Possibilities of Low Cost GPS Technology for Precise Geodetic Applications

FIG Working Week 2005 and GSDI 8

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Possibilities of Low Cost GPS Technology

Structure

1. Low Cost GPS Technology
2. Evaluation System
3. Baseline Measurements
4. Conclusions and Outlook

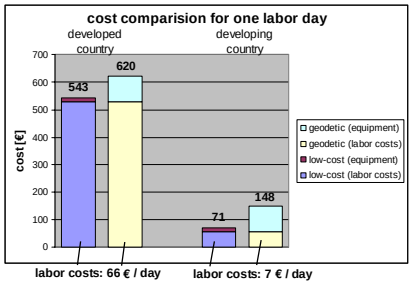
Possibilities of Low Cost GPS Technology

1 Low Cost GPS Technology

receiver class	used signal	applications	accuracy	appr. costs
low cost	code or phase-smoothed code, 1 frequency	car navigaton, location based services, sailing, mass market	1 to 10 m	100 – 500 €
geodata acquisi-tion	phase-smoothed code, 1 frequency	infrastructure planning, architecture, GIS applications	0,5 to 3 m	5000 – 10000 €
geodetic	code and phase, in general 2 frequencies	surveying, geodynamics	0,001 to 0,1 m	10 000 – 30 000 €

Possibilities of Low Cost GPS Technology

Cost reduction by Low Cost GPS



Cost reduction in developping countries around 50 % !

Possibilities of Low Cost GPS Technology

2 Evaluation System

Hardware:

2 Garmin eTrex Vista

2 serial interface cable

2 PCs (notebooks)

Software:

GRINGO Software
of University of Nottingham

SKI-Pro
of Leica company

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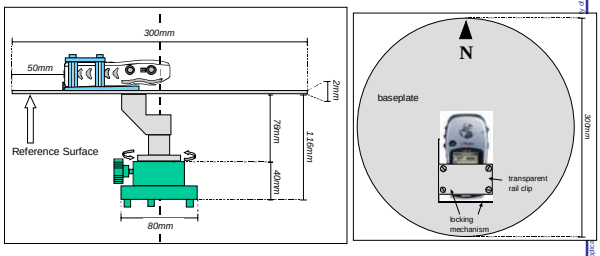
Receiver-adapter-system



Lateral view

Top view

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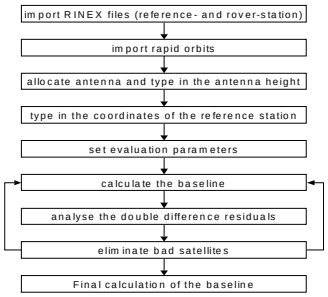
Evaluation Procedure

Problems:

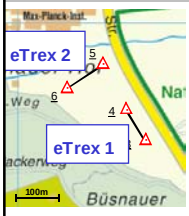
- 1 frequency
- half cycle slips
- no orbit information

Solutions:

- use only short baselines
- float solution
- use of external orbits



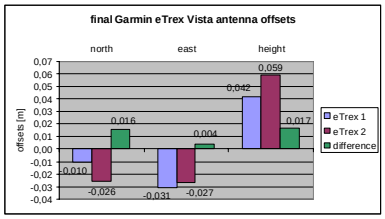
Possibilities of Low Cost GPS Technology



Pilars near
University Stuttgart

Antenna calibration
by antenna change procedure

- baseline lengths: ca. 100 m
- observation time: 2 hours
- sampling rate: 1 second
- elevation mask: 15 degrees



Offsets are significant and coincide for the two receivers within the accuracy of the determination !

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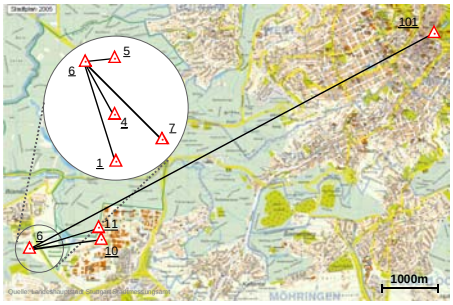
3 Baseline Measurements

observation time:
0.5 hours

sampling interval:
1 second

different multipath and diffraction environments



Baselines up to 8 km length measured with two Garmin eTrex vista !

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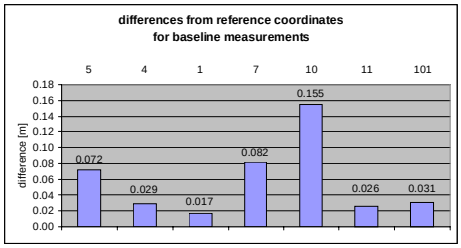
baseline from pojnt 6 to	5	4	1	7	10	11	101
baseline length [km]	0,12	0,26	0,45	0,45	1,1	1,1	7,8
observation			trees		building		
eliminated satellites	13 / 25	19	19 / 20	19	01 / 20	11	26
number of satellites *(after elimination)*	5	7	5	7	4	5	7



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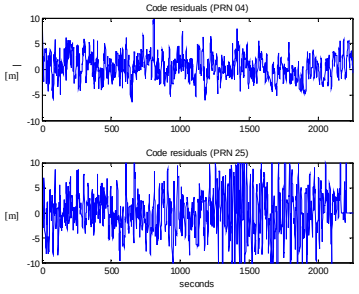
Disturbed and undisturbed Signals



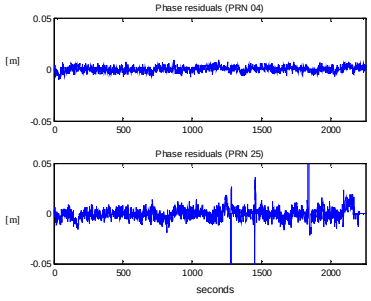
High quality !

Low quality !

code residuals for baseline 6 – 5

(as deliverd by Ski-Pro)

Possibilities of Low Cost GPS Technology



High quality !

Low quality !

PRN 25 was eliminated !!

phase residuals for baseline 6 – 5

(as deliverd by Ski-Pro)

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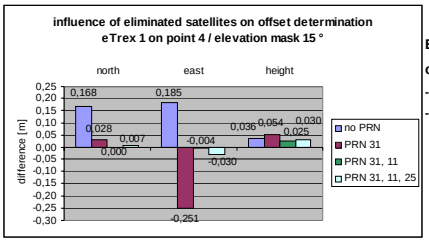
Influence of eliminated satellites



Extreme example
of antenna calibration
- Garmin eTrex on point 4,
- Leica SR 530 on point 3

- Influence of disturbed signals is large (up to a few dm level)
- Number of eliminated satellites may be high (up to three)
- Decision for a solution is made by the given standarddeviation of SKIPro

Possibilities of Low Cost GPS Technology

4 Conclusions

- Accuracy of 8 cm for low multipath environment.
- Multipath (and diffraction) may severly decrease the quality .
- Disturbed satellites influence the solution heavily.
- Number of remaining satellites used for positioning is a very important influence on the position quality.
- The baseline length is without influence up to 8 km.
- Almost no influence of the elevation mask.

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Baselines up to 8 km length may be estimated
with an accuracy of 8 cm and
an observation time of 0.5 hours,
if low multipath environments exist,
with a complex non-automatic procedure.

Main problem:

- ambiguities can not be fixed,
  no detection of half cycle slips !

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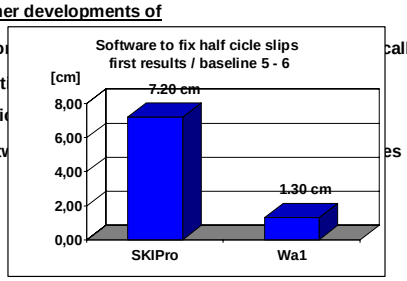
Outlook

Further developments of

- algo cally,
- realt
  typi
- softw es !



An accuracy jump seems to be possible !

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Thank you very much for your attention !

CONTACT

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