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A Recipe for Processing Positions of a GPS Network Using GAMIT/GLOBK

by

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Objective: calculate position of site AAUC using 3 IGS stations MORP, ONSA, and POTS

This recipe follows one by Eric Calais called "GAMIT—A WORKING RECIPE". His recipe is available at:
http://www.eas.purdue.edu/~calais/teaching/eas591t/gamit.recipe

Date Updated: 21 March 2004.
Version of software: Gamit/Globk version 10.01 - 2004/02/10.

Commands in italics are from GAMIT, and thus they require that GAMIT is correctly compiled and installed on your server/workstation. You can ask for a free GAMIT license from Robert King at MIT. This information is at the GAMIT/GLOBK homepage:
http://www-gpsg.mit.edu/~simon/gtgk/

1 Prepare files in working directory

- CREATE A PROJECT DIRECTORY
  - mkdir aauc
- CREATE A WORKING DIRECTORY WITHIN YOUR PROJECT DIRECTORY

  - mkdir aauc/001

- GO TO YOUR WORKING DIRECTORY
  - cd aauc/001
- GET (AND UNCOMPRESS) YOUR DATA FILE(S) FROM ARCHIVE
  - The archive could be an ftp site, local disk, or an http web site. For example: http://gps.aau.dk/aauc/data/2004/
  - For this exercise, I chose the GPS station in Aalborg (AAUC) for the first day (001) of 2004.
  - The files stored on this website are in *.zip format and can be decompressed easily with PC software like WinZip or PCZip. Also, Windows XP has the capability of decompressing *.zip files.
  - The archive on the Danish GPS Center's web site stores the station observation file and a navigation file at the receiver. The navigation file can be discarded; we will get a different navigation file from another database (called auto0010.04n).
- CHOOSE IGS FILES FOR TIE TO ITRF: For IGS files stored locally
  - For efficiency, IGS station files may be stored locally on an archiving disk, or on an ftp site (lox.ucsd.edu). The files may be stored in /my_disk/data_directory/001 or on an ftp site in Hatanaka compressed format. If so, you would need to uncompress them and convert them to rinex format
    * cp /my_disk/data_directory/001/????0010.04d.Z
    * uncompress *Z
    * *crx2rnx* ????0010.04d
    * rm *.04d
- CHOOSE IGS FILES FOR TIE TO ITRF: For IGS files stored on IGS ftp site
  - http://igscb.jpl.nasa.gov/network/map.html
  - Click Europe on the world map.
  - Choose your IGS reference sites.
    * Recommendation: The shorter the baselines the better. That is, I prefer baselines to be shorter than 100 km. This, however, is not always a plausible or best situation. I chose as the reference sites: MORP, ONSA, and POTS.
- GET IGS DATA FILES
  - ftp lox.ucsd.edu [anonymous]

    - cd /pub/rinex/2004/001
    - bin
    - mget morp0010.04d.Z
    - mget onsa0010.04d.Z
    - mget pots0010.04d.Z
    - quit

- UNCOMPRESS AND CONVERT DATA FILES TO RINEX FORMAT
  - uncompress *Z
  - *crx2rnx* morp0010.04d
  - *crx2rnx* onsa0010.04d
  - *crx2rnx* pots0010.04d
  - *crx2rnx* aauc0010.04d (if needed; that is, the data on the Danish GPS Center's web site is already in rinex format)
  - rm *.04d

- GET EPHEMERIDES FILE, THEN UNCOMPRESS AND CHANGE NAME
  - The name needs to be changed such that GAMIT will recognize the ephemerides file
  - `ftp lox.ucsd.edu` [anonymous]
    - cd /pub/rinex/2004/001
    - bin
    - get auto0010.04n.Z
    - quit
  - uncompress auto0010.04n.Z
  - mv auto0010.04n epgga4.001

- GET PRECISE IGS ORBIT AND UNCOMPRESS IT
  - *gweek* 001 2004 [answer = 1251 4], OR
  - *doy* 2004 001
  - If you don't have GAMIT installed yet, there is a handy web site that has a calendar for GPS time at: `http://www.ngs.noaa.gov/CORS/Gpscal.html`
  - `ftp igscb.jpl.nasa.gov` [anonymous]
    - cd igscb/product
    - cd 1251
    - bin
    - get igs12514.sp3.Z

    - quit
  - uncompress igs12514.sp3.Z

- LINK TABLES
  - *link_tables* 2004 /home/soft/geodesy/mit/tables (on my workstation)
    - The path that you are linking to your working directory will depend on the location of GAMIT.
    - We link tables so that we don't have to copy them to each working directory (there is a working directory for each day of the year). A large amount of storage space would be needed if we stored the tables in each working directory.
    - The commands add 14 new files to the working directory. The files appear in bold case because they are linked.

- PREPARE L-FILE: A PRIORI COORDINATES (Section 4.2 in GAMIT manual)
  - Option 1:
    - *gapr_to_l* gt/itrf00.apr ltmp "" 2004 001
    - grep MORP ltmp >! laauc4.001 (not in ITRF2000 will need info)
    - grep ONSA ltmp >> laauc4.001
    - grep POTS ltmp >> laauc4.001
    - grep AAUC ltmp >> laauc4.001 (not in ITRF2000 will need to add info)
    - rm ltmp
  - Option 2:
    - *gapr_to_l* gt/itrf2000_2001_rfwg ltmp "" 2004 001
    - grep MORP gt/litrf00.2004_001 >! laauc4.001 (will need info)
    - grep ONSA gt/litrf00.2004_001 >> laauc4.001
    - grep POTS gt/litrf00.2004_001 >> laauc4.001
    - grep AAUC gt/litrf00.2004_001 >> laauc4.001 (will need info)
  - If a station is not in litrf00.2004_001, then use its approximate coordinates from the rinex file header and transform them to spherical with *tform*.
    - *tform*
    - 1 (Cartesian coordinates)

    - Enter (we want terminal input)
    - Type coordinates from header
    - 4 (cartesian to spherical)
    - 2 (spherical)
    - 2 (output to be in form of L-file)
    - Enter (we want terminal output)
    - 3 (quit)
    - Now you have your coordinates to copy and paste into the L-file
  - Edit laauc4.001: add one line at the top of the file, for example: 'Epoch 2003.0247: From file itrf00.apr'. The line can say anything.
  - Note the formatting of the L-file (see GAMIT manual).

- PREPARE STATION.INFO: ANTENNA HEIGHTS, EQUIPMENT TYPE (Section 4.3 in GAMIT manual)
  - grep MORP gt/station.info >! station.info
  - grep ONSA gt/station.info >> station.info
  - grep POTS gt/station.info >> station.info
  - grep AAUC gt/station.info >> station.info (will need to add info)
  - Edit station.info:
    - add info for sites not present in station.info
    - use rcvant.dat to find receiver and antenna code
      - Only one needs to be added: the Aalborg site. There is not enough information in the aauc observation file to determine the exact type of antenna and receiver. I use an old code for the Ashtech Z-12 receiver, and choose an arbitrary antenna code from rcvant.dat.
    - add first line: aauc pgga
    - add second line, a format statement: (A1,2(A4,1X),A16,F7.4,2(1X,F8.4),2(1X,A6),1x,a5,1X,F5.2, 1X,I4,1X,I3,1x , I 2 , 6 (1 X,I2))
    - add third line: TRCK SITE Station Name Ant Ht Ant N Ant E Rcvr AntCod HtCod Vers Yr Doy SN Start Stop

- PREPARE SITTBL: SITE SPECIFIC PROCESSING PARAMETERS (Section 5.2 in GAMIT manual)
  - grep MORP gt/sittbl. >! sittbl. (will need to add info)
  - grep ONSA gt/sittbl. >> sittbl.

- grep POTS gt/sittbl. >> sittbl.
- grep AAUC gt/sittbl. >> sittbl. (will need to add info)
- Edit sittbl.:
  * add info for sites not present in sittbl.
  * add two lines at the top:
    · SITE FIX WFILE –COORD.CONSTR.– –EPOCH– CUTOFF APHS CLK KLOCK CLKFT DZEN WZEN DMAP WMAP — MET. VALUE—- NZEN ZCNSTR ZENVAR ZENTAU
    · « MY SITES »
  * IMPORTANT: decide on a priori constraints for your sites. This is the user's interaction with the covariance weight matrix. By specifying values for the so-called constraints, one can weight the observations. Large numbers have small weights, and small numbers have large weights due to the nature of the covariance matrix (1/variance).
    · Because the local site, AAUC, is unknown use 99.99/99.99/99.99 (NEU, meters).
    · You can look up good values for the IGS sites at http://igscb.jpl.nasa.gov/network/eur.html.
    · The values that are commonly used are around 0.005/0.005/0.050 for the IGS sites (NEU, meters).
  * set the number of zenith delays to be estimated to 7 (could be as many as 25).

- PREPARE SESTBL: PROCESSING PARAMETERS (Section 5.2 in GAMIT manual)
  - cp gt/sestbl.
  - Edit sestbl. as necessary for your experiment.
    * Check number of zenith delay parameters
    * Check iterations
    * Check satellite constraints
      · If you know something about the behavior of the satellite orbits it may be necessary to change this.
    * Check choice of experiment

- WHAT SHOULD THE WORKING DIRECTORY NOW CONTAIN?
  - It should contain similar files to the following:
    * aauc0010.04o epgga4.001 grid.oct laauc4.001 morp0010.04o pole. sestbl. station.info svs_exclude.dat antmod.dat fort.106 gt leap.sec nutabl. pots0010.04o sittbl. stations.oct ut1. autcln.cmd gdetic.dat igs12514.sp3 luntab. onsa0010.04o rcvant.dat soltab. svnav.dat

2 Prepare GAMIT run

- FIRST, PREPARE SESSION
  - *makexp* aauc pgga epgga4.001 2001 001 4 laauc4.001 30 00 00 2880
- THEN, PREPARE ORBIT FILE WITH PARTIAL DERIVATIVES
  - *sh_sp3fit* -f igs12514.sp3
  - *sh_check_sess* -sess 001 -type gfile -file gpgga4.001
- PREPARE SATELLITE CLOCK FILES
  - *makej* epgga4.001 jpgga4.001
  - *sh_check_sess* -sess 001 -type jfile -file jpgga4.001
- CONVERT RINEX FILES TO X-FILES
  - *makex* aauc.makex.batch > /dev/null
- PREPARE GAMIT BATCH FILE
  - *fixdrv* daauc4.001

3 Run GAMIT

- In the foreground: csh baauc4.bat
- In the background: csh baauc4.bat > /dev/null &

4 Evaluate the quality of the results

- grep “Postfit nrms” qaauca.001
  - the postfit rms should be less than 0.5. If it is not, the data is either no good, or there is a problem in your processing scheme.
- Edit output file `qaauca.001` and verify that the adjustments (only provided for the two constrained solutions) are small: they should be on the order of a few millimeters.

5 GLOBK

- I am less familiar with this part of the data processing. In summary, though, GLOBK uses the output q-file and/or h-file from GAMIT. It reads the covariance matrix, positions, and other information from the two files. In the step of GLOBK, the positions determined by GAMIT are combined and adjusted into a specified reference frame i.e. "stable" Eurasia, "stable" North America, or better ITRF. These reference frames are specified by groups of GPS sites designated to represent the reference frame. The sites are designated for different reasons; depending on your purpose, this may have a significant effect on your evaluation of positions. The manual can be found at the GAMIT/GLOBK homepage.

Additional Resources

- http://www-gpsg.mit.edu/~simon/gtgk/
  - Gamit-Globk homepage at MIT. The GAMIT and GLOBK manuals are found here.
- http://www.seismo.berkeley.edu/~battag/GAMITwrkshp/wrkshp.html
  - Gamit/Globk tutorial
- http://sopac.ucsd.edu/processing/gamit/
  - GAMIT setup files from SOPAC
- ftp.ngs.noaa.gov
  - Public data from permanent GPS array in US. The array is a collection of rinex files from GPS networks (SCIGN, PANGA, SOPAC, etc.) which make up the CORS network (archived by the U.S. National Geodetic Survey).