DGNSS Based Multi Sensor Navigator for Railway State Monitoring

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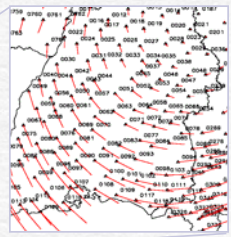
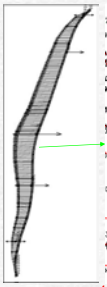
Non homogenous DHDN System ⟺ ETRF 89

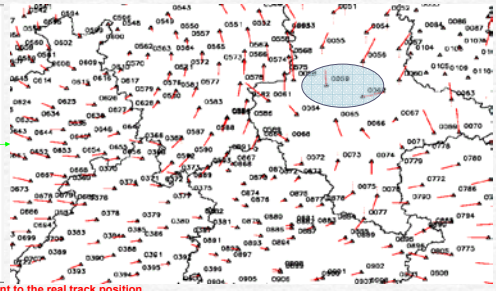
Vector size ~ 0,5 bis ~3 m



Source: B. Lahr DB

Non Homogenous Track Position





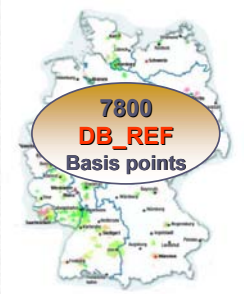
movement to the real track position
Fixed point surveying

Source: B. Lahr DB

Homogenous Reference Frame DB_REF

- different coordinate systems applied nation-wide
- non-homogeneous, inconsistent databases and documentation
- network distortions in former systems
- inadequate for modern surveying techniques
- satellite-based techniques not easily integrated
- no uniform transformation regulations

DB_REF



- **Homogenous**
- **Precise**
- **Covers the whole area**
- **In adjacency to the track**
- **4km raster distance**
- **Repeatable**
- **International**
- **Congruent**
- **In the same datum like the SAPOS CORS Network**

DB Infrastruktur Netz DB

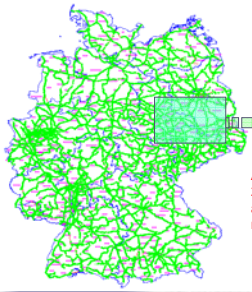
3603 AC 00311

Systeme und Daten Infrastruktur
Regionale Infrastrukturdaten Mitte

Vermarkungsart:	Bolzen	Strecke:	3603	Vermarkung/Vermessung durch	
Punktstatus nach Ril 883:	PS 1	Km:	6,9 + 30	VERMESSUNGSBÜRO RIEMENSCHNEIDER	
Bezugssystem:	ETRF 89	seitliche Lage:	rechts 30,0 m		
Lagesystem	DB_REF				
Höhensystem	DB_REF	Gemarkung/TK25:	Nied/5825	Datum : April 2006 Name : M. Teuber	

Realization ⟺ DB_REF

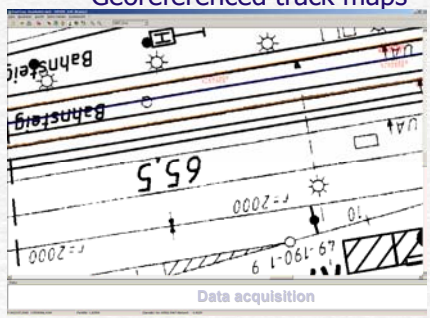
One gauge -> one coordinate system



Geodetic Datum: ETRF 89 / GK / Bessel
~7000 Points / Covers ~98 % of all tracks
density : app. 4 km

Accuracy 3 D
2 Sigma
abs. = +- 10mm
rel. = +- 5mm

Georeferenced track maps



- 2.5 D Systems
- 2D graphics
- Can not be used for automated solutions

Scans of the drawings in Scale 1:1000 TIFF format

Requirements to the Track and construction surveying

- Homogeneous Data in a unique reference system
- High quality
- High density of availability
- Rise the planning quality
- Repeatable
- Cost optimization

Sensors based on the surveying navigator – SurVer generation 1

- Inclinometer
- Extensometer
- GPS receiver
- 1Hz data acquisition

- Plane absolute/relative : ± 4.5 / ±1 mm
- Height absolute/relative :± 4.5 / ±1 mm
- Gauge: ± 0,3 mm
- Cant : ± 0,3 mm
- Scan clearance absolute :± 10 mm

Phase Scanner Sensor

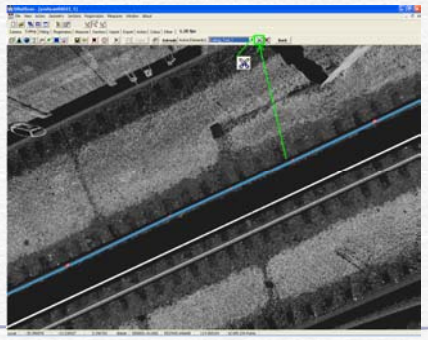
Efficient measuring system for 3D environment data acqui

Scanning Methods

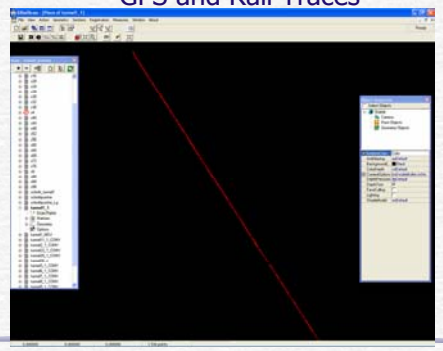
- Static
  - As environment scans from stations placed near to the object of interest
- Stop and Go
  - As environment scans from moving platforms supported by tacheometer scanner positioning
  - Post processing based georeferencing using artificial objects (sphere, cylinder) as benchmarks and identical points
- Kinematic
  - Profile scans from moving Platforms –Rail SurVer in combination with DGPS and enables direct - „real time" georeferencing

Georefernced GPS and Laser trace

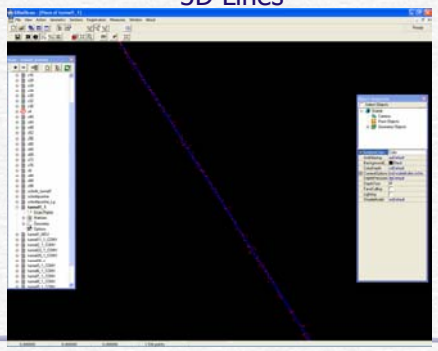
Ortho View



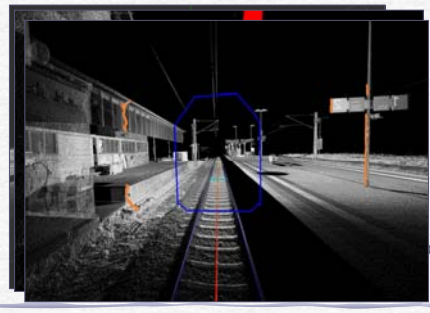
GPS and Rail Traces



3D Lines



Clearance Between the Obstructions and the Structure Gauge of the Train

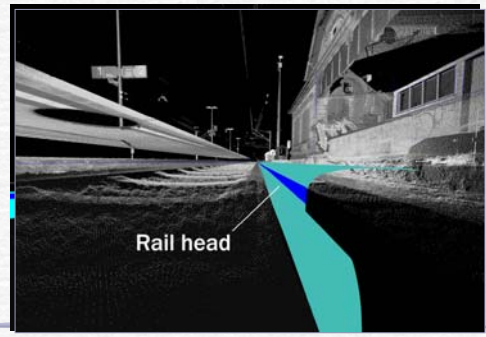


Area of the structure gauge

Critical distances

Lichtraum- und Engstellenvermessung

Fitted Rail



Automated Rail Head Finder for Tunnels

Geodetic Interoperability inside of DB AG

Benefits and Performance of the multi sensor system

- Results presented direct in target system DB_REF
- It is not a „Stop an go“ method – 1.5 m/s
- Direct Measurement without reference point aggregation or “pre measure”
- Basis for track calculations
- Basis for DB-GIS – Spatial Information System
- Verification of the clearance restrictions
- Drive trough dynamics simulations because 3D

Thank you for your attention!