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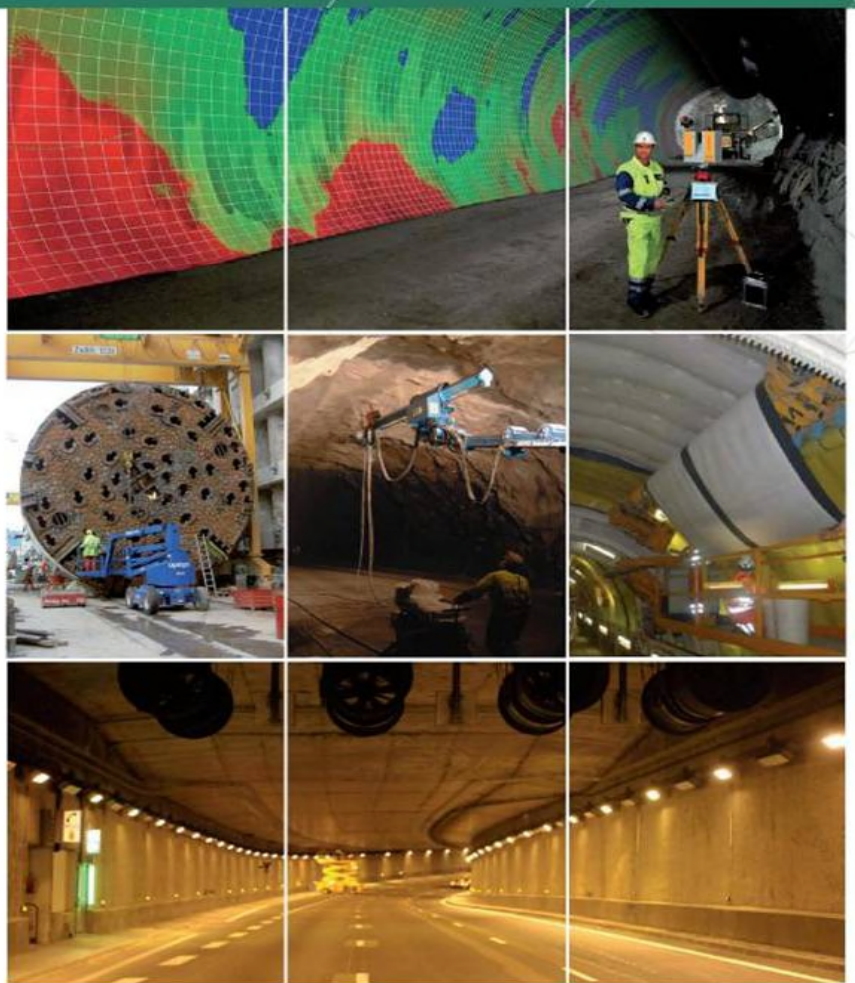
MONITORING



AG Monitoring – Current Members

Currently the following companies are members of the AG ‘Monitoring’

- itmsoil, France
- Soldata, France
- Geodata, Austria
- Amberg Technologies, Switzerland
- Babendererde Engineers, Germany
- Astrium Services, Germany
- Seli s.p.a

Further members are welcome.

AG Monitoring – Potential Topics

Proposal on topics to work on by the members of the AG

- frequency of measurements (urban tunnels, soil) / TBM parameters
- micro seismic monitoring *I*
- robotic total station I
- specification on output data /report format
- probing ahead (TBM / D&B)
- information and communication systems
- remote measurements (air borne measurements / scanning)
- measurements in / on segments (fibres etc)
- defined process for bulding state assessment, instrumentation manner and density

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AG MONIORING – SELECTED TOPICS

Sub AG1: frequency of measurements (urban tunnels, soil) / TBM parameters

- typical specifications for designers

Sub AG 2: Information and communication systems

- plug and play system for all data on a site: basic vision

Sub AG 3: remote measurements (air borne measurements / scanning)

- state of the art, recommendations for application…

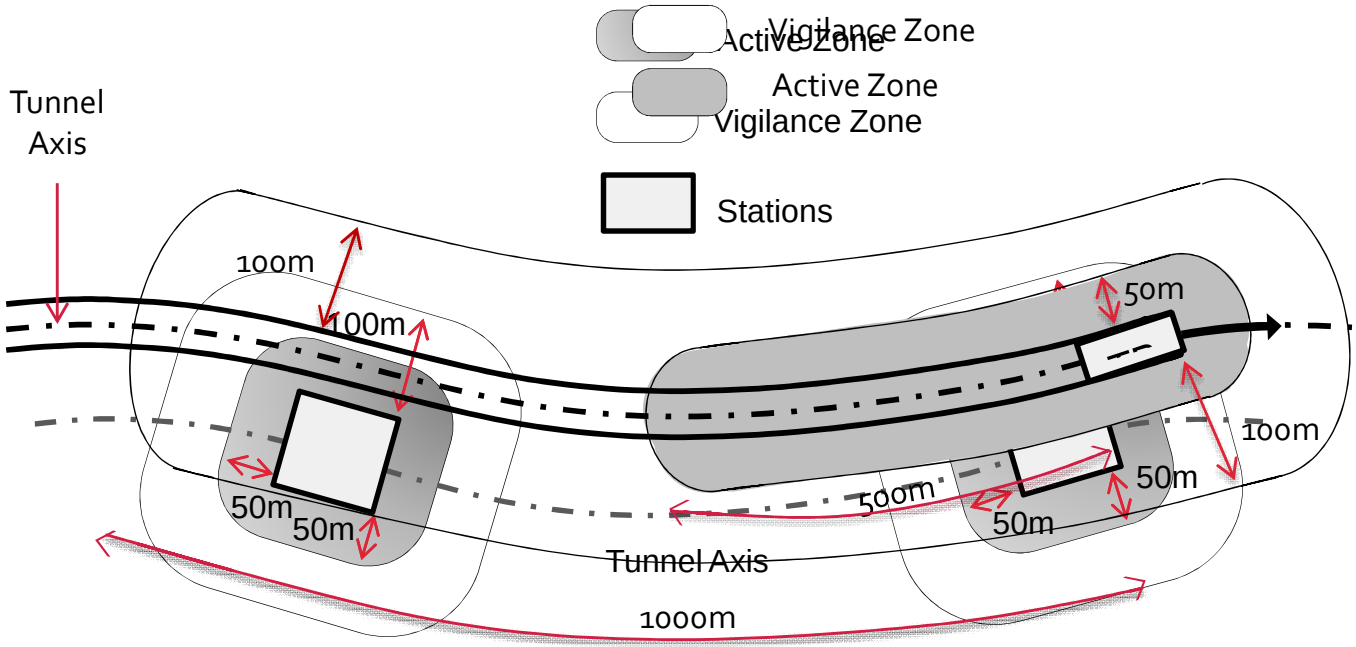
Soil- Structure Interaction – Frequencies of Measurements

- Guideline draft ready, ITA tech internal peer review
  - Dynamic aspects of risks
  - Monitoring frequencies
  - Practical Guideline

Draft Guideline

- Zone of Measurements

STATIONS TUNNEL



Draft Guideline

- Frequencies of Measurements

	Background	Vigilance Zone	Active Zone	Close-out
TUNNEL (TBM)				
Pressures (face, grout, etc.)	NA	NA	1 Measurement /10 ''	NA
Excavated volumes	NA	NA	1 Measurement /10 ''	NA
Injected volumes (Grout, Bentonite loss, etc.)	NA	NA	1 Measurement /10 ''	NA
Forces (contact, push rams, etc.)	NA	NA	1 Measurement /10 ''	NA
Cutting diameter, copy cutter if applicable	NA	NA	1 Measurement /10 ''	NA
TUNNEL (above ground)				
Survey (automatic or manual)	1 Measurement / 1 month	1 Measurement / 4h	1 Measurement /30'	1 Measurement / 1 month
Levelling (Automatic or manual)	1 Measurement / 1 month	1 Measurement/ 4h	1 Measurement / 30'	1 Measurement / 1 month
Air Pressure and temperature	1 Measurement / 1 month	1 Measurement / 4h	1 Measurement / 30'	1 Measurement / 1 month
Tiltmeter on buildings	1 Measurement / 1h	1 Measurement / 15'	1 Measurement / 15'	1 Measurement / 1h
Crackmeter on buildings	1 Measurement / 1h	1 Measurement / 15'	1 Measurement / 15'	1 Measurement / 1h

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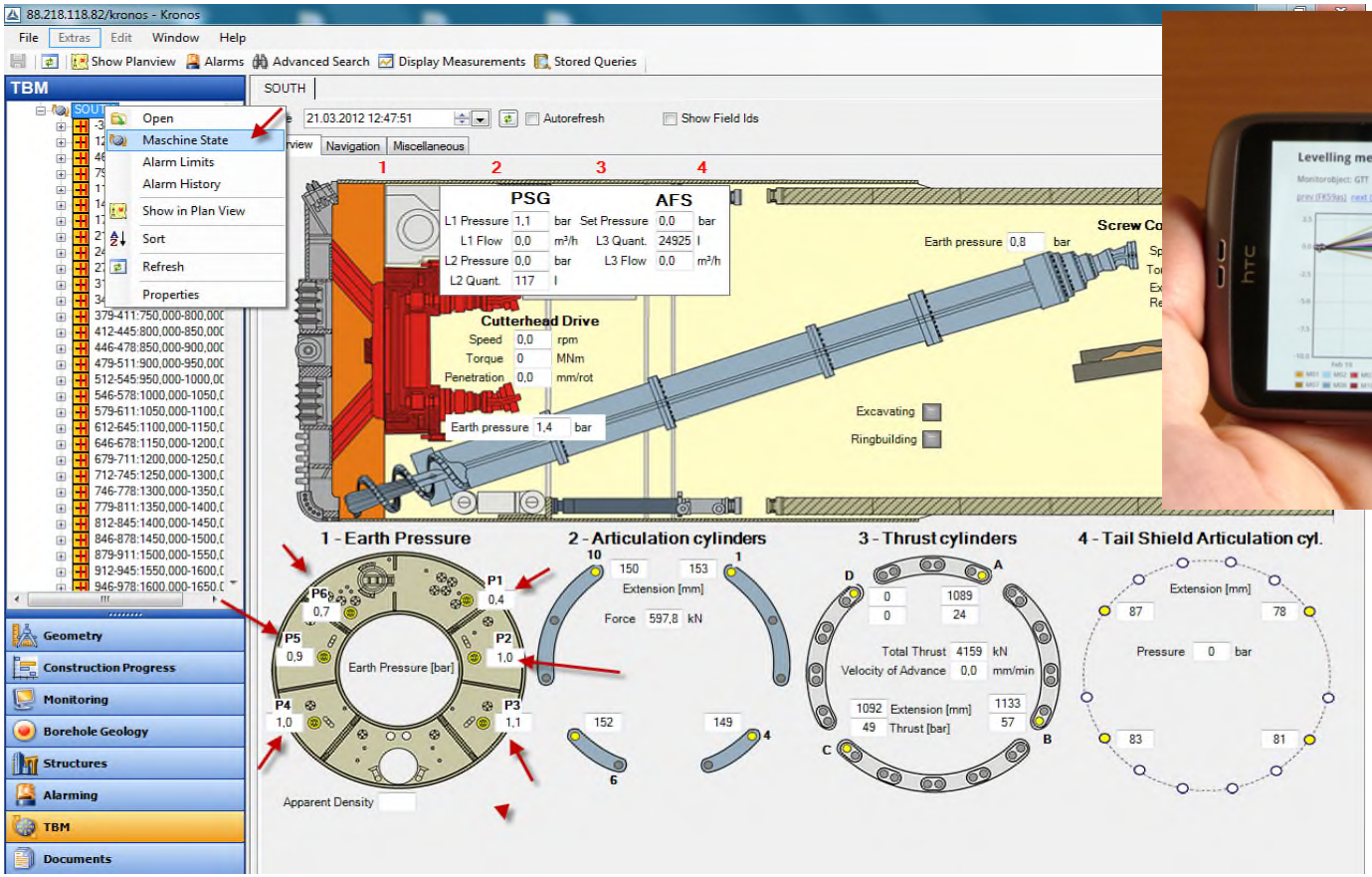
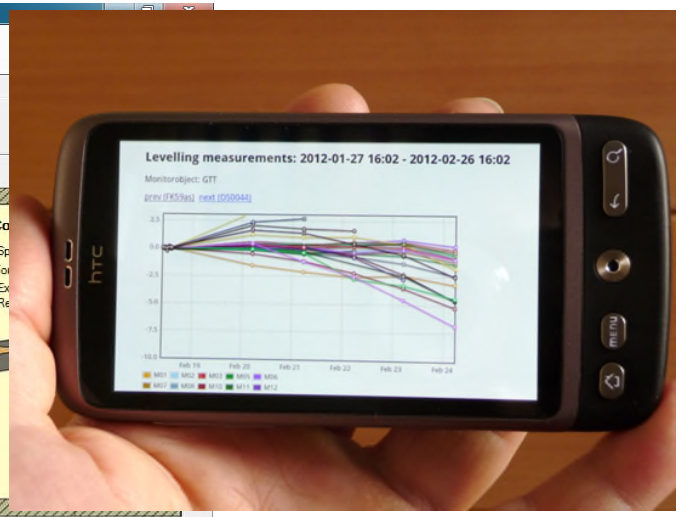
AG MONITORING – SUB GROUP 2





Objectives

- Analyse the current practice of using i- & c- systems in urban tunnel projects
- Analyse the users and their information requirements
- Analyse the data sources (e.g. machines, instruments, persons, materials, etc)
- Analyse processes and flow of data incl. ownership of data
- Identify the involved technologies
- Identify the key lessons learnt from the application
- Identify the needs/tests/research/best practice to allow the beneficial use
- Identify the relevant future/upcoming technologies
- Identify information requirements that are not met in current practice
- Develop a vision how to close the gap

Work done

- Preparation of a first draft report
- Input from other AG members expected

Next Steps

- Elaboration of a second draft report
- Presentation of second draft report at AG-meeting on June 4th, 2013 in Geneva
- Revision of second draft report and preparing a final draft until Oct. 30, 2013
- Final checks and changes
- Delivering a final report ready for review on Dec. 31, 2013

Topics

- Report of ITA WG 2 on Monitoring (2011) is a valuable state of the art report on monitoring during construction infrastructures
- Not covered topics in the reports
  - New innovative technologies which are today already in use
- Topic of the subgroup: Remote Measurements
  - Todays misunderstanding of the benefits of these ‘new’ Technologies
  - Guidelines and project examples
  - Possible combination of the ‘new’ Technologies with traditional methods
  - Guidelines of the possible accuracy of these systems
  - Lesson learnt from todays project

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AG MONITORING – SUB GROUP 3

System	Specifications/discussions	Decision for paper	
InSAR (Interferometric synthetica aperture radar), PSInSAR	▪ Satellite based or terrestrial SAR (Synthetic Aperture Radar)	▪ Analysed in stage one	
Laser Scanning	▪ Complete area based settlement analysis with laser scanner ▪ Laser beams followed by a distance and angle measurements (up to 1Mio. points/sec.)	▪ Analysed in stage one	
Reflectorless Measurements	▪ Low cost laser scanner or total station systems ▪ Measuring cross section or a fix raster without placing any targets on the surface	▪ Analysed in stage one	
Photogrammetry	▪ Close range photogrammetry ▪ Often used in metrology today	▪ Not analysed in phase one	

Optical surface measurements methods	▪ Different technologies available
	  ▪ Bar projection (triangulation)
	  ▪ Multiple point projection
		▪ Not analysed in phase one	

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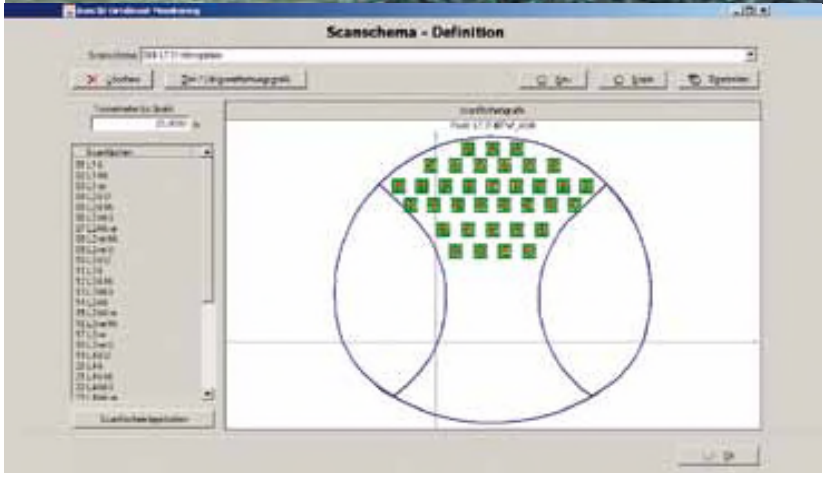
AG MONITORING – SUB GROUP 3

- Reflectorless Measurements
  - A remote monitoring system able to measure surface deformation 24 hours/day
  - Robotic Total station equipped with a reflectorless distance meter
  - Data logger, communication box, processing SW for comp.
- Main advantages
  - Uninterrupted traffic, neither for installation nor for taking readings
  - Very cost effective for high frequency of readings



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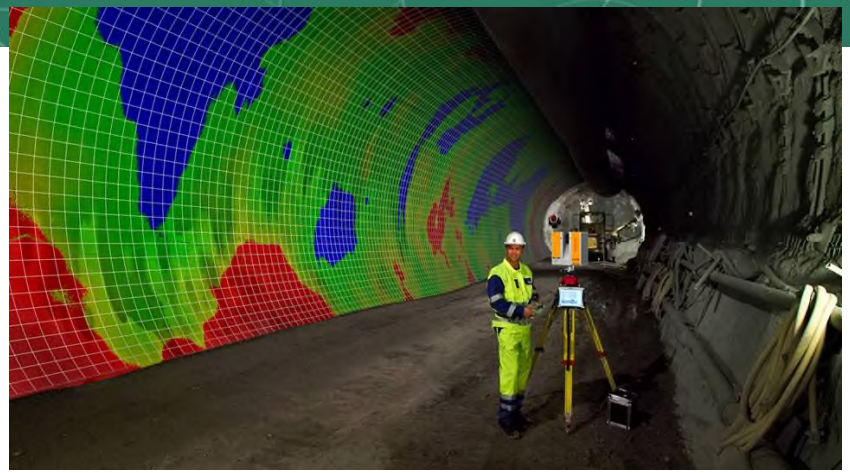
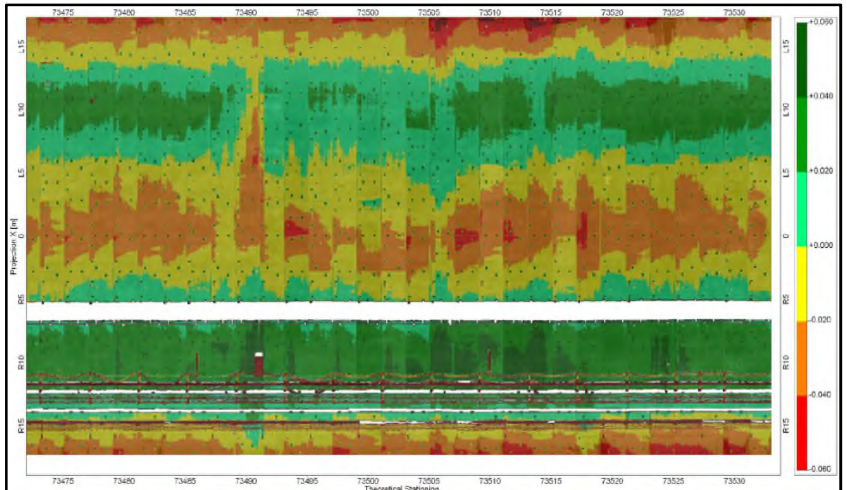
AG MONITORING – SUB GROUP 3

- Laser Scanning
  - Deflection of laser beams (reflectorless measurements)
  - Rotating mirror ends up to 1 Mio points/sec.
  - No installation on the monitored object/area
- Main advantages
  - Complete deformation analysis of the structure
  - Laser scanning technologies gets more affordable
  - Little interruption of the heading process





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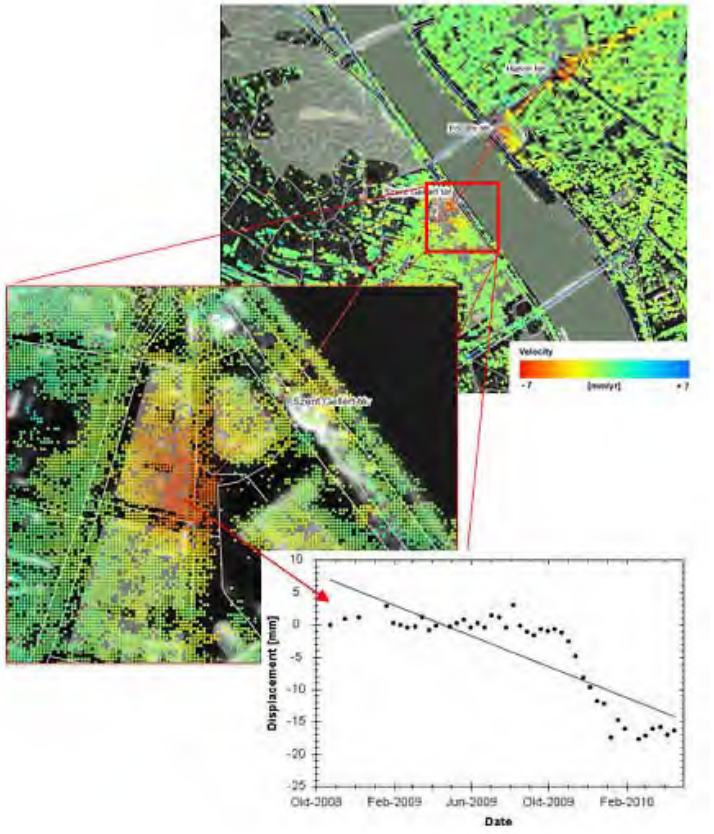
AG MONITORING – SUB GROUP 3

- InSAR
  - Satellite based or terrestrial SAR (Synthetic Aperture Radar)
  - Covers a big area of an underground project
  - Remote Monitoring system which measures in a time frame of weeks
- Main advantages
  - Complete deformation analysis of a bigger perimeter than just the active zone
  - Precision reached in millimetres



Next Steps

- Each task leader works on the chapters
  - Reflectorless mesaurements
  - InSar
  - Laser Scanning
- Review of draft Guideline within Subgropu
- Review of guideline within AG Group
- Peer review by ITAtech AG Design (October 2013)
- Publication of Guideline (4. quarter 2013)