LAB 3
GNSS data post-processing

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RTKLIB

http://www.rtklib.com/
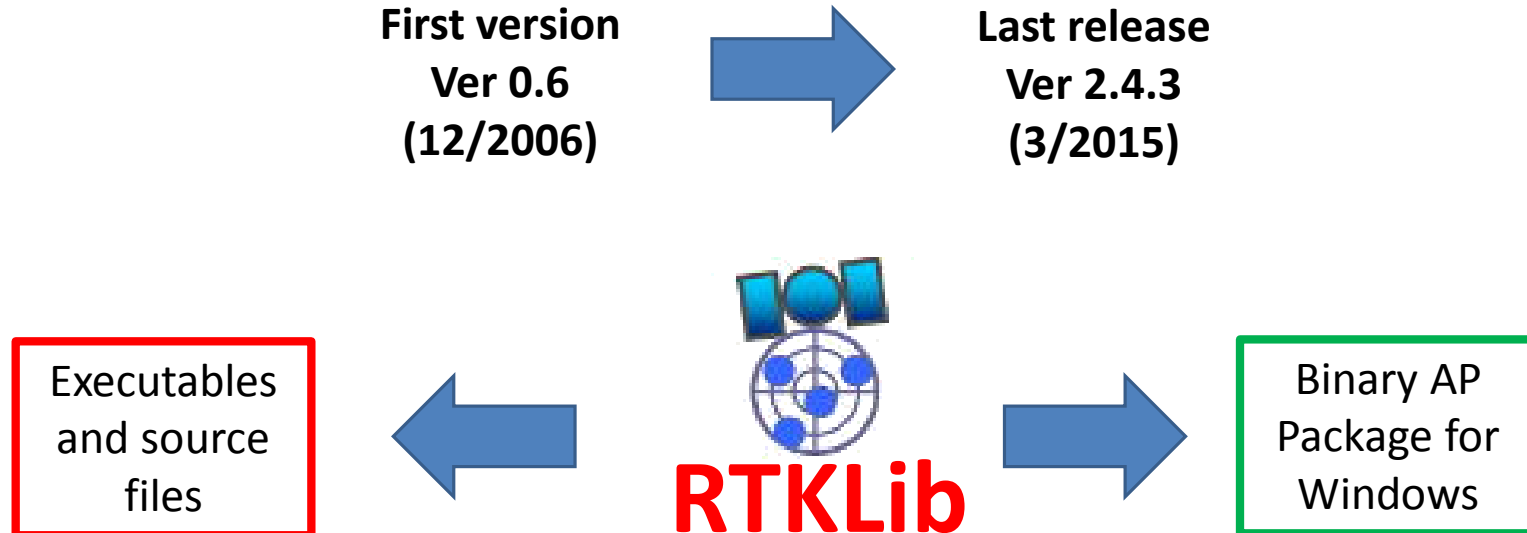
RTKLIB is a suite composed of numerous tools and applications, developed by Tomoji Takasu of the Laboratory of Satellite Navigation, Tokyo University of Marine Science and Technology.

First version
Ver 0.6
(12/2006)

→

Last release
Ver 2.4.3
(3/2015)

RTKLib

Executables and source files ← **RTKLib** → Binary AP Package for Windows

http://wiki.openstreetmap.org/wiki/RTKLIB

- **Supported satellite constellations**: GPS, GLONASS, GALILEO, BEIDOU, QZSS, SBAS

- **Types of positioning obtainable**: Single, DGPS / DGNSS, Kinematic, Static, Moving-Baseline, Fixed, PPP-Kinematic, PPP-Static and PPP-Fixed

- **Supported protocols**: RINEX 2.10, 2.11, 2.12 OBS / NAV / GNAV / HNAV / LNAV / QNAV, RINEX 3.00, 3.01, 3.02 OBS / NAV, RINEX 3.02 CLK, RTCM ver.2.3, RTCM ver.3.1 (with amendment 1-5), ver.3.2, BINEX, NTRIP 1.0, RTCA / DO-229C, NMEA 0183, SP3-c, ANTEX 1.4, IONEX 1.0, NGS PCV and EMS 2.0

- **External communications available**: Serial, TCP / IP, NTRIP, local log file (record and playback) and FTP / HTTP (automatic download)

- **Supported GNSS receivers**: NovAtel: OEM4 / V / 6, OEM3, OEMStar, Superstar II, Hemisphere: Eclipse, Crescent, u-blox: LEA-4T / 5T / 6T, SkyTraq: S1315F, JAVAD: GRIL / GREIS, Furuno: GW -10 II / III and NVS NV08C BINR

RTKLIB

RTKlib is made up of the following modules:

- **RTKconv (data conversion)**

- **RTKget (download data and products from webserver)**

- **RTKpost (post-processing data)**

- **RTKnavi (RTK positioning)**

- **RTKplot (visualization of the GNSS solution)**

- **STRSVR (streaming data to server)**
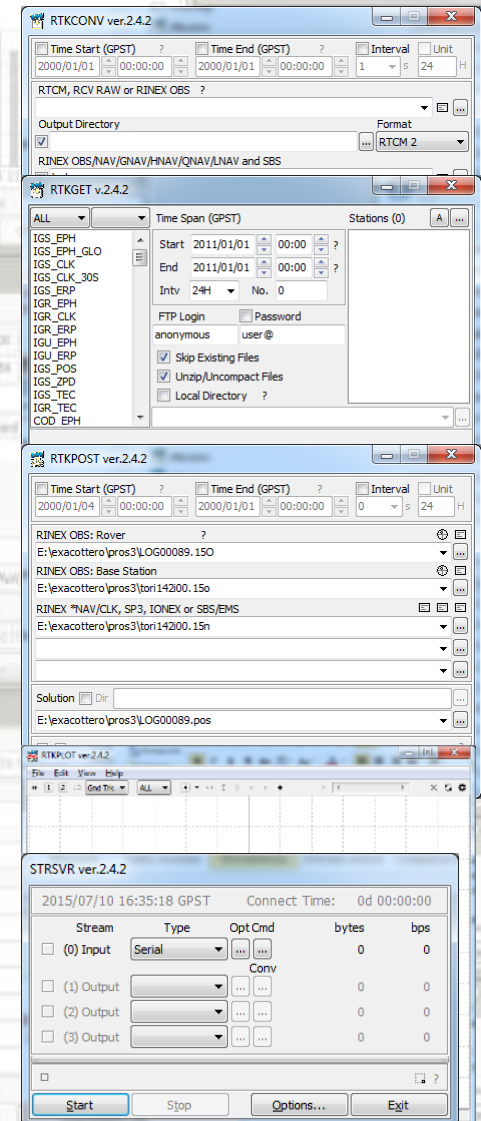
obs: observation for receiver ;
auxiliary files (rinex, nav.....)

RTKLIB

RTKPOST is the tool dedicated to GNSS data processing.

RTKLIB

This tool allows to process GNSS data considering different positioning techniques and different frequencies

it's possible changing costellations.

It is possible to fix the phase ambiguity for GPS, GLONASS and Beidou satellites, in different ways:

- FIX and HOLD
- Istantaneous
- Continuous
- PPP-AR

possible to fix ambiguity not as an integer but as a flot

It is also possible to consider only FLOAT solutions without seeking to fix the phase ambiguity.

Options — Setting2 tab:

Integer Ambiguity Res (GPS/GLO/BDS)	Fix ar	ON	ON
Min Ratio to Fix Ambiguity	3		
Min Confidence / Max FCB to Fix Amb	0.9999	0.25	
Min Lock / Elevation (°) to Fix Amb	10	0	
Min Fix / Elevation (°) to Hold Amb	10	0	
Outage to Reset Amb/Slip Thres (m)	5	0.050	
Max Age of Diff (s) / Sync Solution	30.0	ON	
Reject Threshold of GDOP/Innov (m)	30.0	30.0	
Number of Filter Iteration	1		
Baseline Length Constraint (m)	0.000	0.000	

Load... | Save... | OK | Cancel

The fixing strategies for the GPS constellation are:

- **OFF**: No ambiguity fixing

- **Continuous**: ambiguities are continuously estimated and resolved in full

- **Instantaneous**: ambiguities are estimated and resolved era by era (epoch - by - epoch)

- **Fix and Hold**: ambiguities are continuously estimated and resolved in full. If the validation is OK (ratio test), the ambiguities are kept fixed at the values estimated at the previous time.

- **PPP - AR**: resolution of ambiguity in PPP (Experimental)

RTKLIB

The solutions can be exported in different formats

- Lat/Lon/Height
- X/Y/Z - ECEF
- E/N/U baseline
- NMEA 0183 message

It is possible to export both ellipsoidal heights and orthometric heights, considering different geoid models:

- EGM2008
- EGM96
- Internal model (low res)

Particular attention must be paid to the insertion of the correct antenna model for both the master and the rover.

It is possible to constrain the coordinates of the master station in different ways:

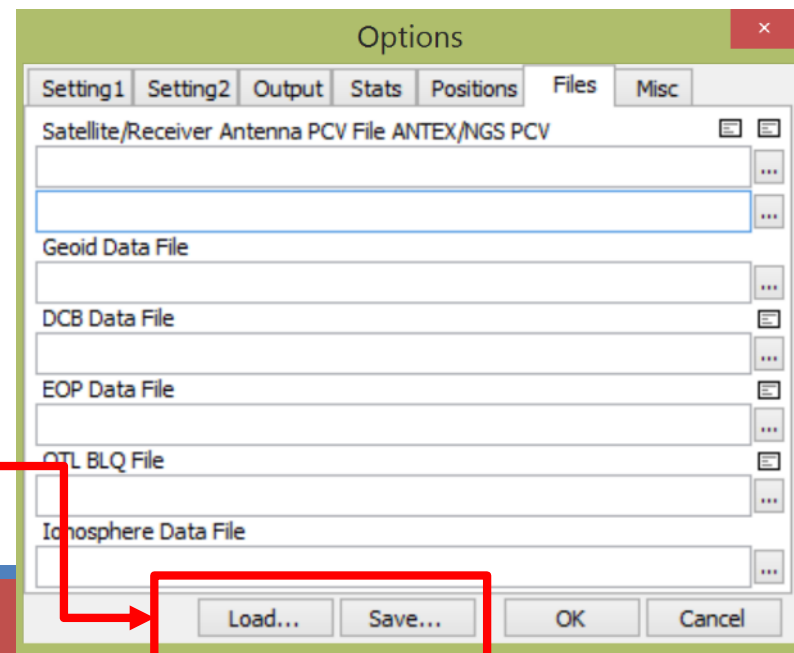- RINEX header position
- Lat/lon/height
- X/Y/Z-ECEF
- from file

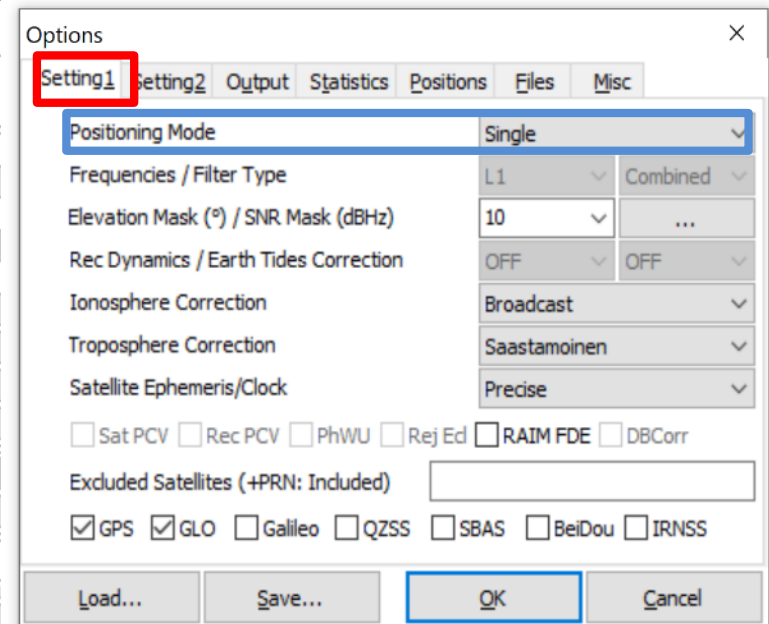Other input files can be considered, especially for precision applications (e.g. geodetic points, CORSs ...):

- PCV for satellite antennas/rec
- DCB files
- EOP
- OTL BLQ
- Ionospheric delays

Which can be downloaded with RTKGET

It is also possible to consider further geoid models

Configuration files can be saved and loaded to speed up processing

RTKLIB - SPP

RTKLIB – Relative positioning

To view the results:

Ex. 1 GNSS data processing

INPUT: The available dataset is composed of:

• Static data

- A folder called **TORI** which contains:
    - tori307l00.18o → observation file
    (code and phase measurements)
    - tori307l00.18n → GPS navigation file
    - tori307l00.18g → GLONASS navigation file

Reference Station
TORINO (ETRF2000)

UTM Nord (m):	4990861.136	Lat:	45° 03' 48.112513" N
UTM Est (m):	394604.567	Long:	7° 39' 40.599491" E
Qta ort. (m):	261.67	h ell. (m):	310.74

- A folder called **VIRTUAL RINEX** which contains:
    - vref079j00.18o
    - vref079j00.18n
    - vref079j00.18g

Virtual Station

- A folder called **IGM** which contains:
    - 1000790.18o
    - 1000790.18n
    - 1000790.18g

Static survey:
(see monograph:
igm_assoc1.pdf)

Ex. 1 GNSS data processing

TORINO (Piazzale Duca di Aosta - Ass.1) | 056906 | 155 sez II | 056 IIISE

Nazione:	ITALIA		Proprietà:	Politecnico di Torino
Provincia:	TORINO			
Comune:	TORINO		Indirizzo:	Corso Duca degli Abruzzi, 24
			Comune:	TORINO
Carabinieri:	TORINO		Cap:	10129 Tel: 0115646200 Fax:
			Provincia:	TORINO

e, con foro accecato al centro, infisso nella pavimentazione asfaltata,
'l'Italia", al centro della piazza ubicata lungo il Corso Duca d'Abruzzi di

Geografiche (Roma40)
φ: 45°03'41.1663"
λ: -04°47'18.8948"

Piane (Gauss-Boaga)
F.O. N: 4.000
E: 1.000

Geografiche (WGS84)
φ: 45°03'43.5550"
λ: 07°39'48.0040"

Piane (UTM-WGS84)
F.32 N: 4.000
E: 394.000

Quota s.l.m.: 246.066
Le coordinate nel Sistema Roma'40 sono state calcolate, dalle coordinate WGS84, tramite algoritmo di trasformazione.
F.E. N:
E:

Quota ell.: 295.070
Le coordinate nel Sistema WGS84 sono state determinate nell'anno 1998.
F.33 N:
E:

no di vario tipo   DH = 0,000

Rete primaria di inquadramento (IGM95)
Con quota derivata da caposaldo di livellazione (Rete Fond.)
Produttore: IGM

Stazioni astronomiche:

98 Cart. Maseroli Renzo
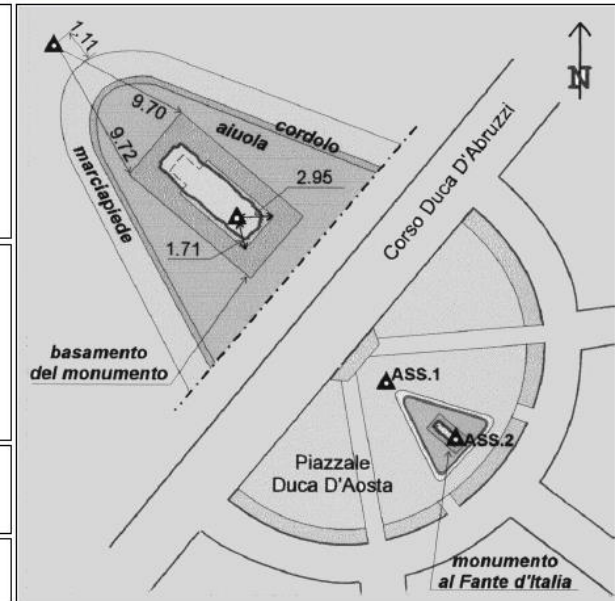L-2003 Cart. Deninno Francesco

Ex. 1 GNSS data processing

INPUT: The available dataset is composed of:

- ## Kinematic data
  - A folder called **MONV SP** which contains:
    - monv020i00.20o
    - monv020i00.20n
    - monv020i00.20g

  Reference Station MONDOVì

  - A folder called **SnowGroomer** which contains:
    - 20200120_COM3_165803.20o
    - 20200120_COM3_165803.20n
    - 20200120_COM3_165803.20g

  Kinematic data

  Kinematic: 2020/01/20 17:00:00

Ex. 1 GNSS data processing

GOALS:

1_A) Single point positioning of IGM station point

1_B) Relative Static positioning

- **IGM station post processing using TORI as Ref (GPS only)**
- **IGM station pp using TORI as RF (GPS+GLONASS)**
- **IGM station pp using Virtual Rinex as RF (GPS+GLONASS)**
- **Results comparison**

1_C) Kinematic positioning
- **Snow groom data pp using MONV as Ref (FIX & Hold)**
- **Snow groom data pp using MONV as Ref (Continuous)**
- **Results comparison**