What Lies Beneath: The Use of Subsurface Mapping GPR in Clandestine Grave Research & FBI Investigations

Disclaimer: The following article could be considered sensitive in nature or contain sensitive subject matter.

Overview

- Youngstown State University (YSU) conducted a research project to locate clandestine graves.
- The Proceq GS8000 Subsurface Mapping GPR was used to scan the areas to detect changes in the ground.
- Researchers at YSU were able to achieve high resolution at different depths, resulting in compelling findings.

This article is about research being conducted at Youngstown State University (YSU) on using GPR to locate clandestine graves. The project aims to improve the understanding of human decomposition and to train law enforcement on the use of geophysics in forensic geology.

Youngstown State University (YSU) is a public university founded in 1908 and situated in Northeastern Ohio, United States of America. The principal investigator is Tom Jordan, Adjunct Professor at the Department of Physics, Astronomy, Geological and Environmental Sciences (PAGES) at YSU.

Challenge

A clandestine grave is an unrecorded burial, often in a remote location, that generally has been hand-dug to <1m depth below ground level. They usually have irregular burial shapes and uneven depth. Locating clandestine graves is difficult and expensive (typically costs ~USD100,000 per effort).

Cadaver dogs are trained to detect the volatile organic compounds (VOCs) emitted by decomposing bodies. However often clandestine graves need to be detected after 15+ years and at this stage cadaver dogs are unsuitable because VOCs are no longer being emitted. A suitable alternative at this stage is to use geophysical methods such as ground penetrating radar (GPR), electromagnetic induction (EMI) and high sensitivity gradiometer to detect changes in the ground due to the decomposing body.

Ground Penetrating Radar (GPR) can be used to detect interfaces of different materials in the subsurface e.g. soil and rock. In the case of graves, GPR can detect the fatty acid that encases the body and forms in the soil pore space during advanced decay. This remains detectable for decades or longer and it is sometimes referred to as 'grave wax' or 'adipocere'.

The team at YSU are working to improve the success rate of the geophysical survey (including GPR) through a better understanding of the long-term and seasonal relationship between organic decomposition and resulting geophysical signatures. They have set up an extensive test site to do this using pig carcasses, which have similar masses and body compositions to humans. The pigs are buried in different geological conditions e.g. dry, wet, with roots present etc.

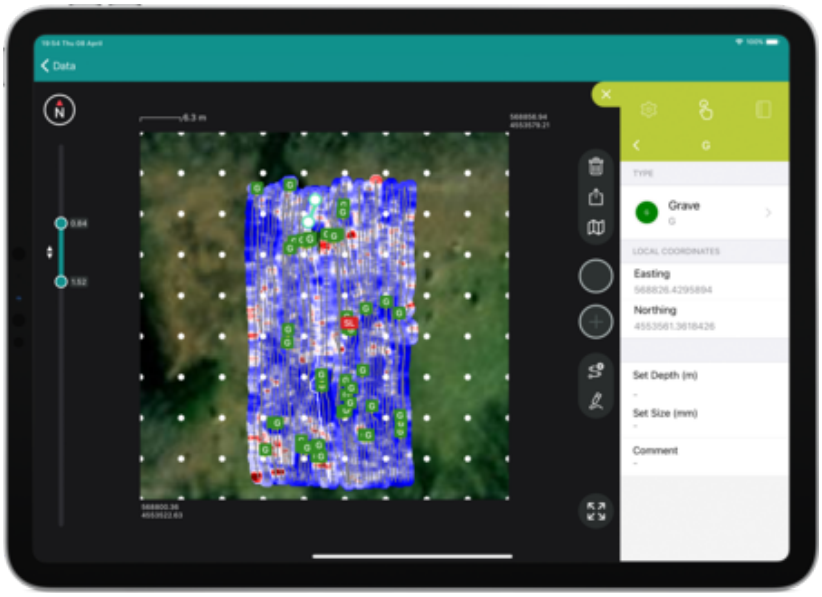
Solution

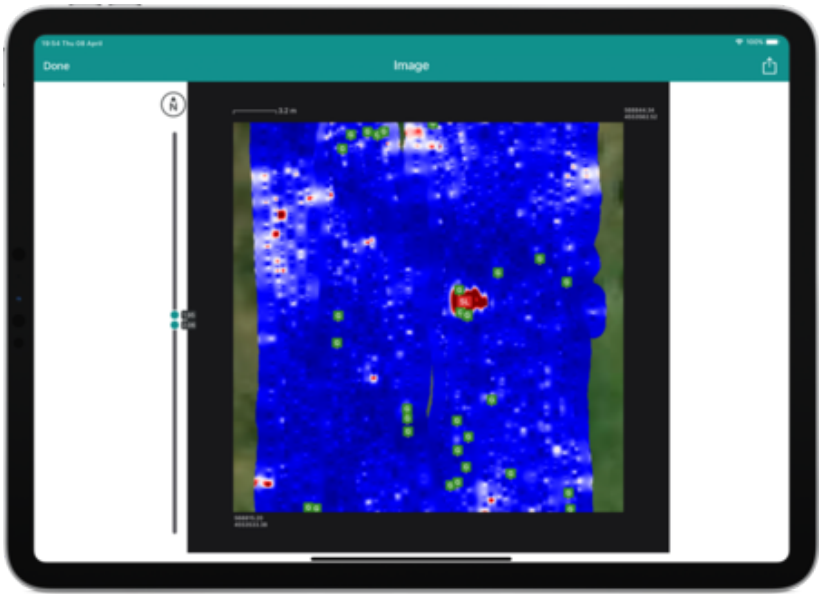
Proceq GS8000 is a GPR subsurface mapping system by Screening Eagle Technologies. The researchers at YSU have been using GS8000 in their research project and have declared the results to be "compelling". Recent grave locations, where vaults are present, give clear hyperbola responses. Older graves without vaults usually produce a stack of pancake-like responses, but some also gave a response typical to that from a void suggesting there might be an empty, intact coffin.

Of particular benefit to them is the Stepped Frequency Continuous Wave (SFCW) technology which provides an ultra-wide bandwidth of frequencies. This improves the resolution at different depths, enabling the graves to be more easily detected.

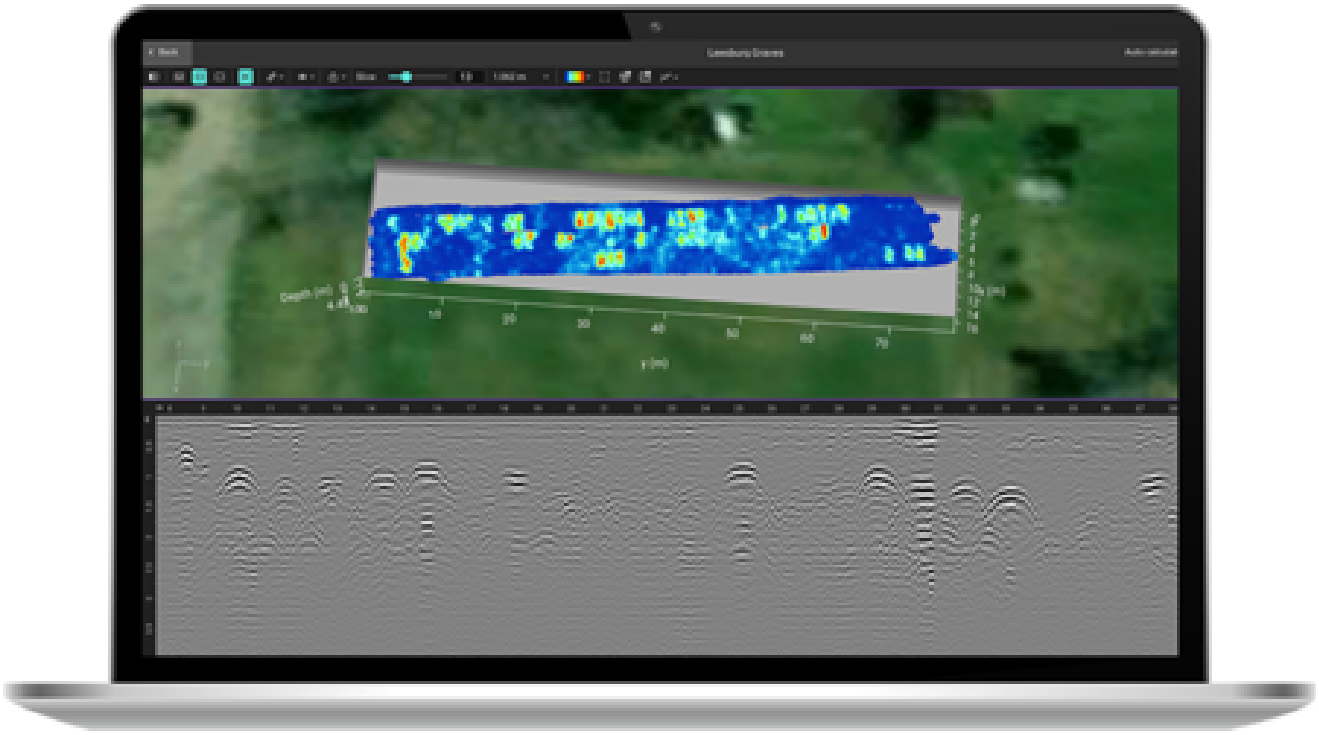
Result

The team also appreciate the intuitive interface and the SSR (State Space Representation) augmentation which enables them to be georeferenced during data collection. The unique 'free path' function which liberates the user from following a grid pattern is particularly useful for the team since they need to scan large, irregular surfaces.





All inspection data is automatically synchronized to the cloud and the Screening Eagle Workspace platform. From there, the team are able to easily access the data and perform post-processing using GPR SLICE and GPR Insights.



GPR data visualized using post-processing software, GPR Insights

Tom Jordan and his team recently won the FBI Director's Community Leadership Award in recognition for assisting the FBI in several criminal investigations through the use of geophysics.

Screening Eagle Technologies congratulate YSU on receiving this prestigious award and look forward to supporting them further with their commendable work.

Contact us for more information about using GPR for these types of investigation and many others.

Visit our Tech Hub to check out other applications for GPR.