



The Location and Positioning of Buried Pipes and Cables in Built Up Areas

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- Problem
 - Massive network of buried services, 4million km
 - Need to know asset location for planning and maintenance
 - Many databases, varying accuracy and provenance
 - ~4M street openings p/a
 - Direct costs of £1B p/a
 - Indirect costs of £3B p/a
 - Old assets, many laid in Victorian times



- Mapping the Underworld
 - UK EPSRC "Sandpit" project
- VISTA: result of larger UK DTI technology bid
 - ~£900K government funding
 - Leeds ~£629k, Nottingham ~£268k
 - ~£1.4M industrial input



- EPSRC Funded
- £1 million programme
 - Buried asset location, identification and condition assessment, multi sensor
 - Mapping and positioning
 - Knowledge and data integration
 - Enhanced methods of detecting buried assets
- MTU Networks
- Bath, Birmingham, Leeds, Nottingham, Oxford, Sheffield, Southampton



- Stakeholders
 - Severn Trent Water, Thames Water, Transport for London
 - Ordnance Survey, Yorks Water, BT
 - United Utils, Anglian Water, Transco
 - Three Valleys Water
- Contractors and Equipment Manufacturers
 - Leica, Ewan Group, Adien
 - Scott Wilson, Jacobs
- Umbrella organisations and Professional Bodies
 - UKWIR (Lead partner)
 - NJUG, Pipeline Industries Guild, Inst. Civil Engineers
- Universities
 - Leeds, Nottingham
- 21 so far and still growing ...



- Aim: Swift, safe, cost-effective street-works
- Several novel approaches
- Enhances existing approaches
- Integrating systems
- Precise positioning in built up areas



Positioning



- GNSS Based
- Pseudolites
- Locatalites
- INS
- Cellular positioning
- Future GNSS through simulation
- Field trials



Campus Network



- Aim:-** was to define a trial area with different obstruction levels:
- Open area (A)
 - buildings with different streets width (B and C)
 - Tall building (Tower building D)
 - Building and trees street (E)



Network



-Open area (A)



Network



- North-South obstructions (B)



Network



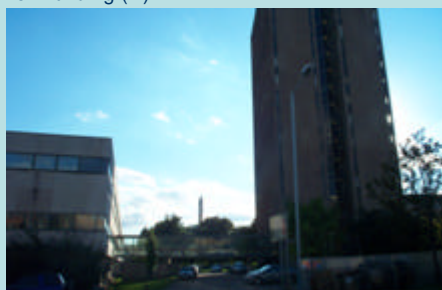
- East-West obstructions (C)



Network



-Tower Building (D)





Network



-Building and trees (E)



Campus Network



Ahmad working in the Digital Level (left) and Jon helping in the staff (right)

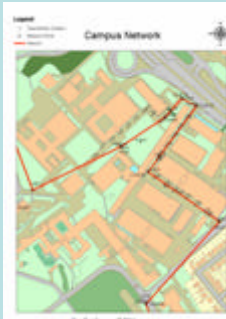


SmartStation



SmartStation Results

"Truth" coordinates - SmartStation coordinates				
PointID	dE (m)	dN (m)	dHt (m)	Method
POP	0.032	0.030	0.003	Measured from ST1
TOWER	0.026	0.047	0.003	Measured from ST2
COATS1	0.018	0.036	0.005	Measured from TOWER
COATS2	-0.051	-0.026	0.023	Measured from COATS3
COATS2	0.005	0.007	-0.004	Occupied
COATS3	0.029	-0.022	0.017	Measured from STOP
STOP	0.010	0.039	0.016	Occupied
PHARM	0.019	0.016	-0.028	Measured from ST10



Campus Network



GPS Data Collection (left) Total Station Data Collection (right)



SmartStation



Leica Geosystems new SmartStation: GPS + Total Station



GPS-INS integration



GPS data processing Results – Combined Solution

Using: Applanix POSGPS software



GPS-INS integration

GPS-INS integration Results

GPS-INS integration

GPS-INS integration Results

*Truth/SmartStation - INS				
PointID	dE	dN	dHt	GPS Availability/Quality
REF2	-0.001	0.008	0.014	Available GPS/Q1
ST1	0.037	-0.006	-0.044	Available GPS/Q2
TOWER	0.067	-0.047	-0.085	Available GPS/Q1
COATS1	-0.029	0.056	-0.043	Available GPS/Q1
COATS2	0.051	-0.022	-0.028	Available GPS/Q1
COATS3	-1.668	0.072	-1.122	Available GPS/Q3
STOP	-0.032	-0.042	-0.036	Available GPS/Q1
T36	-0.816	0.054	-0.662	570 sec. gap before point & 669 sec. after point
T10 (under bridge)	0.036	-0.024	-0.048	168 sec. before point & 171 sec. after point
T4	-0.497	-0.541	-1.098	Available GPS/Q3
Max. error/ PointID	-1.668/ COATS3	-0.541/ T4	-1.1215/ COATS3	Q1- Fixed Integer Q2- Stable Float Q3- Converging Float

GPS-INS integration

GPS/INS integration, Dr Hide (left) and the A Taha (right) during training session

Status

- “Mapping the Underworld”
 - running since mid-2005
 - Workshop 14 Sept
- VISTA
 - Contract arrangements continuing
 - Running since Jan 2006
 - 4-year timeline
 - Most effort intended in first 3 years
 - Dissemination/exploitation continues in 4th year.

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