

How to transfer geodetic network orientation through deep vertical shafts – an inertial approach

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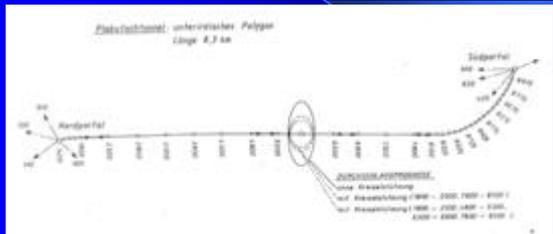
[1]: Chair of Geodesy – TUM

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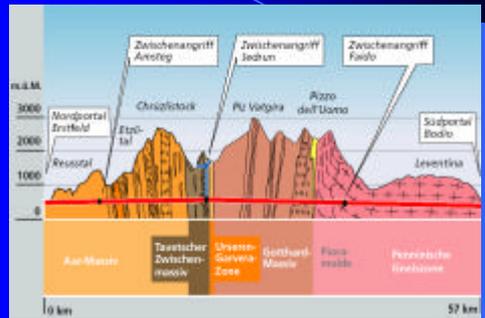
Contents

- the need
- the idea
- the instrument
- the experiment
- the campaign
- the result

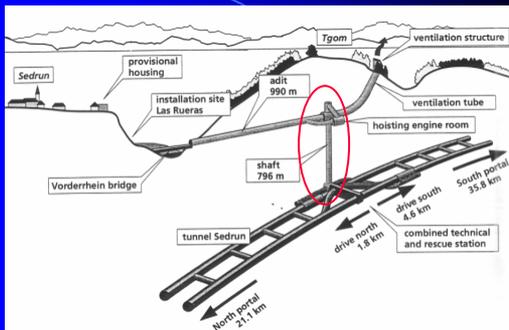
preparing tunnel breakthrough



very long tunnels in short time



intermediate attack – 800 m down



mechanical plumbing



optical plumbing

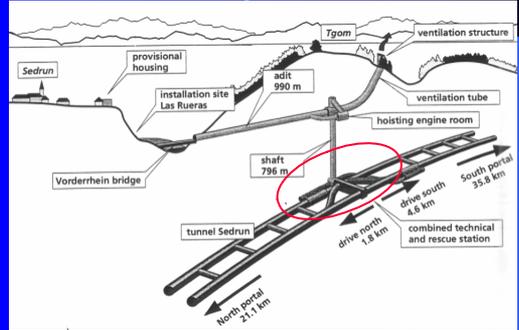


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intermediate attack – orientation ?



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independent control of gyro bearings

we can use world's best gyro technology (by DMT)



but lack of precise knowledge of deflections from the vertical calls for independent confirmation

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inertial azimuth transfer is possible

The Use of Strapdown Technology in Surveying*

By K. P. SCHWARZ, E. H. KNICKMEYER, H. MARTELL, Calgary AVN 1990

that is required is an accurate transfer of an initial reference azimuth from one part of the building to another. Transport times are very short, usually a minute or two, and the accuracy required is 10 arcseconds or better. The azimuth of the SISS can be transferred to another device either mechanically or optically by collimation using a plane mirror attached to the SISS.

K. P. Schwarz & N. El-Sheimy 2001:

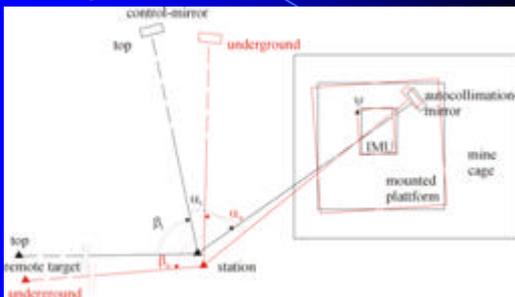
KINGSPAD™
Software Agreement, UTI – Rummel, Wunderlich

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vertical azimuth transfer – gyro orientation control

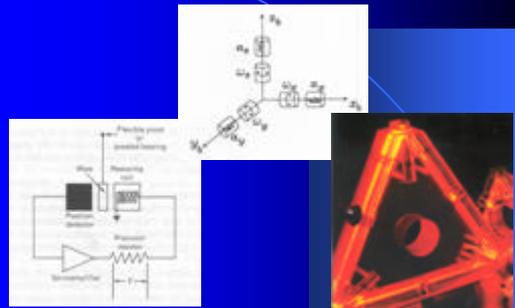


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inertial measurement unit



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imar TUM-IMU (IAPG&GEO)



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errors & mitigation concepts



- Biases
- Drifts
- ZUPTs
- CUPTs
- two faces
- forward and reverse
- short transfer time

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experiment: fast vertical platform motion (elevator)



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test results [gon]

Fahrt	Auffahrt	Abfahrt	Abfahrt korrigiert durch Autokoll.	Mittel Auf- und korr. Abfahrt
1	0,0369	-0,0431	-0,0423	0,0396
2	0,0365	-0,0413	-0,0406	0,0385
3	0,0391	-0,0431	-0,0420	0,0405
4	0,0400	-0,0409	-0,0399	0,0399
5	0,0380	-0,0422	-0,0414	0,0397
6	0,0378	-0,0400	-0,0412	0,0395
Mittelwert	0,0380	-0,0418	-0,0412	0,0396
σ (Einzelwert)	0,0013	0,0013	0,0009	0,0007
σ (Mittelwert)	0,0005	0,0005	0,0004	0,0003

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down and up with 16 m/s



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campaign results & conclusions

- the weighted azimuth mean of the independent campaigns in April 2004 and January 2005 confirmed the gyro results ($\sigma = 2,2$ mgon).
- the weighted azimuth mean's r.m.s. was $\pm 1,5$ mgon!
- the most important preconditions for success are short transfer times (1 min) along forward and reverse tracks.
- The method is not set to replace gyro measurements, but only to deliver an independent control for extreme tunneling scenarios as the vertical intermediate attacks at the present St.Gotthard Base Tunnel and the future Brenner Base Tunnel.

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