



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

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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)
- The cause of many accidents during excavations is a lack of knowledge of the subsoil conditions
- 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





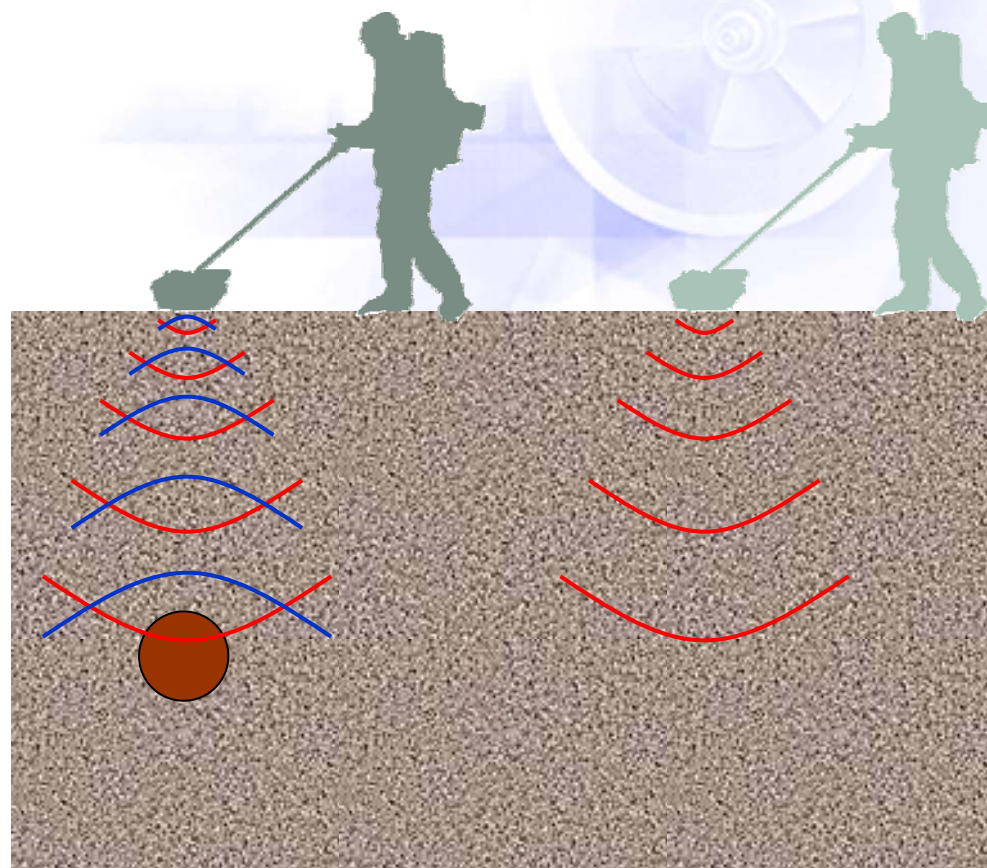
Current location methods

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



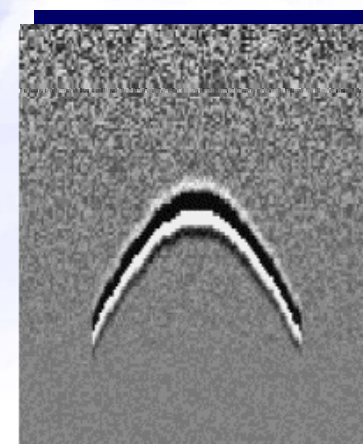
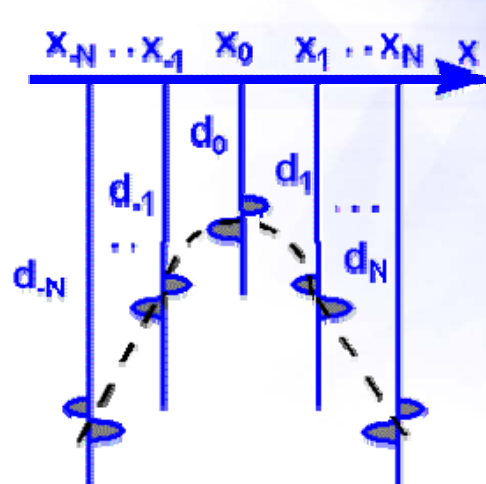
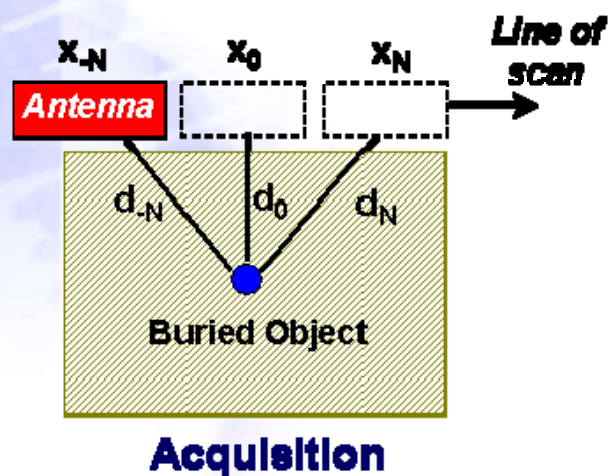
GROUND PENETRATING RADAR

- ✓ 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.



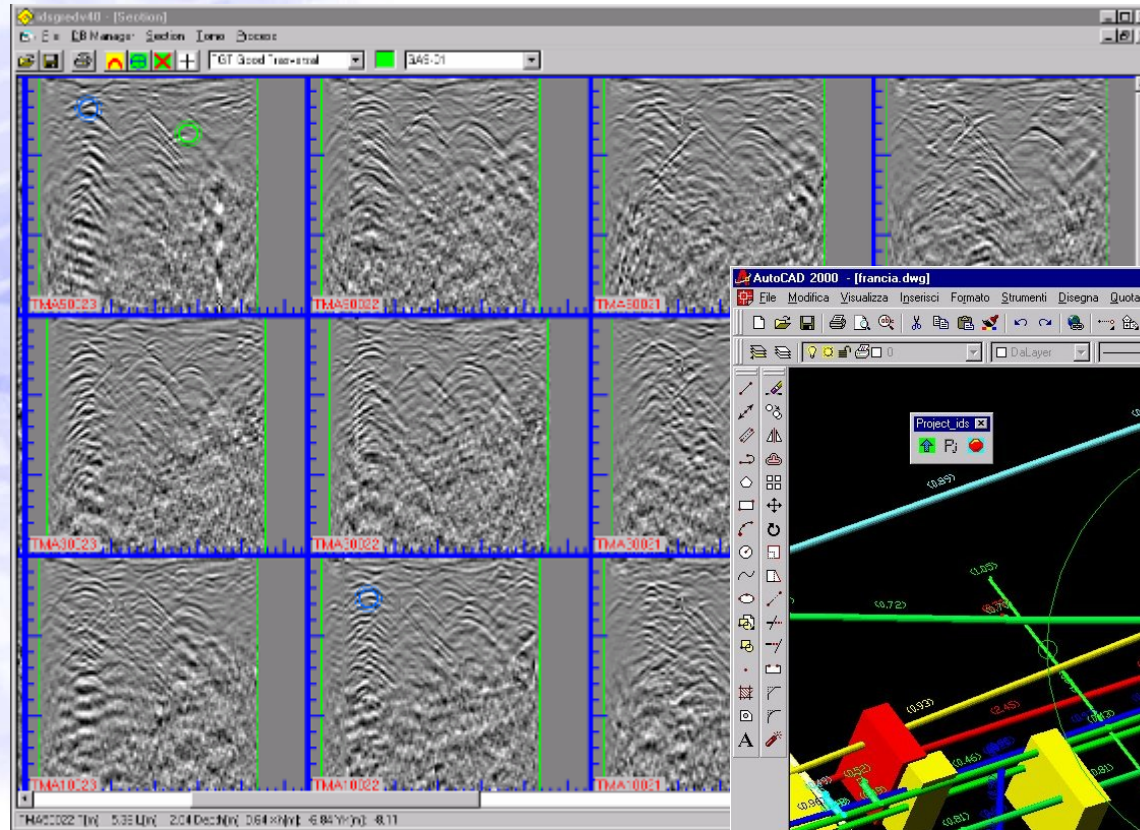
TYPICAL GPR DATA SET

The round-trip transit time of the pulse emitted by the GPR and its reflection provide range information on the target

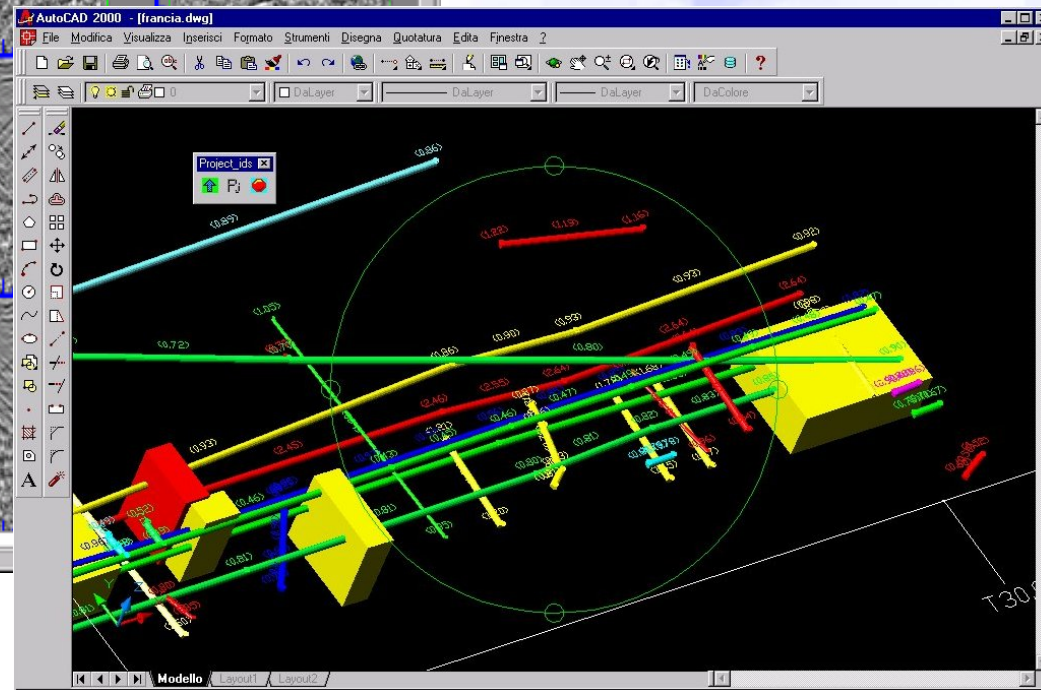


Radar map

GPR FINAL OUTPUT



*Multi-channel data
visualisation*



3D CAD map



Main limitations of 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

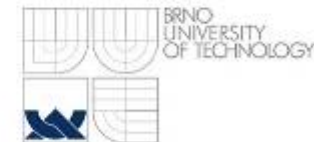


The ORFEUS project: main facts

- Collaborative research project with financial support from the EC



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



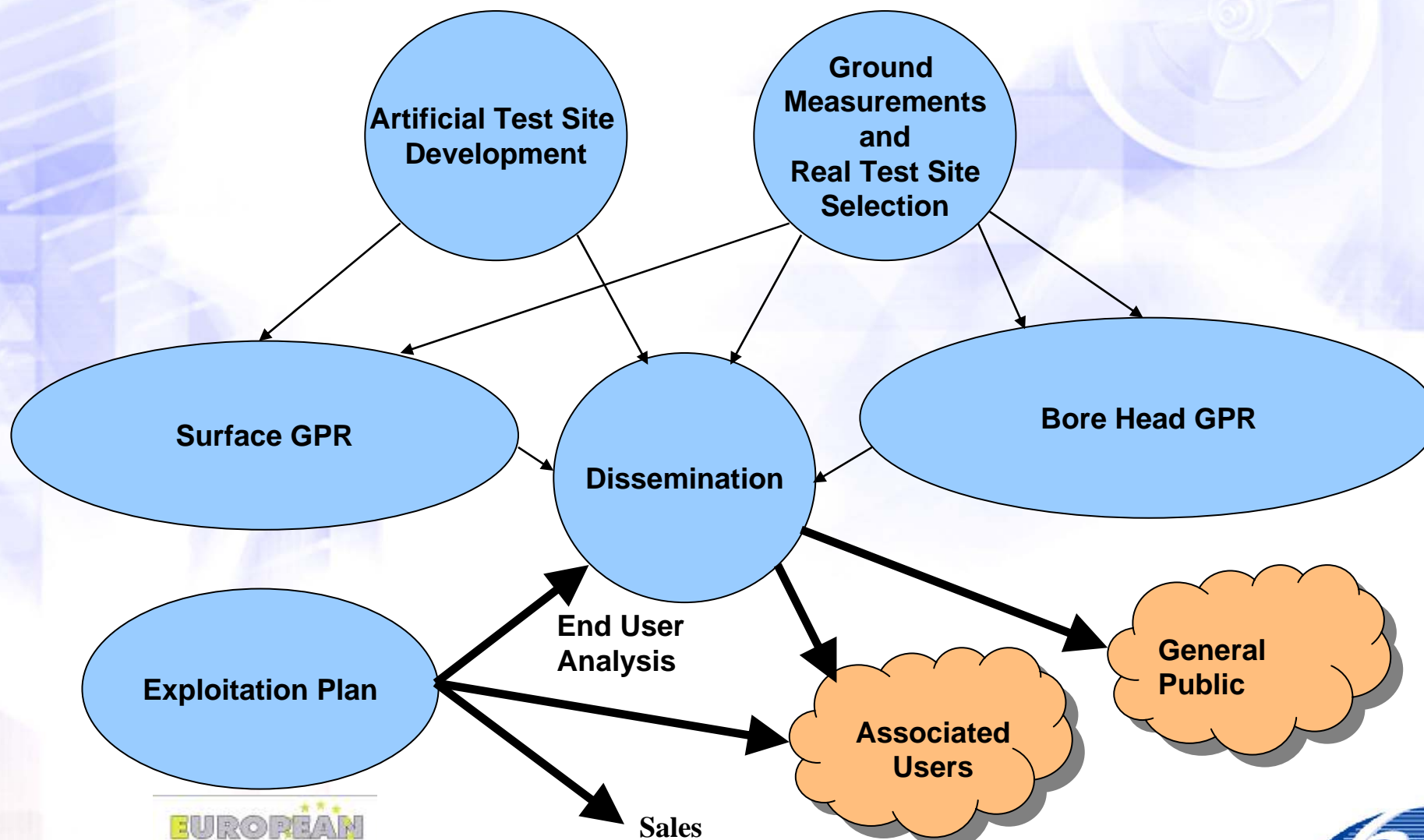


Orfeus main objectives

- 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



ORFEUS Major Work packages





A different approach to the research

- ORFEUS will have failed in its objectives if it is not adopted by the target end-users, no matter how successful the project is technically
 - Strong user input for the requirement and evaluation phases of the work
 - Periodic user meetings (2 per year) and update sessions to evaluate major achievements of the project
 - Pan-European-field trial programme (wide range of test sites where to evaluate the new equipment against present day state-of-the-art equipment)

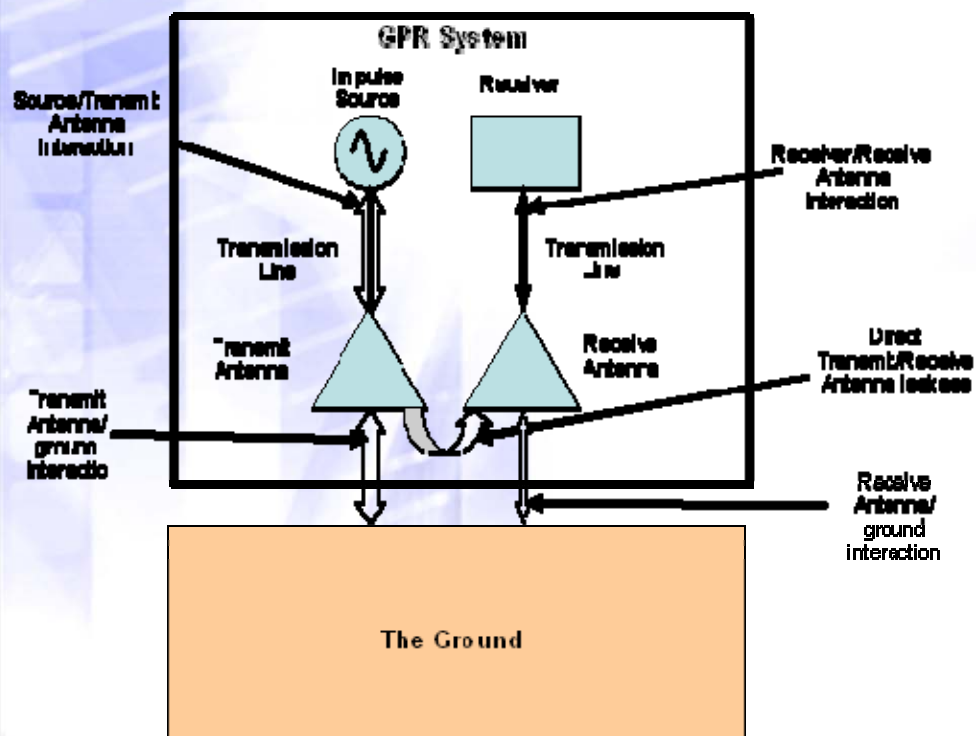


Advanced downward-looking GPR

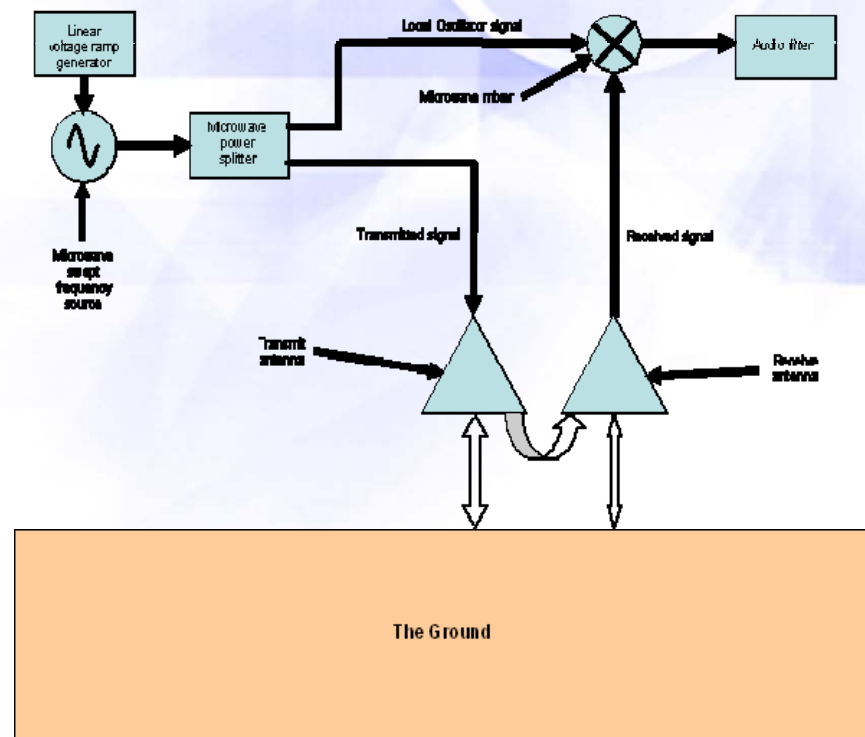
- High performance, cost effective, ultra-wide band Stepped Frequency Continuous Wave (SFCW) source and receiver
- Adaptivity of the radar sensor to the variations in ground characteristics
- Innovative ultra wide-band antenna design (to closely match the requirements of target detection)



Impulsive vs. CW GPR



Impulsive GPR

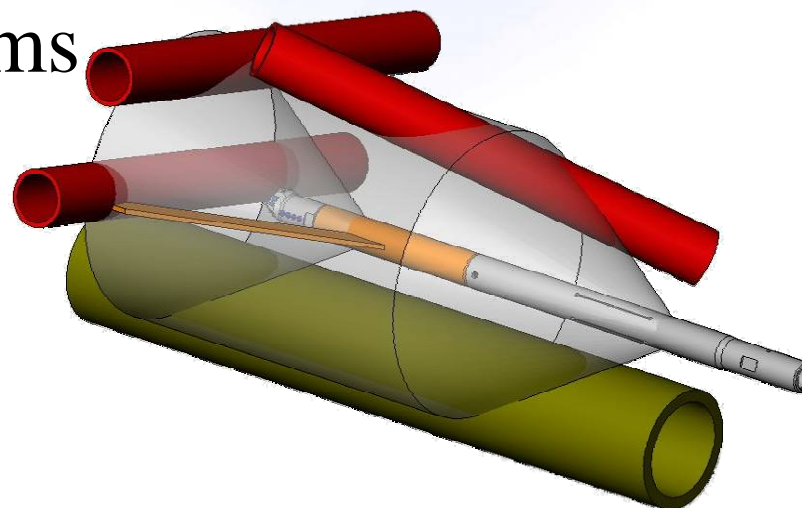


CW GPR



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



Progress update (31/8/2007)

- End user requirements completed
- Systems specification in progress
- System design & development started



Learning more...

- 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