More studies about GPS accuracy on postprocessing, threshold value (SNR) and all.

1. Overview

We Japanese mapping team, strictly speaking I - Hatori Kazushige, have looked into improving the accuracy of GPS for o-mapping in using our top line model GPS receiver Trimble XR.

Our study has been also improved from last summer 2003.

First and foremost the big difference is to realize postprocessing.

First I talk about more efficient measurement condition, and next I will mention about postprocessing.

2. Evaluation for the relation between SNR (sound noise ratio),

Satellite numbers, measurement interval and accuracy

We always need to consider 3 parameters to get most effective condition for forest GPS measurement.

- SNR (sound noise ratio)

  Setting lower sound noise ratio means improving the number of available satellite.

  Weaker signal from satellites may have much more drift from accurate position.

- Satellite numbers

  At least 4 satellites (except you set the absolute altitude in 2dimension mode) are needed.

  5 satellites is usually

- Measurement interval

  Longer measurement decreases the error of measurement.

3. SNR (signal noise ratio) threshold

In open area, SNR is normally set to 6.0.

In cedar forest, signals from satellite is always lower than 6.0.

Now we use SNR ca2.5 in Japanese Thick cedar forest. Using 2.0 is depending on the case.

1.5 is not recommended. But during lower satellite availability season, 2.0 or 1.5 may use.

But in very steep slope or valley, value1.5 may probably have multi path signal that affect the accuracy.

4. Satellites numbers

5 satellites is good enough for measurement even under deep forest condition,
so long as some(real-time or postprocessing) differential correction is available.
However, I believe 5 satellites included one bad position is worse than only use of rest good 4 satellites.
So it means so-so good positioned 4 satellites is at least but enough for measurement.

5. Measurement interval

If differential correction information interval is 10sec,
10sec measurement (1sec sampling) has one accurate point logically.
Measurement interval should be multiples of correction information intervals.
At the beginning of measurement, normally one or two measurement (second) is not necessarily stable.
You had better take multiples and a couple of seconds more for measurement.

6. Differential correction interval

I have evaluated the relation between the lengths of measurement and differential information correction interval.

Logically speaking, max distance of available differential correction information is 500km.
Needless to say, nearer to fixed base producing information and shorter interval of correction is better.
It would have always ca.1m error per 100km in average.

For now, around Aichi WOC2005area, 3 different distance & interval of information are available for postprocessing.

Those are,

a. From Nagoya sea beacon 50km 10sec interval

b. From Daiousaki sea beacon 100km 10sec interval

c. From Kyoto university 150km 5sec interval

I compared between each other, in open area and forest.

Accuracy is in average,

a >= c, and c > b

If c, 5-10% of data correction points by postprocessing are not realized from 150km distance due to the different satellites status.

Both have normally different condition weather, satellite signal strength and all, so some failure may occur. But normally sampling 1sec 12sec measurement has 12points, so it has enough accuracy even though 10% data failure.

And then, measurement interval is to be 10sec (12sec), and sampling is 1sec.

Logically and arithmetically 5sec may have larger error.

To spend 12sec at each point is reasonably needed for now, and of course it is not highly demanded.

I guess 95%or more of points -12sec measurements- has within less 2meters drift.

The result is really satisfied now.

If correction interval is longer than 20sec or further than 200km,

I think both are NOT good enough for GPS measurement since it takes 20sec or more in order to get on every measurement point within 2meters drift.

7. Now evaluation 2004 summer

I'm now evaluating the fact between SNR and PDOP.

PDOP is the index showing reliabilities of satellites positions.

From my roughly experiences,

Under 10sec 10times measurement situations,

- SNR3.0 PDOP below6 has little problems
- SNR2.5 PDOP 6to8 will have over 90% reliabilities (within2m drift).
- PDOP over9 is to be recommended to have Tea break…

8. Next investigation

Kyoto university research group using correction data for nature investigation reported 5sec correction interval is not necessarily enough for many aspects of forest research.
As a consequence, they improved the correction interval setting from 5sec to 1sec.
(it looks for now quite excessive for any purpose, and it means data package amount seems to become huge normally for 8hours)
Now we can use 1sec differential correction data.

SO next investigation will be focused on,

1) If we normally measure each point for 10sec on every situation, which is better to use
Nagoya data interval 10sec 50km away
or Kyoto data interval 1sec 150km away?

2) if we normally measure each point only for 5sec,
which is better, and 5sec measurement is good enough or not ?

3) Relation to another parameter SNR ? How it affects and works ?

Those are very interesting...

I suppose this research may not only unique on TRIMBLE XR,
and also it can apply other GPS mapping.

That's all for now my comments about GPS mapping.

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