3D MIMO GPR

Ground-penetrating radar for real-time detection and 3D image reconstruction of subsurface structures

What it is

CEA-Leti's ground-penetrating radar (GPR) technology enables high-precision, real-time georeferenced 3D imaging of underground structures. Based on an advanced multiple-input multiple-output (MIMO) architecture, the solution capitalizes on CEA-Leti's extensive expertise in wireless system design—spanning propagation modeling, antenna design, signal processing, RF front-ends and platforms, and precise multi-modal geolocation algorithms.

What it can do

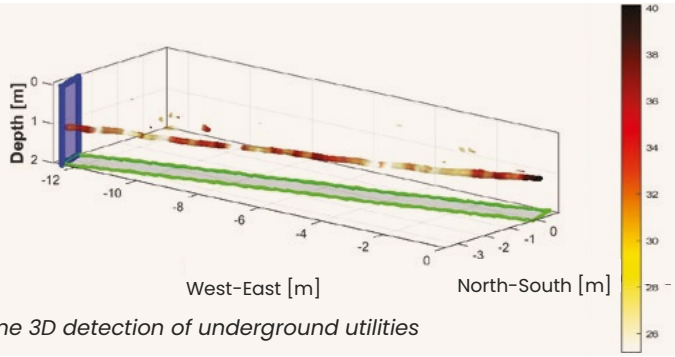
This 3D radar technology is specifically designed for civil engineering applications, offering detailed three-dimensional imaging of underground utilities such as pipes, cables, and other buried infrastructures.
The high-resolution images are accurately geolocated with centimeter-level precision and are being integrated into underground digital twin models.
In addition to utility mapping, the radar provides real-time soil permittivity without calibration. Broader applications could include the detection of underground cavities and mines.

What makes it unique

This new radar system is powered by innovations across multiple domains:

- A compact, wide-band multi-antenna system, the result of extensive miniaturization efforts
- Radio-frequency and digital electronics design for precise signal generation and acquisition
- Advanced algorithms and signal processing enabling the detection and identification of buried targets by leveraging the capabilities of multiple antennas
- Robust multimodal geolocation delivering centimeter-level accuracy
- User ergonomics and human-machine interface for intuitive operation and usability

These advances reflect CEA-Leti's multidisciplinary expertise in wireless technologies.



▲ *Real-time 3D detection of underground utilities*

At a glance

- Wide band detection: 100 MHz to 2 GHz
- Full MIMO 64-channel transmission
- Can detect structures up to 5 meters deep

Working with CEA-Leti

Global transportation infrastructure construction and maintenance leader Colas Group has been working with the CEA for many years. Faced with staffing shortages and excavation-related risks, the company turned to CEA-Leti in 2019 for a detection solution operable by all Colas employees.

The result is a simple, accurate subsurface mapping technology for civil engineering projects that leverages algorithms rather than operator interpretation of images, reducing human error. The solution is now being field-tested by Colas, and the technology is ready for development for new use cases, such as defense.

Interested in this technology?

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