

H24VSP Project 3

INTRODUCTION TO PPP USING DL5

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NGI

In last practical of the H24VSP module we will explore the capacities of the Precise Point Positioning (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 chipset¹. We are interested in assessing difference between:

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

¹For short introductory video see <http://bit.ly/VeriposLD5>.

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

Veripos Services

Veripos is a commercial company offering both hardware (receivers) in combination with following services²:

- **Veripos Standard** - single frequency code DGPS, 1-2 m accuracy.
- **Veripos Standard²** - single frequency code GPS and GLONASS DGPS.
- **Veripos APEX** using global orbit, clock correction and dual-frequency GPS/GLONASS observations for dm level accuracy.

The last service consist of three: APEX, Ultra, APEX² and Ultra² - the difference is correction provider and number of constellations used. In all cases the corrections are transmitted via Inmarsat geostationary satellites - 25E, 98W, 143.5E, AORE, AORW, IOR, POR³. All coordinates provided are in ITRF2008.

²Also check <http://www.veripos.com/services.html> and for video <http://bit.ly/VeriposServices>.

³<http://www.veripos.com/global-coverage.html>

- Provides RTCM Type 1⁴, 3⁵ messages.
- Normal accuracy: 1-2m.
- Typical latency: 4 seconds⁶.
- Single difference code solution (DGPS) using GPS C/A code on L1 frequency.

⁴DGPS corrections.

⁵GPS reference station parameters.

⁶Typical correction update interval is 15 seconds.

Single frequency code GPS and GLONASS DGPS.

- Provides RTCM Type 1, 3, 31⁷, 32⁸ messages.
- Normal accuracy: 1-2m.
- Typical latency: 4 seconds.
- Single difference code solution (DGPS) using GPS and GLONASS C/A code (L1/G1)⁹.

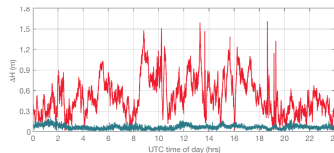
⁷DGPS GLONASS corrections.

⁸GPS GLONASS reference station parameters.

⁹It is possible to calculate position using only GLONASS with this service.

- 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.

Horizontal accuracy



Vertical accuracy

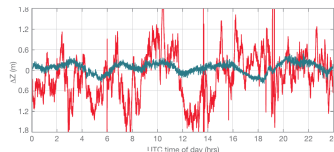
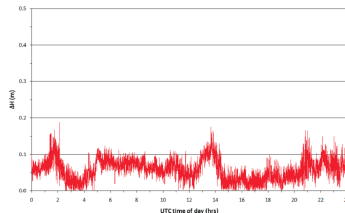


Figure 1: *Standard and Ultra solutions at a monitor site in Singapore.*

- Orbit and clock corrections in Veripos OCDS 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 and GLONASS.

Apex horizontal accuracy



Apex vertical accuracy

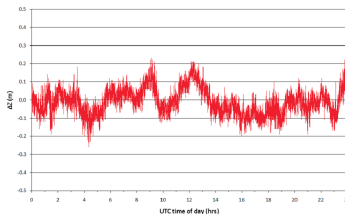


Figure 2: *Veripos Apex solution at a monitor site in Aberdeen.*

Live demo

Practical work

- 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 Apex² (LD5).
- **Make sure that Veripos NMEA file has been split into \$GPGGA and \$GPGST ones before leaving.**

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.

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*

^aAntenna heigh = 0.18m.

^bAntenna offset for ionosphere free solution is $2.545L_1 - 1.545L_2$ so
 $2.545 * 55.3 - 1.545 * 64.2 = 41.5mm$.

^cConverted from ETRF97 to ITRF2008 at epoch 2016-12-04.

^dNEMEA GGA string DDMM.MMMMMMMM format.

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

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 *

^aNotice 17s offset to GPS time.

Questions?