User Manual Version V1.0-20171024



# **Tersus Geomatics Office** User Manual

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#### Table of Content

1. In	stallation and Uninstall	2
1.1	Software component	3
1.2	Installation	3
1.3	Uninstall	7
2. Qu	uick Start Guide	3
2.1	Static GPS Data Processing	)
2.1	1.1 Create a new project	)
2.1	1.2 Set Property of the Project	)
2.1	1.3   Set up a Coordinate System	1
2.1	1.4   Import Static Data1	1
2.1	1.5 Edit Files Information14	1
2.1	1.6 Baseline Processing	5
2.1	1.7 Adjustment Setting	7
2.1	1.8 Network Adjustment	)
2.1	1.9 Report	l
2.2	Dynamic Route Processing22	2
2.2	2.1 Import Data	2
2.2	2.2 Set Property of Observation Files and Points	3
2.2	2.3 Dynamic GPS Data Solution	5
3. M	ain Window3	L
3.1	TGO Main Window	2
3.1	Menu and Toolbars	1
3.2	Navigation Field	1
3.3	Plan View	5
3.4	Tree List View of Work Field	3
3.5	Detail view of Work Field	)
4. Pr	oject Management	L
4.1	Create a New Project	2
4.2	Observation File	)
4.3	Observation Station	)



4.4	Baseline	62
4.5	Repeat Baseline	64
5. Ba	seline Processing	65
5.1	Processing Options	
5.2	Baseline Processing	
5.3	Test Baseline Processing Result	
5.3	3.1 RATIO	75
5.3	3.2 Closed Loop and Repeat Baseline Testing	
5.3	3.3 Identify Every Effect Factors	
5.4	Reprocess a Baseline	
5.5	Dynamic Route Processing	
6. Ne	etwork Adjustment	83
6.1.	Function and Steps of Network Adjustment	
6.2.	Network Adjustment Preparation	
6.3.	Run Network Adjustment	
7. Re	port	
7.1	Static Baseline Processing Report	
7.2	Network Adjustment Report	96
7.3	Dynamic Route Processing Report	
8. Im	port and Export	99
8.1	Import and Export Observations and Ephemeris	
8.2	Export the Coordinates of Result Points	
8.3	Export Network Map	
8.4	Export Baseline Result	
8.5	Export Report	
9. Us	sing of Tools Software	
9.1	Usage of Antenna Manager	
9.2	Coordinate Transformation Tool	
9.3	Summarize	
9.4	Satellite Prediction Software	

### List of Figures

6	
Figure 1-1 GTO wizard	4
Figure 1-2 TGO installation 1	4
Figure 1-3 TGO installation 2	5
Figure 1-4 TGO installation 3	5
Figure 1-5 TGO installation 4	6
Figure 1-6 Start menu	
Figure 1-7 Uninstall	7
Figure 2- 1 Project menu	9
Figure 2- 2 New project	
Figure 2- 3 Tolerance bar	
Figure 2- 4 Coordinate system	
Figure 2- 5 Import menu	
Figure 2- 6 Import files	
Figure 2- 7 Select mutiple files	
Figure 2- 8 Imorting files	
Figure 2- 9 Import files successfully	14
Figure 2- 10 Observations files	
Figure 2- 11 Edit an observation file	
Figure 2- 12 Baseline processing	
Figure 2- 13 Baselines' schedule	
Figure 2- 14 Processing result	
Figure 2- 15 Set control point	
Figure 2- 16 Control points	
Figure 2- 17 Control point details	
Figure 2- 18 Adjust options	
Figure 2- 19 Network adjust	
Figure 2- 20 Report options	
Figure 2- 21 Report demo	
Figure 2- 22 Import files	
Figure 2- 23 Static and dynamic file	
Figure 2- 24 Observations files mode	
Figure 2- 25 Reference station position	
Figure 2- 26 Add RSP file	
Figure 2- 27 Process options	
Figure 2- 28 Minimum time for stop&go	
Figure 2- 29 Dynamic options	
Figure 2- 30 Porcessing status	
Figure 2- 31 Project plot	

Figure 2- 32 Stop points	29
Figure 2- 33 Report demo	30
Figure 3-1 Main window	
Figure 3- 2 Fields in main window	33
Figure 3- 3 Main menus	34
Figure 3- 4 Tool bar	34
Figure 3- 5 Import sub-menu	35
Figure 3- 6 Plan view	35
Figure 3- 7 Sites and baselines	
Figure 3- 8 Operation tools	37
Figure 3-9 Customized options	38
Figure 3- 10 Tree list view	39
Figure 3- 11 Pop-up menu	
Figure 3- 12 Edit properties	40
Figure 4- 1 Project properties	
Figure 4- 2 Tolerance tab	44
Figure 4- 3 Advance tab	45
Figure 4- 4 Ellipsoid tab	
Figure 4- 5 Projection tab	47
Figure 4- 6 Convert tab	48
Figure 4- 7 Project subdirectory	
Figure 4- 8 Observation files format	50
Figure 4- 9 Import files	52
Figure 4- 10 GNS files	53
Figure 4- 11 All the observations files	54
Figure 4- 12 Pop-up menu	55
Figure 4- 13 Edit observation property	56
Figure 4- 14 Single position menu	57
Figure 4- 15 Data track status	57
Figure 4- 16 Skyplot infomation	58
Figure 4- 17 Convert to Rinex format	59
Figure 4- 18 Rinex options	59
Figure 4- 19 View stop&go info	60
Figure 4- 20 Points	61
Figure 4- 21 Pop-up menu for points	61
Figure 4- 22 Edit site	62
Figure 4- 23 Baseline menu	63
Figure 4- 24 Pop-up menu for baseline	63

Figure 4- 25 Repeat baseline info	64
Figure 5- 1 Baseline processing options	66
Figure 5- 2 Cutoff angle	
Figure 5- 3 Dynamic mode	
Figure 5- 4 Ion/trop options	
Figure 5- 5 Advanced options	
Figure 5- 6 Baseline processing	
Figure 5- 7 Baseline information	
Figure 5- 8 Residual map	
Figure 5- 9 Processing edit	
Figure 6- 1Network adjustment steps	85
Figure 6- 2 Adjust options	
Figure 6- 3 Control points setting 1	
Figure 6- 4Control points setting 2	
Figure 6- 5 Control points setting 3	
Figure 6- 6 Network Adjust page	
Figure 6- 7 Network error message	90
Figure 6- 8 Adjust report options	
Figure 6- 9 An adjust example	92
Figure 7- 1 Static report	95
Figure 7- 2 Reference information	
Figure 7- 3 Ambiguities report	
Figure 7- 4 Network Adjustment report	
Figure 7- 5 Report header	97
Figure 7- 6 Adjusted baseline report	
Figure 8- 1 Convert to Rinex format	
Figure 8- 2 Batch convert	
Figure 8- 3 Export points	102
Figure 8- 4 Network map export	
Figure 8- 5 Export baseline	
Figure 8- 6 Report format	
Figure 9- 1 Receiver antenna information	106
Figure 9- 2 Conversion process of seven parameters model	108
Figure 9-3 Conversion process of four parameters model	
Figure 9- 4 Conversion process of elevation fitting	109



Figure 9- 5 Parameters	110
Figure 9- 6 Transformer window	111
Figure 9- 7 Parameter calculation	
Figure 9- 8 Star report	115
Figure 9- 9 Status window	116
Figure 9- 10 Setup options	116
Figure 9- 11 Time config	118
Figure 9- 12 Instrument set	118
Figure 9- 13 Detailed satellites' status	119
Figure 9- 14 Satellites tracking map	120
Figure 9- 15 Constellations map	120
Figure 9- 16 PDOP value	121
Figure 9- 17 Satellites world map	122
Figure 9- 18 Download SP3 file	123

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2017-10-22	Release	Tersus Geomatic Office User
		Manual1.0

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## 1. Installation and Uninstall

### 1.1 Software component

The whole software contains a CD and an operation instruction.

The CD contains all the installation procedure; this instruction introduces the operation of the software.

### 1.2Installation

TGO software can be installed directly from the CD or the hard disk. It needs at least 32M internal storage and 200M hard disk. This software can be operated in the environment below:

- Microsoft ® Windows 95, 97, 98, SE, ME
- Microsoft <sup>®</sup> Windows NT Service Pack 4 and the latter version
- Microsoft ® Windows 2000/XP
- Microsoft ® Windows7
- Microsoft .Net Frameworks 2.0

#### Installation steps:

If your computer has not installed Microsoft NET Framework 2.0 framework, please install the package "NetFrame2.exe first.

Run the program "TERSUS Geomatics Office.msi" which in the installation directory.

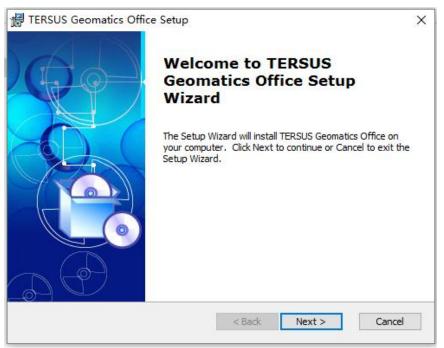


Figure 1-1 GTO wizard

#### Click *Next*:

🖁 TERSUS Geomatics Office Setup	<u>522</u> 2		×
Select Installation Folder		6	
This is the folder where TERSUS Geomatics Office will be installed.			
To install in this folder, click "Next". To install to a different folder, "Browse".	enter it be	elow or clic	k
Eolder:	=092		
C:\Program Files (x86)\TERSUS Geomatics Office\		Browse	•
dvanced Installer			

Figure 1-2 TGO installation 1

Choose an installation path and then click Next:

🚏 TERSUS Geomatics Office Setup	×
Ready to Install	100
The Setup Wizard is ready to begin the TERSUS Geomatics Office installation	
Click "Install" to begin the installation. If you want to review or change any of installation settings, click "Back". Click "Cancel" to exit the wizard.	your
Advanced Installer	
< Back	Cancel

Figure 1-3 TGO installation 2

#### Click Install:

TERSUS Geomatics Offic		
		<u> </u>
Please wait while the Sei take several minutes.	up Wizard installs TERSUS Geomatic	s Office. This may
Status:		
vanced Installer		
	< Back	Next > Cancel

Figure 1-4 TGO installation 3

Wait until the entire program is installed successfully, then you will see the interface below:

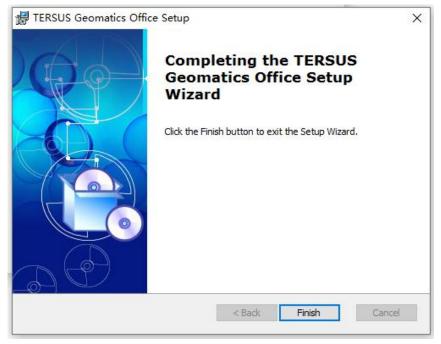


Figure 1-5 TGO installation 4

There will be a *Tersus Geomatics Office* directory generated automatically in the *Start* menu, and this file contains several icons (look at the picture below).

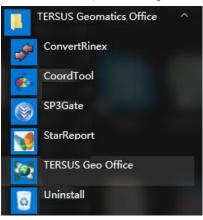
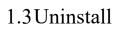


Figure 1-6 Start menu



Select Start\Program\Tersus-Geomatics Office\Uninstall to uninstall TGO.

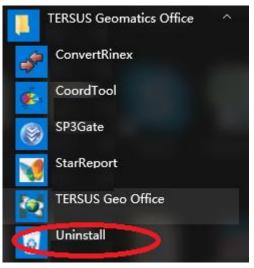


Figure 1-7 Uninstall



# 2. Quick Start Guide

In this chapter, we will provide the draft procedure about TGO software to resolve the data of static or dynamic. This chapter helps you to complete data processing roughly.

### 2.1 Static GPS Data Processing

### 2.1.1 Create a new project

Run TGO software, click button in the navigation field to create a new project (Figure 2- 1). If necessary, set the project name and folder to store the project files. Otherwise, the files will be stored in the installation folder (Figure 2- 2). Click *OK* button to finish the project creation.



Figure 2- 1 Project menu

🙀 New Proje	ect	1 <u>2-2</u>		×
Project:	07-27-2017			
Directory:	C:\TERSUS-GNSS		Explore	e(E)
		OK(0)	Cancel(	(C)

Figure 2- 2 New project

The project name and the directory to save the project files can be changed.

### 2.1.2 Set Property of the Project

Follow the wizard or click button in the navigation field, the Project Properties dialog appears as Figure 2- 3. You can set the detail info of the project. Generally, you need to set the tolerance tab.

fomation Tolerance Adva	anced
tandard: China Global	Survey Standard 2009 🔹 👻
evel:	•
eceiver Precision(mm) 5	Relative Precision(ppm) 1
Name	Value
Baseline Lenth (km)	10
Horizontal RMS(mm)	20
Vertical RMS(mm)	40
RMS for Poorest Baseline	45000
Baseline Fixed Error	Unlimited
Sync Loop Closure	Math.sqrt(3)/5 * sigma
ASync Loop Closure	3*Math. sqrt (n)*sigma
Repeated Baseline Closure	2*Math.sqrt(2)*sigma

Figure 2- 3 Tolerance bar

### 2.1.3 Set up a Coordinate System

It is necessary to set up the coordinate system parameters for a new project. Click button in the navigation field, the following dialog appears as Figure 2- 4. Generally, it's only needed to set the fields in **Ellipsoid**, **Projection** and **Convert** tabs. You can find more details of coordinate parameter setting in the following sections.

File: default1	1 Save
Ellipsoid Pro	ojection Convert Plane Height Fitting 2nd Grid Config
Source Ellip	WGS 1984 👻
a(m):	6378137
1/f:	298.2572236
arget Ellip	Krassovsky 1940 🗸
a(m):	6378245
1/f:	298.3

Figure 2-4 Coordinate system

### 2.1.4 Import Static Data

Once you have set up your TGO project, you can import data into it.

Select **Import** Files item in the navigation field, we can load on GPS data observation files (Figure 2- 5). Select static or auto mode in the dialog, click Select Files button or double-click to enter the file selection page, as Figure 2- 6:

Control	μ×
Proj	ect
Imp	Import data files
	1
Import	Files
C	Þ
Control Po	oint File
15	
Stop&&Go	RSP File
Process H	Baseline
Network Ad	ljustment
Exp	ort

Figure 2- 5 Import menu

File Type RINEX File	Extention *.??O;*.OBS	Select Files(S)
SP3 File	*.SP3	
GNSS Raw File	*.GNS	Select Folder(F)
		Auto
		Cancel(C)

Figure 2- 6 Import files

Select the static files, as Figure 2-7, you can press *CTRL* or *SHIFT* key to select multifiles, click *Open* to import the files (Figure 2-8):

🗸 🚽 🔺 📩 « bir	n > examples	5 ~	搜索"examples	
目织 ▼ 新建文件夹			1	== •
Install software ^	名称	1	多改日期	类型
常用文档	2017 07 27 .obs	2	2016-11-25 10:08	OBS 文件
ConeDrive	Nanjing_project_2017_06_05.obs	2	2017-5-4 16:52	OBS 文件
	Station-A.obs		2017-4-12 14:33	OBS 文件
2 我的电脑	Station-B.obs	2	2017-4-12 14:33	OBS 文件
Desktop				
视频				
▶ 图片				
2 文档				
➡ 下载				
▶ 音乐				
L Windows (C:)				
~ ~	<			
文件名	5(N):	~	RINEX File(*.?)	?O;*.OBS) SP3

Figure 2-7 Select mutiple files

Reading Station-A.obs	16/2
Single positioning!	

Figure 2-8 Imorting files

After importing the files, TGO software can automatically generate the baselines, repeat baseline, sync loop, asynchronous loop and so on (Figure 2-9).

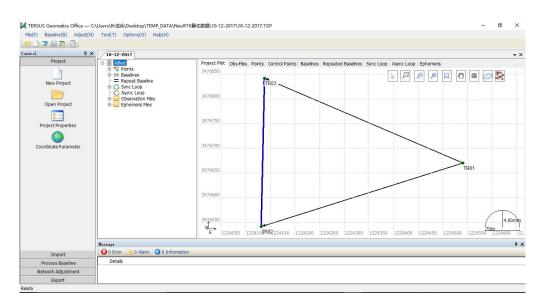


Figure 2-9 Import files successfully

### 2.1.5 Edit Files Information

After all the files are loaded, TGO will display all the observation files. Select the Observation files and switch to *Obs-files* tab in the working field, and then you can see all files (Figure 2- 10). Double click one file to enter the editor window. Make sure the height antenna, the type of receiver and antenna are right (Figure 2- 11). Check these items for all files.

	21-07-2017											
Brejait	- 2 00.20	Pealers first; The	files du	and from	of Points   Associates   B.	quarter Band Land   Spic	Long August	Long   Sple	-			
Dent	to the Augusta	Tile	Faint .	Bula (	Digit. Tons	Red Type	line mart	Aprela	Briand	Set.	lin .	
1	- III August Baseline	T_mmont and		Destas	APPA/DEED TO HT JPE AM	1/14/2001 0 (0 Tor M	100 101 205	100	3		100.10.00.00018	14
Separat Billion	C Augur Long	S		31wile	APV8/0001 7 38 25 w	3/16/1000 N 10.100 W	30.37.25	1178		107 M. M. TOLLA	310 10 10 1010	-
agent from the	Basretia File	1_WOULAND	-	Tister	171A/1010 1 24 20 at	Managers is let up at		-	8	OT 40 11 INTER	100-00 (7.711118	-
10	B_30000 140	4		Date	1/17/2000 0:00 (0:00 MF	10111-101 A TO 10 AF	30.00.00	181		107 st 11 791008	300.00.17 50948	-
of Faint Fills		1_90112.44	-	Date	311110000 0.00.00.00	3/17/080 7.0s et al.	(0.51.6)	79.	3.	ICT M 41 005CH	120 22 17 81668	
		4.,200071.004	1000	314110	1717/1000 8-00.00 all	3/11/2008 11:00 20 48	10.06	70.0		107 H. R. (87) 48	330 11 47 425418	-
Card Street and	B100011 ++4	1,0000.00	162	Thatse	1110/0014 12:07 05	3/16/2001 4.17.10.48	HE 41.10	741		127 45 46 101079	129 18 10 179408	-
to BP Film	ALISTIC 14	A	164	Date	Area/poor it as all all	AVANUES & DE 10 M	100-102-010	140		107 al. 10 1039-B	310.14.52 09479	-
	. Are 182204. 18	B_ADDING and	42	Shahari	1710/080 4 17 NL M	110,000 4.50.05 4	10.4130	401	A	107.46.11.788/48	220 18 41 199718	-
	B (40011 red.	440 (FUEAL 91	16.7	Status.	111110001 0.09.00 48	1717/2010 4 50 50 48	10.02.05	1870	*	ICT IN 12 WORK	320-17-26-60118	
	1 .min	to particular	18.5	25 white	110A/0001 1: 47 50 M	3716/2010 6.27 15 48	30 44 (M	54		107 6 15 OFFICE	120 17 18 834042	-
	2 210071 eve	10 211011 44	100	Date	LIVERSE & HT IN AR	1777/0001 8 (01.45.48	36.36.15	394	3.	NUT 40-01 104008	100-02-01 403018	
		Ave 2710175, 61	100	Date	LONDER ETHERI AL	1/11/2000 9 (0.10 M	0.8.15	444	8	127 el 01 401348	120 22 41 498328	-
	10 1001 104	14, 20075.04	100	Dates	31103001 6-04.05 48	1717/000 F-01-01 M	36.54.00	753		107.05.05.762408	100-10-04-011948	(mb)
	3 JTRON	of prost and	911	Statis	Aretropoly it are all all	10100010-010-014	36 et 16	29		127 el. 01 10041#	120 22 24 942768	-
	B JINCTL HA	10 JUNE 1	90	Date	VIVIER TALE M	N1000111210-0-0	00.44.55	941	A	17 4 4 6179	310.02.14.94948	-
	C Grant T and	17,,79071.000	79	214110	1111/1001 0 10 JB all	3/15/2000 8:10:40 48	30.34.25	414		107 AL OL AND 18	100-11-17 34/748	-
	m - Tytereris Filter	10 JTIDIN and	100	Stats+	UNVERT 1.0.30 M	LUMPER FILENCE	0.41.00	1.81	8	ILT IN IN COMM	100 11 10 100008	(ed-
		10.,770111 244	100	Shahar	1117,000 8.07.00 w	3717/0801 8:02190 48	30.8.10	477		107 41 10 (01.)48	330-31-18-896948	-
		01 (Q100001	10.00	These	1710/0801 4 32 38 AM	TRADE I STATE	10.00	420			10117-0120848	
		CT_WOWDYTE and	1004	31411	71112000 3:00 00 40	Anything a set of all	70.10.40	144	×	107 M. 10 11-079	100 17 31 10000	-
Second Readlines												
Adapti Minimal												
		14 0										
Barri .		1										

Figure 2-10 Observations files

Basic	Ånten	na Receiver		
Antenn	a phas	e center		
Ant 1	[уре:	unkown	▼ Assign to(A)	This 🗸
-Ant He		tenna correctio	n: No	
Measure	e to:	Ref. Point (Slan	1 ▼ Assign to(M)	This ▼
Hei	ght:	1.404	Assign to (H)	This 🗸

Figure 2-11 Edit an observation file

### 2.1.6 Baseline Processing

After all the data are loaded, TGO shows all the GPS baseline vectors and the plane view shows all the information about the GPS network.

Then you can process the baseline, click **Process Baseline** -> A button on the navigation field to process baselines, TGO will process all the baselines according to the default settings (Figure 2- 12)

Processing :_	_990171.zsd-G1040171.zsd	7/21
Start Proces	sing Baseline	
Start Proces	sing Baseline	

Figure 2-12 Baseline processing

During the processing, program shows the schedule of the baselines as Figure 2-13, we can find the processing information about each baseline processing in the list of *Baselines*.

	Enable	Nane	Туре	Start	End	TimeSpa	Result	Frequency	Ratio	RMS (n)	DX (m)	DY (m)	DZ (m)
_FY20171 1 1 _990161	[es	_1010171. zsdPY20171. zsd	Static	101	PY2	58	Passed	L1Fixed	6.5	0.0108	-1051.9777	-205.999	-834.3468
2 1	ſes	980162.zsd990161.zsd	Static	98	99	97	Passed	L1Fixed	7.2	0.0169	-3437.4427	-1248.4737	-1207.947
3 1	ſes	980161.zsdGL10162.zsd	Static	98	GL1	51	Passed	L1Fixed	99	0.004	1782.4161	958.9315	50.383
4 1	[es	980161.zsdGL50161.zsd	Static	98	GL5	49	Passed	L1Fixed	99	0.0038	1318.364	435.3671	285.583
51	les	980162. zsdPY50161. zsd	Static	98	PY5	97	Passed	L1Fixed	13.1	0.0115	-5152.5972	-1690.3182	-2438.9192
6 1	les	990172. zsd1010171. zsd	Static	99	101	59	Passed	L1Fixed	5.3	0.0165	-2290.422	-968.8255	-761.3664
7 1	les	990171. zsd-G1040171. zsd	Static	99	G104	71	Passed	L1Fixed	69.3	0.0166	3970. 3986	2237.2301	-135.0759
8 1	ſes	990171. zsdGL30171. zsd	Static	99	GL3	79	Passed	L1Fixed	32.6	0.0182	3876. 4741	1927. 4909	270.34
9 1	ſes	990172. zsdPY20171. zsd	Static	99	PY2	58	Passed	L1Fixed	1.9	0.0174	-3342.3991	-1174.8219	-1595.7121
10 1	les	990161. zsdPY50161. zsd	Static	99	PY5	102	Passed	L1Fixed	7.7	0.0189	-1715.1488	-441.8258	-1230.9086
11 1	(es	_GL10161.zsd-G1040161.zsd	Static	GL1	G104	35	Passed	L1Fixed	23.5	0.0071	-1249.4673	29.8052	-1393. 4078
12 1	ſes	_GL10161.zsdGL20161.zsd	Static	GL1	GL2	39	Passed	L1Fixed	99	0.0048	9.6256	569.1725	-1034.6262
13 1	les	_GL10162. zsdGL50161. zsd	Static	GL1	GL5	49	Passed	L1Fixed	99	0.0032	-464.0526	-523.5645	235.1998
14 1	les	_GL20161. zsd-G1040161. zsd	Static	GL2	G104	36	Passed	L1Fixed	26.3	0.0059	-1259.0918	-539.3667	-358.7784
15 1	[es	_GL30171. zsd-G1040171. zsd	Static	GL3	G104	71	Passed	L1Fixed	99	0.0055	93.9264	309.7309	-405.419
16 1	ſes	_PY10171. zsdPY20172. zsd	Static	PY1	PY2	30	Passed	L1Fixed	36.6	0.0067	-504.2133	-377.6221	110.8752
17 1	les	_PY10171. zsdPY30171. zsd	Static	PY1	PY3	30	Passed	L1Fixed	10.7	0.0085	-482.0121	-43.7142	-409.5812
18 1	les	PY10172. zsd- PY40171. zsd	Static	PY1	PY4	34	Passed	L1Fixed	34.7	0.0076	869.706	382.7269	185.9591
19 1	les		Static	PY1	PY5	36	Passed	L1Fixed	9.5	0.0092	1123.0212	355.3788	475.7014
20 1	les	PT20172. zsd- PT30171. zsd	Static	PY2	PY3	48	Passed	L1Fixed	14	0.0079	22.1968	333.9107	-520.4559
	(es	_PY40171. zsdPY50171. zsd	Chattin.	PT4	PY5	34	Passed	L1Fixed	50, 9	0.0048	253, 3134	-27.3456	289.7433

Figure 2-13 Baselines' schedule

The time of baseline solution depends on the number of the baseline, the time of the observation, the baseline processing setting and the performance of the computer. After all baselines are completed, the baseline solution result displays in the baseline list window.

The color of the previous unsolved baseline in the map changes from light to dark green. (Figure 2- 14)

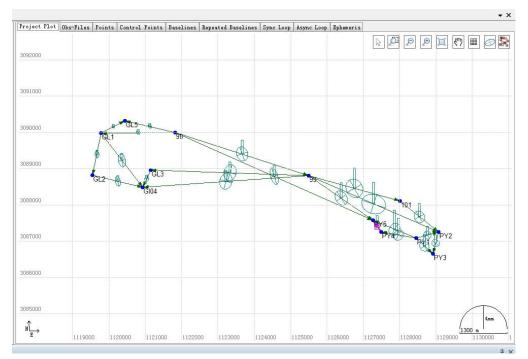


Figure 2-14 Processing result

### 2.1.7 Adjustment Setting

After the baseline processing, it is needed to check the adjustment result. But for this simple section, we suppose all the baselines are good. Generally, if the observation condition is good, we can process all the baselines once successfully.

It is needed to delete part of a baseline, according to the quality of synchronous observation after the solution. Here we will not explain it, too.

Now we begin to prepare the network adjustment.

First we should set some points as control points. Switch work field to *Points* tab, select one site and right-click the selected site. Then select *Set as Control Point*, the selected point will be add to the list of control points automatically (Figure 2-15).

AllNet	Project Pl	.ot Obs-Fil	es Points	Control P	oints	Baselines	Repes	ted Baselines	Sync Loop	Async	Loop Ephemeri:
- 🍄 Points	Fixed	Name	WGS84 X(m)	WGS84	Y (m)	WGS84 Z	(m)	Local N(m)	Local EG	n) (	Feoid feight (m)
- 98	1	101	-2855091.805	55 487353	4.9299	2953020.	813	3088103.9703	1128024.6	049 1	06.7638
@ 99 @ G104	2	98	-2849363.940	08 487575	2 2291	2954990.	1263	3089995.5502	1121825.9	946 1	58.141
@ GL1	3	1000	-2852801.383	0000 00000000		2953782.	08:0143	3088801.9106	1125507.1	A100000 22	77.1246
9 GL2	1.20	Skonast	li Sesten Dans solaris	2010 2014030404	2012 (97.76a)	2	0 12/2021	Refs/2424510028753.0.8	112/10/2010/02/04/07/2	2000	1000.020.00
GL3	4	G104	-2848830.982	29 487674	0.9772	2953647.	1003	3088480.2381	1120939.1	11 4	9. 7987
GL5 PY1	5	GL1	-2847581.524	487671	1.1606	2955040.	5093	3089969.2024	1119792.3	37 1	18.7694
PY2	6	GL2	-2847571.899	487728	0. 333	2954005.	8831	3088807.9051	1119554.8	042 6	7.2273
PY3	7				1.2463	2954052.	5193	3088955.3135	1121153.4	81 4	3.9663
) PY4	0	dit( <u>E</u> )			. 5961	2955275.	7091	3090314.2442	1120443.4	075 3	5. 4425
PY5 selines	9 🙆 🛙	elete( <u>D</u> )			0188	2952066.	02.69	3087080, 8652	1128461.5	10010 100	2. 4688
_1010171.zsdPY20171	5	et as Control	Point(S)		1000000		522422			10040	
980162. zsd990161			I Point Relate		1. 3967	2952177.	3275	3087245.1086	1129082.8	338 2	1.3688
980161.zsdGL10162	11	PT3	-2856114.331	13 4873655	9.3074	2951656.	8715	3086643.713	1128924.9	52 2	4.0663
980161. zsdGL50161	12	PY4	-2854762.614	487408	5. 7457	2952252.	4114	3087247.9394	1127503.1	033 2	2. 2647
980162.zsdPY50161 _990172.zsd1010171	13	PY5	-2854509.301	15 487405	8. 4001	2952542.	1547	3087565. 4399	1127280.5	971 2	3.0168

#### Figure 2-15 Set control point

Switch work field to *Points* tab, you will find this point which you set as control point (Figure 2- 16). Double click one point's name, you can edit these points as Figure 2- 17. Do this for all control points.

r	ject Plo	t Poin	ts Control P	oints Obs-Fil	es Baselines	Repeated Ba	aselines Sy	me Loop	Async Loop	Ephemeris
	Name	Fixed	North(m)	East (m)	Geoid Height(m)	WGS84 Fixed X/B6	n/°)	Y/L(m/	/°)	Z/H(m)
1	GL3		3088952, 4914	1121146.3882	41.096	2848	917.9906	487643	3.6651	2954049.0207
2	GL5		3090314.1237	1120443.1013	34.5106	2848	044. 9178	487618	7.0827	2955275.1826

Figure 2-16 Control points

📝 Fix WGS8	4 Coor	linate (¥)				
WGS84						
۲	Spatial	(XYZ)	0	Geod	letic(BLH)	
V X/B	-28489	17.9906	m	±	0.0000	m
V/L	V/L 4876433.6651				0.0000	m
🔽 Z/H	295404	9. 0207	m	±	0.0000	m
-	State		0	Loca	1	
📝 North (N	D:	3088952.4914	m	±	0.0000	m
👿 East (E)	:	1121146.3882	m	±	0.0000	m
🔽 Geoid H	leight:	41.0960	m	±	0.0000	m
	D Adju	control points of stment, while locs ant 2D Adjustment	al cont			

Figure 2-17 Control point details

### 2.1.8 Network Adjustment

Click button in the navigation field in the navigation field, enter the adjustment setting window (Figure 2- 18). After setting adjustment options, you can choose Adjust item, then Network Adjustment tool window appears in Figure 2- 19.

veral Weighted Strategie	s	
Enable non-Fixed Baseling	e ?	
🔘 Yes ( <u>Y</u> )	(й) он 💿	
3D Free		
💿 Fix one point(G)	🔘 Rank Defect	Free (Z)
3D Biased		
🔘 Adjust 7 Paramete(S)	🧿 Don't Adjust	7 Para( <u>T</u> )
Height Fitting		
Height Fitting model:	Plane	•
Height Fitting model: TAU Test	Plane	•
	F1 ane 0.005	m
TAV Test	0.005	m ppm

Figure 2-18 Adjust options

djust	
	Auto Adjust (A)
◯ 3D Biased(C) [WGS84 Datum 💌	
⑦ 2D Biased and Height Fitting(I)	Process (S)
lesult	Get Report (R)
	Get Report (R) Apply Result (R)

Figure 2-19 Network adjust

Click *Auto Adjust* button, it will do free 3D adjustment, constraint 3D adjustment under WGS84 ellipsoid, constraint 3D adjustment and 2D adjustment under local ellipsoid according to the settings above. It also can generate adjustment result list.

### 2.1.9 Report

Click button in the navigation field, you can set output items which you want to view in the adjustment report and the format of adjustment report (Figure 2- 20).

ljust Report Options	
Output Items	
📝 Baselines Input in ¥	YGS84
📝 Control Points Input	t
📝 Adjusted Baselines i	in WGS84
📝 Baseline Residuals	
📝 Adjusted Points in ¥	IGS84 XYZ
📝 Adjusted Points in ¥	IGS84 BLH
📝 Adjusted Points in I	Local NEV
Report Format	
🔘 Text file(TXT)	
) HTML file(HTML)	
🔘 MS Office (WORD)	
	OK Cancel

Figure 2-20 Report options

Then click *is* to select one result which you want to view in the adjustment result lists, click Get Report button. It will generate adjustment report as Figure 2- 21. You can find the content of the report in the following chapter.

Content	Name					Value		
Jontent	Number of GPS Baselines:					16		
	Number of Adjusted Points:					13		
	Confidence level:					10.00c		
Free 3D NetAdjust	Significance Level for Tau Test:					1.00%		
1.Baselines Input in WG584	Ratio of Standard Error of Unit Weight:					0.0875		
2 Control Points Input	x2 Test Value:					1.0496		
3 Adjusted Baselines in WOS84	x2 Test Range:					3.0738 - 28.2995		
A Baseline Residuels	x2 Test Result:					False		
<ul> <li>5 Adjusted Points in WG584 (XYZ)</li> </ul>								
CAdjusted Points in WGS84 (BLH)		1004						
<ul> <li>7. Adjusted Points in Terpet System(NEU)</li> </ul>	1.Baselines Input in WG	584						
8.Weakest Baseline and Point	Baselines	Tau	ΔX(m)	Std.Dev(mm)	ΔY(m)	Std.Dev(mm)	ΔZ(m)	Std.Dev(mm)
	_1010171.zsd_PY20171.zsd	True	-1051.9778	15.6	-205.9986	15.9	-834.3466	19.2
	980162.zsd990161.zsd	True	-3437.4427	15.0	-1248.4737	24.4	-1207.9470	13.7
	980161.zsdGL50161.zsd	True	1318.3640	5.1	435.3671	4.5	285.5830	4.4
	980162.zsdPY50161.zsd	True	-5152.5972	10.3	-1690.3182	17.3	-2438.9192	18.7
	990171.zsd-G1040171.zsd	True	3970.3986	12.4	2237.2301	18.4	-135.0759	18.4
	990171.zsdGL30171.zsd	True	3876.4741	12.7	1927.4909	17.6	270.3400	18.3
	990172.zsd_PY20171.zsd	True	-3342.3991	27.1	-1174.8219	28.4	-1595.7121	31.7
	_GL10161.zsd-Gl040161.zsd	True	-1249.4673	9.1	29.8052	12.1	-1393.4078	12.9
	_GL10161.zsdGL20161.zsd	True	9.6256	5.5	569.1725	7.2	-1034.6262	6.7
	_GL10162.zsdGL50161.zsd	True	-464.0526	4.2	-523.5644	3.7	235.1998	3.6
	_GL20161.zsd-G1040161.zsd	True	-1259.0918	7.5	-539.3667	9.9	-358.7784	10.3
	_GL30171.zsd-Gi040171.zsd	True	93.9264	4.1	309.7309	6.3	-405.4190	6.3
	_PY10171.zsdPY20172.zsd	True	-504.2131	9.2	-377.6219	16.3	110.8752	7.3
	_PY10171.zsdPY30171.zsd	True	-482.0121	12.0	-43.7142	21.1	-409.5812	9.5
	_PY20172.zsdPY30171.zsd	True	22.1968	8.7	333.9106	15.4	-520.4558	7.7
	_PY40171.zsd_PY50171.zsd	True	253.3133	11.2	-27.3457	17.5	289.7433	7.3
	2.Control Points Input							
	Station Name	X/Lat	Std.Dev(mm)	Y/Lon		Std_Dev(mm)	Z/H	Std.Dev(mm)

Figure 2-21 Report demo

At this time, the processing is completed. You can select *m* in the navigation field to export the solution result.

Next we will introduce how to process dynamic GPS data.

#### 2.2 Dynamic Route Processing

Dynamic GPS data processing has three solving mode: RTD, Stop&Go, PPK (Post Process Kinematic). The difference of them can be found in chapter 4.55.1.

#### 2.2.1 Import Data

First we create a project as static GPS data processing. Because during the outdoor observation, one dynamic baseline includes two files at least, one is a static observation file and the other is a dynamic observation file, they are collected synchronously. When you import the observation data files with dynamic and static mode, make sure which file is static and which is dynamic. Generally, data files exported from rover is dynamic files, from base or CORS is static file. If you import data files by auto mode, you just need to import all observation data files (Figure 2- 23).

Mart Import		– 🗆 X
File Type	Extention *.??O;*.OBS	Select Files(S)
SP3 File	*.SP3	
GNSS Raw File	*.GNS	Select Folder(F)
		Dynamic ~
		Auto Static
		Dynamic
		Cancel(C)

Figure 2-22 Import files

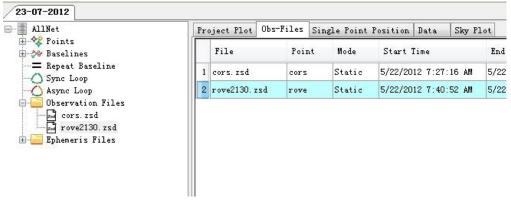


Figure 2-23 Static and dynamic file

### 2.2.2 Set Property of Observation Files and Points

#### Set the Mode of Observation Files

If you import data files by auto mode, you need to convert the data file which is exported by rover to dynamic mode. Click *Switch to Static/Kinematic* menu in the pop-up menu as Figure 2- 24.

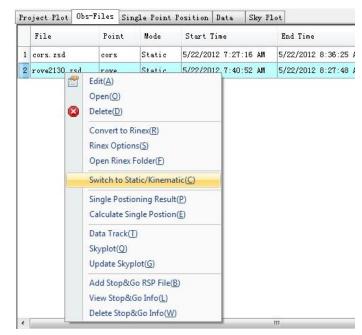


Figure 2-24 Observations files mode

#### **Edit the Coordinate of Points**

Select the *Points* node in the left of work field, choose the base point (reference station) and double click it, Station window displays as Figure 2- 25. Edit and confirm the coordinate of the station.



**Notice:** The coordinate of reference station must be accurate, or the error will be introduced to the solution.

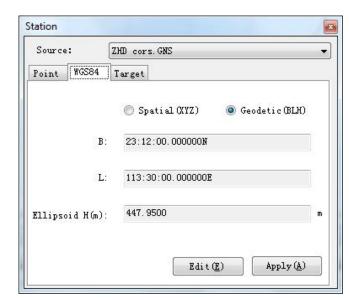
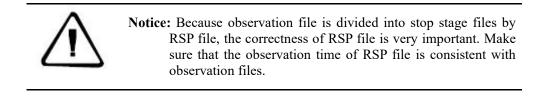


Figure 2-25 Reference station position

#### Add Stop&Go RSP File

Stop&Go RSP file is a time file which record the start time and end time of a stop stage in field work. If you do stop&go or PPK processing, you can add stop&go RSP file to dynamic observation file. If you don't add stop&go RSP file, TGO will do processing, too. In fact, the result is just pure dynamic solution and you only get go stage solution in the report. Select *Stop&Go RSP File* menu item in the pop-up menu as Figure 2- 26, add corresponding stop&go RSP file.



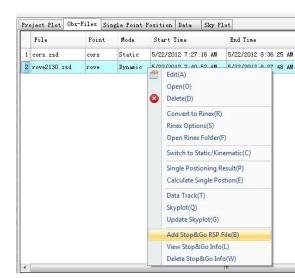


Figure 2-26 Add RSP file

### 2.2.3 Dynamic GPS Data Solution

After the operation of the above, the next step is to process baselines.

#### **Processing Settings**

Select the *Baselines* node in the tree list view, you can see the detail view switch to *Baselines* tab page. Right click one or more baselines. Select *Process Options* menu item in the pop-up menu (Figure 2- 27), enter the following window as Figure 2- 28.

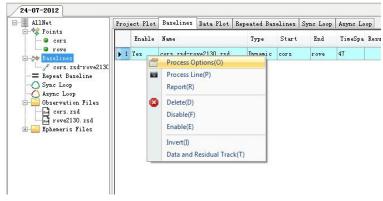


Figure 2-27 Process options



Notice: If you do Stop&Go processing, it's suggested that you set the minimum epoch to 180s. If the minimum epoch is too small, the integer ambiguity will not be fixed.

General Ion/trop	Dynamic Advanced	
	Elevation Mask:	10
	Interval:	1
	Minimum Epoch:	180
	Frequency:	Auto 👻
	Navigation:	Broadcast 🗸 👻
	Reference Satellite:	Auto 👻
	Auto Process Mode:	Normal 🗸 🗸
	System	NASS 📄 COMPASS

Figure 2-28 Minimum time for stop&go

Select Dynamic tab page in the above window, set the mode of procession as Figure 2-29.

After you finish your settings, click *Apply to* button to complete setting and back to work window.

General	Ion/trop	Dynamic	Advanced
Dynami	c Solve Mo	de	
	🔘 Auto		
	🔘 RTD		
	🧿 Stop&Go		
	🔘 PPK (Pos	t Process	Kinematic)
Defaul	t Value(F)		Apply to (A) Selected

Figure 2- 29 Dynamic options

#### **Process Baseline**

Select Process Line menu item in the pop-up menu, begin to process the chosen baselines. You can see solution status on the process status bar as Figure 2- 30.

ition Type	
ι	ution Type

Figure 2- 30 Porcessing status

After processing, you can view the plan map of dynamic route. The green color means fixed solution, yellow is float, red is single.

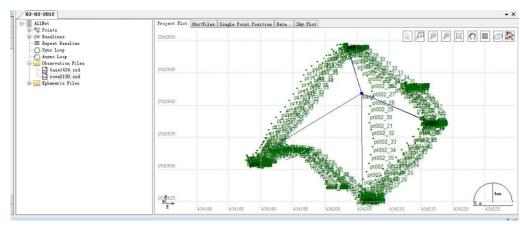


Figure 2- 31 Project plot

Click button, the map display as Figure 2- 32. The map just display the stop points.

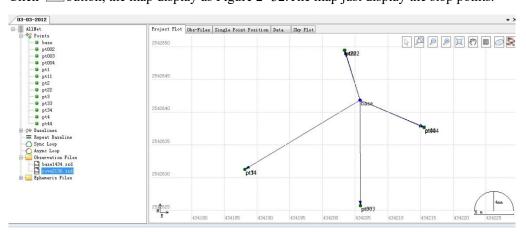


Figure 2- 32 Stop points

#### Report

Select Process Line menu item in the pop-up menu to generate the solution result report.

Content	1.Reference:			
Stop&Go Report	Variable		Value	
1.Reference:	Marker name:			
2.Coordinate Parameter	Marker code:		cors	
3.Stop Report	WGS84 X(m):		-2338994.4234	
4.Go Report	WGS84 Y(m):		5379318.8927	
AND	WGS84 Z(m):		2497268.9877	
	WGS84 latitude:		023:12:00.00000N	
	WGS84 longitude:		113:30:00.00000E	
	WGS84 height(m):		447.9500	
			2566774.6453	
	North(m)			
	East(m)		448814.1146	
	Up(m)		447.9500	
	Receiver type:		iRTK.	
	Receiver version:			
	Receiver S/N:		980014	
	Antenna type:		iRTK	
	Antenna S/N			
	Antenna height(m):		0.0000	
	Measured to:		Ref. Point(Slant)	
	2.Coordinate Par	rameter		
	Datum Name:	default1		
	Ellipsoid:	Krassovsky 1940		
	Major Axis:	6378245		
	Inverse Flattenning:	298.3		
	Projection Method	Guass 3		
	Central Meridan:	114:00:00.00000E		
	Central Latitude:	000:00:00.00000N		
	Original Latitude:	000:00:00.0000N		
	Scale:	1		
	Projection Height:	0		
	12 1 2 * *	000.00.000000		

A static baseline control network has been processed now. You can select *control* to export the solution result.



3. Main Window

# 3.1 TGO Main Window

Run Tersus Geometrics office Software Package in the Start menu, or directly press Icon, it enters the main window. Now you can get the window as Figure 3-1. This window includes Menu bar, Tool bar, Status bar, Navigation field, Message field, Work file, etc.

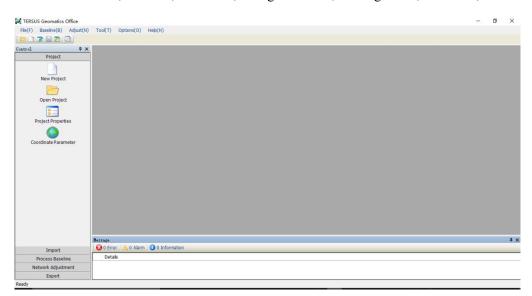


Figure 3-1 Main window

Select file menu or select a project in the Project Navigation Filed, open a project, if you select GPS (China) Pro which is a demonstration project, you will find the window in Figure 3-2.

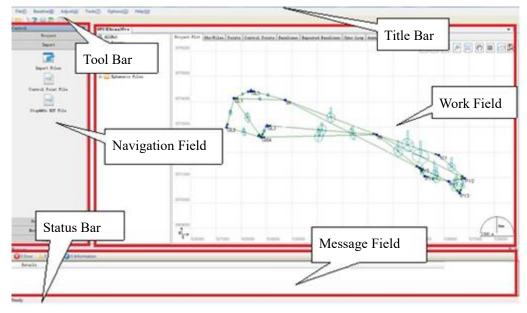


Figure 3-2 Fields in main window

According to the design, user window includes fields as following:

**Title bar:** Title bar can help you quickly determine the type of current application. And you can do a few programs controlling, such as, Maximum, Minimum and Exit program. If you open a project, it will display the project name.

**Menu bar:** The list menu is an important part of any type window. It supplies many commands to create engineering files, process data, and manage data.

Tool bar: Provide majority common shortcut keys to fast operation.

Status bar: Display a few guides about current operations.

**Work field:** It is the user's main work field, generally includes every type views related to the project.

Navigation field: Provide common shortcut keys for fast operation.

Message field: Output message of processing.

We shall explain all the operations to the main program in the following sections.

# 3.1 Menu and Toolbars

#### Menu

The main menu of the program includes File, Baseline, Adjust, Tools, Options and Help. Every menu item has a window shortcut key. The menus provide the operation to complete most of the data processing work and the main processing steps.

 File(E)
 Baseline(B)
 Adjust(A)
 Tools(T)
 Options(O)
 Help(H)

 Figure 3- 3 Main menus

#### **Tool Bar**

You can achieve a few common operations and accelerate the rate via the Toolbars in the main program. It includes create new project, open project, save project, import data, export data, get default view (Figure 3- 4).



Figure 3- 4 Tool bar

# 3.2 Navigation Field

The navigation field is a quick entrance of menus; you can show or hide it. It is used to make user's operation faster.

Control	<b>Ļ</b>	x
Project		
Import		
Import Files		
cp		
Control Point File		
rsp		
Stop&&Go RSP File		
Process Baseline		
Network Adjustment		
Export		

Figure 3- 5 Import sub-menu

# 3.3 Plan View

Plan view in the work field mainly displays the added information, such as site, baseline, error ellipsoid, scale, grid and so on.

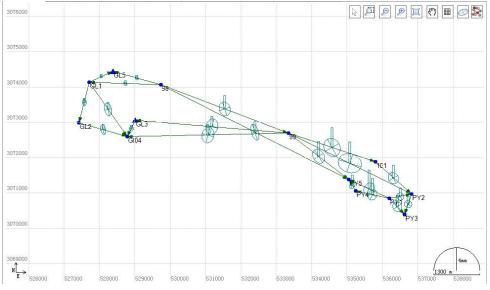


Figure 3- 6 Plan view

#### **Observation Site**

In the map, ▲ means that GPS observation site have been associated with the control site.
means that GPS observation site is a common site.

#### Baseline

The static baseline is marked by arrowhead line, and the arrowhead can be hidden. When it can't be resolved, or hasn't been resolved, the baseline is gray.

Move the mouse, when you click the site or baseline, the site or the baseline will be high-lighted as Figure 3-7.

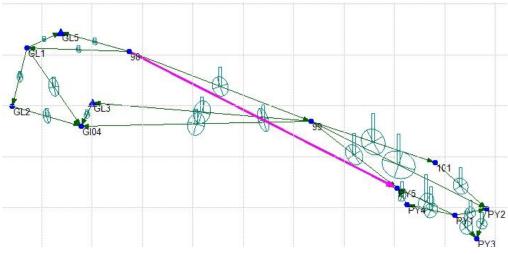


Figure 3-7 Sites and baselines

#### **Error Ellipsoid**

After finishing baseline processing the error ellipsoid and the height residual of baselines will be displayed with green color. It shows the baseline resolving quality.

### **Graphical Operation Tools**

Graphical operation tools are on the upper right corner of the plan view. Click the tool firstly, then click the network graph, you will achieve the corresponding graphical operation.





Select Button: Select the site and baseline of the network graph.

Square Select Zoom Button

Zoom Out Button

🔎 Zoom In Button

Full Screen Button

Pan Move Button

▦

Grid Reference Line Displayed Button

Error Ellipse Displayed Button

Rover Point Displayed Button

## Setting the Drawing Mode of Plan Grid Reference Line

Choosing *Options->Customize* menu item to enter custom configuration dialog (Figure 3-9), you can choose the language and the drawing mode of plan grid reference line as plan or geodetic coordinate.



Figure 3-9 Customized options

# 3.4 Tree List View of Work Field

The left of the work field is a tree list view. It's used to manage all contents of the project, including points list, baselines list, synchronous loop list, asynchronous loop list, observation files list and ephemeris files list. Click one node in the list, the detailed view will display some related information according to the selected node. For example, click *Points* node, the detail view will display Project Plot, Points and Control Points and position on Points tab (Figure 3- 10).

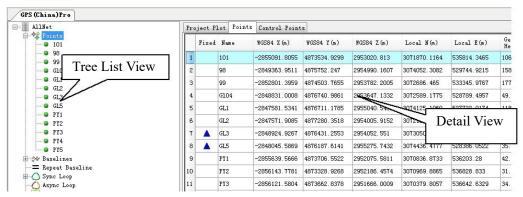


Figure 3-10 Tree list view

# 3.5 Detail view of Work Field

The detail view of work field contains several tabs, every tab will display or hide to get different display combinations according to the selected node of tree list.



Notice: The tabs of detail view will change automatically according to the selected node of tree list, users don't need to search.

## Pop-up Menu of Detail View

Select one item in the detail view, and right click it, the pop-up menu will display as Figure 3-11.



Notice: Pop-up menu will change when the tab content changes.

GPS (China) Pro			R'1				1	
- PY4	^ Proj	ect Plot Obs-	Files Sin	gle foint	Position Data	Sky Plot		
@ PY5		File	Point	Mode	Start Time		End Time	
🗄 🗇 Baselines	1	980161. zsd	98	Static	1/16/2001 1:47:3	5 PM 1	/16/2001	2:38:50
Repeat Baseline	2				16/2001 3:39:2	19669-19	/16/2001	
Async Loop		Open(O)			16/2001 3:34:3	22803838 PG	/16/2001	
😑 🦲 Observation Files		Delete(D)			202233			
980161. zsd					17/2001 11:31:	30 AM 1	/17/2001	12:51:30
980162. zsd	5	Convert to Rinex(R)		17/2001 2:06:0	5 PM 1	/17/2001	3:04:45	
990161. zsd	E	Rinex Opti	ons(S)		17/2001 2:05:1	5 PM   1	/17/2001	3:05:20
	1	Open Rine	x Folder(F)		16/2001 12:12:	05 PM 1	/16/2001	12:57:15
	8	Switch to 9	Static/Kiner	natic(C)	16/2001 1:44:1	5 PM 1	/16/2001	2:38:10
	ę	Single Pos	tioning Res	sult(P)	16/2001 12:17:	55 PM 1	/16/2001	12:59:15
GL20161. zsd GL30171. zsd	10				17/2001 11:29:	55 AM 1	/17/2001	12:50:50
	≡ 11				16/2001 1:47:5	0 PM 1	/16/2001	2:37:15
PY10171.zsd	12	Data Track(T)			17/2001 4:07:3	OPM 1	/17/2001	4:37:45
PY10172. zsd PY20171. zsd	13	Skyplot(Q) Update Sk			17/2001 4:56:4	O PM 1	/17/2001	5:33:35
	14		ypiot(d)		17/2001 2:04:1	5 PM 1	/17/2001	3:03:35
	15	Add Stop8	kGo RSP Fi	le(B)	17/2001 3:49:4		/17/2001	
PY40171. zsd PY50161. zsd	13	View Stop	&Go Info(L	)	17/2001 3:49:4		/17/2001	

Figure 3- 11 Pop-up menu

# **Property Window**

Choose *Edit* in the pop-up menu, you can edit properties of the chosen item. Property Window is different as different tab of detail view.

Basic An	tenna Receiver		
Antenna p	hase center		
Ant Typ	e: unkown	✓ Assign to (A)	) This 🔹
Is find	l antenna correc	rtion: No	
Ant Heigh	t		
Measure t	o: Ref. Point (S	lan¹ ▼ Assign to(M	) This 🔻
Heigh	t: 1.404	Assign to (H	) This 🗸

Figure 3-12 Edit properties



# 4. Project Management

Tersus Geomatics Office Software Package is managed via the Object Oriented method, so whether you do point positioning, do static baseline processing, dynamic route processing, or even do network adjustment, you should create a new project or open an existed project firstly.

Follow the steps below to create a new project:

- 1. Create a new project firstly, enter the project name and the save path;
- 2. Enter property and tolerance of the project;
- 3. Enter the coordinate parameters in the coordinate management system.

After this, you can do the next operations.

# 4.1 Create a New Project

### Set the Property of a Project

Click *Project / Project property* or click in the navigation field to set the property of the project.

### **Base Information**

The basic Information all display in the report of the network adjustment.

Infomation	Tolerance	Advand	red		
Project	:				
Construction					
Principal	:			Ĵ	
Surveyor	;[				
Start date	:		End date:		]
Description					
Time Zone	: [+8		•		

Figure 4- 1 Project properties

### Tolerance

The tolerance of project is very important. You can choose national standard or custom define standard. Many tests are conducted according to the tolerance settings during data processing. The details precision dilution can be found in the Global Position System (GPS) Survey Criterion.

nfomation Tolerance Advanced	1
Standard: China Global Surv	vey Standard 2009 🔹
Level: D 🔻	
Receiver Precision(mm) 5	Relative Precision(ppm) 1
Name	Value
Baseline Lenth (km)	10
Horizontal RMS(mm)	20
Vertical RMS(mm)	40
RMS for Poorest Baseline	45000
Baseline Fixed Error	Unlimited
Sync Loop Closure	Math.sqrt(3)/5 * sigma
ASync Loop Closure	3*Math. sqrt (n)*sigma
Repeated Baseline Closure	2*Math.sqrt(2)*sigma

Figure 4- 2 Tolerance tab

#### Advance

Advance setting determines the control item of data processing, such as using first four characters of \*TRS file as the point name of observation file, Minimum Time span of Static Baseline and Dynamic Baseline.

▼       Use Common Ephemeris(E)         Point name of obs file: First 4       ←         Minimum TimeSpan of Static Baseline(s):       300         Minimum TimeSpan of Dynamic Baseline(s):       10         Maximum Baseline Length(km):       200	: of file name	
Minimum TimeSpan of Static Baseline(s): 300 Minimum TimeSpan of Dynamic Baseline(s): 10	s of file name	e of obs file: First 4
Minimum TimeSpan of Dynamic Baseline(s): 10		
		imeSpan of Static Baseline
Maximum Baseline Length(km): 200		imeSpan of Dynamic Baselin
		aseline Length(km):
-When the software to Search Repeated Baselines and Lo Automatically(while observation files is being imp Manually (when i want to check it)		tically(while observation

Figure 4- 3 Advance tab

### Set the Coordinate Parameters

Click *File* menu->*Coordinate System* item or click *in the Project navigation field* to set the coordinate parameters. Generally, you can set coordinate parameters by following common three steps.

#### Set Ellipsoid

Ellipsoid tab page can set the Source Ellipsoid and Target Ellipsoid. You just need to select the ellipsoid name in the Ellipsoid combo box. If the ellipsoid can't be found in TGO,

File: default1	(	Save
Ellipsoid Pro	ojection Convert Plane Height Fitting 2nd Grid Config	
Source Ellip	WGS 1984	•
a(m):	6378137	
1/f:	298.2572236	
Farget Ellip	Krassovsky 1940	•
a(m):	6378245	
1/f:	298.3	

please contact our support to get parameters of the ellipsoid.

Figure 4- 4 Ellipsoid tab

### **Set Projection**

Projection tab page includes projection method and parameters of projection. Select the projection method and enter the corresponding parameters. If the projection method is not available, please contact our technicians and provide the calculation method and corresponding parameters.

File: default1	▼ Save
Ilipsoid Projection	Convert Plane Height Fitting 2nd Grid Config
Method Transvers	se Mercator
Name	Value
Central Meridian False North False East Central latitude Ko Zone + X -> North Y -> East	120:00:00.00000E 0 500000 000:00:00.00000N 1 False True True
	OK

Figure 4- 5 Projection tab

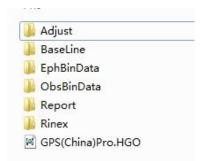
### **Set Conversion**

Convert tab page is used to set parameters of datum conversion. Select one model in the Model combo box and enter the corresponding parameters. If you have no model parameters, you can use our Coord Tool to calculate. If the model is not available, please contact our technicians and provide the calculation method and corresponding parameters.

Ellipsoid	Projection	Convert	Plane	Height Fitting	2nd Grid	Config	
Model	Bursa-Wol	f					
DX(m)	0						
DY(m)	0						
DZ(m)	0						
RX(")	0						
RY(")	0						
RZ(")	0						
K(ppm)	0						

Figure 4- 6 Convert tab

The files will be created during a project processing. These files are saved in the project route and subdirectory. When we view the project subdirectory (Figure 4-7), we can find a project file "\*.TGO" and six subdirectories created in the project directory. Adjust subdirectory is used for save the information during adjustment processing, Baseline subdirectory is used for keep the baseline processing information, EphBinData subdirectory is used for save the Ephemeris data, ObsBinDat subdirectory is used for save the subdirectory is used for save the report document, Rinex subdirectory is used for save the rinex files transformed from the observation files.



#### Figure 4- 7 Project subdirectory

So all the data and the processing information are saved in the same subdirectory, when completed this project, you can pack and save the whole directory and the corresponding subdirectory. In addition, the project folder can be transplanted from one computer to another computer and be opened.

# 4.2 Observation File

The data formats exported by the GPS receiver are NEMA0183 and the original survey data. In the term of TGO (Tersus Geomatics Office) Software Package, it needs the original survey format. The original surveying data of most GPS receivers is binary format, which is different from each other.

TGO Software Package can process data with the defined format, the data from several popular GPS receiver. It supports RINEX text format, too.

#### The Content of the Observation File

The observation files mainly save the original observation data of each ephemeris recorded by the GPS receiver. Each ephemeris includes observation time and the satellite information of every channel, C/A code, P1 code pseudo-range, P2 code pseudo-range, L1 carrier phase, L2 carrier phase. For the static observation files of the TGO Software Package, it is necessary to include the observation time, C/A code pseudo-range, L1 carrier phase; For dynamic observation files it is necessary to include the observation time and the c/A code pseudo-range.

The observation files include information besides the above of the point information, initial coordinate and the ephemeris information correlative the observations files.

In order to process stop&go data, stop& go time files is necessary except for static data file. It includes the start observation time and end observation time of a point.

The observation files can be expressed as the follow Figure 4-8:

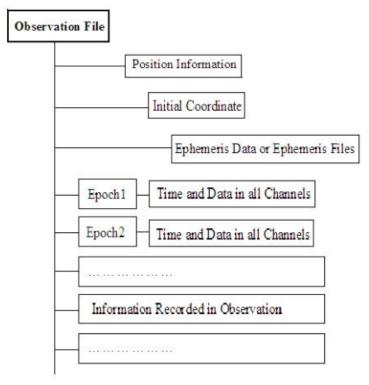


Figure 4-8 Observation files format

#### The TRS/GNS Format Observations of Tersus Receiver

The observation files of the TRS or GNS Format defined by Tersus include the original observations, ephemeris data, the coordinate of the start and end points, several editions including the point information and the rout information of the dynamic capture record.

#### The Observation in the RINEX Format

In order to process the data unified collected by different types of receivers, the RINEX format, which is a universal data format, is established. The RINEX format is brought forward by the Berne University, Astro Institution in Switzerland. It has become a standard format among all the manufacturers, schools and institutes now. And currently the main GPS receivers are all supporting to transform the observations to RINEX format.

#### **Other Observation Format**

TGO also support other observation format, such as SP3 format.

#### **Data Preparation**

The TGO Package has the ability to process a few types of data format.

Generally, you should do the next steps before processing a group of GPS observations:

### **Import Data**

Click File menu->Import or click	in the navigation field.
----------------------------------	--------------------------

File Type RINEX File	Extention *.??O;*.OBS	Select Files(S)
SP3 File	*.SP3	
GNSS Raw File	*.GNS	Select Folder(F)
		Auto
		Cancel(C)

Figure 4-9 Import files

At the right of the dialog, there is an Observation file mode combo box, it includes three modes: Auto, Static and Dynamic.

Auto: Import both static and dynamic data file. The mode of all imported files is static.

Static: Import static data file.

Dynamic: Import dynamic data files which is exported by rover.

Import folder, the TGO Package can import all files which meet the conditions automatically.

If you select import GNS data files, the program will pop-up a file dialog as Figure 4-10.File dialog will be transferred to the path of current project and lists all files with corresponding extension. You can select one or multiple files.

) 🖉 📕 « Users 🕨 Administr	ator 🕨	Desktop > Stop&Go 0522_2	<b>▼</b> 49	Search Stop&Go 0522_2	
Organize 🔻 New folder					. 0
🔆 Favorites		Name		Date modified	Туре
🖳 Recent Places		🔤 base1434.GNS		5/22/2012 4:44 PM	GNS Fil
🧮 Desktop	=	🚾 cors.GNS		5/22/2012 4:44 PM	GNS Fi
🚺 Downloads		🚾 rove2130.GNS		5/22/2012 4:44 PM	GNS Fi
<ul> <li>Documents</li> <li>Music</li> <li>Pictures</li> <li>Videos</li> <li>迅雷下载</li> <li>Administrator</li> </ul>					
📜 Computer	-	•	III		
File <u>n</u> ame:			•	ZHD File(*.ZHD) Rinex File	(* 77C 🔻

Figure 4- 10 GNS files

File import only imports observation files. In fact, at the same time, it imports the corresponding ephemeris files. For the files in the TRS/GNS format, the observations file and the ephemeris are included in one file, so they are imported at the same time. For other format, the observation file and the ephemeris may be not in the same file, then they should be saved in one directory, and the software will automatically distinguish and import the ephemeris by the format of the file. Or, the user should input the ephemeris in the post processing.

After all the files are imported, TGO will get the observation station from the observation files and automatically assemble to the static baseline and the dynamic route by the observation time spans, you will find more detail in the following (Figure 4-11).

GPS (China) Pro
- AllNet
🖻 🤣 Points
🗄 🛷 Baselines
💳 = Repeat Baseline
🗄 🔿 Sync Loop
Async Loop
🗄 🦲 Observation Files
🛓 🦲 Ephemeris Files

Pre	oject Plot Obs	-Files Po	ints Contr	ol Points	Baselines	Repeated Baselines	Sync L	oop Async	Loop
	File	Point	Mode	Start Ti	me	End Time		Time Span(Min)	Epo
1	980161.zsd	98	Static	1/16/200	1 1:47:35 PM	1/16/2001 2:38:	50 PM	00:51:15	616
2	980162. zsd	98	Static	1/16/200	1 3:39:25 PM	1/16/2001 5:16:	50 PM	01:37:25	1170
3	990161. zsd	99	Static	1/16/200	1 3:34:35 PM	1/16/2001 5:16:	20 PM	01:41:45	1222
4	990171.zsd	99	Static	1/17/200	1 11:31:30 A	M 1/17/2001 12:51	:30 PM	01:20:00	961
5	990172. zsd	99	Static	1/17/200	1 2:06:05 PM	1/17/2001 3:04:	45 PM	00:58:40	705
6	_1010171. zsd	101	Static	1/17/200	1 2:05:15 PM	1/17/2001 3:05:	20 PM	01:00:05	722
7	_GL10161. zsd	GL1	Static	1/16/200	1 12:12:05 P	M 1/16/2001 12:57	:15 PM	00:45:10	543
8	_GL10162. zsd	GL1	Static	1/16/200	1 1:44:15 PM	1/16/2001 2:38:	10 PM	00:53:55	648
9	_GL20161. zsd	GL2	Static	1/16/200	1 12:17:55 P	M 1/16/2001 12:59	:15 PM	00:41:20	497
10	_GL30171.zsd	GL3	Static	1/17/200	1 11:29:55 A	M 1/17/2001 12:50	:50 PM	01:20:55	972
11	_GL50161.zsd	GL5	Static	1/16/200	1 1:47:50 PM	1/16/2001 2:37:	15 PM	00:49:25	594
12	_PY10171.zsd	PY1	Static	1/17/200	1 4:07:30 PM	1/17/2001 4:37:	45 PM	00:30:15	364
13	_PY10172. zsd	PY1	Static	1/17/200	1 4:56:40 PM	1/17/2001 5:33:	35 PM	00:36:55	444
14	_PY20171.zsd	PY2	Static	1/17/200	1 2:04:15 PM	1/17/2001 3:03:	35 PM	00:59:20	713

Figure 4-11 All the observations files

### Pop-up menu of the Observation File

Select a file in the Obs-Files tab in the detail view, right click it, then the pop-up menu will display as Figure 4- 12, then you can operate the observation file.

	Pr	ject P	Lot Obs	Files Sin	gle Point	Position Data Sk	ry Plot
"980161. zsdGL50161. zsd "980162. zsdPY50161. zsd		File		Point	Mode	Start Time	End Time
_990172.zsd1010171.zsd 990171.zsd-G1040171.zsd	1	9801	61. zsd	98	Static	1/16/2001 1:47:35	PM 1/16/2001 2:38:50
dGL30171. zsd	2	9801	62. zsd	98	Static	1/16/2001 3:39:25	PM 1/16/2001 5:16:50
0171.zsd	3		Edit(A)			5/2001 3:34:35	PM 1/16/2001 5:16:20
51. zsd 51. zsd	4		Open(C	))		7/2001 11:31:30	AM 1/17/2001 12:51:30
0161. zsd	5		Delete(l	D)		7/2001 2:06:05	PM 1/17/2001 3:04:45
GL50161.zsd 1040161.zsd	6	1	Conver	t to Rinex(R)		7/2001 2:05:15	PM 1/17/2001 3:05:20
.0171. zsd	7	_0	Rinex O	ptions(S)		3/2001 12:12:05	PM 1/16/2001 12:57:15
PY20172. zsd PY30171. zsd	8	_0	Open R	inex Folder(F	F)	3/2001 1:44:15	PM 1/16/2001 2:38:10
)171. zsd )171. zsd	9	_	Switch	to Static/Kin	ematic(C)	5/2001 12:17:55	PM 1/16/2001 12:59:15
71. zsd	10	_0				7/2001 11:29:55	AM 1/17/2001 12:50:50
71. zsd 71. zsd	11		-	ostioning R		5/2001 1:47:50	PM 1/16/2001 2:37:15
orrit. Est	12	F		te Single Po:	stion(E)	7/2001 4:07:30	
	13	F	Data Tr			7/2001 4:56:40	
	14	F	Skyplot			7/2001 2:04:15	
-	15	F	Update	Skyplot(G)		7/2001 3:49:45	
	16	F	Add Sto	p&Go RSP F	ile(B)	7/2001 3:48:50	7 20. 24 COL 35 CA 200 000 00000
	17		View St	op&Go Info	(L)		
	1.0	_F		top&Go Inf		7/2001 4:58:20	
	18	_Proor	01. ISU	PY5	Static	1/17/2001 3:32:30	Carlos Contractor and Contractor Contractor

Figure 4-12 Pop-up menu

#### **Property of Observation File**

Select a file in the Obs-Files tab in the detail view, right click or double click it, and select *Edit* in the pop-up menu. You can edit the property of the selected observation file in Figure 4-13.

	nna Receiver		
Antenna pha	se center		
Ant Type:	unkown 👻	Assign to (A)	) This
Is find a Ant Height	ntenna correction:	No	
Measure to:	Ref. Point (Slant 🔻	Assign to (M)	This

Figure 4-13 Edit observation property

### Single Point Positioning Result of Observation File

Choose a file in the Obs-Files tab in the detail view, right click it, and select *Single Positioning Result* in the pop-up menu. Then Single Point Position tab will be activated, the single point positioning result of the observation file will display in the plan view, as Figure 4- 14.

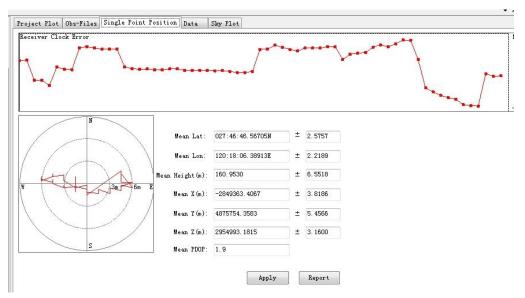


Figure 4-14 Single position menu

### The Data Track Map of Observation

Choose a file in the Obs-Files tab of the detail view, right click it, and select **Data Track** in the pop-up menu. Then Data tab will be activated, the tracking information about each satellite of the selected observation file displays in the plan view as Figure 4- 15. The interruption part means blockage of the satellites of the receiver.

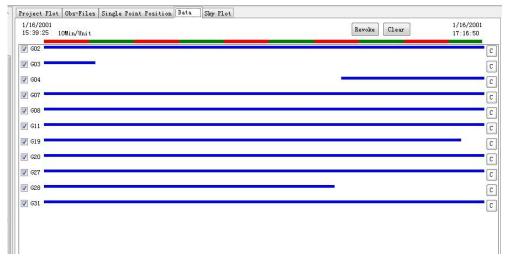


Figure 4-15 Data track status

#### The Tracking Satellite Map of Observation

Select a file in the Obs-Files tab of the detail view, right click it, and select *Skyplot* in the pop-up menu. Then Sky Plot tab will be activated, the sky plot and SNR (Signal to Noise Ratio) plot about all the tracking satellites of the selected observation file displays in the plan view as Figure 4- 16.

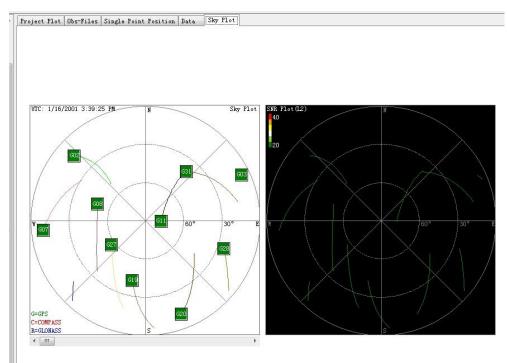


Figure 4-16 Skyplot infomation

#### **Transform Observation Data to the RINEX Format**

Choose a file in the Obs-Files tab of the detail view, right click it, and select *Convert to Rinex* in the pop-up menu. Then the selected observation file will be converted to a RINEX format (Figure 4- 17). The options of RINEX file can be selected by choosing *Rinex Options* item menu in the pop-up menu to set up (Figure 4- 18). The created Rinex file is saved in the RINEX subdirectory of the corresponding project directory. You can view them by clicking *Open Rinex Folder* menu.

	File	Point	Mode	Start Time		End Time	Time Span(Min)	Epochs
3	990161.zsd	99	Static	1/16/2001 3:34	:35 PM	1/16/2001 5:16:20 PM	01:41:45	1222
4	990171.zsd	99	Static	1/17/2001 11:3	1:30 AM	1/17/2001 12:51:30 PM	01:20:00	961
5	990172. zsd	99	Static	1/17/2001 2:06	:05 PM	1/17/2001 3:04:45 PM	00:58:40	705
6	_1010171.zs 🚰	Edit(A)	0.1		15 PM	1/17/2001 3:05:20 PM	01:00:05	722
7	_GL10161.zs	Open(O	)		2:05 PM	1/16/2001 12:57:15 PM	00:45:10	543
8	_GL10162. zs 🔇	Delete(D	D)		15 PM	1/16/2001 2:38:10 PM	00:53:55	648
9	_GL20161. zs	Convert	to Rinex(R	0	7:55 PM	1/16/2001 12:59:15 PM	00:41:20	497
10	_GL30171.zs	Rinex O	ptions(S)		9:55 AM	1/17/2001 12:50:50 PM	01:20:55	972
11	_GL50161.zs	Open Ri	inex Folder	r(F)	:50 PM	1/16/2001 2:37:15 PM	00:49:25	594
12	_PY10171.zs	Switch to	o Static/Kir	nematic(C)	:30 PM	1/17/2001 4:37:45 PM	00:30:15	364
13	_PY10172. zs		ostioning I		:40 PM	1/17/2001 5:33:35 PM	00:36:55	444
14	_PY20171.zs		e Single Po		:15 PM	1/17/2001 3:03:35 PM	00:59:20	713
15	_PY20172. zs		12	ostion(c)	:45 PM	1/17/2001 4:37:40 PM	00:47:55	576
16	_PY30171.zs	Data Tra	1000		:50 PM	1/17/2001 4:37:45 PM	00:48:55	587
17	_PY40171.zs	Skyplot(			20 PM	1/17/2001 5:32:45 PM	00:34:25	414
18	_PY50161.zs	Update	Skyplot(G)		:30 PM	1/16/2001 5:17:30 PM	01:45:00	1261

Figure 4-17 Convert to Rinex format

1.Version	2.11 💌	
2.System	📝 GPS (G)	
	📝 GLonass ( <u>R</u> )	
	🦳 Compass (C)	
3. Include:	📝 SNR (S)	
	📝 Doppler (D)	

Figure 4- 18 Rinex options

#### Stop &Go RSP File

If you do stop&go data processing, you need to add stop&go RSP File (stop&go time file) to dynamic file. Choose a file in the Obs-Files tab of the detail view, right click it, and select *Add Stop&Go File* in the pop-up menu (Figure 4- 19) to add a RSP file to this observation file. Click *View Stop&Go RSP File* to view the RSP file you have added.

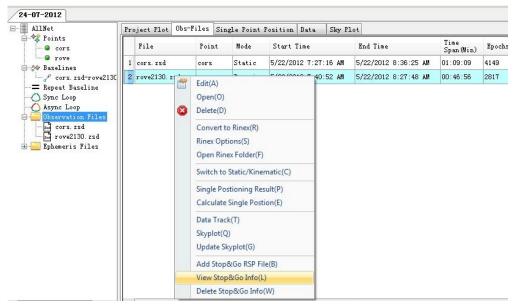


Figure 4- 19 View stop&go info

You can delete stop&go RSP File too, just select *Delete Stop&Go Info* menu item in the pop-up menu.

# 4.3 Observation Station

Click the *Points* node in the tree list view, and the right detail view will display information about site. There are two tabs in the right detail view, including points tab, control points. The control point list information is used to adjust network, and has nothing to do with baseline procession.

AllNet	Pro	ject P	Lot Points	Control Point	.s			
-*** Points • 101		Fixed	Name	WGS84 X(m)	WGS84 Y(m)	WGS84 Z(m)	Local N(m)	Local E(m)
• 98 • 99	1		101	-2855091.8055	4873534.9299	2953020.813	3071922.5407	535814.9558
G104	2		98	-2849363.9511	4875752.247	2954990.1607	3074104.7698	529745, 4276
GL1 GL2	3		99	-2852801.3959	4874503.7655	2953782.2005	3072738.9033	533346. 544
GL3	4		G104	-2848831.0008	4876740.9861	2953647.1332	3072641.6141	528789.9855
GL5	5		GL1	-2847581.5341	4876711.1785	2955040. 5432	3074177.6598	527722.489
- • PY1 - • PY2	6		GL2	-2847571.9085	4877280.3518	2954005.9152	3073034.7664	527429.7829
— 🔍 рүз	7		GL3	-2848924.9267	4876431.2553	2954052.551	3073103. 4428	529026.2266
PY4 PY5	8	<b>A</b>	GL5	-2848045.5869	4876187.6141	2955275. 7432	3074488. 9458	528386.535
💝 Baselines	9		PY1	-2855639.5666	4873706.5522	2952075.5811	3070889.2799	536203.895
= Repeat Baseline	10		РҮ2	-2856143.7781	4873328.9268	2952186. 4574	3071022.2954	536829, 4595
🔿 Sync Loop 🔿 Async Loop	11		рүз	-2856121.5804	4873662.8378	2951666.0009	3070432.2045	536643.256
Observation Files	12		PY4	-2854769.8587	4874089.2803	2952261.5376	3071102.0003	535259.3596
🧾 Ephemeris Files	13		PY5	-2854516.5446	4874061.9351	2952551.2799	3071428.4273	535053.642

Figure 4- 20 Points

The detail view lists each observation site name, fixed (whether the control points associated with it), spatial rectangular coordinate under WGS84 coordinate system and grid coordinate in local system.

## Pop-up Menu of Observation Station

Right click the selected site, pop-up menu display as Figure 4- 21. You can change the properties of the point.

	Fixed	Name	WGS84 X(m)	WGS84 Y (m	)	WGS84 Z(m)	Local N(m)	Local E(m)	Normal Height (m)	
1		101	-2855091.8055	4873534.92	99	2953020.813	3071870.1164	535814.3465	106.7638	
2		98	-2849363.9511	4875752.24	7	2954990.1607	3074052.3082	529744.9215	158. 1753	
3		99	-2852801.3959	4874503.76	55	2953782.2005	3072686.465	533345. 9767	177.1477	
4		G104	-2848831.0008	4876740.98	61	2953647.1332	3072589. 1775	528789, 4957	49.8288	
5		GL1	-2847581.5341	4876711.17	85	2955040. 5432	3074125.1969	527722.0174	118.8031	
6		GL2	-2847571.9085	4877280. 3518		2954005.9152	3072982.3231	527429. 3163	67.2609	
7		GL3	-2848924.9267	4876431_25	553 2954052 551		3073050 9983	529025.7329	43. 9957	
8		GL5	-2848045.5869	4876: 💆	Edit(	1000		528386.0522	35. 4765	
9		PY1	-2855639.5666	4873' 🥝	Delet	Contraction of the second	2.0	536203.28	42.6591	
10		PY2	-2856143.7781	4873:		s Control Point(		536828.833	31.5569	
11		рүз	-2856121.5804	48736	Delet	e Control Point	Related(R)	536642.6329	34.2533	
12		PY4	-2854769.8587	4874089.28	03	2952261.5376	3071049.5901	535258.7598	32. 4533	
13		PY5	-2854516.5446	4874061.93	51	2952551.2799	3071376.0115	535053.0466	33.205	

Figure 4- 21 Pop-up menu for points

#### **Property of Observation Site**

Source:	NetAjust_Free							
Point WGS84	Target							
	🔘 Spatial (XYZ) 🛛 🔘 Geodetic (BLH)							
В	27:46:14.031880N							
L	120:17:40.089240E							
Ellipsoid H(m)	43. 9957	m						
		_						

Select *Edit* in the pop-up menu or double click selected site, you can set the property of the observation site, such as its name, WGS coordinate, local grid coordinate.

Figure 4- 22 Edit site

TGO software package record all coordinate source, such as an observation file. You can change the coordinate source of a site by selecting source in the source pull down menu and apply it by clicking *Apply* button. Click *Edit* button to enter coordinate.

# 4.4 Baseline

Click the *Baselines* node in the tree list view, and the right detail view will display information about baselines (Figure 4-23).

Pro	oject P	Lot Baselines	Data Plot Rej	eated Ba	selines	Sync Loop	Async L	oop			
	Enat	le Name		Type	Start	End	TimeSpa	Result	Frequency	Ratio	RMS (m)
71. zsd 61. zsd	1 Yes	_1010171. 2	sdPY20171. zsd	Static	101	PY2	58	Passed	L1Fixed	6.5	0.0108
	2 Yes	980162. z	sd990161.zsd	Static	98	99	97	Passed	L1Fixed	7.2	0.0169
	3 Yes	980161. 2	sdGL10162. zsd	Static	98	GL1	51	Passed	L1Fixed	99	0.004
	4 Yes	980161. 2	sdGL50161.zsd	Static	98	GL5	49	Passed	L1Fixed	99	0.0038
	5 Yes	980162. z	sdPY50161. zsd	Static	98	PY5	97	Passed	L1Fixed	13.1	0.0115
	6 Yes	990172. 2	sd1010171. zsd	Static	99	101	59	Passed	L1Fixed	5.3	0.0165
	7 Yes	990171. 2	sd-G1040171.zsd	Static	99	G104	71	Passed	L1Fixed	69.3	0.0166
	8 Yes	990171. 2	:sdGL30171. zsd	Static	99	GL3	79	Passed	L1Fixed	32.6	0.0182
	9 Yes	990172. z	:sdPY20171. zsd	Static	99	PT2	58	Passed	L1Fixed	1.9	0.0174
1	0 Yes	990161. z	sdPY50161. zsd	Static	99	PY5	102	Passed	L1Fixed	7.7	0.0189
1	1 Yes	_GL10161. z	sd-G1040161.zsd	Static	GL1	G104	35	Passed	L1Fixed	23.5	0.0071
1	2 Yes	_GL10161. z	sdGL20161. zsd	Static	GL1	GL2	39	Passed	L1Fixed	99	0.0048
1	3 Yes	_GL10162. z	sdGL50161.zsd	Static	GL1	GL5	49	Passed	L1Fixed	99	0.0032
1	4 Yes	_GL20161. z	sd-G1040161.zsd	Static	GL2	G104	36	Passed	L1Fixed	26.3	0.0059
1	5 Yes	_GL30171. z	sd-G1040171.zsd	Static	GL3	G104	71	Passed	L1Fixed	99	0.0055
1	6 Yes	_PY10171. 2	sdPY20172. zsd	Static	PY1	PY2	30	Passed	L1Fixed	36.6	0.0067
1	7 Yes	_PY10171. z	:sdPY30171. zsd	Static	PY1	РТЗ	30	Passed	L1Fixed	10.7	0.0085
1		1.		m	10				1	10	10

Figure 4-23 Baseline menu

### **Pop-up Menu of Baseline**

Click the *Baselines* node in the tree list view, and the right detail view will display information about baselines (Figure 4- 24).

With this pop-up menu, you can set procession option, process baseline, view report and delete baseline.

F	roj	ect	Plot	Baselines	Data Plot	Repeated Ba	selines	Sync Loop	Async	Loop			
		En	able	Name		Type	Start	End	TimeS	pa Result	Frequency	Ratio	RMS (m)
ie 📘	1				-d- PV20171 -	-d Static	101	PY2	58	Passed	L1Fixed	6.5	0.0108
		1		ess Options(	0)	Static	98	99	97	Passed	L1Fixed	7.2	0.0169
	'	0		ess Line(P)		Static	98	GL1	51	Passed	L1Fixed	99	0.004
			кер			Static	98	GL5	49	Passed	L1Fixed	99	0.0038
			Dele	te(D)		Static	98	PY5	97	Passed	L1Fixed	13.1	0.0115
				ble(F)		Static	99	101	59	Passed	L1Fixed	5.3	0.0165
			Enal	Enable(E)		Static	99	G104	71	Passed	L1Fixed	69.3	0.0166
			Invert(I)		Static	99	GL3	79	Passed	L1Fixed	32.6	0.0182	
			Data	ata and Residual Track(T)		Static	99	PY2	58	Passed	L1Fixed	1.9	0.0174
	10	Yes	8	990161. zs	adPY50161. ;	sd Static	99	PY5	102	Passed	L1Fixed	7.7	0.0189
	11	Yes		_GL10161. zs	ad-G1040161.	sd Static	GL1	G104	35	Passed	L1Fixed	23.5	0.0071
	12	Yes		_GL10161. zs	adGL20161. a	sd Static	GL1	GL2	39	Passed	L1Fixed	99	0.0048
	13	Yes	8	_GL10162. zs	sdGL50161. ;	sd Static	GL1	GL5	49	Passed	L1Fixed	99	0.0032
	14	Yes		_GL20161.zs	d-G1040161.	sd Static	GL2	G104	36	Passed	L1Fixed	26.3	0.0059
	15	Yes	8	_GL30171. zs	d-G1040171.	sd Static	GL3	G104	71	Passed	L1Fixed	99	0.0055
	16	Yes	92	_PY10171. zs	adPY20172. :	sd Static	PY1	PY2	30	Passed	L1Fixed	36.6	0.0067
	17	Yee	š.	PV10171	d- PV30171	ed Static	PY1	PYS	30	Poread	IlFived	10 7	0 0085

Figure 4- 24 Pop-up menu for baseline

# 4.5 Repeat Baseline

Click the *Repeat Baseline* node in the tree list view, and the right detail view will display information about repeat baseline (Figure 4- 25).

nts 🗖	Proj	ject Plot	Baselines	Data Plot	Repeated	Baselines	Sync Loop	Async Loop		
ne		Name	Quali	ty DX	(mm) D	Y (mm)	DZ (mm)	DLength(mm)	Avg Length(m)	Tolerance(mm)
	► 1	98-99	Passed	. 0	0		0	0	3851.4718	17.9
	2	99-G104	Passed	. 0	0		0	0	4559.3321	19.1
	3	99-GL3	Passed	. 0	0		0	0	4337.6672	18.7
	4	99-PY5	Passed	. 0	0		0	0	2156.8684	15.4
990161.zsd 990171.zsd 990172.zsd 990172zsd										





# 5. Baseline Processing

### 5.1 Processing Options

Before processing baseline, processing options must be set. Right click one baseline,

select *Process Option* item in the pop-up menu, or click in the navigation filed, the following dialog display:

Elevation Mask: 10 Interval: 1 Minimum Epoch: 180 Frequency: Auto	4
Minimum Epoch: 180	20.000
Frequency: Auto	
Navigation: Broadcas	t 🗸
Reference Satellite: Auto	•
Auto Process Mode: Normal	•
System	MPASS

Figure 5-1 Baseline processing options

The dialog is consisting of four setting pages: General, Ion/trop, Dynamic and Advanced.

### **General Setting**

For static baselines, the minimum epoch count is 5s, or observation data can't form the baseline; for dynamic baseline, the minimum epoch count is 180, or the integer ambiguity can't be fixed.

### **Cutoff Angle**

Cutoff angle is used to limit the satellite data with relatively lower height angle, these data won't be processed when you processed baseline.

The signals from low cutoff satellites are not easy to use. Besides, the signals of lower height can be influenced by several factors, such as multi-path effect, electromagnetic waves or an in deliberate jammer. So generally the quality of these signals is not good. These signals should be removed from the procession.

From the atmosphere refraction perspective, observation for a short distance can be reduced cutoff angle height; for long distance observation, cutoff angle should be increased. The shorter the distance, atmospheric refraction affects is easier to be removed. Cutoff angle should be determined according to the field condition.

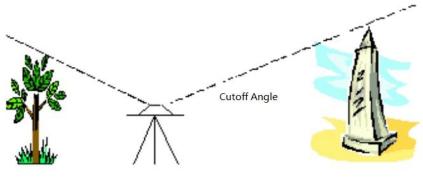


Figure 5- 2 Cutoff angle

The default cutoff angle is 20 in TGO software package.

### Sampling Interval

The epoch interval is the data interval taken from the original observational data drawn Take in the baseline process.

For example: when two receivers are processing static surveying, they are set up to capture a group of data every 5 seconds. But when it comes to the inside processing, this high density data usually degrades the accuracy of the baseline processing, instead of increase. So in order to accelerate the processing rate, user can increase the interval time appropriately. Generally, for the short line, and the observation time is not long, you can reduce the interval time appropriately, while for the long line, you can increase the interval time. e.g. For a static baseline shorter than 2 k, and the observation time within 20 minutes, then you can set up the interval to be 5seconds. But if the baseline is longer, you can increase the interval to 60 or 120 seconds.

Why set up so little interval surveying in outdoors? Because the random of the Observations and the limit of the software, you can change the epoch interval then process the baseline again to get a better result when you have the worse data. The default epoch interval is 60 seconds.

### Minimum number of epoch

Because the dual-difference is formed via the difference of the single-difference observations among the satellites, for simple processing purpose, the software fixes a reference satellite when form the dual-difference observation value. The default minimum number of epoch is 5.

### **Observations (Frequency)**

You can choose different combinations of observed values to process baseline, such as wide lane Lw, narrow lane Ln and so on. When auto mode is chosen, TGO can automatically select the type of observations according to the baseline length. Generally, baseline less than 5km use L1 observations, baseline greater than 5km use a Lc ionosphere-free combination observations.

#### **Ephemeris (Navigation)**

You can choose the broadcast ephemeris or precise ephemeris to process. Generally, if baselines are very long, precise ephemeris can improve the accuracy of the baseline solution; for short-distance baselines, the broadcast ephemeris can meet the requirements.

#### **Reference Satellite**

The default of reference satellite is auto. In this mode, TGO will select the observation data from the satellites with the greatest elevation angle as a reference satellite.

However, due to the influence of the conditions of observation, such choice may not be the most reasonable .When the reference satellite selected is not reasonable, the results of the baseline processing will be affected. Under this condition, you need to set the reference satellite based on observation data.

#### **Auto-Process Mode**

TGO software package can remove the gross errors in satellite data automatically. It can help users to reduce the work of removing the data manually and get the qualified baseline solution in short time. This feature can be enabled if "enhanced" is chosen. If the user wants to remove the data manually, just choose "general".

### **Dynamic Solving Mode**

This page is used to set dynamic route procession mode. This tab is only used for dynamic route processing. Dynamic GPS data processing has three solving mode: RTD, Stop&Go, PPK (Post Process Kinematic).

General	Ion/trop	Dynamic	Advanced	
Dynami	c Solve Mo	de		
9	Auto			
1	🔘 RTD			
1	🔘 Stop&Go			
1 8	🔘 PPK (Pos	t Process	Kinematic)	
Defaul	t Value(F)		Apply to (A) Selecte	d

Figure 5- 3 Dynamic mode

Auto: Software will choose mode to process baseline according to the existence of stop&go RSP file. No RSP file, using RTD mode, or Stop&Go mode.

**RTD**: The solving method of integer ambiguity for RTD solution mode is pure dynamic method. It can achieve 5 m precision within 300 kilometers and above 1m precision within 100 kilometers.

**Stop&Go**: This solution mode is suitable for short, middle, long baseline processing. Both stop stage and go stage is processed according to the principle of least squares method. The solving method of integer ambiguity, for stop stage, is fast static method and for go stage, is pure dynamic method. The precision of solution mode has better repetition than PPK, because it only has one ratio value.

**PPK:** This solution mode is suitable for short, middle baseline processing. Both stop stage and go stage are processed according to Kalman Filtering method. The solving method of integer ambiguity, for go stage, is pure dynamic method. For stop stage, integer ambiguity is obtained according to the dynamic single epoch results. The precision of this solution mode has less repetition, because every epoch has a ratio value.



**Notice:** If the quality of satellites single is good, the result of PPK and Stop&Go is much same. But if the quality of satellites single is worse, you'd better choose PPK solution method.

### **Ionosphere/**Troposphere

In general, not need to change the troposphere, ionosphere settings. Long baseline can improve the solution setting precision according to actual situation.

General	[Ion/trop]	Dynamic	Advanced			
		Tro	posphere	model:	Hopfield	•
				Temp:	18	•
				Press:	1013.25	•
				Humid:	50	-

Figure 5- 4 Ion/trop options

#### Advanced

In general, the default value can meet the requirements. It's recommended that users keep all the default parameters in this tab, any change may influence the solution stability.

General	Ion/trop	Dynamic	Advance	d		
		Gross	error de	tect para:	3.5	Ŧ
			Triple	Diff .Max.	0.25	•
			Mini	mum Ratio:	1.8	•
	Chi Pr	obability	(Single	frequecy):	25	•
	Chi	Probabili	ty (dual	frequecy):	10	•
		pseudo r	ange pre	cision(m):	10	•
	Phase ob	servatior	n precisi	on(cycle):	0.01	•
Split Se	esstions, if	start ti	me diffe	rs (Hour):	4	•
	Vse L1, i	f baselir	ne shorte	r than(m):	10000	•
			No L	1 Fix (m):	30000	•
Defeul	.t Value(F)	1	<b>_</b> •	apply to(A)	Selecte	d ·

Figure 5- 5 Advanced options

### 5.2 Baseline Processing

After all the settings are finished, select Baseline/Process line all baselines, or click in the navigation field, the software will process each baseline in sequence and display the information frame.

Project	E- AllNet		Project	Plat Bazeline	5 Data Plot R	mented Ba	raliner	Sume Loor	Arme I	000	
Import	Points     Aselines			ble Name	baca 110C   K	Type	Start	End	in land in some	a Result	Freq
Process Baseline			1 Yes	1010171	zsdPY20171.zs		101	PY2	58	Passed	LIFiz
₩.			2 Yes		zsd- 990161.zs		98	99	97	Passed	L1Fiz
$\bowtie$			3 Yes		zsdGL10162. zs	-	98	GL1	51	Passed	L1Fiz
Process All			► 4 Yes		zsd- GL50161. zs		98	GLS	49	Passed	LIFiz
	990172. zsd-1010171. zsd 990171. zsd-G1040171. zsd		5 Yes		rsd- PY50161. zs	and the second second	98	PYS	97	Passed	LIFis
			6 Yes		rsd1010171.rs		99	101	59	Passed	LIFIS
Process							1920		71		0.000
E.			7 Yes		zsd-G1040171.zs	C	99	G104	79	Passed	L1Fis
Report		Processin	8 Yes		zsdGL30171.zs		99	GL3	79	Passed	L1Fis
1		Processin	1g :		our present of					Passed	
		Proces	sing :	980161.zsdGI	.50161. zsd		4/21		102	Passed	L1Fi>
ssing Options	J							14	35	Passed	L1Fi:
× 1								-	39	Passed	L1Fi>
Vicational International Inter		Start	Process	ing Baseline				1	49	Passed	L1Fis
ort Options	PY20172. zsd-PY30171. zsd PY40171. zsd-PY50171. zsd							14	36	Passed	L1Fi:
	Repeat Baseline				Cancel			14	71	Passed	L1Fi>
	Async Loop				Cancer				30	Passed	L1Fi:
fetwork Adjustment	Dbservation Files		291 11		ISd"_FIDUITI.ZS	a Static	111	113	30	Passed	L1Fi2
Export		+	•			m				-	
Export age 0 Error 1 1 0 Alarm 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		+	•			m					
Details			_			_	_	_	_		_
Start Processing Baseline	1010171. zsd- PY20171. zsd		-					-			-
0. A 42 6000 000 000 - 00 000 00 000	rontal Std :0.0016 (<0.0200)m Vertical Std :0.0	025 (<0.0400)m (	Ratio:6.5	(>1.8) RMS:0.	0108m x2 Testing	:8.1(<25	0). Test	Passed			
Start Processing Baseline											
	contal Std :0.0018 (<0.0200)m Vertical Std :0.0	026 (<0, 0400 )m ·	Ratio:7 2	()1.8) RMS 0	0169m x2 Testing	: 19.8 (<2	5.0). Tes	st Passed			
Antik Astro					resering				10		
tart Processing Baseline	980161. zsd- GL10162. zsd										

During the processing, click *Cancel* button, then you can stop process baseline.

Figure 5- 6 Baseline processing

The baseline solution result will display in the message filed after the solution as Figure 5-7.

		(ana (a) : ) n										
Jon	Project	GPS (China) Pro			Pro	iect Plat	Baselines	Data Plot	Repeated	Recelines	Sung Loop	Asuno
	Import	H- 🛠 Points		W	110	Enable		Data IIOt	Type	Start		TimeS
	Process Baseline		. zsdP¥20171. zsd		5	5 Yes	980162. z	sdPY50161. :	sd Stati	c 98	PY5	97
	_		. zsd990161. zsd . zsdGL10162. zsd		e	3 Yes				1227.52	101	59
	<u> </u>		. zsdGL50161. zsd		7	Y Yes	990171. z	sd-G1040171. :	sd Stati	c 99	G104	71
	Network Adjustment		. zsdPY50161. zsd . zsd1010171. zsd			Yat	990171 -	≂d- GT30171 →	ed Stati	. 99	GT 3	79
	Export		75d-G1040171 75d	*	•				III			_
-	age											
ø	0 Error 🛕 0 Alarm 🚺 43 Inform	nation										
_	Details											
D	Solve Finished L1Fix. Horizon	ntal Std :0.0014(<0.020	0)m Vertical Std :0.0	0014(<0.0400)m	Rati	io:23.5(>1	.8) RMS:0.0	0071m x2 Test	ing :3.5(	(25.0). 1	est Passed	8
D	Start Processing Baseline _GL	L10161. zsdGL20161. zsd	8									
D	Solve Finished L1Fix. Horizon	ntal Std :0.0008(<0.020	0)m Vertical Std :0.0	0008(<0.0400)m	Rati	io:99.0(>1	.8) RMS:0.0	0048m x2 Test	ing :1.6(	(25.0). 1	est Passed	
D	Start Processing BaselineGL	L10162. zsdGL50161. zsd										
	Solve Finished L1Fix. Horizon	ntal Std :0.0004(<0.020	0)m Vertical Std :0.0	0005(<0.0400)m	Rati	io:99.0(>1	.8) RMS:0.0	0032m x2 Test	ing :0.6(	(25.0). 1	est Passed	
D	Start Processing Baseline _GL	L20161.zsd-G1040161.zsd										
0	Solve Finished L1Fix. Horizon	ntal Std :0.0012(<0.020	0)m Vertical Std :0.0	0011 (<0.0400)m	Rati	io:26.3 (>1	.8) RMS:0.0	059m x2 Test	ing :2.4(	(25.0). T	est Passed	
D	Start Processing Baseline _GL	L30171.zsd-G1040171.zsd										
0	Solve Finished L1Fix. Horizon	ntal Std :0.0007 (<0.020	0)m Vertical Std :0.0	0007 (<0.0400)m	Rati	io:99.0(>1	.8) RMS:0.0	055m x2 Test	ing :2.1(	(25.0). 1	est Passed	
D	Start Processing Baseline _PT	¥10171. zsdP¥20172. zsd										
	Solve Finished L1Fix. Horizon	ntal Std :0.0011 (<0.020	0)m Vertical Std :0.0	0017 (<0. 0400)m	Rati	io:36.5(>1	.8) RMS:0.0	067m x2 Test	ing :3.0(	(25.0). T	est Passed	
0	Start Processing Baseline _PT											
	Solve Finished L1Fix. Horizon	ntal Std :0.0014(<0.020	0)m Vertical Std :0.0	0022 (<0.0400)m	Rati	io:10.7(>1	.8) RMS:0.0	0085m x2 Test	ing :5.0(	(25.0). T	est Passed	
	Start Processing Baseline PY	¥10172. zsd- P¥40171. zsd			100100							· · · · · ·
n	Solve Finished L1Fix. Horizon		0)m Vertical Std :0.0	0032 (<0. 0400)m	Rati	io:34.6 (>1	.8) RMS:0.0	076m x2 Test	ing :4.0(-	(25.0). 1	est Passed	8
	Start Processing Baseline _PT	and a second							• •			
	Solve Finished L1Fix. Horizon	Value and a start and a	STREET AT THESE METATOMS AND	0037 (<0. 0400)m	Rati	o:9.4 ()1.	8) RMS:0.00	92m x2 Testi	ng :5.8(@	25.0). Te	st Passed	
	Start Processing Baseline _PT											
	Solve Finished L1Fix. Horizon			0016(<0_0400)m	Rati	ia:14 0(≻1	8) BMS:0.0	1079m x2 Test	ing :4 3(-	(25 M) T	est Passed	
	Start Processing Baseline _PT											2
~	Solve Finished L1Fix. Morizon		MV-	0020(/0_0400)~	Rati	a-50 9 (\1	9) <b>205</b> -0 0	049= u2 Tost	ing :1 6 (	(25.0) 7	ant Parred	
9	Sorve rinished Lifix. Norizon	acar 5ta .0.0008(KU.020	oym vertical and (0.)	0020 (ND. 0400)M	nati	10.30.3(/1	. 07 Ama. U. U	Josom X2 lest	1 mg . 1. 0 (*	veu. 0). 1	est russed	8

Figure 5-7 Baseline information

If there is warning, click one warning message and you will find the corresponding baseline in the list. The result of the solution can form the baseline report via select

Baseline->Report or click on it to create a baseline report.

### 5.3 Test Baseline Processing Result

Control Baseline Quality

After the baseline is processed, you can check the quality of the baseline by the quality standards such as RATIO, RMS and the point precision.

### 5.3.1 RATIO

The RATIO is the ratio of the less least RMS and the Least RMS after the integer ambiguity analysis, that is:

$$RATIO = \frac{RMS_{\text{sec}}}{RMS_{\min}}$$

The RATIO reflects the reliability of the integer ambiguity parameter, which is determined by a few factors. It is related to the observation quality and the observation time.

The RATIO is a key factor to the quality of the baseline, generally, the RATIO is required to be bigger than 1.8.

#### RMS

RMS is the Root Mean Square, that is:

$$RMS = \sqrt{\frac{V^T P V}{n - f}}$$

V is the residual of the observations;

P is the weight of the observations;

n - f is that the total numbers of observations subtracts to the number of known number.

RMS means the quality of the observations. The smaller the value of RMS is, the better the quality will be; The RMS is not effected by the observation time.

According the theory of Symbolic Statistics Mathematical Statistics, the rate of the observation error within the 1.96 times RMS is 95%.

#### **Point Precision**

Point precision is an important standard of the internal accuracy of solution results. It is depended on line with the strength of the satellite geometry and RMS, it can be divided into the precision of horizontal direction, precision of the vertical direction, the baseline length precision and so on. The software will check the different accuracy standard according to tolerance setting of a project.

### 5.3.2 Closed Loop and Repeat Baseline Testing

### **Closed Loop**

1. The Definition of the Misclosure

The closed loop test is an useful way to verify the quality of the baseline. The closed loop includes the synchronous loop, asynchronous loop and the duplicate baseline. In theory, the misclosure of the closed loop is zero, but in practice, surveying a certain deviation is allowed. Please refer to the relation information about the deviation limit.

The types of the misclosure are as the followings:

<sup>1.</sup> Component misclosure, that is:

$$\begin{cases} W_{\Delta X} = \sum \Delta X \\ W_{\Delta Y} = \sum \Delta Y \\ W_{\Delta Z} = \sum \Delta Z \end{cases}$$

<sup>2.</sup> Total misclosure, that is:

$$W_s = \sqrt{W_{\Delta X}^2 + W_{\Delta Y}^2 + W_{\Delta Z}^2}$$

2. Synchronous closed loop

The misclosure of the closed loop is the misclosure of the closed loop formed by the observation baselines. Because of the relativity among the baselines, the misclosure should be zero in theory. If the deviation of the misclosure is out of the limit, then one baseline vector is wrong at least. If the misclosure is within the limit, it generally means that most static baselines are OK.

3. Asynchronous closed loop

The asynchronous closed loop is a closed loop formed by all the baselines synchronously. The misclosure of the asynchronous loop is the asynchronous loop's misclosure. If the misclosure is within the limit of the deviation, it means the baseline vector is OK. If the misclosure is greater than the limit of the deviate, it means that at least one vector is not OK. You can check which baseline vector is not OK by the vicinity asynchronous loop and the duplicate baselines.

### **Repeated Baselines**

The observation result between two stations at different observation times is the repeat baselines. The difference between the repeat baselines is the repeat baselines comparability difference.

### 5.3.3 Identify Every Effect Factors

### **Effect Factors**

Factors effecting on the baseline's result are as follows:

1. The starting coordinate setting is wrong when you process the baseline. The wrong starting coordinate will cause the baseline deviation in the scale and direction.

2. The too short observation time cannot decide the integer ambiguity of the satellite. And for the baseline processing, if the integer ambiguity corresponding is not computed, the baseline processing result will be effected.

3. The number of the cycle slips is too big during some time and cause the cycle slips repairing is not perfect.

4. The multi-path effect is very much during the data collection, and the corrections of the observation value are general big;

5. The effect on the troposphere and ionosphere is too much;

6. The electromagnetic noise cannot be ignored.

7. The receiver itself has problem and cause the quality of the data too bad, e.g. the degraded phase accuracy of the receiver or the clock of the receiver is not accurate.

#### **Problems and the Solutions:**

1. The identification of the effect factors on the GPS baseline resolution

In the effect factors, some are easy to distinguish, such as the too short observation time, too many cycle slips, serious multi-path effect and too much effect from the troposphere or ionosphere. But other factors are not easy to tell, such as the inaccurate starting coordinate.

The inaccurate starting coordinate

It's not easy to tell the effect of inaccurate starting coordinate to the quality of the baseline solution, so the beginning coordinate have to be as accurate as possible.

The identification of the short observation time

You can tell this factor easily. You can view the number of each satellite's observations in the record files. The TGO Software Package supplies the visible satellite map.

The identification of many cycle slips

You can analyze the observation residual of the baseline solution to tell the cycle slips. Now most baseline processing software use the dual-difference value, so when the observations include the uncorrected cycle slips, all the residual of the dual-difference corresponding to the cycle slips will have the obviously increase at several times. The Identification of the serious multi-path effect and the too much effect of the troposphere or the ionosphere refraction

To the multi-path effect and the refraction of the troposphere or the ionosphere, we distinguish them by the residual of the baseline, too. But different to the integer cycle slips, when the multi-path effect and the refraction effect of the troposphere or the ionosphere serious, the residual increase within one time not several times and obviously bigger the normal residual.

- 2. Solutions
  - 1) Inaccurate starting coordinate

To solve the problem starting from the inaccurate points, you can use the most accurate point as the starting point when you process the baseline. The relative accurate starting coordinate can be got by the long time point positioning or connecting with the more accurate the WGS-84 coordinate, or do as the following way:

When you resolve the baseline in a network, select one point's coordinate as the derivation of all the points' coordinate, so it is the baseline's starting coordination, then all the baselines have the same system error, so you can introduce the system parameter to resolve it during the network adjustment.

2) Too short observation time

If the observation time is too short, you can delete their observations. So you can improve the result by preventing them from solution.

3) Too many cycle slips

If in an observation time, many satellites have lots of cycle slips, you can remove this time to improve the solution quality. If only one or two satellites have too many cycle slips, you can delete the satellites to improve the solution quality.

4) Serious effect of the multi-path

The result of the multi-path effect is that the observation value residual is too big, so the big residual observation value can be deleted by reducing the edit dilution. Or you can delete the observation time or the satellite effected on serious by the multi-path.

- 5) Serious effect of the troposphere or the ionosphere refraction:
- Increase the elevation cutoff angle and delete the data of little elevation angle which is effected on by the refraction easily. But this method is not smart, because the signal of little elevation angle may not be effected severely.
- \* Modify the delay of the troposphere's or the ionosphere's model.
- \* If the observation value is dual-frequency, you can use the value, the fraction of the ionosphere is not used.

### The Residual Map

The residual map is a useful tool to condense the baseline processing. When you process a baseline, it's often necessary to solve the solution problem, for example, which satellites, or during which observation time, has problem. The residual map is useful to solve this problem. The baseline residual map is a figure expressing the residual of the observations. Select the *Previous* or the *Next*, you can view the residual of the combination of each dual-difference. See Figure 5-8.

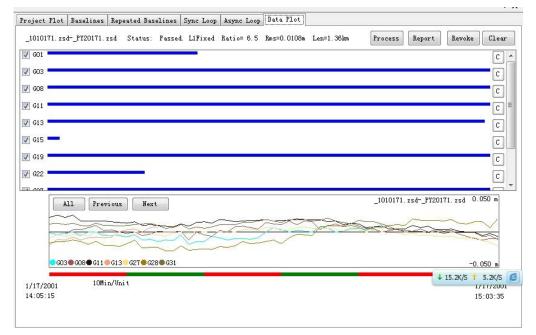


Figure 5-8 Residual map

This picture above is a general format of the baseline residual map. The horizontal axe is the observation time, the vertical axes are the observation residual.

The residual value fluctuates with the zero axes, and the amplitude is within 0.1 cycle.

### 5.4 Reprocess a Baseline

If the reason for the baseline's quality is found, you can reprocess this baseline by changing the baseline processing setting or editing the observation time of the baseline.

In the observation map, you can drag the mouse to select the deleted data. See Figure 5-9 Processing edit, the data in the broken lines box will be removed, and will not be processed.

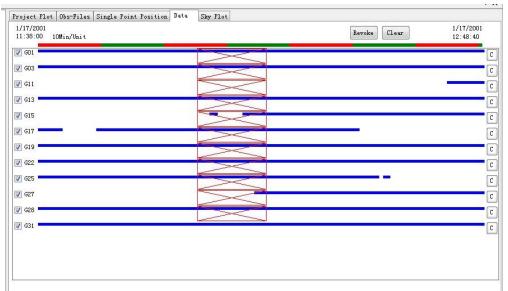


Figure 5-9 Processing edit

When you find the processing is not qualified during the baseline surveying, you need to change the setting of the baseline or edit the observation time. If you still cannot get the qualified solution, you should prevent this baseline from being processed by the network adjustment or delete this baseline. If the baseline is mandatory in the control network, you should resurvey this baseline.

### 5.5 Dynamic Route Processing

The dynamic route post-processing is the post-difference data processing. The post-difference is different from the Real Time Kinematic, which can get the surveying result at once, while the post-difference cannot get the result until the inner processing is finished. If the post-difference processing cannot get the qualified result from the observations processing, the dynamic post processing will not be completed successfully.

The operation of dynamic post-processing is easy, do it as dynamic route processing section of quick start guide chapter.



## 6. Network Adjustment

After you process the baseline, you should test again the result of the processing, optimize the result, and transform the coordinate to the needed national coordinate or the local coordinate. All the above is the content of the network adjustment. The method of this software network adjustment is the Least Square method.

### 6.1. Function and Steps of Network Adjustment

TGO has the function of processing the free network adjustment, the 3D constrained adjustment, the 2D constrained adjustment and the height fitting.

Please see Figure 6-1 for the basic network adjustment steps for the TGO Software Package, the network adjustment includes three procedures.

- The preparations done by the user. You need to set up the coordinate, enter the latitude and longitude, the coordinate, the elevation of the known points;
- Process the network adjustment, which is done by the software;
- The analysis and control to the quality of the processing result, which are done by the user.

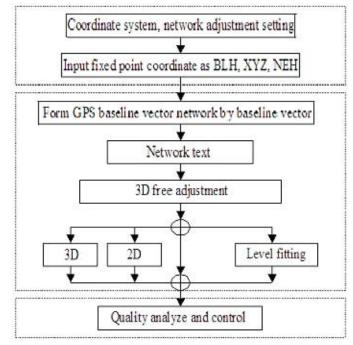


Figure 6- 1Network adjustment steps

We can find that, the software only achieves the solution of the network adjustment. What is more important is the involvement of the user to get a right result, and this is often an iterative procedure.

### 6.2. Network Adjustment Preparation

### **Coordinate Setting**

You should check the setting of the coordinate before set up the network adjustment. The details of setting coordinate system, please reference to **Set the Coordinate Parameters** in section 4.1.

### **Network Adjustment Setting**

Select *Adjust /Adjust options* menu or click in the navigation field, the dialog in Figure 6-2 will display, you can set adjustment parameters and test parameters.

d Strategie	25	
ed Baselin	e ?	
	(И) он 🧿	
oint (G)	🔘 Rank Defect	Free (Z)
Paramete(S)	🛛 🧿 Don't Adjust	7 Para ( <u>T</u> )
ng model:	Plane	•
lute Error	0.005	m
tive Error	1	ppm
	ed Baselin oint(G) Paramete(S) s ng model: Lute Error	ed Baseline ?

Figure 6-2 Adjust options

#### **Control-point Coordinates**

After network adjustment setting is completed, you need to enter control-point coordinate, or you cannot do constrained adjustment. There are several methods to enter the control-point coordinate:

1. Click *Set as Control Point* in the pop-up menu of sites list to set the site to control point.

AllNet	Pro	oject Pl	Lot Points	Control Point	:5			
🖻 💖 Points 👘 101		Fixed	Name	WGS84 X(m)	WGS84 Y(m)	WGS84 Z(m)	Local N(m)	Lo
98	1		101	-2855091.8055	4873534.9299	2953020.813	3071870.1164	535
- G104	2		98	-2849363.9511	4875752.247	2954990. 1607	3074052.3082	529
9 GL1 9 GL2	3		Edit(E)		55	2953782.2005	3072686.465	533
- 🕒 GL3	4			)	61	2953647.1332	3072589. 1775	528
L5 Y1	5			ontrol Point(S)	85	2955040. 5432	3074125.1969	521
2	6			ontrol Point Relat	ed(R) 18	2954005.9152	3072982.3231	521
	7		GL3	-2848924.9267	4876431.2553	2954052.551	3073050. 9983	529
'4 '5	8		GL5	-2848045.5869	4876187.6141	2955275.7432	3074436.4777	528
nes	9		РҮ1	-2855639.5666	4873706.5522	2952075.5811	3070836.8733	536
Baseline	10		РУ2	-2856143.7781	4873328.9268	2952186.4574	3070969.8865	536
oop Loop	11		рүз	-2856121.5804	4873662.8378	2951666.0009	3070379.8057	536
rvation Files	12		РҮ4	-2854769.8587	4874089.2803	2952261.5376	3071049.5901	535
eris Files					1	·		

Figure 6-3 Control points setting 1

2. Click *Set as Control Point* in the pop-up menu of control point list to enter the control point info.

AllNet	Pr	oject Pl	ot Points Co	ntrol Points						
		Name	Fixed (Horiz	Fixed (Verti	North (	n)	East(m)	Normal Height(m)	WGS84 Fixed (Horizo	WGS84 Fixed(Verti
© 98 © 99		GL3			3073050	. 9983	529025.7329	43.9957	1	<b>V</b>
- G G104	2	glə 🔛	Edit(E)			4777	528386.0522	35. 4765	V	V
GL2 GL3 GL5 PY1				trol Point File(S rol Point File(I) Point(A)	·					
- 9 PY2										
- © PY3										
• PY4 • PY5										
- © PY4 © PY5										
<ul> <li>PY4</li> <li>PY5</li> <li>PS</li> <li>Repeat Baseline</li> </ul>										

Figure 6- 4Control points setting 2

3. Click *Import Control Point File* in the pop-up menu of control point list to import the existing control point file to the project.

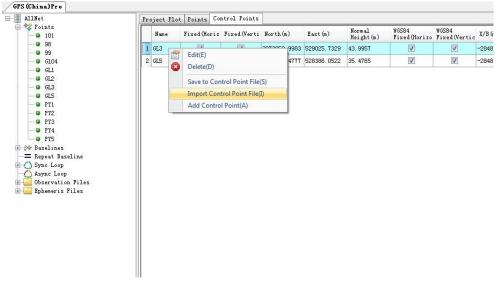


Figure 6-5 Control points setting 3

After entering control point info, you can click *Save to Control Point File* in the pop-up menu of control point list to save control point file.

### 6.3. Run Network Adjustment

Run Adjust in the Adjust menu, or click *button* in the navigation field. Generally, just choose *auto adjust* mode, TGO will process network adjustment based on the known baseline processing result, the network adjustment setting, the observation point's coordinate. When adjustment is completed, the software will form the adjustment results list, select an adjustment result, then click Get Report button, you can view the corresponding adjustment report.

etwork Adjust	
Adjust	
Free (P)	Auto Adjust (A)
🔘 3D Biased(C) 🛛 🗑 WGS84 Datum 👻	
💮 2D Biased and Height Fitting( <u>T</u> )	Process (S)
Result	1
Free 3D NetAdjust Constraint 3D NetAdjust In WGS84	Get Report (R)
Free 3D NetAdjust	Get Report (R)
Free 3D NetAdjust Constraint 3D NetAdjust In WGS84 Constraint 3D NetAdjust In Target System	Get Report (R)
Free 3D NetAdjust Constraint 3D NetAdjust In WGS84 Constraint 3D NetAdjust In Target System	

Figure 6- 6 Network Adjust page

#### **Get Baseline Vector Network**

The first step to run the network adjustment is to get the baseline vector network. The principles to form the vector are listed below:

- 1. This baseline is in this project and it is not be deleted;
- 2. This baseline has a starting name and a calculation name;
- 3. This baseline is computed and display as a qualified baseline in the vector list ;
- 4. This baseline is not set up to not attending the solution and the network adjustment.

The baseline meeting the items above will be downloaded in the first step of the network adjustment and form a baseline vector network.



If you process the adjustment with the network not connective, the result of the adjustment cannot converge. TGO will test the connectivity of the network automatically before the adjustment. If the network is not connective, you will find the error message as Figure 6-7:

Message				
1 Error	🛆 0 Alarm	1 Information		
Detail	5			
🚺 Process	ing: Free Ad	justment In WGS84.	Num	of Baselines j
😵 The Net	is Not Conn	ected!		

Figure 6- 7 Network error message

So you should test the baseline vector, the observation point name of the baseline vector network. The steps are listed below:

1. Check the map whether it is divided into several parts, or it has the separated observation sites or baselines, if yes, delete the separate point or process baseline respectively.

2. Make sure the key baseline is computed successfully, and it is not prevented from the network adjustment. You should reprocess or resurvey the key baseline if it is in the above situation.

3. Make sure no observation site with two difference names, which will be shown on the map two points with little distance. Because the two points observation is the observation of the same site at different time, so they cannot form a baseline and the map is not connective. The solution is to modify the error station name in the observations property.

### **Adjustment Report**

The results of the adjustment will be reflected in the report. Adjustment report content and display format can be set in the Adjust Report Options window (Figure 6- 8). A network adjustment example is given in Figure 6- 9.

Output Items		
📝 Baselines Input in	WGS84	
👿 Control Points Inp	ıt	
📝 Adjusted Baselines	in WGS84	
📝 Baseline Residuals		
📝 Adjusted Points in	WGS84 XYZ	
📝 Adjusted Points in	WGS84 BLH	
📝 Adjusted Points in	Local NEV	
Report Format		
🔘 Text file(TXT)		
🧿 HTML file(HTML)		
🔘 MS Office (WORD)		
	OK	Cancel

Figure 6-8 Adjust report options

Content	Name Number of GPS Baselines:					Value 16	
	Number of Or's Baseanes. Number of Adjusted Points:					13	
	Confidence level:					10.00g	
Free 3D NetAdjust	Simificance Level for Tau Test:					1.00%	
1.Baselines Input in WGS84	Ratio of Standard Error of Unit Weight:					0.0875	
> 2.Control Points Input	x2 Test Value:					1.0496	
> 3.Adjusted Baselines in WGS84	x2 Test Value: x2 Test Range:					3.0738 - 28.2995	
4.Baseline Residuals	x2 Test Result:					False	
5.Adjusted Points in WGS84 (XYZ)	As a tost russum.					1 4130	
6.Adjusted Points in WGS84 (BLH)							
>> 7 Adjusted Points in Target	1.Baselines Input in WGS8	34					
System(NEU)							
8.Weakest Baseline and Point	Baselines	Tau	ΔX(m)	Std.Dev(mm)	ΔY(m)	Std.Dev(mm)	$\Delta Z(m)$
	_1010171.zsdPY20171.zsd	True	-1051.9778	15.6	-205.9986	15.9	-834.3466
	980162.zsd990161.zsd	True	-3437,4427	15.0	-1248.4737	24,4	-1207.9470
	_980161.zsdGL50161.zsd	True	1318.3640	5.1	435.3671	4.5	285.5830
	980162.zsdPY50161.zsd	True	-5152.5972	10.3	-1690.3182	17.3	-2438.9192
	990171.zsd-Gl040171.zsd	True	3970.3986	12.4	2237.2301	18.4	-135.0759
	990171.zsdGL30171.zsd	True	3876.4741	12.7	1927.4909	17.6	270.3400
	990172.zsd_PY20171.zsd	True	-3342.3991	27.1	-1174.8219	28.4	-1595.7121
	_GL10161.zsd-G1040161.zsd	True	-1249.4673	9.1	29.8052	12.1	-1393.4078
	_GL10161.zsd_GL20161.zsd	True	9.6256	5.5	569.1725	7.2	-1034.6262
	_GL10162.zsdGL50161.zsd	True	-464.0526	4.2	-523.5644	3.7	235.1998
	_GL20161_zsd-Gl040161_zsd	True	-1259.0918	7.5	-539.3667	9.9	-358.7784
	_GL30171.zsd-G1040171.zsd	True	93.9264	4.1	309.7309	6.3	-405.4190
	_PY10171.zsdPY20172.zsd	True	-504.2131	9.2	-377.6219	16.3	110.8752
	_PY10171.zsd_PY30171.zsd	True	-482.0121	12.0	-43.7142	21.1	-409.5812
	_PY20172.zsdPY30171.zsd	True	22.1968	8.7	333.9106	15.4	-520.4558
	PY40171.zsd-PY50171.zsd	True	253.3133	11.2	-27.3457	17.5	289.7433

Figure 6-9 An adjust example

#### **Test Network Adjustment Result**

The result of the network adjustment should be checked after the adjustment. To evaluate the quality of the network adjustment, the corrections, the mean square error and the corresponding data statistics result should be checked.

The net adjustment of mathematical statistics test includes the X2 test and Tau test.

- X2 test shows the reliability of the results of adjustment. If the X2 test value is less than the theoretical value, it indicates that adjustment result of the error is smaller than the theoretical error. That is, the adjustment results are good enough, and generally no need to deal with or select the appropriate "baseline standard deviation confidence level (relaxation factor) to make the X2 test. If the X2 test value is greater than the theoretical value, the error of the adjustment results exceed the range which can be accepted, it means the baseline solution error is too large or the control point information has gross errors, you should find the problem with baseline or control points, and process again until test passed.
- Tau test is used to test the existence of gross errors in the baselines involving adjustment. Generally, the test result depends on every baseline corrections. If a baseline Tau test cannot be passed, you need to process baseline again and then make it participate in the adjustment, or disable the baseline directly.

If the result of the network is disqualified, the following items are for your reference:

- 1. Make sure the coordinate setting is right;
- 2. Make sure the known point is correct and in the same system;
- 3. Make sure the baseline vector map is correct. If there is a disqualified static baseline, you can prevent it from network adjustment. If this baseline cannot be deleted or is very important in the baseline network, you need to compute this baseline again or survey again if it's needed;

4. Make sure the observation site and antenna height is correct for the observation files. If it is wrong, the misclosure or the result of the free network adjustment will be very bad.



### 7. Report

In this chapter, we will introduce the detail context of various reports.

### 7.1 Static Baseline Processing Report

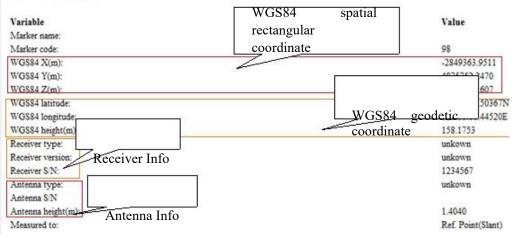
The static processing report consists of reference, rover, processing controls, tracking, baseline solution, ambiguities.



### **Reference and Rover Info**

It records the reference point/rover info, such as name, code, the spatial rectangular coordinate under WGS84 coordinate system, geodetic coordinate under WGS84 coordinate system, receiver info and Antenna info.

### **1.Reference:**





#### **Processing Control**

This part mainly record the observation start time of baseline and end time some processing control parameters which you set in the procession options window.

#### Ambiguities

This part records the status of integer ambiguities solution, such as the following figure:

#### float ambiguity summary(L1)

System	SVID	Week	Seconds	Interval	Float
GPS	28	1097	200365	900	616828.8255
GPS	19	1097	200365	3060	728840.2383
GPS	31	1097	200365	4740	548507.8070
GPS	8	1097	200365	5760	-291432.8050
GPS	2	1097	201385	4740	-834005.8204
GPS	20	1097	202045	4080	-571803.9298
GPS	7	1097	203125	3000	2139850.2347

### fixed ambiguity summary(L1)

System	SVID	Week	Seconds	Interval	Fixed	Ra
GPS	28	1097	200365	900	616829	
GPS	19	1097	200365	3060	728840	
GPS	31	1097	200365	4740	548508	
000	~	4007	200000		201 122	

Figure 7-3 Ambiguities report

### 7.2 Network Adjustment Report

This report is generated by network adjusting. Here we just introduce one report with adjustment-free method.

Free 3D NetAdjust >> 1.Baselines Input in WGS84 >> 2.Control Points Input >> 3.Adjusted Baselines in WGS8 >> 4.Baseline Residuals >> 5.Adjusted Points in WGS84 (XYZ) >> 6.Adjusted Points in WGS84 (BLH) >> 7.Adjusted Points in Target System(NEU) >> 8.Weakest Baseline and Point

Figure 7- 4 Network Adjustment report

The header of report is the result of adjustment test. You can know the adjustment result by these values. For example the test result in Figure 7- 5, the X2 Test result is not in the accepted range, it is not passed. You need to check the baseline according to above chapter.

Name	Value
Number of GPS Baselines:	21
Number of Adjusted Points:	13
Confidence level:	10.00σ
Significance Level for Tau Test:	1.00%
Ratio of Standard Error of Unit Weight:	0.3949
x2 Test Value:	10.6616
x2 Test Range:	11.8076 - 49.6449
x2 Test Result:	False

#### Figure 7- 5 Report header

If the result of the network is under qualified, the baseline of problematic vector will be highlighted in red as Figure 7- 6. You need to check the baseline according to above chapter.

### **3.Adjusted Baselines in WGS84**

Baselines	Tau	ΔX(m)	Std.Dev(mm)	ΔY(m)
_1010171.zsdPY20171.zsd	True	-1051.9830	8.6	-205.9945
980162.zsd990161.zsd	True	-3437.4406	5.0	-1248.4660
980161.zsdGL10162.zsd	True	1782.4153	2.5	958.9313
980161.zsdGL50161.zsd	True	1318.3638	2.5	435.3672
980162.zsdPY50161.zsd	False	-5152.6008	5.4	-1690.3245
990172.zsd1010171.zsd	False	-2290.4346	9.9	-968.8154
990171.zsd-G1040171.zsd	True	3970.4021	4.6	2237.2396
990171.zsdGL30171.zsd	True	3876.4791	4.8	1927.4921
990172.zsdPY20171.zsd	False	-3342.4162	7.8	-1174.8054
990161.zsdPY50161.zsd	True	-1715.1489	5.9	-441.8211
_GL10161.zsd-G1040161.zsd	True	-1249.4680	3.7	29.8029
_GL10161.zsdGL20161.zsd	True	9.6257	3.1	569.1717
_GL10162.zsdGL50161.zsd	True	-464.0525	2.3	-523.5645
_GL20161.zsd-G1040161.zsd	True	-1259.0915	3.7	-539.3677
_GL30171.zsd-G1040171.zsd	True	93.9269	2.5	309.7310
_PY10171.zsdPY20172.zsd	True	-504.2149	4.6	-377.6186
PY10171.zsd-PY30171.zsd	True	-482.0105	5.4	-43.7139

Figure 7- 6 Adjusted baseline report

### 7.3 Dynamic Route Processing Report

There are three types of reports: RTD report, Stop&Go report and PPK report. RTD report includes three parts: Reference point info, Coordinate system parameters and every point info of the rover. And the stop&go report and PPK report has stop point info besides RTD report context.



### 8. Import and Export

In this chapter, we will introduce the import and export function of the software.

The TGO Software Package can support many kinds of function about import and export. Generally, the output part will be hand in, as a part of the result, when you hand in the result text.

# 8.1 Import and Export Observations and Ephemeris

For imported observations, we can convert them to RENIX file by choosing *Convert to RINEX* item in the pop-up menu (Figure 8-1).



Figure 8-1 Convert to Rinex format

You can select *in the navigation to batch conversion (Figure 8- 2). The export achievements are in the "Rinex" folder under project folder.* 

bs File	Baseline Result   Pr	oject Report	
Conter	ıt	Extension	OK (Q)
Rinex	File	*.??0, *.??N	
Points	File	*. TXT	Cancel (C)
Projec	t Plot DXF	*.DXF	
Contro	l Point File	*.cp;*.csv;	
			Setting(S)
			Folder (F)

Figure 8- 2 Batch convert

### 8.2 Export the Coordinates of Result Points

In Figure 8- 2, if *Points Files* item to export is selected, you can get the coordinate of result point of TXT format.

The coordinate of point is separated by ',' symbol:

Point name, Latitude, Longitude, Ellipsoidal Height, Northing, Easting, Normal Height

ile	<u>E</u> dit F <u>o</u> rmat	View	He	lp					
	101 98 99 GL1 GL2 GL3 GL5 PY1 PY2 PY3 PY4 PY5		, , , , , , , , , , ,	027:45:35.08022N 027:46:46.50367N 027:46:01.82863N 027:45:59.04750N 027:46:49.02737N 027:46:11.92167N 027:46:14.03188N 027:46:59.08965N 027:45:01.47702N 027:45:05.73688N 027:45:08.47767N 027:45:19.10109N	, , , , , , , , , , ,	120:21:47.89458E 120:18:06.44520E 120:20:17.33617E 120:17:31.42133E 120:16:52.66466E 120:16:41.77918E 120:17:40.08924E 120:21:01.85508E 120:22:01.98508E 120:22:21.98508E 120:22:21.97765E 120:22:17.97765E 120:21:20.04117E	 $\begin{array}{c} 106.\ 7638\\ 158.\ 1753\\ 177.\ 1478\\ 49.\ 8288\\ 118.\ 8031\\ 67.\ 2609\\ 43.\ 9957\\ 35.\ 4765\\ 42.\ 6594\\ 31.\ 5572\\ 34.\ 2536\\ 32.\ 4532\\ 33.\ 2050 \end{array}$	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3071£ 3074( 3072£ 3072£ 30741 30725 3073( 3074( 3070£ 30705 30705 30705 3071( 30715
< [				III					•

Figure 8- 3 Export points

### 8.3 Export Network Map

TGO software package can export Network Map with DXF format. Select *Project Plot DXF* item to export Network Map.

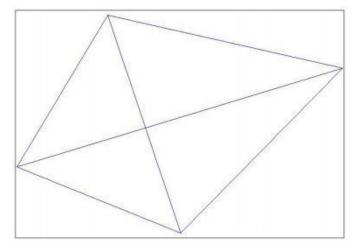


Figure 8- 4 Network map export

**Notice:** If graphics can't be shown in CAD software, it's in out of the zoom range. Please type the command e, z in the CAD software, it will automatically zoom to graphics view area

# 8.4 Export Baseline Result

TGO software package can export baseline result as Figure 8- 5. After exporting, click *Folder* button, you can view the corresponding format baseline result.

bs File	Baseline Result	Project Report	
Conten	t	Extension	0K (Q)
Trimble	e Data Exchar	nge 🔹 🗱 🕹	
Cosa Da	ata Exchange	*. TXT	Cancel (C)
			Setting (S)
			Folder (F)

*Figure 8- 5 Export baseline* 

### 8.5 Export Report

TGO software package can export project report with format: TXT, DOC, HTML

Obs File Baseline Result Pro	ject Report	
Content	Extension	OK (Q)
Project Report(ASCII)	*. TXT	
Project Report(Word)	*. DOC	Cancel (C)
Project Report(Htm)	*.HTM	
		Setting(S)
		Folder (F)

Figure 8- 6 Report format



# 9. Using of Tools Software

The Common tools software of the TGO Data Processing Software Package includes the antenna manager, the satellite prediction software, the Coordinate transformation tool, and the Precise ephemeris download tool. This chapter mainly introduces the methods and the answer to some common questions.

### 9.1 Usage of Antenna Manager

Antenna manager is designed for updating and editing the receiver parameter file (The "HitAnt.Ini" file). When you used the unknown receiver type but know the geometric parameter of the receiver and the phase center height parameters, you can use this tool to add the receiver you needed.

Select *Tools-> Receivers* in the menu, there will be pop-up window, in the *Antenna*, you can set up some commonly used parameters here, such as the radius, the phase center height. See Figure 9-1:

Гуре	Radius(m)	ARP (m)	4
108200 Internal	0.078000	0.058000	I
AT1200	0.089000	0.010000	
AT2200	0.089000	0.010000	
AT2200E	0.089000	0.017000	
108200B Internal	0.097500	0.020000	
3200B	0.097500	0.020000	
Ð5800	0.118000	0.015000	
		'ype AT2200 {adius(m) 0.089000	Add ( <u>A</u> ) Delete ( <u>D</u> )
vertical height physical phase	X	RP 0. 010000	_
hase-	r ant height		

Figure 9- 1 Receiver antenna information

In the list window, select the name of the antenna, you can change the corresponding parameters directly.



**Notice:** This file would influence the data achievement, please don't change it easily!

## 9.2 Coordinate Transformation Tool

The TGO Data Processing Software Package supplies the coordinate transformation tool. Choose *Coord Tool* in the *Tools* menu to function the coordinate transformation tool.

This software can transform between the local coordinate and the WGS84 coordinate, meanwhile it can calculate the parameter. The following is about these tools in details:

### 9.3 Summarize

Firstly, you should know the representation of each coordinate. The common methods are the Longitude-Latitude and Ellipsoid Height (BLH), the Space Rectangular Coordinate (XYZ), the Plane Rectangular Coordinate and the Geoidal Height (xyh/NEU). The ellipsoid height is a geometric sense and the geoidal height is a physical quantity.

The WGS84 is of the BLH system, the Beijing 54 is of the Plane Rectangular Coordinate.

Now it comes to the accuracy of the transformation. In an ellipsoid, the transformation is rigor (BLH--XYZ), but the transformation in different ellipsoid is not rigor. e.g. There is no a transformation parameters can be used all over the national between the WGS84 coordinate and the Beijing 54 coordinate, because the WGS84 coordinate is a geocentric coordinate system, but the Beijing 54 coordinate is a local geodetic reference system. The elevation's transformation is between geoidal height and physical quantity. So in each place must use local ellipsoid fitting, usually with seven parameter model to fitting.

Generally, the more rigor method to transform coordinate between different ellipsoid is the seven parameters transformation. That is the X plane, the Y plane, The Z plane, the X Spin, the Y spin, the Z spin and the Scale Dilution K. For getting the seven parameters in a location, you should have more than three points. If the area is not large, the furthest point is within 30km, and you can use the three parameters, that is X plane, the Y plane, and the Z plane. The X spin, the Y spin, the Z spin and the Scale Dilution K are regards to be zero. The tree parameters are the special of the seven parameters. The essence of the seven parameter model with a local ellipsoid is to fit the form of local coordinate system; so the local ellipsoid height after transformation is the geoidal height. Of course, we can also fit it in the different direction of plane and elevation. For example, using the four parameter model to fit in the plane, and using the secondary surface model to fit in the elevation direction. This mode of handled separately is more freedom than seven parameter model. But because the four parameters model has less parameter, a weak ability of expression, usually uses for small regional coordinate transformation.

To sum up, the TGO coordinate transformation tool provides two practical transformation strategies to choosing by the customers:

1. Seven parameter model, one step to get local plane and level data.

2. Four parameters and elevation fitting model, which is divided into two steps to get local plane and level data.

Because each company has a different definition of the model and process, here is our company's conversion process, its description as follows:

WGS-84 B and L 1 known point 3 known point WGS-84 Space Calculate 7 Calculate 3 Rectangular parameters parameters 7 parameter model transform Beijing-54 Space Rectangular Set Projection Beijing-54 B and L parameter Coordinate projection Beijing-54 Plane coordinate

The conversion process of seven parameters model is in below:

Figure 9-2 Conversion process of seven parameters model

The conversion process of four parameters model is like this:

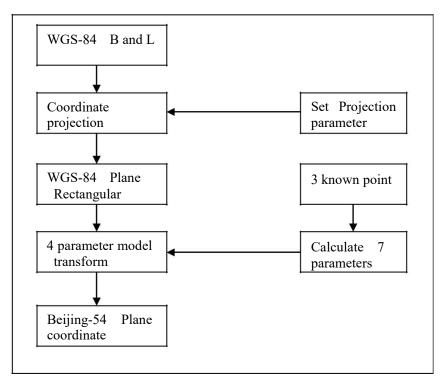


Figure 9-3 Conversion process of four parameters model

The conversion process of elevation fitting is in below:

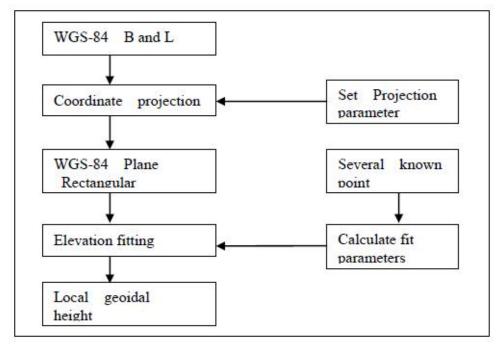


Figure 9-4 Conversion process of elevation fitting

#### Use Software to Transform Coordinate

This software manages the coordinate transformation parameters with file (\*.dam), you can save a group of transformation parameters in a file, and next time you can open this file to transfer the parameters in the file menu.

The coordinate transformation parameters are generally include the ellipsoid parameter, projection parameters, seven parameters, four parameters, elevation fitting parameters, level grid files. All these parameters' input integrated to the following page. After input the parameters, input a file name, and click *Save* button, will create a "\*.dam" parameter file in the "GeoPath" directory which in the "Program" folder.

Click the *Parameter* menu:

File: Det		•	Save							
Ellipsoid	Projection	jection Convert Plane Height Fitting 2nd Grid Config								
Source E	Ellip WGS	WGS 1984 -								
a(m	): 6378	6378137								
1/	f: 298.	298.2572236								
Target El	ip Krass	Krassovsky 1940 👻								
a(m	): 6378	245								
1/	f: 298.3	3								

Figure 9- 5 Parameters

In this page, complete inputting parameters, or click [V] drop-down button to select a file of coordinate transformation, then click the **Ok** button, will get back to the main window to positive and inverse transform coordinate:

1 mer	e Point File Convert			
Sou	urce System		Tar	get System
0	) Cartesian (XYZ)		C	) Cartesian (XYZ)
C	) Geodetic (BLH)		C	) Geodetic (BLH)
C	) Grid(xyh)		(0	Grid(xvh)
0.00				
X:	-2612121.9794		ן x∶	3540092.9287
¥:	4749422.3904	>>> >>>	y:	955299.4093
<b>Z</b> :	3350364.0216	"	h:	11.9206

Figure 9-6 Transformer window

### **Parameter Calculation**

When users have a group of control points (these points have both WGS84 coordinate and local coordinate), you can use this software to calculate the parameters. As previously mentioned, this software provides seven parameters model and four parameters and elevation fitting model solution, the calculation of two models is completed in the same interface, it's convenient to users to compare and choose different precision model. In the main interface, click the *Parameter Clac* in the *Tools* menu, can open the parameter calculation interface (if you have not input the ellipsoid and projection parameters, you will be prompted by pop-up the "Parameter" window).

The process of parameter calculation is:

1. Input basic parameters: First, input local ellipsoid and projection parameters.

2. Import data: Add points coordinate one by one or to one data, or prepared the text file first then click the *Open* button (prepare note: file format is [Name, B, L, H, x, y, H]).

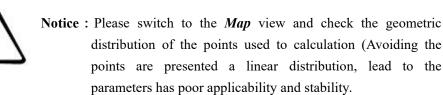
3. Calculate parameters: The software support two modes of coordinate transformation, click the *Calc Bursha Parameter* or *Calc Helmert 2D* + *Height*, if use the second mode, please selected the model of elevation fitting firstly.

4. Check the result: In the result bar will show the calculated parameters, the user can copy and save them.

5. Use parameters: Click the *Parameter settings* button to check the transformation parameters, the ellipsoid parameters and the projection parameters. Make sure these are correct, then you can input a name and save as a "\*.dam" file, this file also can be used in other Tersus software.

11	nts Maj	P				Source
	Enably	Delete	Name	В	L	💿 BLH 💿 XYZ
1		Del	9000	042:03:02.36532N	120:53:16.12066	B: 00:00:00.00000N
2	V	Del	9001	042:03:01.47215N	120:53:15.81408	L: 000:00:00.00000E
3	V	Del	9002	042:03:06.29007N	120:53:44.11550	Н:
ł	V	Del	9003	042:03:05.56338N	120:53:45.098461	
5		Del	9008	042:03:35.97285N	120:53:16.830521	Target
						h:
 .tj	out	III.			•	h: Name: Bdit (E) Bdit (E) Save (S)

Figure 9-7 Parameter calculation



### 9.4 Satellite Prediction Software

The TGO Data Processing Software Package supplies the Satellite Prediction software. Choose *Star Report* in the *Tools* menu to inactive the Satellite Prediction software.

Satellite prediction is used to forecast the distribution conditions of satellites at a certain time in a certain area according to the satellite almanacs data collected by receivers. The field engineer can choose proper time to do fieldwork, which will make the fieldwork more effective and the data better.

The general steps of this software are given below:

- 1. Update historical data;
- 2. Set stations' position and time, elevation angle;

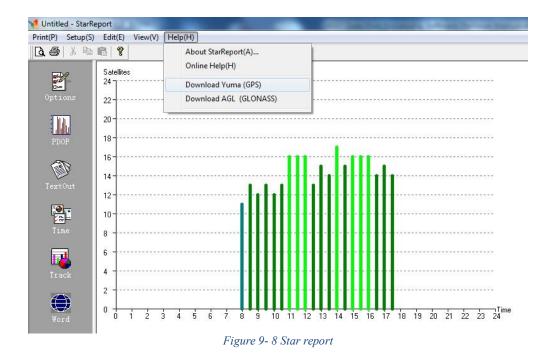
3. Forecast, check the number of satellites, check the sequence chart of DOP value, and choose the measuring time.

#### Input Almanacs Data (Yuma format)

Yuma is a kind of almanacs data format broadcast on internet by America. GPS users all over the world can download the latest almanacs data on the specific official website:

```
http://www.navcen.uscg.gov/ftp/GPS/almanacs/yuma/
```

Select *Download Yuma (GPS)* in the *Help* menu, the software will download the latest Yuma files, save it automatically and show you "download finished". See Figure 9-8:



#### **Observation Station Coordinate and Observing Period Setting**

After the latest almanacs data is loaded, you need to set up the station BL, height, height cutoff angle, observation period and so on, which will enable the software to calculate the parameters.

You can set up the date in *Status* window. The default value is the date of computer system. Users can choose any day by

"reviou", "Today", "Next", "Manual". See Figure 9-9:

Name	Data	
Time	2012-03-04	
Zone	GMT +08:00	
Lon.	E 113:19:00	
Lat.	N 023:00:08	
Date	2012-03-04	
Start	08:00	
Mask A	. 10 (degree)	
Channels Sempli	12 . 5/min	
	. current.alm	
Satell		
PDOP	4.0	
Observ	. 08:00	
Result	Finished	
₹ 7 7	SEAS	12
	d Star	

Figure 9-9 Status window

Click *Setup* ->*Option...* to set up the station BL, height, elevation cutoff angle, observation period. See Figure 9- 10:

	1	Terms Starfile
	Lon.:	€ E C W 113:19:00.000
	Lat.:	S 023:00:08.000
Time	diff with GMT:	C + 08:00

Figure 9-10 Setup options

The BL coordinate can be coarse,  $1\sim 2$  km precision will be ok. Users who does not know the BL coordinate can get it as follows:

With the coordinate transformation software, users can transform the XYZ of a known point to BLH and then input them into the software to do satellite prediction.

Get the BLH format coordinate by specific GPS instruments as HD8100, HD8088, or HD8800, input the BLH into the software to do satellite prediction.

Please pay attention to the selection of the local time and GPS time when you set up the observation period. And ensure the difference between local time and UTC time when you input the observation period in *local time* setting. Usually the computer will suggest you to choose time zone while installing.

When entering the observation period, please make sure that the difference between the start time and the end time is several hours to 24 hours, and the start time is always ahead of the end time. See Figure 9-11:

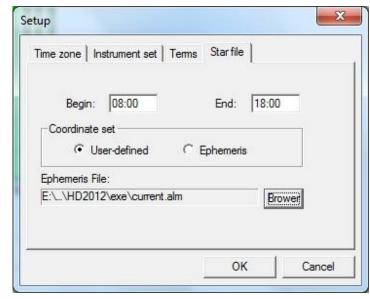


Figure 9-11 Time config

The angle will limit the azimuths of the prediction satellites in the way that only the satellites whose azimuths are over the threshold can do the prediction. Sampling rate control the data output interval. The smaller the sampling rate, the more detailed the data are. See Figure 9- 12:

Time zone	Instrument set Terms	s Starfile	
	Mask angel(degree):	10	
	Sampling rate(m):	5 💌	
	Channels:	12	
		ОК	Cancel

Figure 9-12 Instrument set

#### **Satellite Status Prediction**

After the observation station coordinate and the observing period are input, click *ok* button, you can check the satellite status in any view window.

1. Export satellite detailed status, Click 🐼 button See Figure 9- 13:

-	-	12-03-04. Edit(E)	_		Help(H)											
			vie	W(I)	ieip( <u>m</u> )											
8	do 비밀															
<b>.</b>		SVs(11):	PD0	DP GP02	GP05	GP12	GP13	GP17	GP25	GP26	GL05	GLOG	GL19	GL20		
7	-	08:00 :	1.6	50,35	3 51,252	30,278	20,052	25,134	16,300	18,180	54,011	60,241	33,121	62,020		
io	n <i>s</i>															
		SVs[12]:	PDO	DP GP02	GP05	GP12	GP13	GP17	GP25	GP26	GL05	GL06	GL07	GL19	GL20	
		08:05 :	1.5	50,357	7 52,256	30,275	19,050	23,135	16,298	20,180	51,012	61,246	11,224	31,124	64,024	
	J	08:10 :	1.5	51,00	53,259	30,272	17,049	21,137	17,296	22,179	49,013	62,252	13,226	29,126	66,029	
		08:15 :	1.5	51,003	3 55,263	30,269	16,047	19,138	17,294	24,178	46,014	64,258	15,228	28,129	68,035	
1																
T	3	SVs(13):	PDO	DP GP02	GP05	GP12	GP13	GP17	GP25	GP26	GL05	GL06	GL07	GL15	GL19	GL20
	at	08:20 :	1.4	51,003	7 56,267	29,267	15,045	17,139	17,292	26,178	44,015	64,265	17,229	10,247	26,131	70,042
		08:25 :	1.4	52,01	57,272	28,264	14,043	15,140	17,289	28,177	41,016	65,273	18,232	11,249	24,133	71,050
		08:30 :	1.3	52,014	\$ 57,276	28,261	12,042	13,141	17,287	30,176	39,016	65,280	20,234	13,252	22,135	72,059
		08:35 :	1.3	53,011	8 58,281	27,259	11,041	11,142	17,285	33,176	36,018	65,287	22,236	14,254	20,137	73,070
		SVs(11):	PDO	DP GP02	GP05	GP12	GP25	GP26	GL05	GL06	GL07	GL15	GL19	GL20		
ł		08:40 :	1.7	53,02	2 59,286	26,256	17,282	35,175	34,019	65,295	23,238	15,257	18,139	74,081		
acl	ĸ	08:45 :	1.7	53,025	5 59,290	25,254	17,280	37,174	31,020	64,302	25,241	16,260	16,141	73,092		
		08:50 :	1.6	53,02	9 59,295	24,252	17,278	40,174	29,021	63,308	26,243	17,262	14,142	73,103		
D	2															
or d		SVs(12):	PDO	OP GP02	GP05	GP12	GP15	GP25	GP26	GL05	GL06	GL07	GL15	GL19	GL20	
		08:55 :	1.5	53,03	3 59,300	23,249	11,202	17,275	42,173	27,022	62,314	28,246	17,265	12,144	71,112	
1		09:00 :	1.5	54,03	7 59,305	22,247	13,202	16,273	44,172	25,023	61,320	29,249	18,268	10,145	70,121	
1	ł															
	ić.	SVs(11):	PDO	OP GP02	GP05	GP12	GP15	GP25	GP26	GL05	GL06	GL07	GL15	GL20		
		09:05 :	1.8	54,04	59,310	21,245	15,202	16,271	47,171	23,025	59,325	30,252	19,270	68,128		
		SVs(12):	PDO	OP GP02	GP05	GP12	GP15	GP25	GP26	GL05	GL06	GL07	GL15	GL20	GL22	
		09:10 :	1.6	54,04	5 59,315	20,243	17,202	15,268	49,170	21,026	58,329	32,254	20,273	66,134	10,332	
		SVs(13):	PDO	OP GP02	GP05	GP12	GP15	GP25	GP26	GL05	GL06	GL07	GL15	GL20	GL21	GL22
		10000000000			9 59,320											
		09:20 :	1.4	53,05	3 58,324	18,238	21,203	14,264	55,168	17,029	54,338	34,261	21,279	61,143	12,154	15,332
		09:25 :	1.4	53,057	7 58,329	17,236	23,203	13,262	57,167	15,030	53,342	35,264	22,282	58,146	14,153	17,332
		09:30 :	1.4	53,06	57,333	16,234	25,203	12,259	60,166	13,032	51,345	36,267	22,285	56,150	16,151	19,332
		09:35 :	1.4	52,068	5 56,337	14,232	28,204	12,257	62,164	11,033	49,348	37,271	23,287	53,152	18,149	21,332
		09:40 :	1.4	52,065	9 56,341	13,230	30,204	11,255	65,162	10,035	47,352	37,274	24,290	51,154	20,148	24,331
		CV-(12)	PDr	IP GPD3	GP05	GP12	GP15	GP25	GP26	GI NR	GI 07	GI 15	GI 20	GI 21	GI 22	

Figure 9-13 Detailed satellites' status

#### 2. Satellite tracking map

Satellite tracking map shows the change of the number of the visible satellites with the time elapsing in the limited period. With the map, users can choose the period when the visible satellites are more to do observation so as to improve the fieldwork. Click

button. See Figure 9- 14:

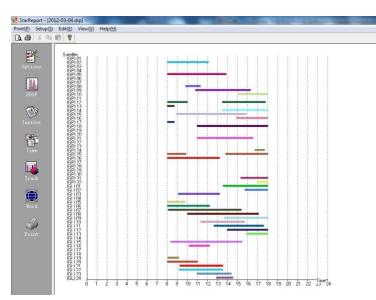


Figure 9-14 Satellites tracking map

### 3. Constellations map

Constellations map shows the distribution conditions and the movement of satellites at a certain time in a certain area. For example, in the Figure (click ), the satellite 32 will travel northwest to south in prediction. And the map shows the BL coordinate as well as the observing period.

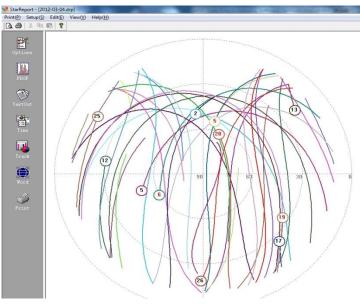
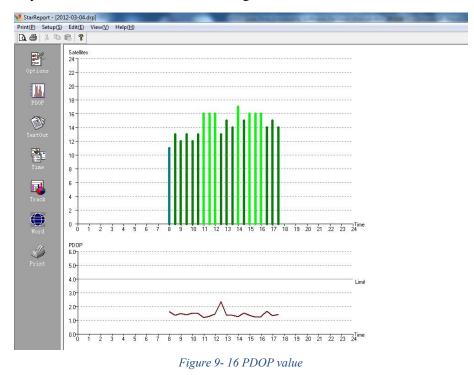


Figure 9-15 Constellations map

4. Number of the visible satellites and the PDOP

Click the relationship of the satellites number and the time will show in upside map while the PDOP will show in the downside map. The PDOP denotes how the positioning accuracy acts on satellites distribution. See Figure 9-16:



5. World map Click , you can see the satellites traveling tracks in the world map. See Figure 9- 17:

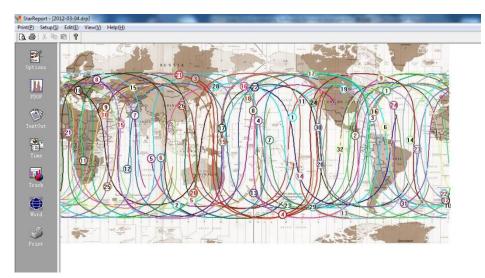


Figure 9-17 Satellites world map

### 6. Print out

File shows, satellite number, PDOP value and satellites distribution all can be print out.

### **Update Ephemeris Data**

To predict satellites precisely, the ephemeris data should be updated often. It's recommended that ephemeris should be updated once in a month. The config of the software can prompt users to update the ephemeris when it's necessary.

### **Precise Ephemeris Download Tool**

In order to improve the precision of the static data processing software, you can download SP3 precision ephemeris data from the FTP server which is provided by the United States IGS. This tool is developed for automatic download the data rapidly and easily from the data server. It's easy to use, just select the data date and data types, click *Start* to download.

Date Span From	: Sunday , Marc → to Sunday , Marc →	🔘 Utral Rapid
Save to folder	: C:\HGO Project\SP3\	<ul> <li>Rapid SP3</li> <li>Final SP3</li> </ul>
TP Server:	cddis. gsfc. nasa. gov 🔹	
1. URL 2. Mes	sage	Start (S)
		Folder (E)
		0/0

Figure 9-18 Download SP3 file



**Notice** : In the whole world, there are multiple FTP servers providing data download service. Please choose a proper download site to download the data according to your field site.