GPS in orienteering mapping

Practical use of GPS in orienteering mapping
For WOC2005 JAPAN

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Introduction

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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 lazer 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

- GPS signal has satellite position and very accurate clock
- Three measurements with accurate clocks, in two dimensions
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).
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

Unstable

Multi-path

Weaker signal
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** existing 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 4 days 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…