ORFEUS User Group meeting
Pisa/Florence
Wednesday November 26th 2008

Hotel Academia Palace – Pisa

REPORT

Purpose of meeting – Project Dissemination and User Involvement

This was a workshop and meeting orientated towards the GPR user community designed to involve users beyond the main project team – It was intended to appeal to users who need to be updated on issues of detailed performance of the new GPR being developed within ORFEUS and who have in an interest in the technology. It was also be a meeting for end users who wish to be involved in the ORFEUS test programme and who have offered test sites. It gave those users attending a direct input in to the extended test programme and planning of practical on-site GPR tests. In addition, the workshop continued to address the issues of accuracy in a session run by Andrew Thomas of Mapping the Underworld (MTU) who's notes form part of this report.

Programme

Tracto Technik and IDS described the project progress in the development of the bore-head radar and the downward looking radar. Information on this progress forms part of the ORFEUS mid-term report, so is not reproduced here. The workshop then addressed a programme of live user field-tests in 2009, and then issues of accuracy and of operator training (Quality of inspection) which was raised by the users as an industry problem affecting data quality.

- Project plan and progress - Howard Scott, OSYS technology
- Downward radar development – Guido Manacorda, IDS
- Bore head radar development – Hajo Bayer, Tracto Tecknik
- User based test site selection – Martin Morey, OSYS technology
- Test scope/plans and Result evaluation process plans- All
- Accuracy issues – This will pick up on issues raised with Jo Parker (Vista) and Andrew Thomas (MTU) at the Birmingham user workshop and consider how we judge results.

Delegates were asked to consider potential available live test sites available to them, and to bring outline maps/photographs and any relevant data and consider how they might establish ground truth for any site.

User test programme

The following were proposed/discussed as possible external test sites in addition to the internal site at GDFSuez:

1. **Newcastle Brewery redevelopment site. Newcastle upon Tyne UK**
2. **Dublin City Council – Highways. Dublin Ireland**
3. **Liverpool University campus. Liverpool UK**
4. Frankfurt University
5. **Strutgart (village outside town) –proposed by TT**
6. Barcelona (NWL/Suez)*
7. **Kingsnorth Power Station UK (Mott Mc Donald)**
8. **City of London (Subtechnics)**
9. EIGG test site in Leicester UK
10. MTU test site in Birmingham

Martin Morey – OSYS technology limited

11. **Sardinia TST offering sites with high Basalt content**
12. Sophie Gerrads - various sites in France surveyed already by her firm*

Those highlighted in bold text were considered the first runners. Those with a * were also to be followed up. The MTU, Frankfurt university and EIGG sites provide more artificial sites if needed.

Following discussion of the various sites it was agreed that each of them would be classified in to whether they were sites with complex underground history (old sites such as city centre) or new sites, with a simple history of development. First generation sites and 3rd generation sites.

The geology was to be classified, as was any known difficulty of access, the expected attenuation issues and a range of other factors. These would be developed using a spread sheet drafted by the Consortium, which will be used to select the order of sites and assess if they would be suitable for trenchless radar tests, or just surface radar.

The three GPR sub contractors present offered, where possible, to be a 'local host' at the trials assisting in identification of sites, and some logistics support.

A spreadsheet (draft attached as part of this report) will be circulated to those present and the consortium by January 2009, as the programme indicates that a programme of tests, of the surface radar could start in March 2009.

Accuracy of results

Accuracy of results and integration of test data to users GIS, and the issue of retention of raw GPR data were discussed. Andrew Thomas of MTU has summarised the issues below.

The discussion session programmed into the latter half of the workshop considered the issues associated with integrating ORFEUS GPR data into geographical information system (GIS) software. After a brief initial presentation by Andrew Thomas (Mapping the Underworld, University of Birmingham, United Kingdom) delegates were invited to discuss relevant issues and identify the most important ones for consideration by policy makers and academic researchers.

Of greatest concern to those present were the combined issues of standards and training. It was noted that, in the United States, standards for sub-surface utility location published by the American Society of Civil Engineers provide guidance on geophysical utility location, but no such standard exists in Europe. For this reason, it was also suggested that this prevents a 'level playing field' existing for survey companies, as the resulting lack of effective client specification may cause significant variation in works proposals when competitive pricing is sought. For client organisations, this may cause risks associated with not obtaining the level of utility location expected, and the resulting loss of confidence in geophysical techniques for survey companies. It may also result in loss of contracts due to being undercut in quotations by organisations pricing for work that may be considered below best practice by the GPR community.

This led also to the proposal that survey operatives and organisations need to have an appropriate level of training in geophysical utility location, if best practice is to be ensured and clients are to obtain adequate location data quality using GPR. It was also noted that, in contrast to other aspects of the utility location industry, survey operatives are not required to be accredited to an appropriate standard for the work they are required to undertake, and that no organisation has been tasked with such accreditation. Indeed, the potential for reduced confidence in the efficacy of the improved ORFEUS GPR, if used by persons with limited understanding of utility location incorporating geophysical devices, was also noted.

It should also be noted that the issue of training is not specific to survey operatives, but should also include clients involved in devising specifications for utility location contracts. Such persons may have limited understanding of best practice in the geophysical utility location sector, which includes significant ground-related factors that may vary significantly on a site-by-site basis. They may also, therefore, lack the skills and knowledge required to assess tendered data in terms of cost, risk and value.

Therefore, it was considered important that modern standards and specifications be developed for utility location surveys involving geophysical techniques, covering particularly GPR as the dominant geophysical method used. It was also considered important that the issue of training be considered in parallel, with a potential need for different levels of accreditation for different quality levels in surveying (e.g. basic GPR use, data interpretation, integrated use of GPR with non-geophysical techniques, etc).

Martin Morey – OSYS technology limited

Other issues were also discussed, and these may be of relevance also to the production of standards. These issues are detailed below, but with no as yet determined order of importance:

1) Storage of GPR survey data involves very large files, especially if raw data is to be stored. Therefore, the data cannot be kept by Survey companies ad-infinitum. It was considered pragmatic to provide data archiving for a period between three and six years. The archive format (e.g. Paper, cad files, raw data, etc.) currently varies between organisations.

2) Any utility location data, whether or not using GPR, may become obsolete very quickly. For instance, utility maintenance, installation, or decommissioning may occur, or redevelopment of the site may be undertaken. This may impact on the usefulness of archived data, and the question of who is responsible for its accuracy, for instance.

3) There are currently no standardised formats for the digital exchange of GPR survey data. However, at present it was considered that most data is provided in a limited number of ways: for example dxf, seg, and vrml formats. Therefore, it was considered possible that developing a standardised approach will be more important than developing new datafile formats.

4) Clients currently generally only require utility survey data in a cad format, which is inherently an interpretation of raw geophysical data. It was noted that this may be due to limited knowledge of raw survey data and its interpretation, which may limit clients' understanding of what quality of location is possible with current GPR techniques.

5) Most clients are currently interested only in cad data, possibly in 3D but often simply as plan data for inclusion in scheme drawings. However, there is a trend toward more sophisticated use of 3D visualisation in engineering, such as fly-throughs, which may need to be considered in future presentation of GPR data.

6) The issue of the size of survey data required to be archived led to discussion of possible use of data-compression techniques. It was considered that this is a more complex subject than it may at first appear, due to the lack of a compression technique proven to prevent the loss of important survey features. For instance, fractal compression techniques allow significant reduction in the size of files on computers, but can also give the impression of fine detail that was not present in the raw data. It was considered important to exercise caution if GPR data files are to be compressed.

7) It was considered important that GIS systems allow the confidence associated with the location of individual utilities to be adequately represented. Such confidence variability may be due, for instance, to operator training/accreditation level, whether physical truthing (e.g. manhole cover lifting, excavation, etc.) was employed, and even the cost-to-risk ratio accepted by the client.

8) It was noted that issues may exist with the integration of GPR outputs into existing utility location data. For instance, there are issues of integrating relative (i.e. old records using positions relative to features possibly now removed) and absolute (i.e. locations recorded using satellite positioning) data. This may also affect GPR data interpretation, as it may be difficult to determine with certainty whether a feature identified in raw data is associated with information shown on historical records.

It was concluded that the issues identified in Pisa, as outlined above, be presented to the next ORFEUS workshop for continued discussion, and identification of means to address the issues in future.

Workshop conclusions

- There is a general issue relating to retention of historic raw GPR data which needs debate outside ORFEUS
- There is a significant issue with training and quality in the GPR field made worse by the appearance of low cost commercial GPR systems and un-trained operators. This issue needs to be taken outside/beyond ORFEUS in due course.
- There is now a good range of test sites on offer.
- There is a spreadsheet/table of possible ORFEUS test sites. All concerned need to review this sheet to allow the project manager to confirm a test programme
- There remains considerable scope for cooperation between ORFEUS and MTU on data issues.
- Most user sites will be tested with the surface radar. There will only be a limited number of sites suitable for trenchless inspection.

A further programme of dissemination activities will be announced alter as part of the main project team activities.

See table of proposed test sites.