

GPS in orienteering mapping

Practical use of GPS
in orienteering mapping
For WOC2005 JAPAN

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Introduction

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Why the use of GPS in o-mapping

- ◆ Very rusty basemap (made by local government) around Aichi WOC2005 Area
- ◆ Japanese thick cedar forest
 - Test making basemap by Harvey was still not good enough
- ◆ Cost saving
 - taking new aerial photos is expensive
 - still expensive to conduct satellite or aerial laser mapping

Why the use of GPS in o-mapping

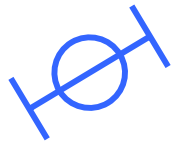
- ◆ Demo at ICOM97 Grimstad by Trimble
- ◆ Need? to support GPS tracking system
- ◆ Cost & Time saving
 - man power shortage
- ◆ High-spec GPS already used at nature protection/investigation for rare animals, birds, forest vegetation, etc...

How GPS works

5sec

4sec

- ◆ GPS signal has satellite position and very accurate clock



- ◆ Three measurements with accurate clocks, in two dimensions



3sec

How GPS works

- ◆ In 3 dimensions, 4 satellites are needed to know altitude/accurate position.
- ◆ 28 satellites available for now, each orbit is ca. 12 hours round
- ◆ Still ca. 5m horizontal error normally (even after S/A was canceled)

4sec

5sec

3sec

How GPS works

Differential correction

In order to correct normal ca.5m error,

- ◆ Remote (public) GPS receiver at a fixed position can calculate the error, and broadcast the differential information for **Realtime differential correction.**
- ◆ In Japan, longwave signal is transmitted from a sea beacon. Info is 10sec sampling interval (it's available within 50-100km from beacon)
- ◆ In Europe ? How long sampling intervals ?

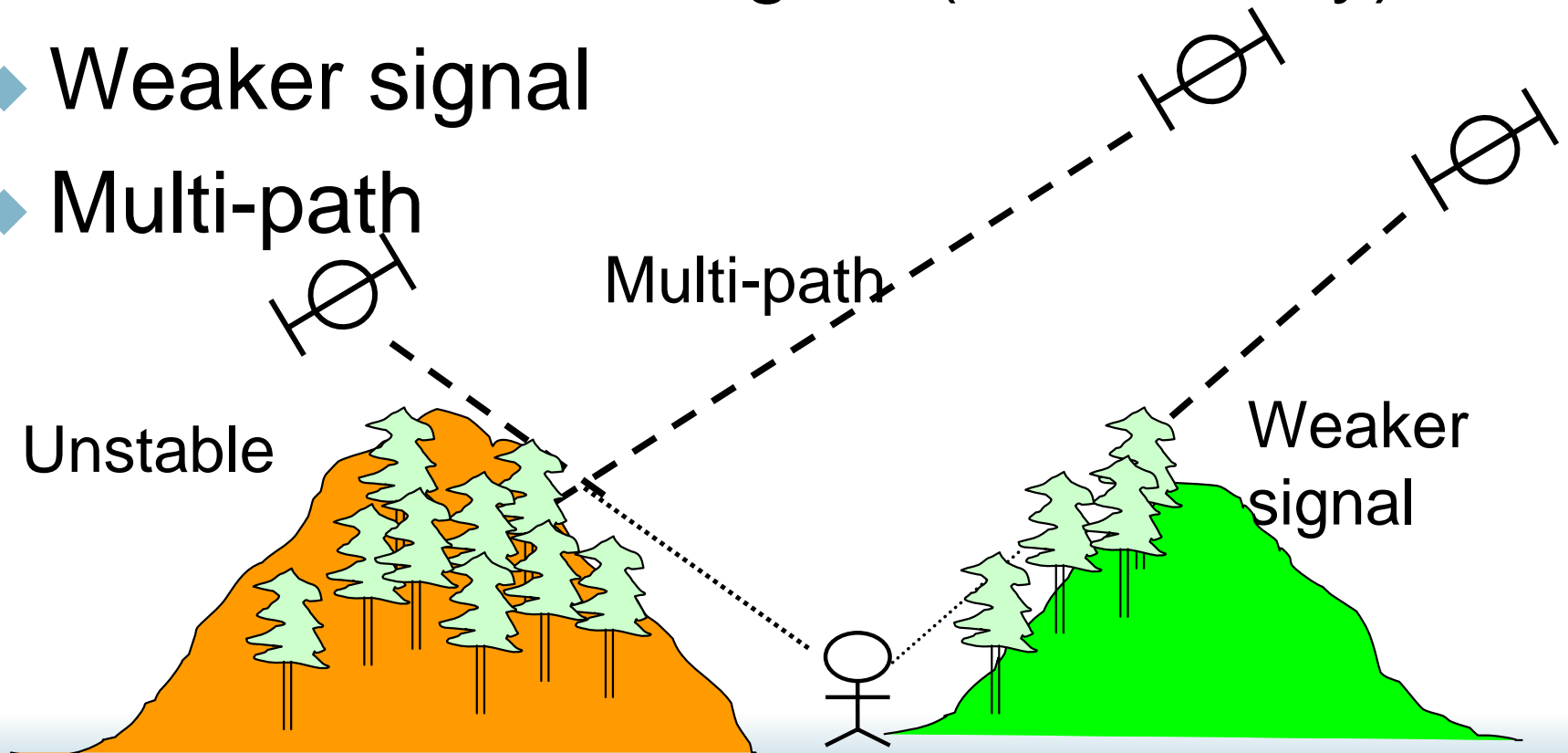
How GPS works

Differential correction

- ◆ **Postprocessing** Differential Correction
 - At fixed GPS, differential information is collected and logged as file. (or getting public info from Internet nowadays)
 - Both the differential info-file and file collected field rover are run through a process in the software, and then the output is corrected.
- ◆ **We haven't succeeded to use PDC yet.**

GPS problems in o-terrain

- ◆ Fewer, unstable signal (narrow sky)
- ◆ Weaker signal
- ◆ Multi-path



GPS problems in o-terrain

- ◆ GPS measurement is not all the time available, depending on satellite positions (at least 4 good position satellites needed, but uneven distributions due to the war!)
 - However, unavailable time can be calculated by software beforehand (demo)
(lunch time, road measurement, or when moving to another area)

How to do o-mapping with GPS

- ◆ GPS is used to measure only
 - **Point** (stone, saddle, peak, end of...)
 - **Line** (path, veg.boundary, ridge, valley...) *with text comment,*
before manual mapping.
- ◆ As GPS measure with seeing basemap, it's possible to know in advance where on basemap is horrible to survey

How to do o-mapping with GPS

- ◆ Converting GPS data to local plane coordinate (making DXF file)
- ◆ Public basemap scanned and adjusted to OCAD
- ◆ Put measured point/line features to ocad basemap exactly (import DXF)
- ◆ Print basemap with OCAD...
(also enable to use the features in case of map drawing)

How to do o-mapping with GPS

What's needed for o-mapping

- ◆ GPS, Trimble Pathfinder Pro XR
 - ◆ Software, Trimble Pathfinder Office
 - support for 600 local coordinates, diff-info postprocessing, etc...
 - ***in total ca. 10-15,000 euro in JPN***
 - ◆ OCAD7/8, scanner, PC
- (Other GPS gears, ex. cheaper or less accurate one is possible to use ?)

Trimble Pathfinder Pro XR

- ◆ High-class realtime DGPS
- ◆ GPS receiver
- ◆ Datalogger (data collector)
- ◆ GPS signal & differential information
Antenna (long wave 288-320 KHz)
- ◆ (Extra long wave antenna & booster)

Trimble Pathfinder Pro XR



Backpack
over 5kg...



GPS receiver and 2 batteries

Trimble Pathfinder Pro XR



GPS antenna

Datalogger ca.1kg?



Dif.info wave booster
Antenna handmade...



Trimble Pathfinder Pro XR

- ◆ Realtime Differential GPS (water proof)
- ◆ Realtime accuracy is within 30cm - 68% normally in open area
- ◆ Other high spec. function
- ◆ Taking ca.3-5sec to measure one point feature
- ◆ Line feature is basically consisted of point features. Vertex or Liner sampling(min.1sec)

However, in case of Japanese thick forest...

How to make basemap, on Trimble

After GPS measurement,

- ◆ Import logged data to PC
- ◆ On Software, convert WGS-84 data to local plane coordinate system
(ex. japan plane zone7)
- ◆ Export as DXF format file

How to make basemap, on OCAD

- ◆ Need to make your o-map as Real world coordinates
- ◆ **Angle** should be magnetic north angle in order to incline the map grid
- ◆ **Horizontal/Vertical offset** should be offset distance from Local Coordinate Reference Position

How to make basemap, on ocad

- ◆ Make 3 symbols for GPS measure point, line, and comment, in advance
- ◆ File...Import DXF file
 - **Offset** exsiting offset/angle
 - **Coordinate** GIS 1meter/unit
- ◆ Change all symbols to Point, Line, and Text(comment)

Actual output from GPS measurement

- ◆ 90% of measure points has within 2-5m divergence
(mainly depends on the satellite numbers)
 - however, you can know 10% of error points easily during manual o-mapping.
- ◆ 80% time is suitable for GPS measurement in long term average
- ◆ Fresh differential information within 10sec lifetime is important (30sec is useless)

Actual output from GPS measurement

GPS spec. requirements

- ◆ GPS accuracy requirement should be always within 1m.
 - In the thick forest, divergence would be 3 times or more.
- ◆ Differential info age should be within 10sec.
- ◆ Time schedule for measurement is very important, it may require highspec GPS

Effectiveness of using GPS

- ◆ A day GPS measurement cover more than 4days mapping area.
- ◆ Saving 25% more in mapping time
- ◆ you can get the information, condition of whole mapping area in advance

Effectiveness of using GPS

- ◆ In general, more accurate than any other mapping techniques
- ◆ Less frustration for mapper
 - no use for counting pace, picking up path, veg., lines during manual mapping.
- ◆ Even non-mapper can use GPS gears

Effectiveness of using GPS

- ◆ 25% saving time = 25% saving cost ?
 - In Japan, we also rent Trimble GPS gears for ca.300euro per a week to local clubs, organizers.
- ◆ 5kg weight, 8hours, Good Training !!
- ◆ Any other use ?

Weak points of using GPS

- ◆ Expensive high-class GPS gears
- ◆ Impossible to use altitude information
- ◆ Every point measured is not necessarily correct
 - but a good mapper like all of you, can distinguish error point easily...
- ◆ Not all the time and season, is good for GPS measurement

Weak points of using GPS

- ◆ How to get fresh (within 10sec) differential information ?
 - if without using DI, GPS is no use for now
 - Buy&Using another High-class GPS to make differential information ???
 - getting from public information nearby
 - Cheaper hand-made task force, using handy garmin and PC, has not succeeded yet

Conclusion

- ◆ Using GPS is necessary for thick forest o-mapping, for the time being
- ◆ Effective in saving time, raising accuracy, and sharing o-mapping jobs
- ◆ Good cost performance ?!
- ◆ Interesting and enjoyable to use GPS

Future

- ◆ All the terrains for WOC2005 Japan will be measured by GPS
- ◆ In the near future, we'll realize postprocessing differential correction by cheaper way - for use everywhere (even in Europe)
- ◆ Amazing lazer mapping will appear soon. Contour intervals will be 15cm...