A step by step guide to set up Ground Control Points for RPAS mapping

What is a Ground Control Point (GCP)?

Ground Control Points (GCP's) are points located on the ground with known coordinates. They can be anything that can be easily recognizable and measurable in both the image and the ground. For example, Figure 1 (a) shows a typical manmade GCP and (b) shows a well-constructed GCP using spray-painted onto the concrete using a stencil. Anyone can use a distinguishable feature on the ground as GCP too (Figure 1 (c)). They should be spaced strategically throughout your study area. Typically, they are as follows;
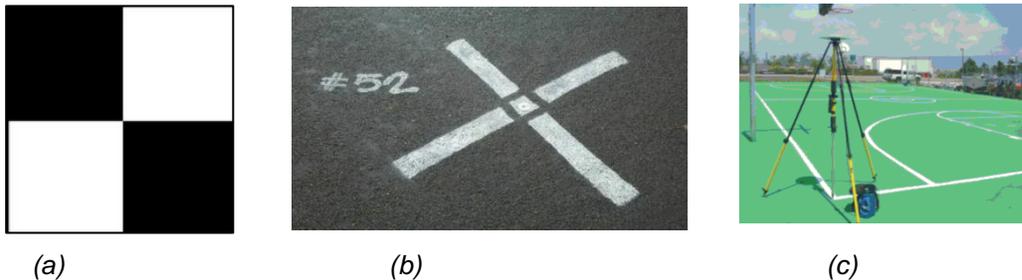

| (a) | (b) | (c) |

Figure 1: Different types of GCP's

The main purpose of a GCP is to improve the positional accuracy of the RPAS mapping project. They help to ensure that the coordinates of any point on the map correspond accurately with actual GPS coordinates. This is important in situations where precision mapping and true global accuracy are needed.

GPS Receivers

EMLID RS2 GNSS Receiver (Multi-band RTK GNSS receiver with centimetre precision (https://emlid.com/reachrs2/)

Reach RS2 gets a fixed solution in just seconds and maintains robust performance even in challenging conditions. Centimeter accuracy can be achieved on distances up to 60 km in RTK, and 100 km in PPK mode.

GPS, GLONASS, BeiDou, Galileo, and QZSS (L1OF, L2OF, L1C/A, L2C, E1B/C, E5b, B1I B2I)

RINEX raw data logs are compatible with PPP services like the NRCan PPP service that processes RINEX files and get a position with absolute accuracy.

EMLID RS+ GNSS Receiver (Single-band RTK GNSS receiver with centimetre precision (https://emlid.com/reachrs/)

GPS/QZSS L1, GLONASS G1, BeiDou B1, Galileo E1, SBAS

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**Establish a Control Point (Base Station) in your worksite (PPP)**

Real-Time Kinematic (RTK) technique requires two receivers. One is stationary and is called a "base station", the other one is called a "rover". The base station is a coordinate known point that should establish before RPAS flight or a geodetic monument near the worksite. Here is the step-by-step guide to set up your own base station using Precise Point Positioning (PPP) method. Although PPP technique provides accurate coordinates, it may take a considerable time to get them. General steps are;

- Enable logging of raw data and record log for a few hours
- Export log with the collected data from ReachView 3 to your mobile device or PC
- Upload the collected file to NRCan PPP service
- After a few minutes, you will get processed data to your email

1. Prepare a permanent point that can be used as a base station (see fig. 1).
2. Use a tripod to place the RS2 receiver precisely above the marked point
3. Measure the antenna height using a tape (antenna height = h + 134 mm)
4. Switch on the receiver, let it initialize and find out its position.
5. Install "Reachview 3" app to your mobile device
6. Turn off mobile data on your device (preferably)
7. Search for WiFi network: EMLIDRS2-BASE and connect it (The Reach unit will be in "hotspot" mode.)
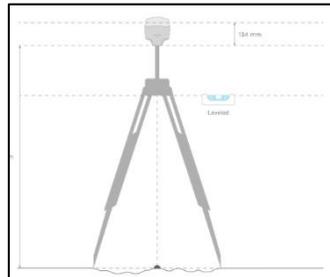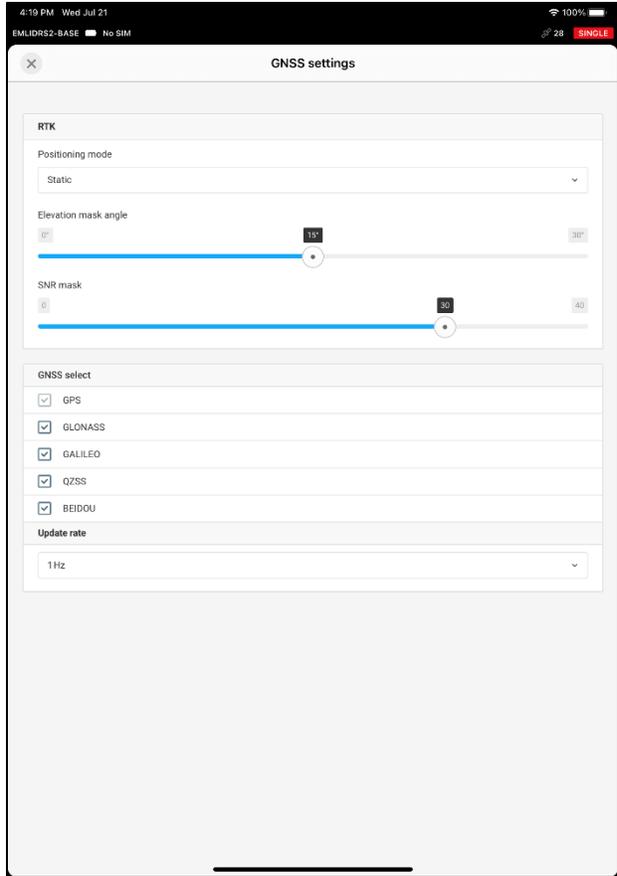
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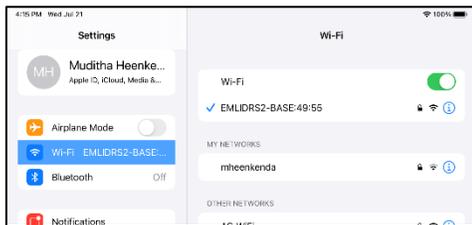
8. Open the Reachview 3 app; in the "Receivers" tab, press "Refresh"
9. You will see your receiver "EMLIDRS2-BASE"

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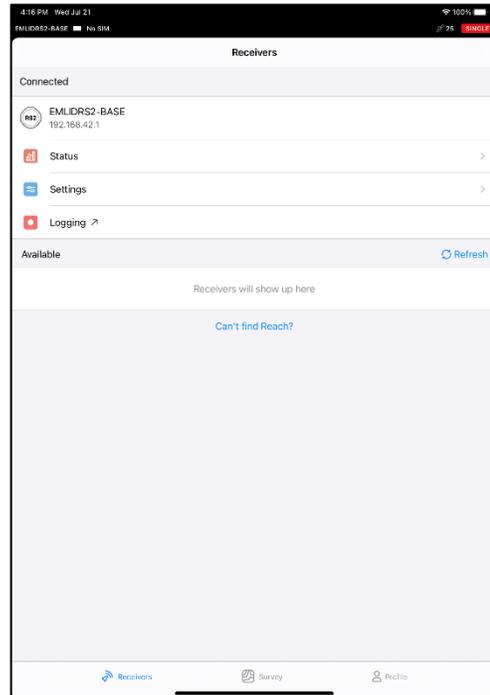
10. Click on "Status"; you will see the number of satellites tracked, PDOP and calculated position.
11. Go back and click "Settings"; go to GNSS settings; configure as follows;

12. Go back to the main page and click "Logging"; Raw data → Settings
Format = RINEX 3.02; Check all satellite systems; Logging interval = 1s; Measured height = the antenna height you measured in step 3; give a name and Apply.

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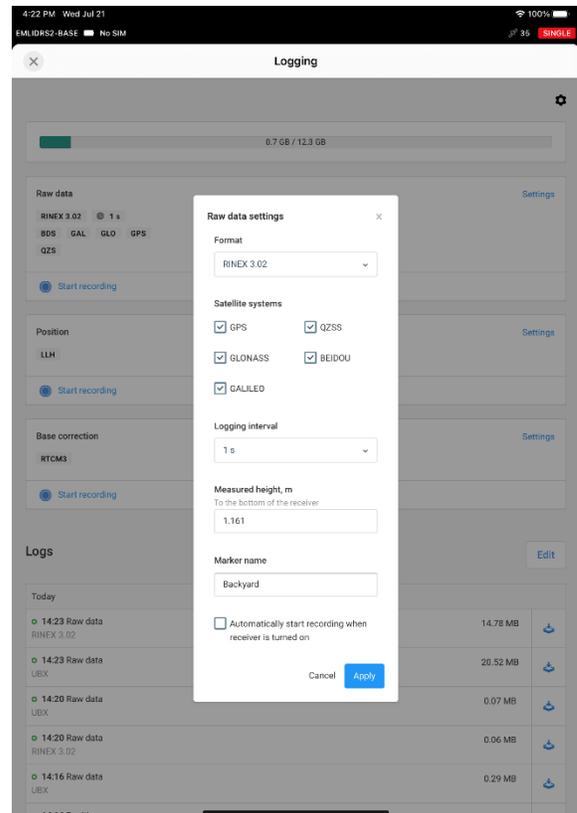
13. Now click "Start Recording" of raw data (the other options are not important to set up a base).
14. After 2hrs, click on the red button to stop recording. It will automatically be compressed and give you an option to share. Email to your email account (you should do this while connected to the receiver).
15. Remove your receiver and tripod from the worksite.
16. In the office, download your raw data zip file and unzip it. You will see three files but RINEX one is with the extension "2IO"
17. go to the NRCan PPP website: https://webapp.geod.nrcan.gc.ca/geod/tools-outils/ppp.php; create an account and sign in
18. Upload the RINEX file for processing;
19. You will get your results within half an hour. To interpret the report see "Report_Static_NRCan_PPP_Sample.pdf"

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