

PBO GPS Velocity Field Naming Convention and Format Description

This document describes the naming convention and internal format for PBO GPS velocity field files.

1 Background

PBO has two GPS Analysis Centers (ACs) that process raw GPS data and produce position solutions for all stations in the PBO and PBO Nucleus networks as well as selected other stations. One AC is operated by the Geodesy Laboratory at Central Washington University and the other by the Berkeley Seismological Laboratory at the University of California, Berkeley. These ACs produce GPS station position solutions on a daily basis using rapid orbit products (“rapid” solutions), as well as with about 14 days latency using the final orbit products (“final” solutions). The ACs send both the rapid and final solutions to the PBO Analysis Center Coordinator (ACC) at MIT. The rapid and final products are available separately from the PBO GPS Archives with latencies of about 24 hours and 14 days, respectively.

The ACC first rotates each of the individual AC products into a single common reference frame. The ACC then combines these intermediate rotated products to produce a single best-estimate PBO combined solution for station position and velocity. The intermediate and final combined products are also available from the PBO GPS Archives with latencies of about 24 hours and 14 days (rapid and final).

From these products, the ACC generates a velocity field estimate which is stored separately and also available from the PBO GPS Archives.

For further details of the GPS processing and products, please see the PBO GPS Processing Plan and the Preliminary Design Review document for PBO data management, both of which are available on the PBO web site.

2 File Name Convention

Each velocity field estimate generated by the GPS Analysis Center Coordinator is identified with a unique file name, with the structure

`<AC_ID>.<PROD_ID>.vel`

where

- **<AC_ID>**
A string that identifies the PBO Analysis Center from whose work the velocity field is derived. Values are one of **CWU** (Central Washington University), **BSL** (Berkeley Seismological Laboratory), or **PBO** (Combined solution from MIT).
- **<PROD_ID>**
A string that identifies the product type. Values are
rapid_loose: Rapid product from a given AC, in the loose reference frame used by that AC.
final_loose: Final product from a given AC, in the loose reference frame used by that AC.
rerun_loose: Rerun product from a given AC, in the loose reference frame used by that AC.

`rapid_frame`: Rapid product from a given AC, rotated into a common reference frame.
`final_frame`: Final product from a given AC, rotated into a common reference frame.
`rerun_frame`: Rerun product from a given AC, rotated into a common reference frame.

For example, the network velocity field derived from final combined solutions generated by the Analysis Center Coordinator would be named `PBO.final_frame.vel`.

3 PBO GPS Network Velocity Field Format

PBO GPS network velocity fields are made available in ASCII format. The file begins with a set of header lines:

```
PBO Network Velocity Field
Release date: YYYYMMDD hhmmss
```

where the release date is the UTC date and time at which the velocity field file was written. In this date, `YYYY` is the 4-digit year, `MM` is the 2-digit month, `DD` is the 2-digit day of month, `hh` is the 2-digit hour, `mm` is the 2-digit minute, and `ss` is the 2-digit second.

Following the header are a series of lines giving one or more velocity estimates for each station. Each velocity estimate is valid for a specified range of epochs and was estimated on a given date. These lines have the structure

```
Dot# station_name ref_epoch ref_jday ref_XYZ ref_NEU...
  X Y Z xx yy zz xy xz yz  N E U nn ee uu ne nu eu first_epoch last_epoch
```

where `...` indicates the line has been wrapped for ease of printing. The entries are described in Table 1 below. Note that all times and dates given are in UTC.

Table 1: PBO GPS Network Velocity Field Format

Entry	Definition
Dot#	4-character PBO Dot Number for a given station
station_name	16-character station name
ref_epoch	Date and time at which the station position is as given in <code>ref_XYZ</code> and <code>ref_NEU</code> . Also the date and time for which the given velocity is first valid. Format is <code>YYYYMMDD,hhmmss</code> . <code>YYYY</code> is the 4-digit year, <code>MM</code> is the 2-digit month, <code>DD</code> is the 2-digit day of month, <code>hh</code> is the 2-digit hour, <code>mm</code> is the 2-digit minute, and <code>ss</code> is the 2-digit second.
ref_jday	Reference epoch, represented as Modified Julian day.
ref_XYZ	Reference position, in ITRF Cartesian coordinates, in meters
ref_NEU	Reference position, given as latitude, longitude and elevation relative to the WGS-84 ellipsoid. Latitude is in decimal degrees, North positive. Longitude is in decimal degrees, East positive. Elevation is in meters.
X	X component of station velocity, in meters/yr. Positive if the station moves in the positive X direction as defined for the ITRF standard Cartesian coordinate system.
Y	Y component of station velocity, in meters/yr. Positive if the station moves in the positive Y direction as defined for the ITRF standard Cartesian coordinate system.
Z	Z component of station velocity, in meters/yr. Positive if the station moves in the positive Z direction as defined for the ITRF standard Cartesian coordinate system.
xx	Standard deviation of X velocity, meters/yr
yy	Standard deviation of Y velocity, meters/yr
zz	Standard deviation of Z velocity, meters/yr
xy	Correlation of X and Y velocity, meters/yr
xz	Correlation of X and Z velocity, meters/yr
yz	Correlation of Y and Z velocity, meters/yr
N	North component of station velocity, meters/yr. Positive if the station moves northward.
E	East component of station velocity, meters/yr Positive if the station moves eastward.
U	Vertical component of station velocity, meters/yr Positive if the station moves downward.
nn	Standard deviation of North velocity, meters/yr
ee	Standard deviation of East velocity, meters/yr
uu	Standard deviation of vertical velocity, meters/yr
ne	Correlation of North and East velocity, meters/yr
nu	Correlation of North and vertical velocity, meters/yr
eu	Correlation of East and vertical velocity, meters/yr
first_epoch	Epoch of first data used to derive the station velocity, in the same format as <code>ref_epoch</code> .
last_epoch	Epoch of last data used to derive the station velocity, in the same format as <code>ref_epoch</code> .

See the PBO web page for a reference for the Modified Julian date.

A given station may have more than one velocity in a given velocity file, for example if the station is near a large earthquake and is affected by postseismic deformation. In this case, there will be two different

velocity lines in the given file, with different `first_epoch`, `last_epoch`, and `valid_epoch`. A given velocity is valid from until a new `valid_epoch` is given for the same station.

An example file would have the following internal structure

PBO Network Velocity Field

Release date: 20051001 000000

```
P041 Marshall__CD2004 20040330,000000 53094 39.949481 -105.193900 1809.6159...
    0.0012 0.0034 -0.0056 0.0001 0.0023 0.0045 0.0067 0.0089 0.0001...
    -0.0023 0.0045 -0.0067 0.0002 0.0003 0.0004 0.0005 0.0006 0.0007...
    20040101,000000 20040517,235945
P511 CoxcombMtnCS2005 20050901,000000 53614 33.886935 -115.296100 273.3447...
    0.0023 0.0045 -0.0067 0.0012 0.0034 0.0056 0.0078 0.0090 0.0012...
    -0.0010 0.0029 -0.0038 0.0047 0.0056 0.0065 0.0074 0.0083 0.0092...
    20050801,000000 20050927,235945
P067 CleggRanchCS2004 20040715,000000 53201 35.551751 -121.002958 106.9845...
    0.0012 0.0034 -0.0056 0.0001 0.0023 0.0045 0.0067 0.0089 0.0001...
    -0.0023 0.0045 -0.0067 0.0002 0.0003 0.0004 0.0005 0.0006 0.0007...
    20040101,000000 20040927,235945
P067 CleggRanchCS2004 20040929,000000 53201 35.551752 -121.002960 106.9852...
    -0.0008 0.0022 0.0022 0.0010 0.0018 0.0105 0.0102 0.0310 0.0508...
    +0.0058 -0.0032 0.0011 0.0002 0.0008 0.0114 0.0039 0.0206 0.0647...
    20050929,000000 20050915,235945
```

and so on, where ... indicates that a single line has been broken for clarity.

In this case, stations `Marshall__CD2004` (P041) and `CoxcombMtnCS2005` (P511) have only one velocity. Station `CleggRanchCS2004` (P067) was near the 28 Sept 2004 Parkfield earthquake and has two different velocities, one determined from data prior to the event, and one determined from data following the event. These are given on separate lines.