Wavelets - *Probing the Past: Subsurface Imaging to Identify Burials at the Mueschke Cemetery, Houston*

By Azie Aziz and Robert Stewart

Figure 1: A University of Houston team member (Marcus Zinecker, with Lone Start's Janet Flores) is pushing the Noggin 250 MHz GPR SmartCart over one of the survey grids.

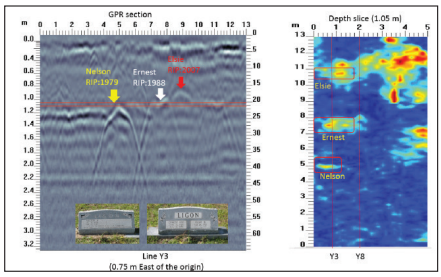

Figure 2: GPR section showing Nelson and Ernest Ligon burials (left). A GPR depth slice at 1.05 m (right) clearly indicates the two burials by the high amplitude areas.

Figure 3: Colorized pointcloud collected with a ground-based LiDAR scanner (located in the center) shows the headstones at the Cemetery.

Figure 4: Project personnel from the University of Houston and Lone Star-North Harris College.

While many geophysics students are enthusiastically investigating ways to find the next massive petroleum deposit, others have turned their attention to shallower targets. The Allied Geophysical Lab has partnered with Lone Star College-North Harris to collaboratively search for unmarked graves at the Mueschke Cemetery in northwest Houston. The project was motivated by the need to preserve and further document this historic cemetery. The effort is supported by the Mueschke Cemetery Association. The Cemetery is the final resting place for several notable Texas residents like Mueschke, Tautenhahn, West, Fussell, and Pennington. Veterans buried there are known to have served in the American Civil War, Spanish-American War, and World Wars I and II. The oldest known, but as yet un-located, grave is that of James R. West, who passed away in 1875 - we aspire to find it.

The collaborative work, which began in September 2013 is not only finding the unmarked graves, but also updating the existing 152 headstones. The project includes a 3D survey using ground penetrating radar (GPR) with various antennae (100 MHz, 250 MHz, 1000 MHz), along with LiDAR and electromagnetic profiling instruments. GPR is often an effective and non-intrusive tool to identify unmarked graves. A total of six survey grids were designed, with four completed to date. The geophysical project is scheduled to be finished by May 2014.

Surficially, the Mueschke cemetery area consists of the Middle Pleistocene and Quaternary Lissie Formation. The soil type is mainly silt, clay, and gravel. The study area is flat (only several inches of topography).

While there is a strong archaeological motivation for the project, we are also interested in developing and assessing geophysical techniques, especially GPR's performance in detecting the characteristics of unmarked graves hosted in various soils.

The GPR data are processed using a standard processing flow (including de-wow, gain, and band-pass filtering). Initial results show a number of diagnostic diffraction hyperbolas which indicate the top of the coffins. The hyperbola tops are often recorded at about 1 m, which is consistent with the typical burial depth (Figure 2). The top of the graves can be clearly imaged even though the soil contains clay, which is often a limiting factor to GPR penetration. The 250 MHz antenna provides a vertical resolution of about 0.1 m and is the choice to image the graves.

We were also thrilled to use a terrestrial LiDAR (Light Detection and Ranging) scanner to create 3D point cloud datasets of the surface of the cemetery. This 3D volume of the cemetery area will be integrated with the subsurface images and headstone records.

It has been a little strange surveying over burials in a graveyard, but knowing that we were providing useful information to families, friends, and the historical associations made the science even more satisfying.

Acknowledgement

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