GROUND PENETRATING IMAGING RADAR 2002 Nova Award Nomination 18

What is the Innovation:
GPiR (ground-penetrating imaging radar) is a new technology for mapping the shallow subsurface, including society's underground infrastructure. Applications for this technology include efficient and precise mapping of buried utilities on a large scale; inspection of the subsurface prior to construction; comparison of "as-builts" to construction plans; inspection of bridge decks and roadbeds; environmental monitoring and assessment; near-surface geological assessment; and "non-invasive" archeology.

Why is it innovative:
This innovative technology has for the first time incorporated a complete system for underground imaging: 1) an array of antennas to make underground mapping by radar feasible on a large scale; 2) advanced signal processing—using 3D imaging techniques adapted from seismic imaging in oil exploration—to convert radar echoes into 3D underground images; 3) precise positioning of the images relative to ground features by monitoring sensors with a survey geodimeter (laser theodolite), 4) advanced image processing to extract and display underground features in 3D and archive the results in CAD or GIS.

What it changed or replaced:
GPiR is locating underground infrastructure more reliably and accurately than standard techniques using metal detectors. By providing accurate coverage in 3D, GPiR will move the utility industry towards non-invasive management of underground infrastructure, avoiding the hazards and inconvenience of digging; it will also improve construction planning and engineering by showing what lies below the surface before the shovels hit the ground.

Where and when it originated, used, and expected to be used:
The initial research project was carried at Schlumberger-Doll Research from 1998 to 2000. The Electric Power Research Institute (EPRI) sponsored the research, with co-funding from the Gas Technology Institute providing (GTI). In May, 2000, the project was spun off by Schlumberger and merged with Witten Technologies, Inc., to combine the imaging software developed at Schlumberger with WTI's array radar, which is being commercialized as the CART Imaging System. The new system has been used at Con Edison, PSE&G, Seattle City Light, TxU, DLC, JEA, PEPCO, OPPD, and other non-utility locations. The market for GPiR will be utilities, construction companies, and government agencies charged with managing society's subsurface infrastructure.

Patent Applications Filed

Title	Authors	Application No	Filed
Ground Penetrating Radar Array and Timing Circuit	Bernth Johansson, Alan Witten, and Anthony Devaney	(US) 09/658,188 Pending	8 September 2000
A Rotating Scanning Antenna Apparatus and Method for Locating Buried Objects	Paul ALBATS et al. Assignee: Witten Technologies, Inc.	(US) 09/703,570 Pending	1 November 2000
Method for Merging Position Information with Measurements and Filtering to Obtain High-Quality Images that are Positioned Accurately with Respect to Global Coordinates	Maclyn Burns et al., Assignee: Witten Technologies, Inc.	Pending	14 March 2001
A Virtual Camera on the Bucket of an Excavator Displaying 3D Images of Buried Pipes	Robert Green Assignee: Witten Technologies, Inc.	Pending	18 May 2001

Articles

Oristaglio, M., Miller, D., and Haldorsen, J., 2001, Ground Probing Radar, in Scattering, P. Sabatier and E.R. Pike, eds., Academic Press, London.

Bernstein, R., Oristagiio, M., Miller, D. E., and Haldorsen, J., 2000, Imaging radar maps underground objects in 3D, IEEE Computer Applications in Power, p. 20-24.

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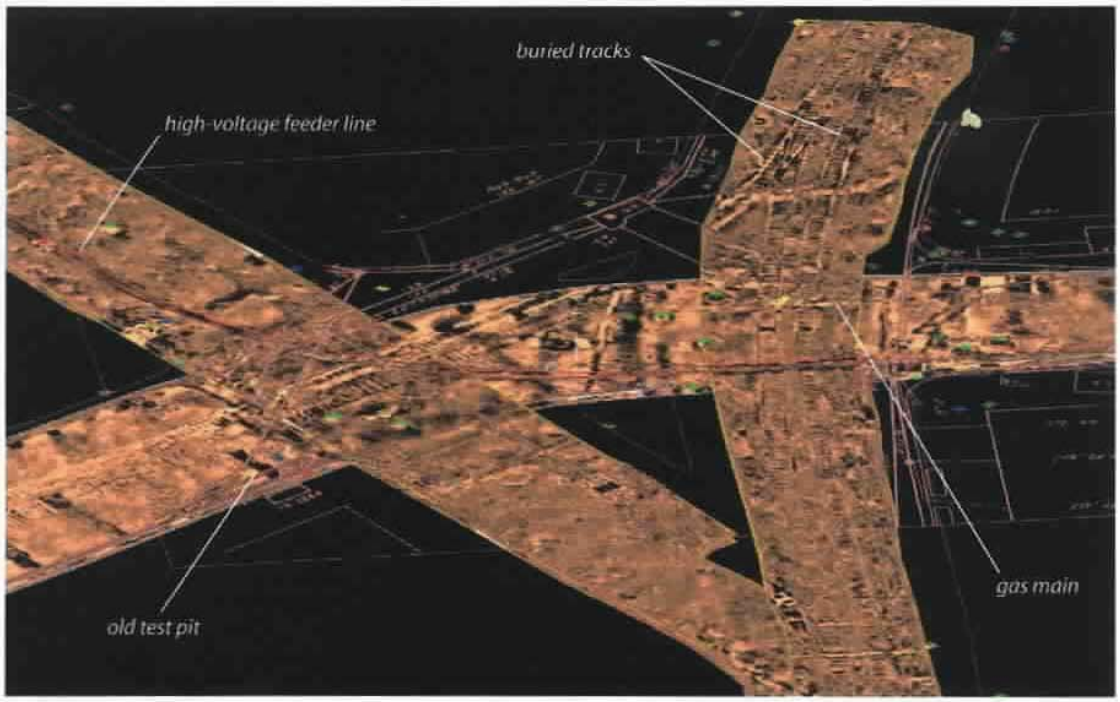

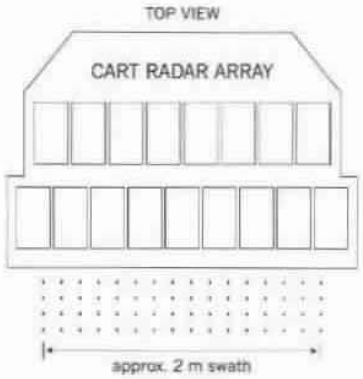

(Center) CART Imaging System uses an array of antennas to improve dramatically the efficiency and accuracy of ground-penetrating radar. A laser theodolite tracks the array as it moves up and down the street, and advanced imaging software converts echoes collected on different passes into a seamless 3D digital image of the subsurface. (Top) Slice through the underground 12 inches below street level in the south Bronx. The full image covers 120,000 sq ft down to a depth of 6 ft with a resolution of about 2 inches. This slice is part of the world's largest high-resolution underground radar image.
(Bottom) 3D rendering of CART image showing transmission lines running under the walkway along Cathedral Parkway in Manhattan. This "Virtual Test Pit" allows engineers to visualize existing infrastructure in place to help maintain lines or design new installations without the hazards or inconvenience of digging.