



FACT SHEET

GNSS CORS Networks and Linking to ITRF

How to link CORS to ITRF

Global Navigation Satellite System (GNSS) baseline processing, whether in post processing or in real time mode, solves a baseline between a known reference and an unknown rover position. The baseline computation is often carried out in the 'World Geodetic System 1984' (WGS84) coordinate system. Thus WGS84 coordinates of the rover are determined relative to the WGS84 coordinates of the reference. Any transformation to local coordinates (or geodetic datum) is carried out afterwards. For successful baseline processing, the WGS84 coordinates of the reference position should be known accurately. As the purpose of reference stations is to serve as the basis for determining the positions of rover receivers, it follows that accurate WGS84 coordinates are needed for the reference stations. There is a global network of over 300 IGS (International GNSS Service) stations. The coordinates of these stations are given in an International Terrestrial Reference Frame (ITRF). For simplicity it could be assumed that the ITRF coordinates of the IGS stations are just about the most accurate WGS84 coordinates available.

Many countries already have a national network of GNSS reference stations. Such a network will usually have been connected to the IGS network and thus the stations will have accurate WGS84 or ITRF coordinates. When establishing a new stand-alone reference station or a new network of stations, it will usually be preferable to connect the new station or the new network to the national network. It is therefore recommended that the national survey organization be contacted for information on the national network and how to obtain data from the national stations. If there is no suitable national network, then the alternative is to connect the

new station or the new network of stations to the IGS network.

For general information on the IGS network and how to obtain RINEX data files consult the 'More Information' section of this fact sheet.

To determine the ITRF or WGS84 coordinates of a new stand-alone station or the "master" station of a new network, the following is suggested:

- Select one station of the new network as the "master".
- At the master log data (30 second or 1 minute rate is sufficient) for at least 24 hours, and possibly for up to 7 days.
- Download RINEX data from the closest IGS station or from the closest national station.
- Process the baseline from the IGS station, or from the national station, to the master using 24 hours of data. If data has been logged for several days, process the baseline for different 24-hour periods and take the mean.
- If possible, process the baselines to the master from an additional one or two IGS or national stations. Take the mean.
- This will provide very accurate ITRF or WGS84 coordinates for the master and link the master to the IGS or national network.

The ITRF or WGS84 coordinates of the stations of the new network have to be fiducially accurate, i.e. the network has to have a very high degree of relative accuracy between the stations. The following procedure is recommended:

- At all stations log data (30 second or 1 minute rate is sufficient) for at least 24 hours, and possibly for several days.
- Using the ITRF or WGS84 coordinates of the master as the starting point, process all the baselines of the network using 24 hours of data. Possibly repeat for another one or



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two 24-hour periods. Adjust the network if adjustment software is available.

- This will provide ITRF or WGS84 coordinates for all stations. The coordinates will have a high degree of relative accuracy.

Note - If real time kinematic (RTK) or differential GNSS is being used to determine coordinates of new points then the resulting position will normally be based on the reference frame defining the reference stations transmitting the real time corrections.

In a GNSS CORS network the surveyor will normally derive a height based on the reference ellipsoid ie Geodetic Reference System 1980 (GRS80). Most users however are working with 'physical' heights based on a local height datum (ie local mean sea level) and thus need to relate the derived ellipsoid height to this local height datum. This is achieved by using a geoid model for the subject survey area.

On-Line GNSS Processing Services

In situations whereby there are no existing ITRF based networks, and processing software is unavailable or not suitable, then there are also internet based on-line processing services which derive ITRF co-ordinates or positions if sufficient RINEX data has been submitted for processing. These systems will provide a position solution based on an ITRF co-ordinate system by calculating baselines from nearby GNSS reference stations of known ITRF position. These reference stations could be in another country and / or IGS sites. Refer to the following web locations to find out more about such on line GNSS processing services and their requirements -

- Auto Gipsy (JPL) - Service provided by JPL <http://milhouse.jpl.nasa.gov/ag/>
- AUSPOS (Geoscience Australia) - Service provided by Geoscience Australia <http://www.ga.gov.au/geodesy/sgc/wwwgps/>
- OPUS - Service provided by NGS, USA <http://www.ngs.noaa.gov/OPUS/>

- SCOUT (SOPAC) - Service provided by SOPAC, USA <http://sopac.ucsd.edu/cgi-bin/SCOUT.cgi>
- CSRS-PPP (NRCAN GSD) - Service provided by Natural Resources, Canada http://www.geod.nrcan.gc.ca/ppp_e.php

More information

The following web pages will provide more information on this topic -

- UNAVCO (For TEQC tool) <http://www.unavco.org/facility/software/pre-processing/preprocessing.html>
- IGS (International GNSS Service) <http://igsceb.jpl.nasa.gov/>
For information on the IGS network
- EUREF (RINEX data) <http://www.epncb.oma.be/dataproducts/dacentres/index.php>
- SOPAC (info on IGS and RINEX data files) <http://sopac.ucsd.edu/cgi-bin/dbShowArraySitesMap.cgi>
- NGS (For information on RINEX) <http://www.ngs.noaa.gov/CORS/instructions2/>
- RINEX (Receiver Independent Exchange Format) <http://www.aiub-download.unibe.ch/rinex/rinex300.pdf>
- ITRF International Terrestrial Reference Frame <http://itrf.ensg.ign.fr/>

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The authors encourage feedback and comments on the usefulness of the fact sheet.