GPS data from receiver to processing input

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Raw data formats

Receiver:
- Ashtech
- Leica
- Topcon
- Trimble

Raw format:
- B-file
- R-file

Pre-processing:

Translation:
- RINEX Converter*
- TEQC
- ConvertToRINEX*

RINEX file

* Windows only
Motivation for Receiver INdependent EXchange (RINEX) format

- All manufacturers have developed their own proprietary file formats for data storage specific to their receivers and processing software
  - Problems occur when processing data from another manufacturer’s receiver

- RINEX developed by the Astronomical Institute of the University of Berne to allow easy and universal exchange of raw GPS data
  - Principal driver was the large European GPS campaign EUREF 89 - involved more than 60 GPS receivers of 4 different manufacturers.
RINEX formats

• RINEX 2
  – Short file names (explained in proceeding slides)
• RINEX 3
  – Long file names (explained in proceeding slides)
• GAMIT currently works with the RINEX 2 format and GPS observables only
• Support for RINEX 3 and GNSS (e.g. GLONASS) observables are under development
RINEX (2) data format

- Includes text file formats for:
  - observation ("o")  } most important for most users
  - navigation ("n")
  - meteorological ("m")
  - ionospheric data ("i")
- Latest definition at ftp://ftp.igs.org/pub/data/format/rinex211.txt
- Each file type consists of a header section and a data section
- Header section contains global information for the entire file and is placed at the beginning of the file.
  - Contains header labels in columns 61-80 for each line contained in the header section
  - These labels are mandatory and must appear exactly as per format description
- RINEX 2 filename convention:
  - For site SSSS, on day-of-year DDD, session T and year YY:
    • SSSSDDDT.YYo (RINEX observation file ie the site’s GPS data)
    • SSSSDDDT.YYn (RINEX navigation file ie the broadcast ephem)
  - E.g., hers1270.03o is observation data for Herstmonceux, day 127, session 0, year 2003.
- All the dates and times in GPST
An example of RINEX (2) observation data

<table>
<thead>
<tr>
<th>PRN</th>
<th>Time (hh:mm:ss)</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>Time of First Obs</th>
<th>Time of Last Obs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRN02</td>
<td>02 10</td>
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<td>00</td>
<td>15.000000000</td>
<td>0 9</td>
<td>2 3 8 15 17 18 22 27 31</td>
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<td>20804365.462</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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RINEX (3) data format

- Must be able to accommodate increased number and complexity of observations from multi-GNSS observations (GPS, GLONASS, Galileo, etc.)
- Each file type consists of a header section and a data section
- Header section contains global information for the entire file and is placed at the beginning of the file.
  - Contains header labels in columns 61-80 for each line contained in the header section
  - These labels are mandatory and must appear exactly as per format description
- RINEX 3 filename convention is longer and more complicated than for RINEX 2, e.g. TG0100USA_R_20150010000_01D_30S_GO.crx.gz

- 4-character site ID (same as RINEX 2)
- Monument and receiver indices
- ISO country code
- Data source (R = receiver)
- First epoch (YYYYDDhhmm)
- File length (01D = 1 day)
- Observation interval and type
Compressing/Uncompressing RINEX

- File compression
  - “*.zip” files
    - Uncompress using “unzip”, “pkzip” or “WinZip”
    - See http://www.pkware.com/ or http://www.winzip.com/, or http://www.7-zip.org/
  - “*.??o.Z” (RINEX 2) and “*.rnx.gz” (RINEX 3) files (UNIX compress or gzip)
    - e.g., hers0010.02o.Z, TG0100USA_R_20150010000_01D_30S_GO.rnx.gz
    - Uncompress using “uncompress”, “gunzip”, “7zip”, “WinZip” or similar
  - “*.??d.Z” (RINEX 2) and “*.crx.gz” (RINEX 3) files (Hatanaka compression)
    - e.g., hers0010.02d.Z, TG0100USA_R_20150010000_01D_30S_GO.crx.gz
    - Need to uncompress as above to get *.??d and *.crx files
    - Then need to ‘unHatanaka’ using CRX2RNX from http://sopac.ucsd.edu/dataArchive/hatanaka.html
  - Leica Geo Office uncompresses files automatically when using “Internet Download” tool. For manual import you need to uncompress the files manually
runpkr00 (Trimble raw to dat)

• Proprietary software from Trimble
• Maintained by UNAVCO nowadays
  – http://facility.unavco.org/kb/questions/744/
• runpkr00 -g -adeimv <raw file> [dat-file root]
• Converts raw data from Trimble receiver to teqc-compatible input “dat”-file
• Always use “-g” option separately from other options
Pre-processing data

- Some level of data quality control may be performed prior to any data processing
- Utilities are available to perform simple but valuable tests
  - The most common example is TEQC (pronounced “tek”)
    - Translate, Edit, Quality Check
    - Translates common binary formats to RINEX format
    - Header editing, windowing, splicing of RINEX data
    - Quality check in ‘lite’ mode (no navigation file) or ‘full’ mode (navigation file available)
    - Download for free from

http://www.unavco.org/facility/software/teqc/teqc.html#executables
Using teqc

- Be sure to use correct raw format
  - teqc -tr d <Trimble .dat file>
  - teqc -ash d <Ashtech B-file, etc.>

- Ability to control observations using “-O.obs”
  - teqc -O.obs L1L2C1P2 -tr d <Trimble .dat file>

- Ability to control header information with other “-O.xxx” options
  - teqc -O.o “M. Floyd” -O.obs L1L2C1P2 -tr d <Trimble .dat file>

- May create and use a teqc configuration file for consistent information
  - teqc -config teqc.cfg -tr d <Trimble .dat file>

- Use a script or command line loop to create RINEX files in batch
TEQC

• Quality Control (QC)
  – In ‘lite’ mode, teqc doesn’t know anything about the satellite positions
    • teqc +qc site1891.02o > teqc.out
    • 7 files generated; use the -plots switch to prevent all but the summary (‘S’) file being generated
  – In ‘full’ mode, additional information is available based on the satellite positions
    • teqc +qc -nav site1891.02n site1891.02o > teqc.out
    • 9 files generated (elevation and azimuth of satellites)
  – Full solution if navigation file matches observation file, e.g. site1891.02o and site1891.02n,
    • teqc +qc site1891.02o > teqc.out
Approximate position

Accurate a priori coordinates necessary for good GPS processing

1. Run teqc to create RINEX observation and (broadcast) navigation files, e.g.
   
   \[ \text{teqc} +\text{nav abcd3650.14n +obs abcd3650.14o -tr d 12343650.dat} \]

2. Run teqc in qc-mode on observation file with navigation file to get pseudorange-derived estimate of approximate coordinate, e.g.
   
   \[ \text{teqc +qc -nav abcd3650.14n abcd3650.14o} \]

May also be done using GG’s \texttt{sh_rx2apr}