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[1] **Veripos LD5** receiver using AsterRx chipset[2]. We are interested in assessing difference between:

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

[1] For application examples see `www.veripos.com/applications/overview/`.
[2] For short introductory video see `http://bit.ly/VeriposLD5`.

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 08:00. This will allow for PPP convergence.
- You will collecting RTK data between 08:30 and 10:50.
- 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 Services

Veripos Services I

Veripos is a commercial company providing high accuracy GNSS positioning, offering both hardware (receivers) and correction services[3]:

- **Apex Service** uses Veripos own Orbit and Clock Determination System (OCDS) and their network of reference stations[4]. Apex utilises dual-frequency GPS, APEX[2] dual-frequency GPS/GLONASS and APEX[5] dual-frequency GPS/GLONASS/Beidou/Galileo/QZSS receivers observations for dm level accuracy.

Veripos Services II

- **Ultra Service** uses JPL Orbit and Clock Determination System (OCDS) which uses data from JPL network[5]. Ultra utilises dual-frequency GPS and Ultra[2] GPS and GLONASS.
- **Standard Service** - provide high integrity, meter level service. Standard provide single frequency code DGPS and Standard[2] single frequency code GPS and GLONASS DGPS.

All corrections are transmitted via Inmarsat geostationary satellites[6] - 25E, 98W, 143.5E, AORE, AORW, IOR, POR. All coordinates provided are in ITRF2014.

[3] https://www.veripos.com/services/overview/.
[4] http://bit.ly/VeriposNet
[5] http://bit.ly/JPLnetwork
[6] http://www.veripos.com/global-coverage.html

Standard Service I

Single frequency code GPS DGPS.

- Provides RTCM Type 1[7], 3[8] messages.
- Normal accuracy: 1-2m.
- Typical latency: 4 seconds[9].
- Single difference code solution (DGPS) using GPS C/A code on L1 frequency.

[7] DGPS corrections.
[8] GPS reference station parameters.
[9] Average age received 10s. Typical correction update interval is 15 seconds.

Veripos Standard[2]

Single frequency code GPS and GLONASS DGPS.

- Provides RTCM Type 1, 3, 31[10], 32[11] messages.
- Normal accuracy: 1-2m.
- Typical latency: 4 seconds.
- Single difference code solution (DGPS) using GPS and GLONASS C/A code (L1/G1)[12].

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

Veripos Standard and Ultra comparison

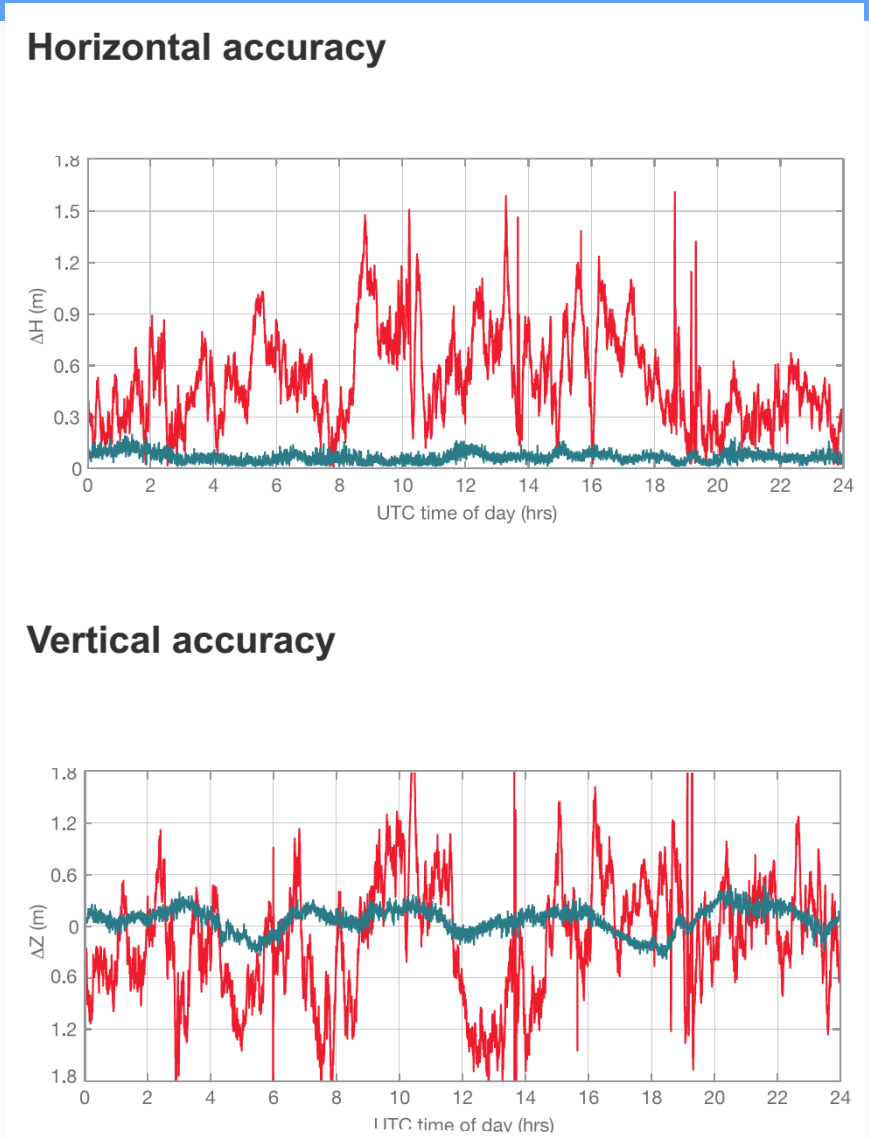

Figure 1: *Standard and Ultra solutions at a monitor site in Singapore.*

Veripos Ultra and Apex[2]

- Orbit and clock corrections in JPL GDGPS format.
- Nominal 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 and GLONASS G1/G2.

- Orbit and clock corrections in Veripos OCDS format.
- Nominal accuracy: 0.1m planar.
- Typical latency: 2 seconds with 30 s update rate.
- PPP, code and carrier phase on GPS L1/L2, GLONASS G1/G2, BeiDou B1/B2, Galileo E1/E5b, QZSS L1C/L2L (exact corections depend on the service type).

Practical work

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	ITRF2014	**52 57 7.07154**	**01 11 1.42594** W	**91.486**	at antenna PCO[c]
NGB5	ITRF2014	**5257.1178589**	**0111.0237657** W	**91.486**	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 ITRF2014 at epoch 2017-12-06.

[d] NEMEA GGA string DDMM.1234567 is eq to 0.0018 m.

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.

Veripos demo