The ORFEUS Project:
a step change in Ground Penetrating Radar technology to locate buried utilities

Guido Manacorda
Engineering Manager
IDS Ingegneria dei Sistemi SpA

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Key issues

- Many pipes and cables are buried beneath our streets (more than 1,370,000 km gas mains in EU15 countries)
- Damages to underground apparatus occur frequently (direct costs + consequential losses in EU > €10 billion/y)
- Street works are also a familiar problem

Buried assets

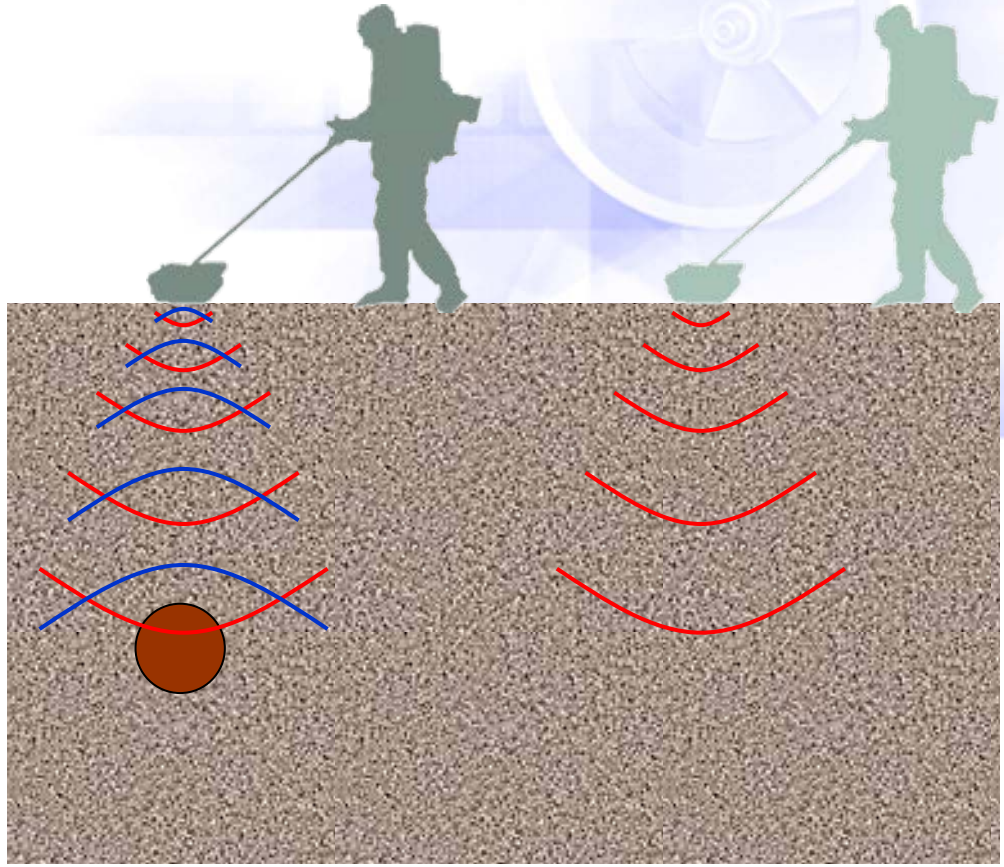
Plans and other records can give an indication of what may be found in the underground, but the location of all buried infrastructure should be confirmed by using location systems

Current location methods

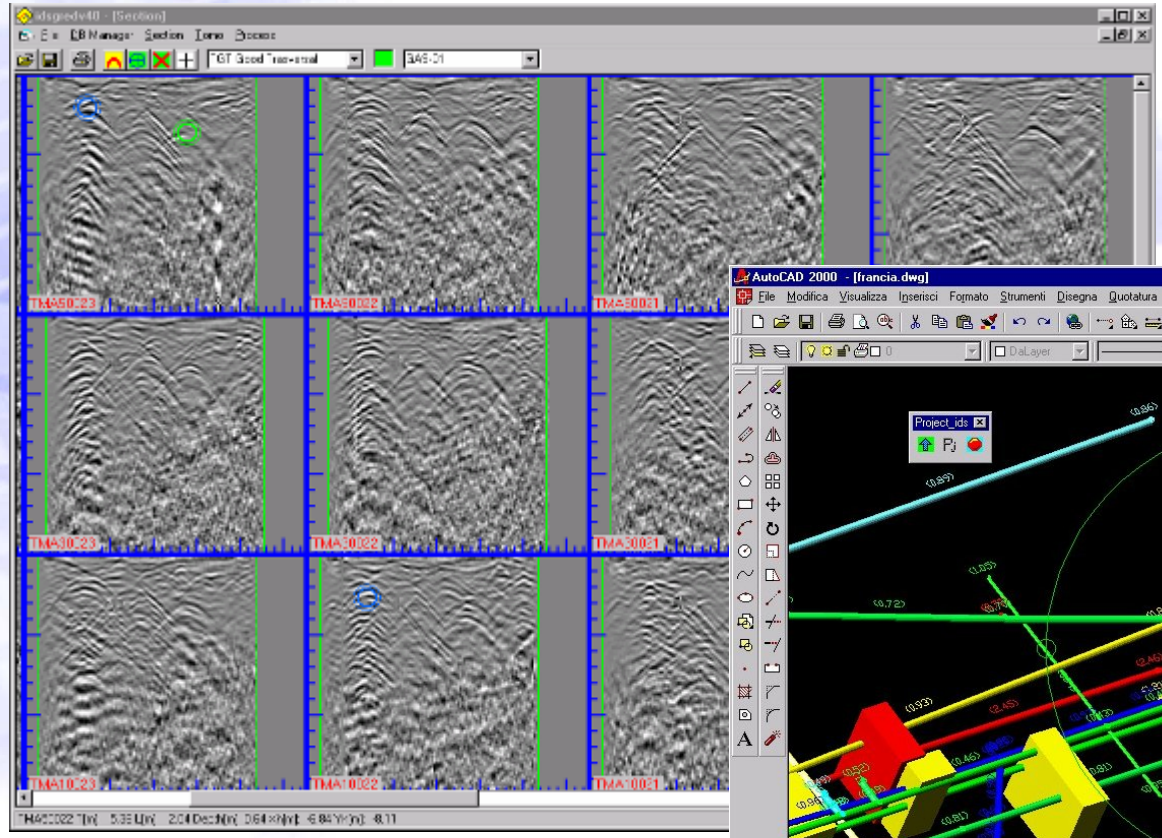
- Test pits
- Pipe and cable locators'
- Marker/warning tapes
- Buried marker systems
- Acoustic systems
- Ground Penetrating Radars (GPR)

GROUND PENETRATING RADAR (GPR)

- ✓ **The GPR transmits a very short pulse of e.m. energy into the material by a transmitting antenna**
- ✓ **Energy reflected by discontinuities is captured by a receiving antenna.**
- ✓ **Depth range & resolution are related to the radar frequency, transmitted power, host material e.m. properties and to the shape and characteristics of the targets.**

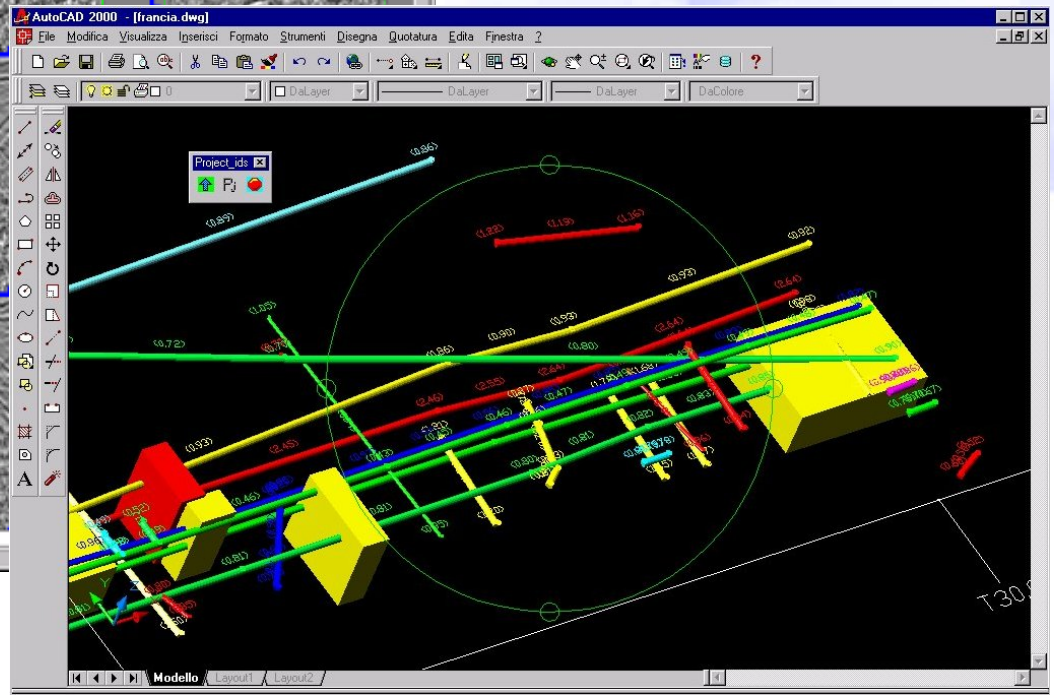


GPR FINAL OUTPUT



Multi-channel data visualisation

3D CAD map



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Main limitations of current GPRs

- A previous research (the GIGA project) carried out a careful technical analysis of limitations of this technology
  - penetration depth is limited when the soil is highly conductive (e.g. wet clay)
  - In these soils, detecting any small (less than 20mm), non-metallic objects beyond a depth of 0.5 metres is extremely difficult
- Without further research and development, this technology will remain of limited use

The ORFEUS project

- Collaborative research project with financial support from the EC

- Started on 2006, Nov. the 1st ending on 2009, Oct. the 31st
- 9 organizations, 5M€ investement (50% from the EC)

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Orfeus objectives

- Provide a step change in the depth penetration and spatial resolution of GPR
- Design a prototype innovative GPR-based real-time obstacle detection system for Horizontal Directional Drilling
- To increase knowledge of the electrical behaviour of the ground
- Dissemination
  - Strong user input (requirement and evaluation phases)
  - Periodic user meetings (2 per year) to evaluate major achievements
  - Pan-European-field trial programme

Advanced downward-looking GPR

- High performance, cost effective, ultra-wide band Stepped Frequency Continuous Wave (SFCW) source and receiver
- Adaptivity of the radar sensor to the variations in ground characteristics
- Innovative ultra wide-band antenna design (to closely match the requirements of target detection)

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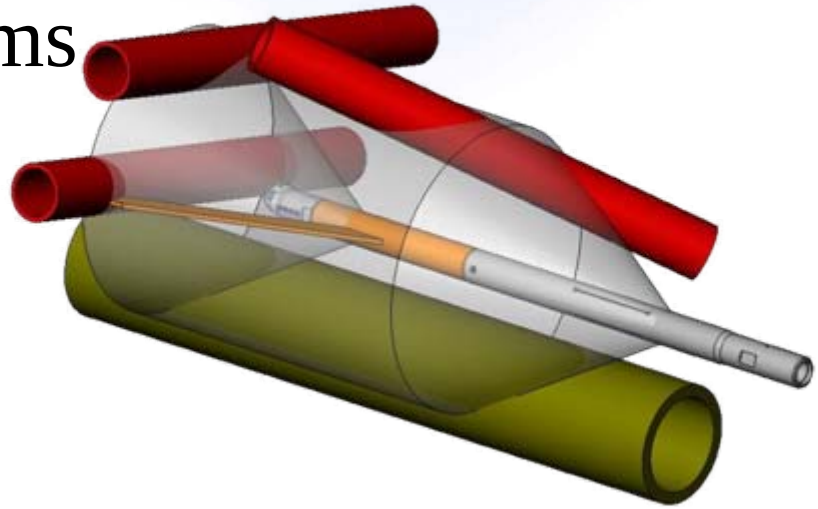
The borehead GPR

- Provide durable antennas and "look-ahead" and "look-sideways" capabilities
- Design ruggedised microwave sources and receivers
- Develop new concepts for signal and data processing algorithms



Ground measurements

- ORFEUS will develop methods for reliable in-situ measurements of soil characteristics relevant to GPR
- These measurements will also be used as an input for the other research activities to provide essential information on the fundamental limits of GPR detection
- It will lead to the necessary knowledge for developing and building a GPR applicability map of Europe.

Summary

- ORFEUS project addresses the requirement to improve the technology used to locate utilities' buried infrastructure
- This will be achieved by implementing a radical change in the fundamental technology used in GPR systems
- A successful project outcome will
  - enhance the safety and efficiency of Utilities' maintenance and replacement activities with consequent environmental and economic benefits
  - reduce the disruption, noise and congestion caused by unnecessary street work activity

Information resources

- www.orfeus-project.eu
- Periodic User workshops
- Join the Mailing list

Acknowledgment

The ORFEUS project is partly supported by the European Commission‘s 6th Framework Program for Community Research ("Thematic Priority" area of sustainable development, global change and ecosystems), managed by Directorate General for Research under the contract n° FP6-2005-Global-4-036856 and would not have been possible without the support of the Commission