

G1-m1™ GNSS Mobile System Horus™ GNSIS Processing Software

V 1.0



Figure 1: Horus™ Main and Display Interfaces

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Purpose: This document is for the G1 GNSS system users. It shows how to process G1-m1™ acquired data in post-mission mode. The end result is a series of the G1 rover locations along with their quality estimates. For instructions on how to use the G1-m1™ system, refer to the system quick guide.

Requirements: This document presumes that you have at least one G1 GNSS receiver (the rover). Optionally, users can collect correction data on a known base station (the base). Or, you can request to download the correction data from the closest Continuously Operating Reference Station (CORS), as described in the Horus™ software guide.

Note: By GNSS data, we mean raw ranges between the G1 receiver and the respective GPS/GLONASS satellites in the form of C/A code and carrier phase observations. The raw ranges are readily available on a uSD card in the form of a binary data file after a successful data acquisition mission.

Horus™

A stand-alone software package for processing the G1-m1™ system data.

User Interface

Horus™ user interface is graphical. It all begins and ends in the main window. Before start processing, copy the rover data file from the uSD card to a folder on the computer hard drive; we will use the sample data 'AAD00010.gps' in 'myData' folder as example. To run Horus™, double click the **horus.exe** executable or its shortcut. The main window interface pops up, see Figure 2. Horus™ loads the configuration parameters in 'horus.ini' while starting.

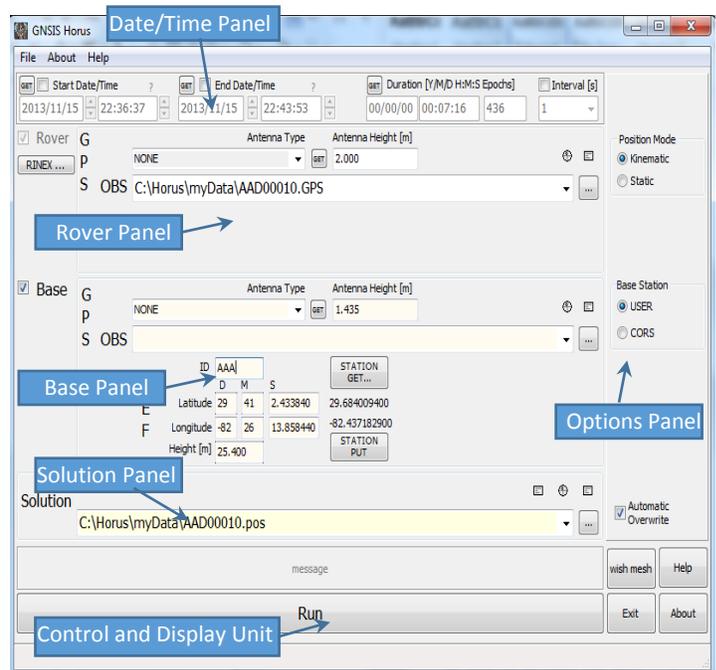


Figure 2: Horus™ User Interface Panels

How to use

Horus™ runs from a single executable, **horus.exe**. You may create a shortcut on the desktop or just run it by double clicking the exe file. Once invoked, it will automatically call the rest of the package components, as needed.

- ❖ To specify the **rover data file**, do one of two things:
 - 1) Drag the 'AAD00010.gps' file from its location and drop it onto the 'OBS' textbox in the 'rover' panel
OR
 - 2) Click the ellipses button next to the 'OBS' text (to the right) and browse to the location of the 'AAD00010.gps' file in the file browser window

Specify the **antenna type** used in the survey by clicking on the antenna dropdown menu and select the corresponding entry.

- *Leave the antenna type to 'NONE' if unknown.*
- *It is NOT recommended to run the raw data file off the uSD card; use a folder on the local hard drive, instead.*

Specify the **antenna height** above the surveyed point in the corresponding textbox, say 2.000 m if you are using a 2m survey rod.

- *You may have noticed that the 'solution' textbox was filled automatically. Horus™ uses the same base name of the rover file and 'pos' extension. Even though you can so, it is highly recommended that you do not change it.*

Optionally, you can specify the information that goes into the **Rinex header** like the surveyor name, organization name, etc. by clicking the RINEX button below the 'Rover' checkbox; the fields in the Rinex information window are self-explanatory.

- *It is recommended to process the rover single point position data in 'kinematic' positioning mode even if it was acquired in static positioning mode. The 'kinematic' positioning mode will allow for better detection of blunders and detailed statistics, if needed. You can always change between 'kinematic' and 'static' positioning modes by clicking the proper radio button of the 'Positioning Mode' group in the options panel.*
- *At this point (if you were curious anyway) do not check any of the other buttons in the main window. Those buttons become meaningful once the rover data preparation takes place after the first run.*
- *Have you noticed the status bar at the very bottom of the main window? It shows status hints when you hover the mouse over an object in the user interface. For instance, it will display 'click to specify rover input file' if you hover the mouse over the rover ellipses button on the right of the rover textbox.*

You are done specifying the basic input parameters and ready to process the data.

- ❖ To start **processing**, click the '**Run**' button at the very bottom of the main window. The button caption changes to '**Abort**' and the progress bar starts moving; the message display panel displays message about what is happening behind the seen. After Horus™ finishes processing, it will beep and it will display a '**done**' message; the 'Abort' caption will also change to 'Run'. That means you have successfully prepared the rover data for other uses and that the single point positioning trajectory is ready to view.

- *The first time processing of a 'raw' data file takes a little longer than the following ones. That is because data preparation usually happens only once.*

- ❖ Horus™ provides **two views** of the data and results, **textual** and **graphical** as shown in Figure 1. For example, to see textual view of the rover data file, click the rectangular button above the ellipses button of the rover textbox. A text window will open showing the contents of the rover 'text' data. To see the same data but this time in the form of plots and charts (graphical), click on the round button next to the rectangular one above the rover textbox. Another window will open showing some plotting area and menu options in a completely new world; this is the 'rtkplot' world; see the instructional material for details of these utilities or refer to the 'rtklib 2.4.2' reference manual.

Click the 'text' view rectangular button above the 'solution' textbox; a text window shows a tabular form of the solution trajectory with or without header information. The 'graphical' view button, however, shows the trajectory in a 2D map-like chart. In this plot window, you can also see the 'events' trajectory overlaid on top of the solution trajectory. To see it, click the 'path/waypoints' button in the middle of the plot menu toolbar.

A textual view of the '**events**' trajectory is also available by clicking on the second rectangular button above the 'solution' textbox of the 'main' window (not the plot window). Check your data and the solution trajectory by browsing around and make sure the data and the solution make sense to you. You can also check start and end dates and times and work around the '**date/time**' panel.

Notes:

- RTKLIB 2.4.2 library © 2007-2013 by T. Takasu
- Consult the instructional material on Geomatics.us website for examples of the solution trajectory reports

Processing Modes

Horus™ processes the acquired rover data as:

- a) Stand-alone **single** point positioning: in which case no correction source is used; this case is meant for quick overview of the acquired data
Or
 - b) **Differential** positioning where a correction source is specified in addition to the rover acquired data.
- *Sub-foot positioning accuracy is only possible under the differential processing mode. Generally speaking, differential positioning should result in better quality solution than single point positioning*

Click the '**Base**' checkbox of the main window to enable the correction-based differential processing mode. The 'base' panel shows up in the main window and a new radio group shows up in the 'options' panel to the right of the main window, as shown in Figure 2. The correction sources are:

1. USER-defined Correction Source

Check this option when you have run a stationary G1-m1™ or equivalent receiver in a nearby control station of known coordinates. The acquired base data is treated the same way the acquired rover data is treated in the previous section. Drag the base data file and drop it onto the textbox in the 'Base' panel; alternatively, you can click the ellipses button to the right of the textbox to browse to the data file and select it. Then specify the antenna type and its height above ground. In addition to the data file and the antenna used at the base station, the base station ID and coordinates are required. You can type these information in the corresponding textboxes. Alternatively, you can click the 'Get Station' button and select it from a pre-defined 'USER' stations database.

- *The 'USER' station database is stored in a text file called "StationsUSER.pos". You can edit the file in a text editor and make changes as necessary. You cannot, however, change the formatting of the data entries. A '%' indicates a 'comment' ignored by Horus™.*
- *Do NOT change the filename or its location, otherwise Horus™ will not know about the 'USER' database*
- *Running a dedicated 'base' station guarantees best survey results. Some nearby CORS data may not be available at the survey time; it is a free service!*
- *You can also modify the coordinate values in the base panel by editing the textboxes manually and then click 'Put Station' to add the new station to the 'USER' database.*

2. CORS* Correction Source

**Continuously Operating Reference Stations*

This is a free service operated and maintained by the US National Geodetic Survey of the US federal government National Oceanic and Atmospheric Administration. Several hundred stations sparsely located throughout North America

and some other locations in the world makeup the network. CORS data is available through anonymous ftp or http; Horus™ uses the former method.

To specify a datum, click on the 'CORS' radio button in the 'Base Station' group. Two datums are supported, WGS84 as defined by IGS08 epoch 2005 and NAD83 as defined by CORS 2011 epoch 2010. Each datum has its own stations database accessible by clicking the 'Get Station' button.

- *In CORS mode, you CANNOT and should not change the database. The 'Put Station' button is disabled. In case NGS updates its CORS stations database and changes are needed to the database files, GUSA will redistribute the new files through its website. In which case, just replace the 'stationsNAD83.pos' and 'stationsWGS84.pos' files with the new ones.*

Horus™ arranges the CORS stations in the database dialog box based on their spatial proximity to the rover. Click the station you would like to use (usually the top-most one) and then click on the 'OK' button. The station 'id' and coordinates will populate the corresponding textboxes of the interface. Although you can technically change the 'id' and/or the coordinate values, it is highly recommended that you do not do so unless you have a reason.

Whether the base station is "USER" or "CORS", the rover data is now ready to be processed again with appropriate corrections from a base station. Hit the '**Run**' button and watch Horus™ process and display messages until it reaches the end of the rover data. You will hear a **beep** and the '**done**' message will show in the 'message' panel. You are ready to examine the results the same way you did in the viewing section.

- *In order to use CORS correction source, your computer MUST be connected to the internet. Horus™ may also require permission from the Windows Firewall installed on the computer; if prompted, allow access to the internet. You may also need to 'add' Horus™ to the 'exceptions' under the 'privacy' section of the Windows firewall.*
- *In CORS mode, Horus™ automatically recognizes the required file to download off the NGS ftp server by reading the rover info from its Rinex 'obs' file. It is highly recommended that you have already pre-processed the rover data in 'single point' processing mode as described in the previous section.*
- *In CORS mode, if the antenna type is set to '*' and the antenna height is '0', Horus™ will automatically read those values from the downloaded 'obs' file.*
- *The 'Solution' panel does not change whether Horus™ is in single point or differential processing mode; the 'solution' information is based on the 'rover' panel information.*

Data and Files

Data processing, in the context of this guide, means extracting the rover trajectory from the acquired raw data. The trajectory includes the system positions and optionally its velocities and accelerations. Special events using the G1-m1™ receiver EVT marker, if collected during the data acquisition session, will also be extracted in a separate trajectory file.

File Names: Each acquired data set is stored in a file. The filename consists of the three letters in the receiver serial number followed by the 5-digit file number; the file extension is always 'gps'. For example, a receiver with a serial number containing 'AAD' as the three letters will have a file that looks like 'AAD00010.gps' on the uSD card. Horus™ uses the same base name of the acquired data set for the processed files. It changes the extension to reflect the type of processed data. For example, the following files, shown in Figure 3, will be produced after Horus™ has processed the 'AAD00010.gps' file:

AAD00010.OBS (<i>Rinex 2 equivalent of the raw ranges</i>)	Required to process the data
AAD00010.*NAV (<i>Rinex 2 equivalent of the satellite ephemerides</i>)	If missing, Horus™ will download an online global ephemerides file
AAD00010.EVT (<i>Text file containing the events</i>)	Available only if EVT is used
AAD00010.POS (<i>Text file containing the processed trajectory</i>)	Required to show the solution (trajectory) and its quality
AAD00010.PNT / AAD00010.PATH (<i>Text file containing the events path</i>)	Available only if EVT is used
AAD00010.POS.STAT (<i>Text file containing solution statistics</i>)	Available only if the statistics advanced option was checked



Each raw '.gps' file of the acquired data will be a session. Keep each session in a separate folder. Data folders get larger and can get messy after it is processed.

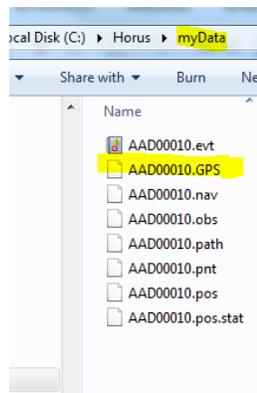


Figure 3: Horus™ Sample Project Folder

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