

# H24VSP Project 3

## PRACTICAL PPP WITH VERIPOS DL5<sup>a</sup>

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NGI

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<sup>a</sup>History of changes at <https://github.com/DfAC/TeachingSlides/>.

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 chipset<sup>1</sup>. We are interested in assessing difference between:

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

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

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

## **Veripos Services**

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Veripos is a commercial company offering combination of a hardware (receivers) and correction services<sup>2</sup>:

- **Veripos Standard** - single frequency code DGPS, 1-2 m accuracy.
- **Veripos Standard<sup>2</sup>** - 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 PPP service comes in four favours<sup>3</sup>: APEX, Ultra, APEX<sup>2</sup> and Ultra<sup>2</sup> - the difference is in the correction provider and number of constellations used. In all cases the corrections are transmitted via Inmarsat geostationary satellites<sup>4</sup> - 25E, 98W, 143.5E, AORE, AORW, IOR, POR. All coordinates provided are in ITRF2008.

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<sup>2</sup><http://bit.ly/VeriposServices>.

<sup>3</sup><http://www.veripos.com/services.html>

<sup>4</sup><http://www.veripos.com/global-coverage.html>

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

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<sup>5</sup>DGPS corrections.

<sup>6</sup>GPS reference station parameters.

<sup>7</sup>Typical correction update interval is 15 seconds.

## Single frequency code GPS and GLONASS DGPS.

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

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<sup>8</sup>DGPS GLONASS corrections.

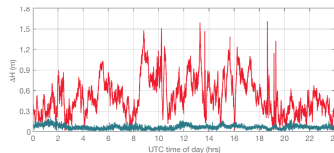
<sup>9</sup>GPS GLONASS reference station parameters.

<sup>10</sup>It is possible to calculate position using only GLONASS with this service.

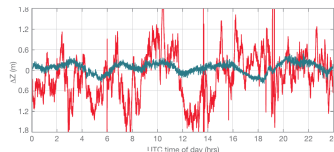


- Orbit and clock corrections in JPL GDGPS format.
- Normal accuracy: 0.1m planar.
- Typical latency: 2 seconds with 30 s update rate.
- Precise Point Positioning (PPP) using C/A and P code and L1/L2 carrier phase for GPS.

Horizontal accuracy



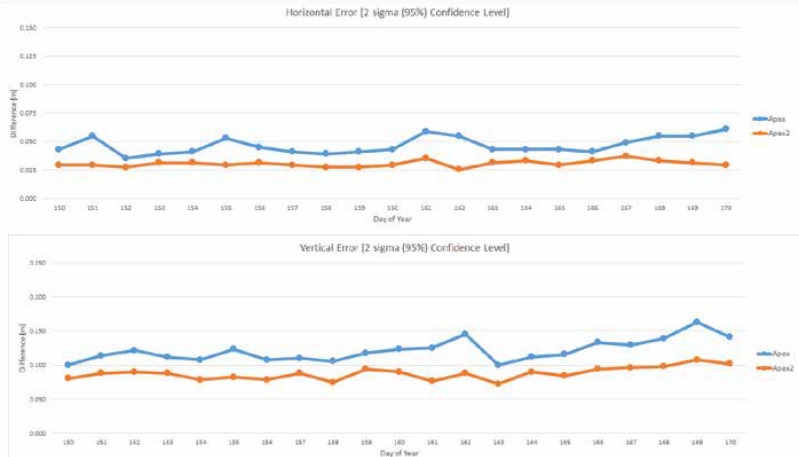
Vertical accuracy



**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 code and carrier phase on GPS L1/L2 frequencies.
- 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 Apex and Apex<sup>2</sup> comparison



**Figure 2:** *Apex and Apex<sup>2</sup> solutions at a monitor site in Aberdeen.*

## Veripos demo

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## Practical work

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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.

- 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<sup>2</sup> (LD5).
- **Make sure that Veripos NMEA file has been split into \$GPGGA and \$GPGST ones before leaving.**

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*<sup>2</sup>

**0281** *APEX*<sup>2</sup>

**0068** *ULTRA*

**0081** *APEX*

**1006** *Standard*<sup>2</sup>



## 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 <sup>a</sup>
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 *

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<sup>a</sup>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 <sup>a</sup>
NGB5	ETRF97	52 57 7.05304	01 11 1.44953	91.434	at antenna PCO <sup>b</sup>
<b>NGB5</b>	ITRF2008	<b>52 57 7.07095</b>	<b>01 11 1.42675 W</b>	<b>91.488</b>	at antenna PCO <sup>c</sup>
<b>NGB5</b>	ITRF2008	<b>5257.1178492</b>	<b>0111.0237792 W</b>	<b>91.488</b>	at antenna PCO <sup>d</sup>

**Table 1:** *Coordinates of NGB5*

<sup>a</sup>Antenna height = 0.18m.

<sup>b</sup>Antenna offset for ionosphere free solution is  $2.545L_1 - 1.545L_2$  so  
 $2.545 * 55.3 - 1.545 * 64.2 = 41.5\text{mm}$ .

<sup>c</sup>Converted from ETRF97 to ITRF2008 at epoch 2016-12-04.

<sup>d</sup>NEMEA GGA string DDMM.MMMMMMM format.

Questions?