Strategic City Wide Mapping of Underground Assets using Ground Penetrating Radar

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TOPICS

• GPR background and current utility locating practices
• Array systems
• Network level capture of above/below ground assets
• One possible framework for co-operation
Contrasting EM properties show as features and these can be mapped

### WHY GPR technology?

- GPR positions underground objects located in a complex geometry.
- GPR can detect all material types and is a **MUST** method in urban environments.
- GPR optimizes excavations and reduces costs and risk.
- GPR complements surface inspection and provides an accurate image of the subsurface.
Current Situation

- Ground is our friend and our enemy
- DBYD - free service linking asset owner to customer.
- Information “as planned” not “as built”
- Variable quality and accuracy of information
- Information lost (MOS), areas surveyed multiple times at considerable cost.
- No National standard (SUE) until June 2013 so no national online database.

SUE (Subsurface Utility Engineering)

- June 2013 - SUI (Subsurface Utility Information) Australian standard derived from US SUE standard AS 5488-2013
- Combines geophysics, surveying and civil engineering to provide accurate identification and mapping of underground assets (A,B,C,D)
- Uses radio detection, GPR,
- vac excavation, trenchless and GPS/TS
- Reduce utility damage /delays,
- improve safety,
- protect environment
We need to think differently

- **Array radar systems can map areas quickly** and allow 3D visualization
- **Allow locators access** to central database of GPR surveys to improve accuracy and speed of locating
- Use locating companies that follow **Aust. SUI standard**
- **Verified deliverables uploaded to central database**
- **Improve accuracy of DBYD service**
- **Trenchless technology** reduce cost of digging hole.

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**SPECIALIZED SOLUTIONS FOR UTILITIES APPLICATION**

- **Real Time Detection**
- **Detection and Mapping**
- Product for extensive utilities mapping

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XXV International Federation of Surveyors Congress, Kuala Lumpur, Malaysia, 16 – 21 June 2014
DETECTOR DUO

UTILITIES DETECTION

- Application: Detection only for smaller projects
- Process: Real time detection
  Physical marking out the assets on the ground
  Verifying with vacuum excavation

30/06/2014

RIS MF Hi-Mod

The only end-to-end “industrial” solution for accurate utility mapping

- 4 dual frequency antennas (200 MHz and 600 MHz)
- 2 m wide Antenna Array for 3D mapping
- Modular design
- High productivity
- CAD/GIS rendering
STREAM-EM: Network level utility mapping

- GPR solution towed by a vehicle (speed > 15 Km/h).
- High productivity
- Avoid blocking the road traffic
- Exploit the same advanced processing feature of RIS MF Hi-Mod

Specifically designed to provide the best possible coverage whilst respecting Nyquist principles by not oversampling the EM waves.

STREAM-EM: modularity and array architectures

- 4 dual frequency 200-600 MHz antennas (DCL array) for the detection of shallow and deep junctions (HH polarization)
- MF Hi-Mod: the DCL array can be extracted from the Stream-EM to be used in the MF Hi-Mod configuration for mapping sidewalks and areas with difficult accessibility.
- 1x200 MHz DML array for detecting main pipes along the road (6 cm transversal sampling; VV polarization)
- Stream X: the DML array can be extracted from the Stream-EM to be used in the Stream-X configuration for archeology or environment surveys.
- Modular composition: easily reassembled
STREAM-EM: Work Flow

1. Data acquisition
2. Data processing (office)
3. Export to CAD/GIS

GRED HD 3D CAD Post processing software

The GRED HD software comes with:

- 3D graphic interface,
- Tomography (time slices),
- Radargrams
- 3D view
- Accurate GPR data positioning (through RTK GPS, total station)
GREDA HD 3D CAD processing software: target insertion
*(e.g. manhole cover)*

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March 2013, England
Stream-EM for network level utility mapping

Coordinated Capture of Above/Below Ground Assets

- 3D Point Cloud for above ground
- GPR for below ground
- Advantages and benefits
  - Seamless integration
  - Capture multiple datasets in one run
  - Easier to relate above/below ground assets and therefore easier to map services
  - Video
One possible framework for co-operation in Australia

- Shared and verified utility information for the benefit of users
- GPR, LIDAR, EMI, vac-ex, survey, DBYD put in central database
- Govt. and asset owners verify data using preferred SUI qualified contractor
- **Asset owners and Govt. are shareholders of centre**
- Centre releases information for a fee bundled into all new construction/excavation permits issued.

**Feedback**

On sell information as part of all new excavation permits

Idea using similar style to idea of UtilityINFO Limited by King Wong and seen in a paper by Spencer Li (Li, 2010)
One possible framework for co-operation in Australia

- Requires:
  - clearly defined standards methods and procedures
  - strong support of the utility survey industry and asset owners
  - verification by accredited utility locators
  - Needs accredited training
  - Effective administration
  - High quality assurance

Hurdles and Challenges to Overcome

- Ensure locating companies follow Australian SUI standards
- Structure, administration, regulation and information consistency
- Liability, commercial sensitivity, ownership, national security
- Cooperation and funding

There are many.....but it can be done!