

Engineering Geodesy - Definition and Core Competencies

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chair of working group 6.1 FIG**

General remarks

- **The introduction of terms and their common understanding are fundamental in every scientific discipline**
- **Engineering geodesy = surveying engineering**
- **Several definitions of „engineering geodesy“ in the last 40 years**
- **As a reaction to broadened and new areas of application**

Source	Definition
[FIG, 1971]	„Technical measurements, which are necessary in connection with planning, execution, approval and later surveillance of buildings.“*)*
[FIG, 1997]	„Surveying in connection with planning, construction, approval and monitoring of buildings and other objects)“*)*
[Brunner, 2007]	„Engineering geodesy is the production of geodetic information necessary for the planning of technical projects, setting out of the project design, control of the correct construction, and monitoring of deformations.“

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***Engineering geodesy is the discipline of
reality capture,
setting-out and
monitoring
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paying particular attention to
quality assessment,
sensor systems and
reference frames***

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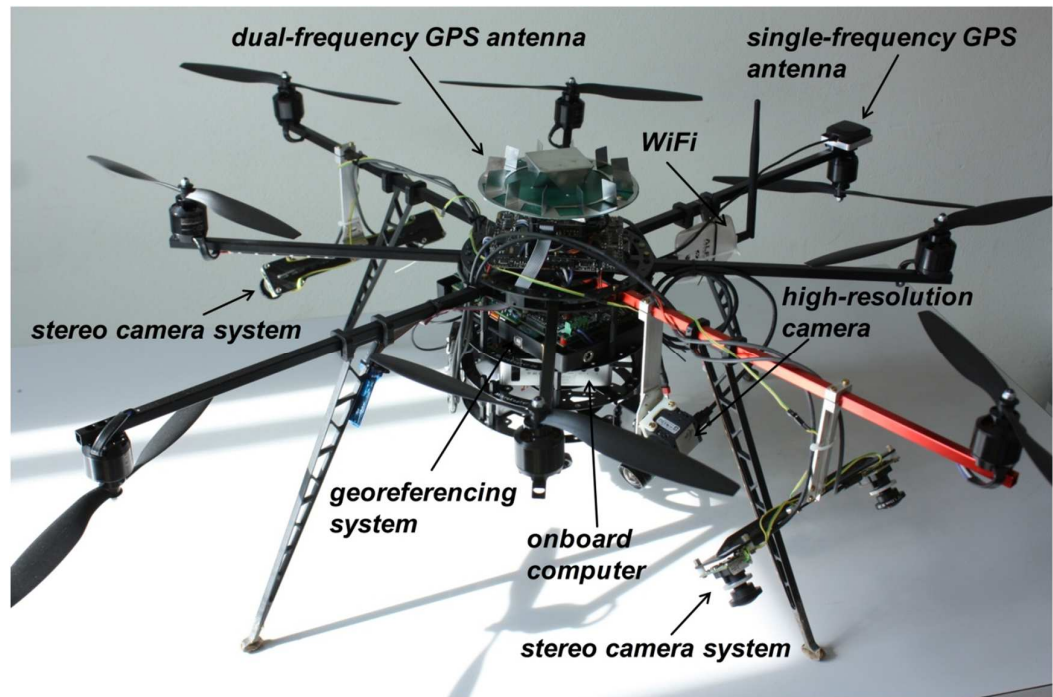
www.topscan.de



www.mobile-mapping.de

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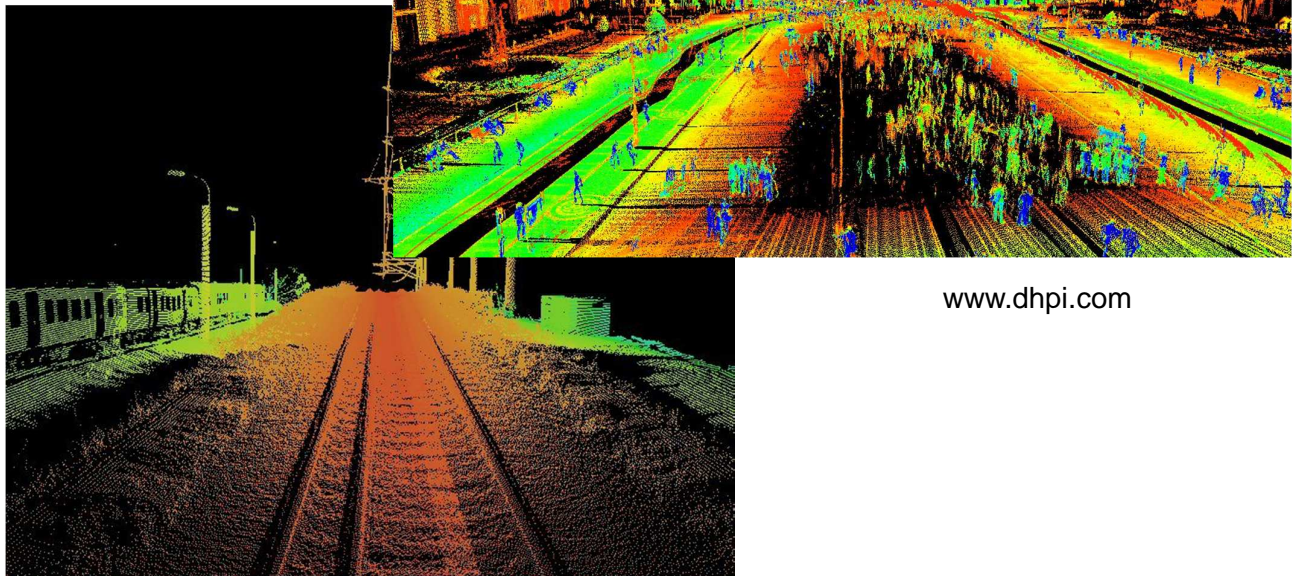
UAV



Klingbeil et al., 2014

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Aus Glaus, 2006; ETH Zürich



www.dhpi.com

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summary

- total station with poles mobile multi-sensor-systems
- terrestrial, air-borne
- fast

- challenge: point cloud -> automatic generation of semantic information

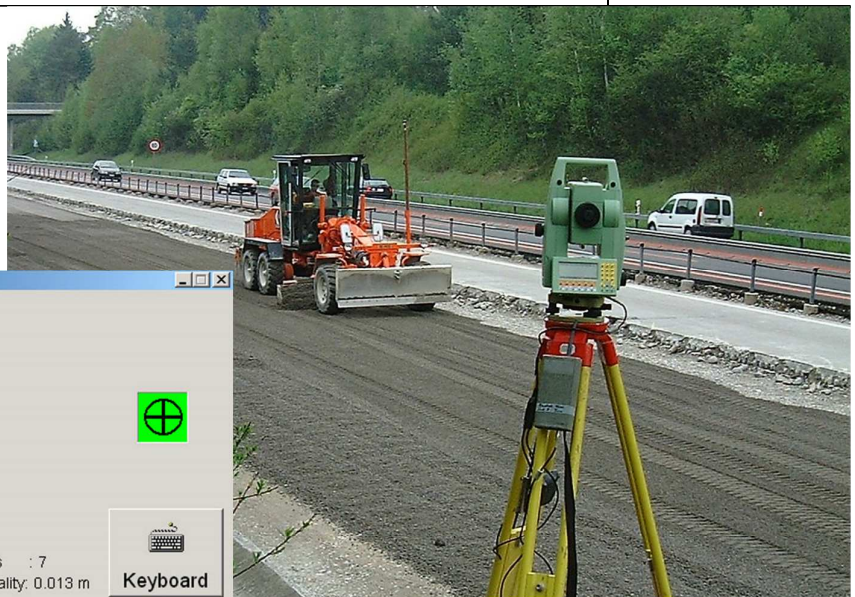
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Different accuracies and reliabilities

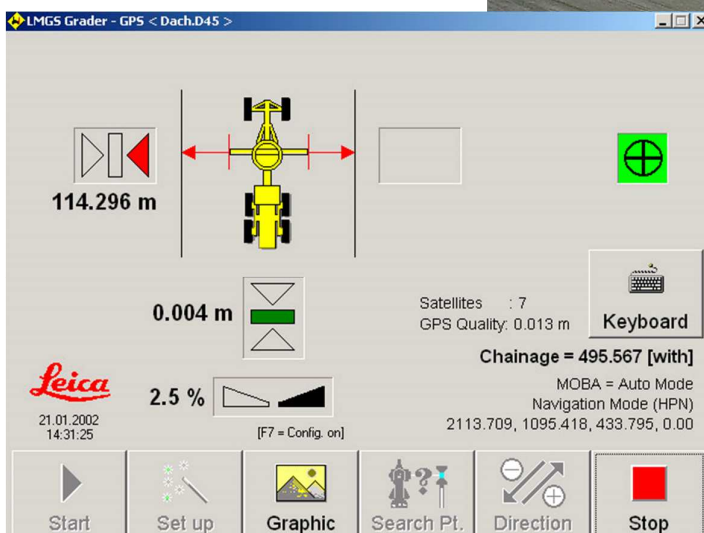
- Marking of the corners of a construction pit
- Marking of a street axis
- Steering of a tunnel machine
- Accelerator alignment
-

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machine guidance



LMGS Grader - GPS < Dach.D45 >



114.296 m

0.004 m

Satellites : 7
GPS Quality: 0.013 m

Keyboard

Chainage = 495.567 [with]
MOBA = Auto Mode
Navigation Mode (HPN)
2113.709, 1095.418, 433.795, 0.00

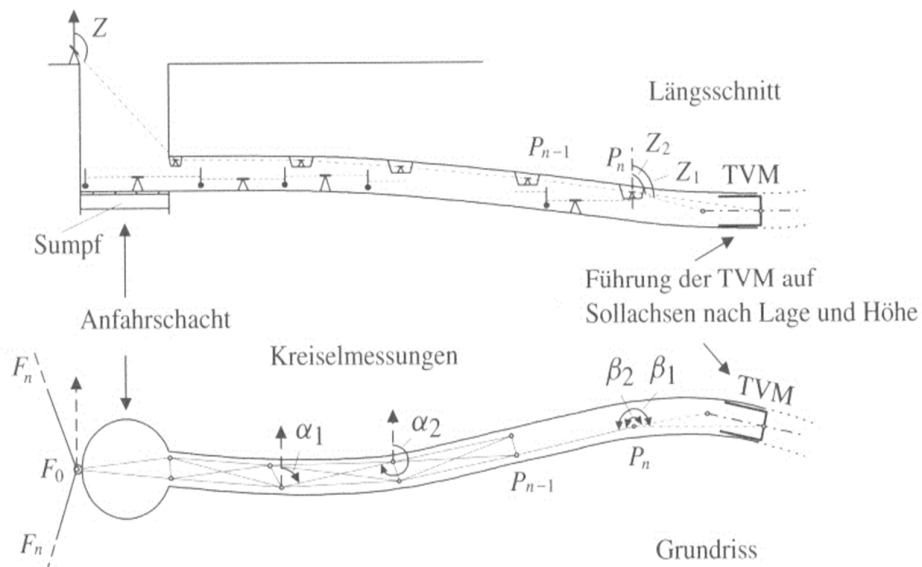
Leica
21.01.2002
14:31:25

[F7 = Config. on]

Start Set up Graphic Search Pt. Direction Stop

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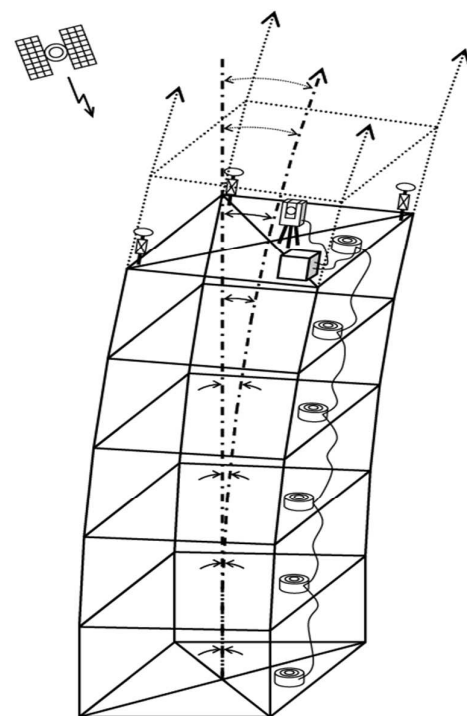
Steering of a tunnel machine



Kahmen, 2006

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Tall buildings



Van Cranenbroek, 2007

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summary

- real-time applications
- errors are expensive

- **Setting out is unique w.r.t. all other geodetic disciplines**

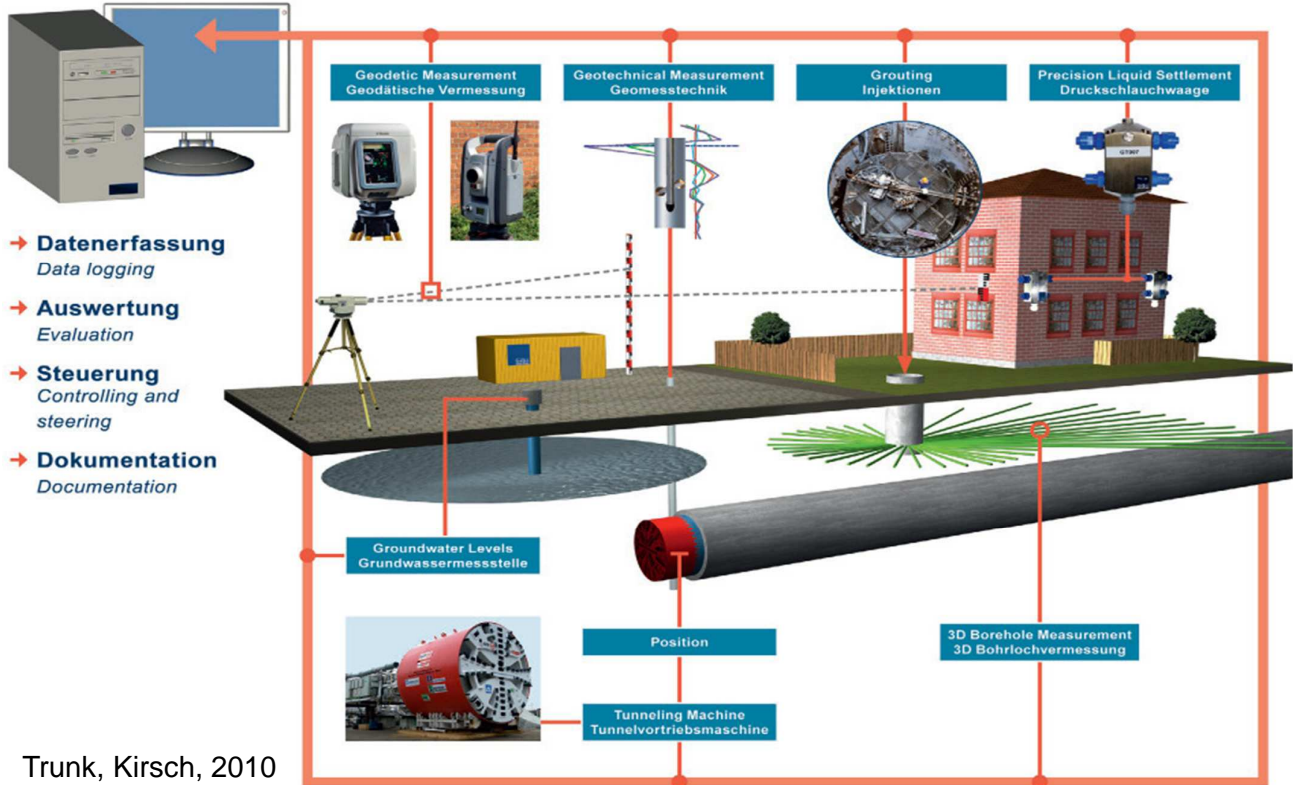
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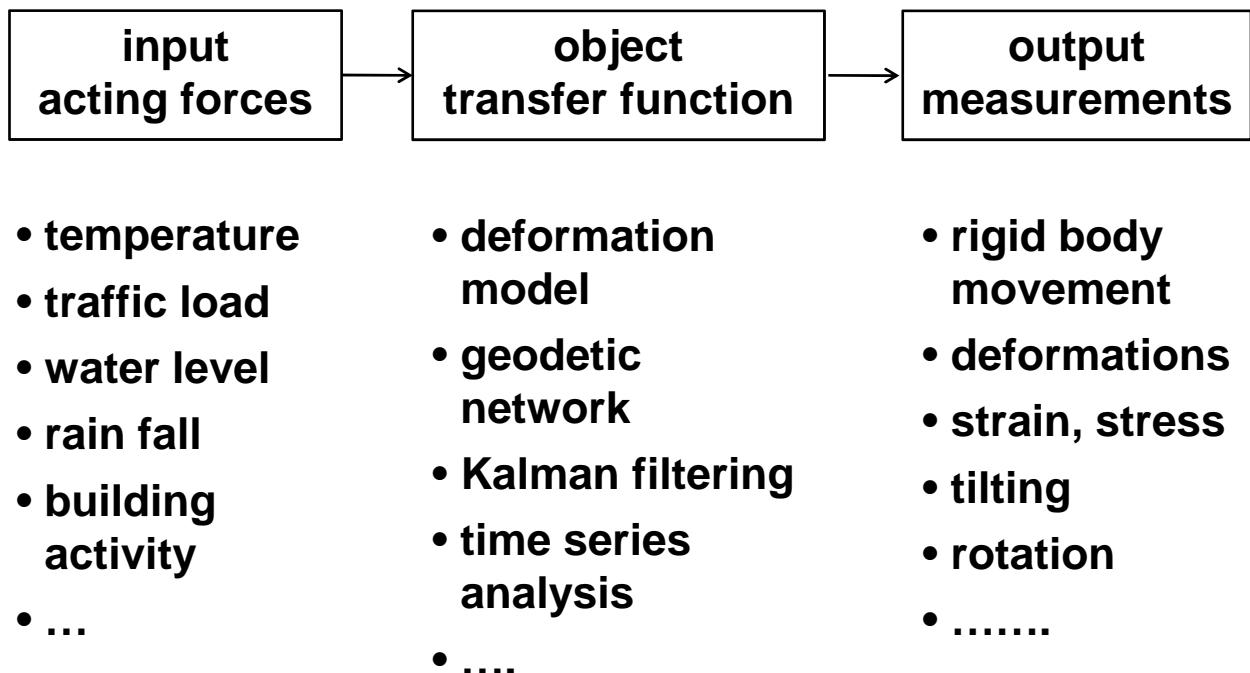
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summary

- Interdisciplinary: civil engineering, mechanical engineering, geo-sciences, ...
- data acquisition, observation
- modelling, understanding, interpretation
- intervention

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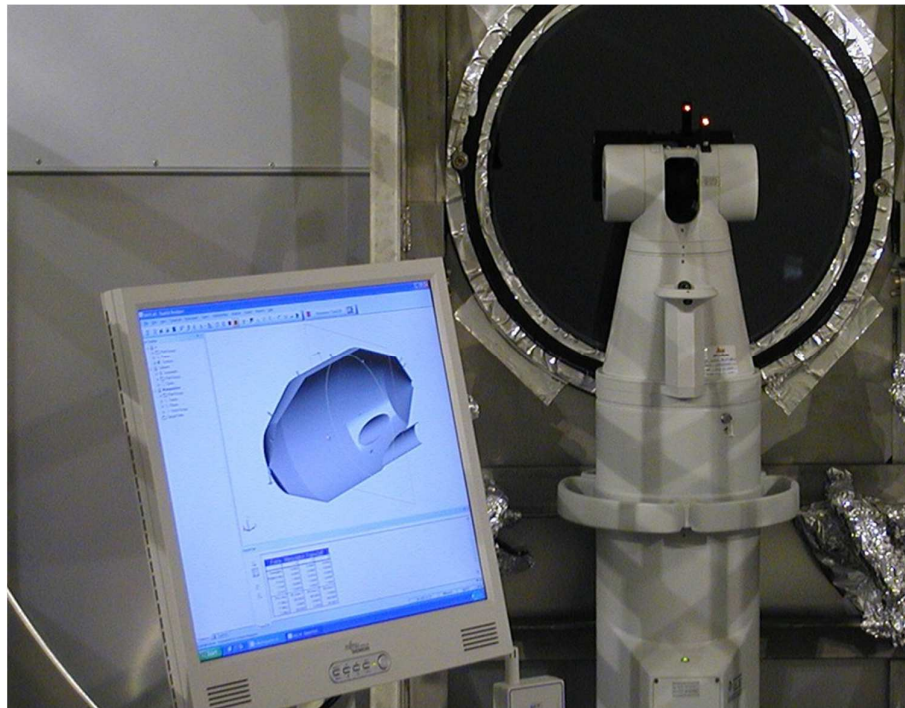
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1...100 cm

**shape
inspection
in
mechanical
engineering**



Juretzko, 2008

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1...100 cm

**Pheno-
typing of
crops**

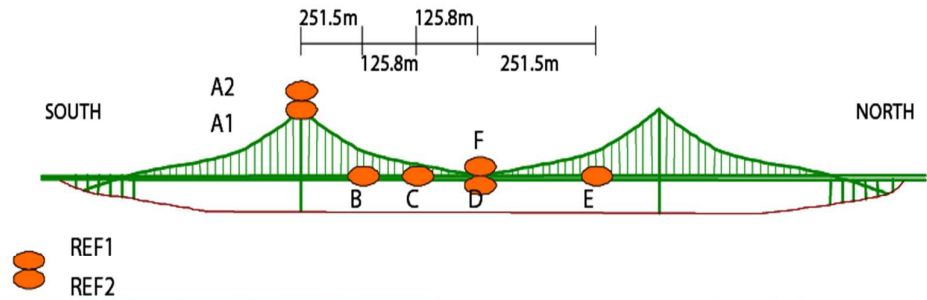


Paulus et al., 2014

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...x00 m

Bridge monitoring

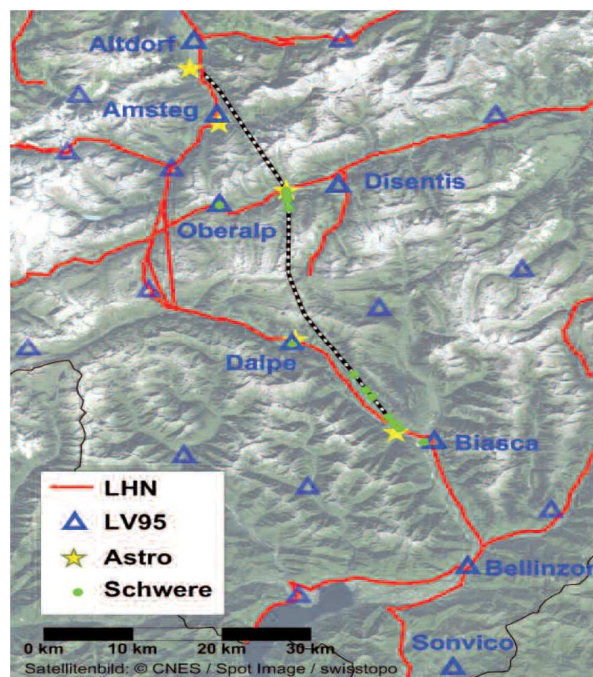


Robertz et al., 2010

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...x0 km

network
Gotthard tunnel

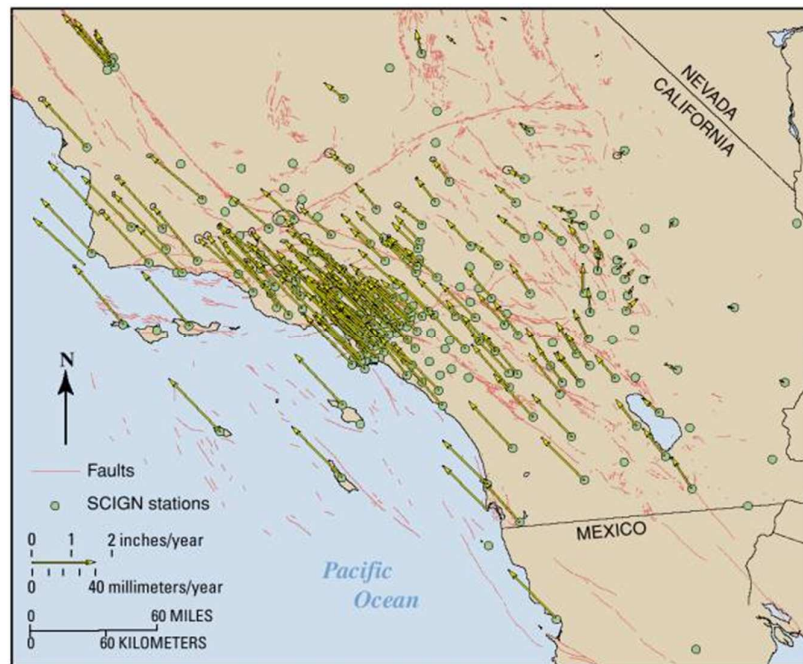


Wiget et al., 2010

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...x00 km

St. Andreas fault



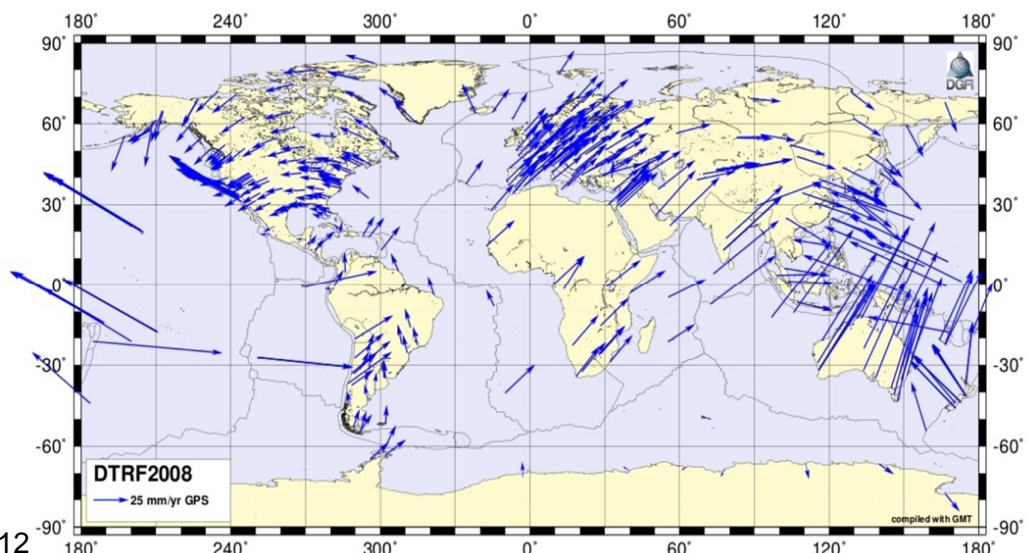
Caltech, 2014

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...x000 km

change of global datum

Connection / borderline to global geodesy



Seitz et al., 2012

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distances

angles

coordinates

straightness

bend

inclination

atmospheric
condition

object
temperature

.....

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accuracy

precision

reliability

sensitivity

seperability

completeness

on time

.....

- from planning of measurements (understanding of sensors, measurement processes, circumstances, ...) to analysis results
- assurance of quality

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Engineering geodesy is a measuring science

tacheometer

GNSS

laserscanner

laser tracker

levelling

plumb line

optical plummet

IMS

camera

inclinometer

extensometer

fibre optic

DInSAR

thermometer

.....

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Engineering geodesy is a measuring science

- Capturing geometric and environmental data
- Physical sensor model
- Stochastic model
- Calibration
- Data transfer
- Temporal and spatial integration of multi-sensors-systems

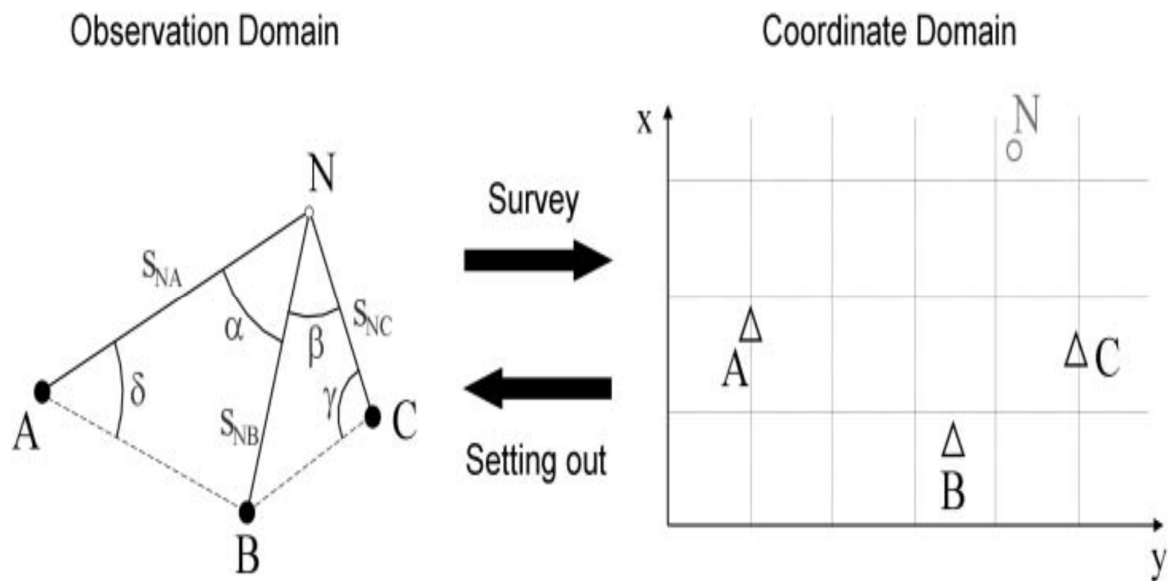
- Most efficient, as precise, reliable ... as it has to be

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Reference frame is necessary

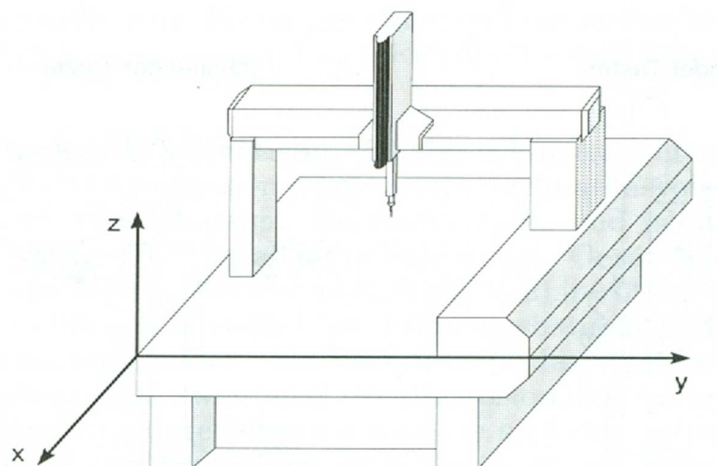


Brunner, 2007

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Reference frame is necessary

- Small -> easy



Schwarz, 1995

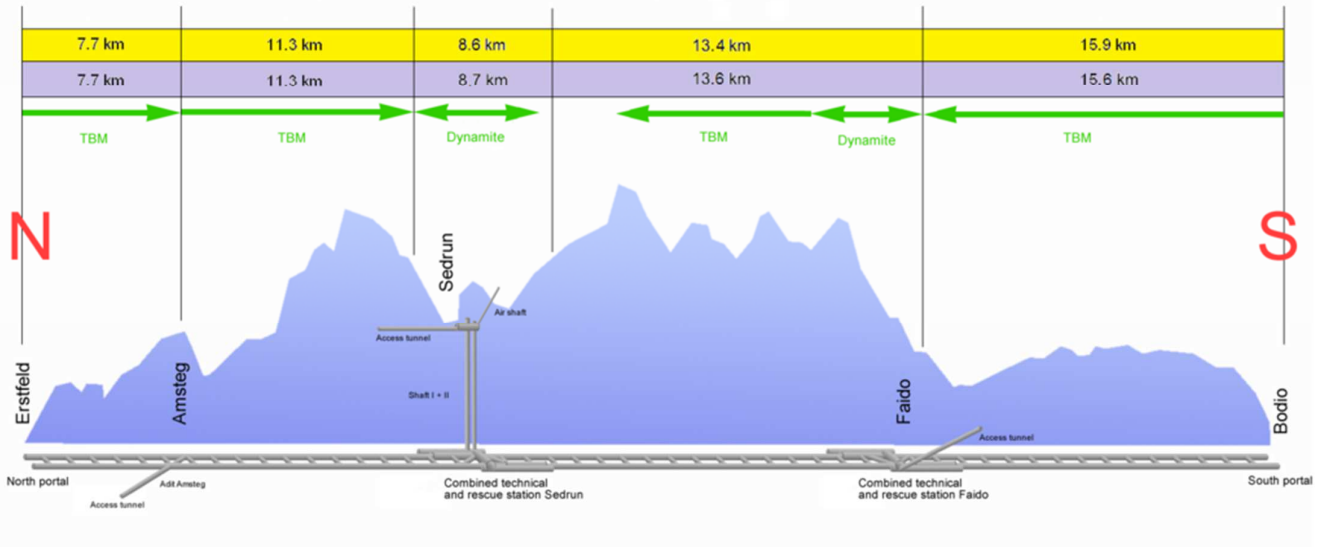
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New Rail Link through the Alps NRLA Gotthard Base Tunnel

between Erstfeld UR and Bodio TI, Switzerland
Length: 57 km / 35.4 mi - Construction: 1995 - 2017

East tube

West tube



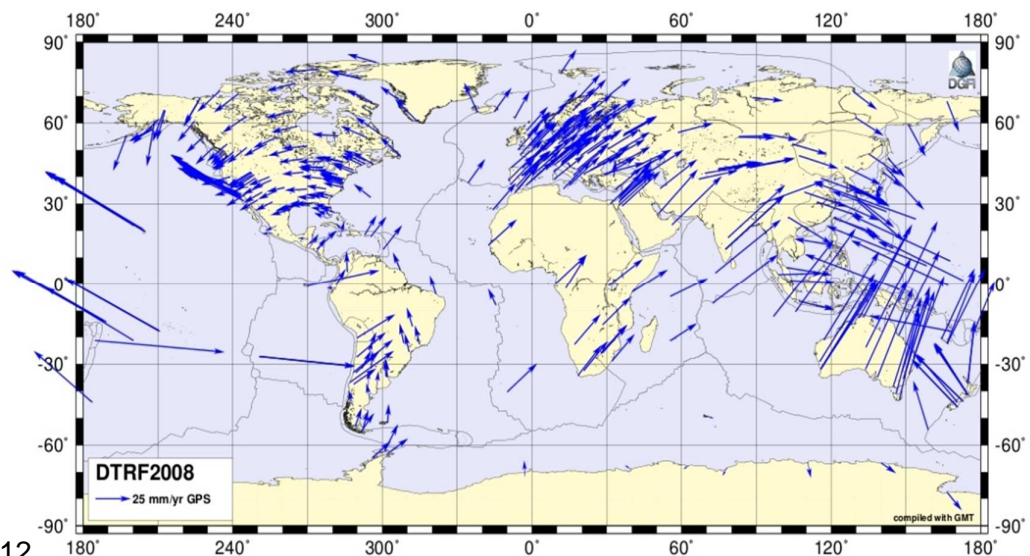
http://en.wikipedia.org/wiki/Gotthard_Base_Tunnel

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... is changing

change of global datum

on local scale as well



Seitz et al., 2012

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In the past

- several definitions of engineering geodesy with relation to applications

Now

- what we do
- which characteristics
- core competencies

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Thank you!

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