email: jpile@bmth.ac.uk*

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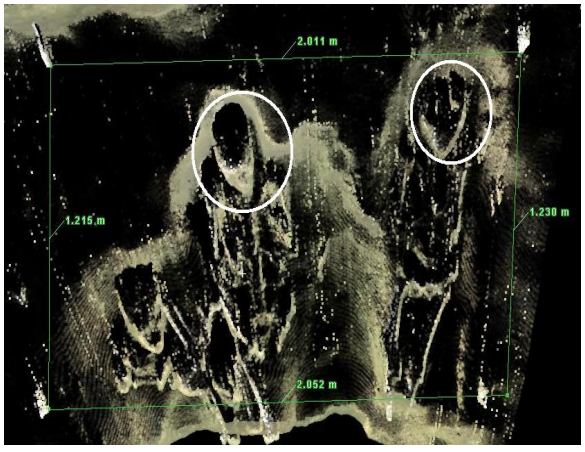
Introduction

The location and recording of buried skeletal remains, particularly if disarticulated and lying through the plane of excavation spits, presents a considerable challenge to investigators recovering and recording with such material. This paper considers the application of high frequency ground-penetrating radar (GPR) in combination with 3D laser scanning for the direct locating and recording of skeletal elements in a shallow burial environment. It assesses the ability of the GPR and to aid the forensic expert in the locating of skeletal remains where the disturbance of the grave itself might not provide a sufficient geophysical contrast. The research was conducted on an archaeological excavation of a cemetery containing a series of inhumations dating to the mediaeval period and earlier. It investigated an area of backfilled ditch that had revealed a series of apparently disarticulated human remains protruding from the ditch section. The matrix at this test area was a relatively dry, loose, sandy clay loam which would be expected to prove suitable for high frequency GPR survey.

Field Methods and Results

The experiment was used high frequency ground penetrating radar (800 MHz) to conduct two orthogonal surveys over a survey area of 1.2m x 2m employing a 0.01m (1cm) sample interval along the survey traverse and a 0.10m (10cm) traverse interval. Prior to the commencement of the GPR survey, and in during the intrusive investigation, 3D laser scanning was applied as a potential rapid pre, mid, and post-excavation recording technique in addition to the traditional photographic and 2D plan recording. Having cleaned the section face and cleared the surface of vegetation, and initial 3D scan was carried out. The GPR survey then commenced running north-south - transverse to the assumed burials, and then east-west – parallel to the assumed burials. Significant anomalous GPR reflections occurred, which were consistent in grid location on both directional surveys (see Figure 2 for sample GPR slices).

AB



C D

Figure 2: *Images A and B are a sample raw data slices of the 800MHz GPR orthogonal surveys in which two clear GPR anomalies are highlighted. On excavation of the target area a conclusion was reached that these anomalies represented the crania of two shallow burials (one intact and one partially fragmented - highlighted in the 3D laser scan- image C, and in site photograph – image D).*

Conclusions

Although the application of high frequency GPR (800MHz) provided considerable guidance as to the precise location of the buried crania and as to the general orientation of the burial as a whole, further experimentation applying a higher frequency radar antenna at a traverse of less than 10cm would be recommended to improve resolution in the hope of individuating bone with greater precision. 3-D laser scanning as a rapid recording technique demonstrated impressive capability both in scan resolution and in general measurement accuracy, however; finite resolution and time consumption are issues to be readdressed with the emergence of upgrading models and advancing scan technology.

Figure 1: Ditch section containing disturbed burials. Surface: 2m X 1.2m GPR survey area.