



Innovation in Surveying Technology

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CURRENT TECHNOLOGIES

- GNSS Positioning
- Aerial Remote Sensing
- Mobile Mapping
- Ground Penetrating Radar
- Static Laser Scanning
- 3D BIM Modelling



Surveying: some of it is rocket science!

- GNSS positioning
- GPS, Glonass, Galileo, BeiDou
- Accuracies
 - Satnav and mobile phones; single frequency; <10m
 - Geodetic instruments; dual frequency; 1m
 - Network RTK; continually operating reference station (CORS); dual frequency; <25mm
 - Static geodetic post processed; 1mm

Grid Coordinate Systems

- GNSS provides WGS84/ ETRS89 coordinates
- Ordnance Survey uses National Grid and Ordnance Datum
- Ordnance Survey transformations OSTN15 and OSGM15 to convert to National Grid from ETRS89
- Ordnance Survey mapping is being updated to this new standard.

Remote Sensing

- Satellite mapping
- Google Earth
- Aerial mapping LIDAR
- Drone survey (UAV, SUA): photography and LIDAR



Aibotix V6 X2


- System Overview



- Max payload 2 Kg
- Climb rate 8 m/s
- Max ground speed 40 Km/h
- Flight time 20 min

Aibotix V6 X2

- Cameras



The image shows an orange Aibotix V6 X2 drone on the left. To its right, four camera options are listed vertically, each with a small image of the camera and a label: RGB Camera, Thermal Camera, Multispectral Camera, and Hyperspectral Camera. A red arrow points from the drone towards the camera options.

Aibotix V6 X2

- Mapping Applications



The image displays three 3D models of mapped areas. One is a simple rectangular block, another is a more complex structure with multiple levels, and the third is a circular area with a winding path or road.

Aibotix V6 X2

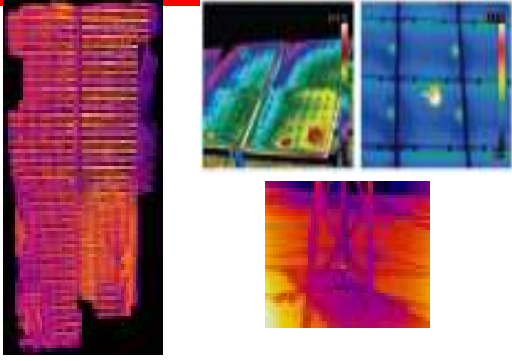
- Inspection Applications



The image shows four small rectangular images arranged in a 2x2 grid, illustrating inspection applications. The top-left image shows a red structure, the top-right shows a green field, the bottom-left shows a concrete structure, and the bottom-right shows a close-up of a concrete surface.

Aibotix V6 X2

- Inspection Applications – Thermal Camera




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Mobile Mapping

- Laser scanning and point cloud production
- Vehicle or backpack mounted
- Positional control by GNSS and inertial navigation systems (INS)
- Mass data collection
- Google Street View



Leica Pegasus: Backpack




- Wearable MM3D
- Reality Capture
- Indoor/Outdoor projects
- Georeferenced Data
- Everything, Everywhere

Pegasus: Backpack

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Leica Pegasus: Backpack

- Award Winning System



Remarks

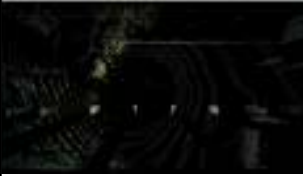
- **Multiple Award winning system**
- Winner **Microsoft Indoor Navigation**
- **History Channel** presence
- **BBC Channel** presence
- **National Geographic** presence






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Leica Pegasus: Backpack

- Absolute Position: **GNSS, INS & SLAM**



GNSS Navigation	INS Navigation	SLAM Navigation
		
Outdoor & Limited Indoor	Position Agnostic	

Simultaneous Localization And Mapping

A method of measuring the environment and determining a location in environment at the same time

- SLAM allows us to measure an arbitrary environment
 - No spatial context
- Mobile Mapping aims to precisely measure the environment
 - Technology limits where we can go
- Combining these techniques allows us to map arbitrary environments
 - No limits on location
 - Data has full spatial context



Ground Penetrating Radar (GPR)

- Variation in radar return indicates presence of changes in density.
- Radargram images show these 'anomalies'.
- Towed GPR array.
- Automated processing maps underground features
- Mapping standard is PAS128.
- Utility mapping has provided a huge decrease in service strikes.

What are the problems?



- **Everything is buried underground**
 - **Vast utility infrastructure**
- Incomplete/Inadequate historical record data
- Complex network of Buried cabling and other assets
- **Inconsistency of surveys & lack of understanding**
 - limitations of technology.
 - Experience/knowledge
- **Utility diversions**
 - H&S risks
- Costly/Time consuming

Would you like to dig here?



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How is a PAS128 Utility Survey Undertaken



Desktop Utility Record Search
Survey Type D

Site Reconnaissance
Survey Type C

Detection
Survey Type B

Verification
Survey Type A

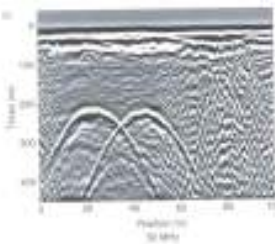


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Field Instrumentation and Software

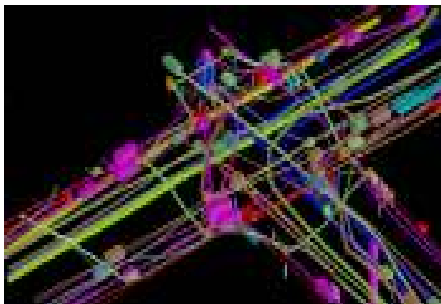


What do we see?



- Radar return shows differences in density
 - Ground conditions or structure appear as banding
 - Anomalies appear as peaks on the radargram
- Data is analysed by skilled operator or post processed in specialist software packages
- It is not possible to identify what features are: this is done by correlation with features measured on the ground

What data does the client receive ?



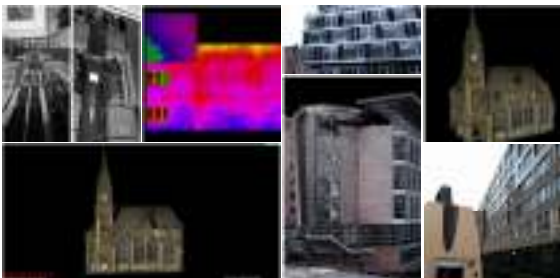
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Static Laser Scanning

- Mass data collection to create point cloud data:
1 million points per second
- Control provides accurate 'registration' of scans
- Increasing automation of data processing to create unified point cloud models
- Scans can be enhanced by photography to provide RGB data







3D modelling for BIM

- Data provided to different levels of detail (LOD):
- LOD1: outline massing model
- LOD 2: Shell and core model: structure and openings
- LOD 3: Standard survey model: basic architectural details, major services and simple fixed fittings
- LOD 4: Detailed survey: detailed architectural and structural elements shown





