H24VSP Project 3

Practical PPP with Veripos DL5[a]

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NGI

[a] History of changes at `https://github.com/DfAC/TeachingSlides/`.

Introduction

In last practical of the H24VSP module we will explore the capacities of the Precise Point Positoning (PPP) by comparing it with real-time kinematic double-differenced positioning (RTK) that you are already familiar with. During practical we will be using **Leica GS10** receiver and maritime **Veripos LD5** receiver with AsterRx chipset[1]. We are interested in assessing difference between:

- convergence time;
- precision - estimated and actual after convergence;
- accuracy after convergence.

[1] For short introductory video see `http://bit.ly/VeriposLD5`.

What we are going to discuss

1. Veripos Services
2. Veripos demo
3. Practical work

Veripos Services

Veripos Services I

Veripos is a commercial company offering combination of a hardware (receivers) and correction services[2]:

- **Veripos Standard** - single frequency code DGPS, 1-2 m accuracy.
- **Veripos Standard**^{2} - single frequency code GPS and GLONASS DGPS.
- **Veripos PPP** using global orbit, clock correction and dual-frequency GPS/GLONASS observations for dm level accuracy.

Veripos Services II

Veripos PPP service comes in four favours[3]: APEX, Ultra, APEX[2] and Ultra[2] - the difference is in the correction provider and number of constellations used. In all cases the corrections are transmitted via Inmarsat geostationary satellites[4] - 25E, 98W, 143.5E, AORE, AORW, IOR, POR. All coordinates provided are in ITRF2008.

[2] http://bit.ly/VeriposServices.
[3] http://www.veripos.com/services.html
[4] http://www.veripos.com/global-coverage.html

Veripos Standard

- Provides RTCM Type 1[5], 3[6] messages.
- Normal accuracy: 1-2m.
- Typical latency: 4 seconds[7].
- Single difference code solution (DGPS) using GPS C/A code on L1 frequency.

[5] DGPS corrections.
[6] GPS reference station parameters.
[7] Typical correction update interval is 15 seconds.

Veripos Standard[2]

Single frequency code GPS and GLONASS DGPS.

- Provides RTCM Type 1, 3, 31[8], 32[9] messages.
- Normal accuracy: 1-2m.
- Typical latency: 4 seconds.
- Single difference code solution (DGPS) using GPS and GLONASS C/A code (L1/G1)[10].

[8] DGPS GLONASS corrections.
[9] GPS GLONASS reference station parameters.
[10] It is possible to calculate position using only GLONASS with this service.

Veripos Ultra and Apex[2]

- Orbit and clock corrections in JPL GDGPS format.
- Normal accuracy: 0.1m planar.
- Typical latency: 2 seconds with 30 s update rate.
- Precise Point Positioning (PPP) using C/A and P code and L1/L2 carrier phase for GPS.

- Orbit and clock corrections in Veripos OCDS format.
- Normal accuracy: 0.1m planar.
- Typical latency: 2 seconds with 30 s update rate.
- PPP, code and carrier phase on L1/L2 and G1/G2 (GPS and GLONASS).

Veripos Standard and Ultra comparison

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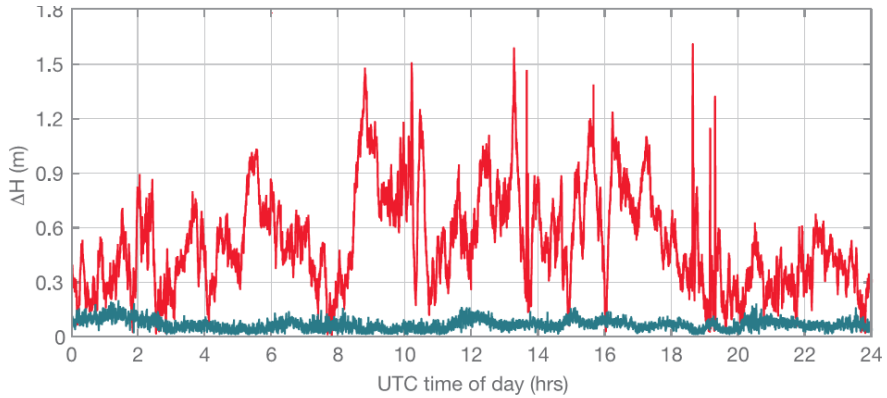
Horizontal accuracy



Vertical accuracy

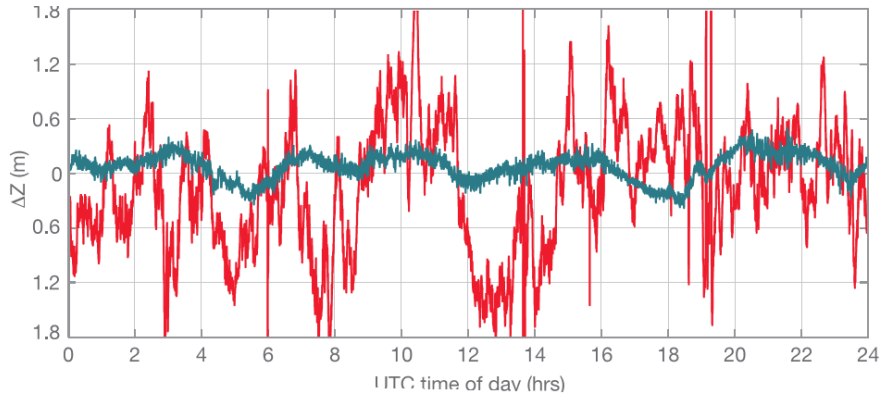


Figure 1: *Standard and Ultra solutions at a monitor site in Singapore.*

Veripos demo

Practical work

Data Collection

You will collect:

- RTK GPS solution;
- RTK GPS+GLO solution;
- Network RTK GPS solution;
- Network RTK GPS+GLO solution.

The PPP data will be provided for you at the end of practical. It is your task to **select approximate point and time span** to carry out comparison between RTK and PPP solutions.

Practice layout

- LD5 will be restarted at 12:00. This will allow for PPP convergence.
- You will collecting RTK data between 14:00 and 16:20.
- Apart from collected data (GS10) you will be given Veripos NMEA strings for Ultra and Apex^2 (LD5).
- **Make sure that Veripos NMEA file has been split into $GPGGA and $GPGST ones before leaving.**

Veripos $GPGGA NMEA strings

In Verpos provides two types of NMEA strings $GPGGA and $GPGST. $GPGGA will behave differently in PPP mode with QA flag always 2 or 5. To obtain any information about solution we need to examine last flag before CRC(*).

Example

$GPGGA,183324.00,5257.1178371,N,00111.0236798,W,**5**,17,0.7,42.76,M,49.01,M,30.5,**0268***54.

Values for the flag indicate:

- **0268** *ULTRA*[2]
- **0281** *APEX*[2]
- **0068** ULTRA
- **0081** APEX
- **1006** *Standard*[2]

Veripos $GPGST NMEA strings

Example

*$GPGST,140545.00,3.81,0.02,0.01,81.00,0.02,0.01,0.02*57.*

Cell	Notes
0	Message ID $GPGST
1	UTC of position fix[a]
2	RMS value of the pseudorange or carrier phase (RTK/PPP) residuals
3	Error ellipse semi-major axis 1 sigma error, in meters
4	Error ellipse semi-minor axis 1 sigma error, in meters
5	Error ellipse orientation, degrees from true north
6	Latitude 1 sigma error, in meters
7	Longitude 1 sigma error, in meters
8	Height 1 sigma error, in meters
9	The checksum data, always begins with *

[a] Notice 17s offset to GPS time.

Point	Frame	Lat[deg]	Long[deg]	EllHt[m]	Notes
NGB5	ETRF97	52 57 7.05304	01 11 1.44953	91.212	at point
NGB5	ETRF97	52 57 7.05304	01 11 1.44953	91.392	at ARP[a]
NGB5	ETRF97	52 57 7.05304	01 11 1.44953	91.434	at antenna PCO[b]
NGB5	ITRF2008	**52 57 7.07095**	**01 11 1.42675** W	**91.488**	at antenna PCO[c]
NGB5	ITRF2008	**5257.1178492**	**0111.0237792** W	**91.488**	at antenna PCO[d]

Table 1: *Coordinates of NGB5*

[a] Antenna heigh = 0.18m.

[b] Antenna offset for ionsphere free solution is $2.545L_1 - 1.545L_2$ so $2.545 * 55.3 - 1.545 * 64.2 = 41.5mm$.

[c] Converted from ETRF97 to ITRF2008 at epoch 2016-12-04.

[d] NEMEA GGA string DDMM.MMMMMMM format.

Questions?