Bernese GPS Software: Recent Developments and Plans

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The Bernese GPS Software is used all over the world.



GND 2008 Aug 18 16:34:57 Geographical Distribution of Institutions using the Bernese GPS Software



Bernese GPS Software: recent developments and plans

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- New GNSS are expected in the near future. There are plans to modernize the existing GNSS.
- Reprocessing efforts are ongoing at many places.
- Many model developments have been carried out in the last years.



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What does this mean for the Bernese GPS Software?



Bernese GPS Software: A multi–GNSS analysis software

- The software has been started as a GPS analysis tool.
- It is capable to process GLONASS data already for a long time.
- The measurements from both systems can be processed together on the observation level.



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Extensions to the announced new/modernized GNSS:

- \blacksquare extension from two to n frequencies for each GNSS
- each GNSS may have different set of observation types

Flexible handling of observation types is necessary:

<mark>∭ 0</mark> Bernese GNSS Software XP <@sedna> Con <u>fig</u> ure <u>C</u> ampaign <u>R</u> INEX <u>O</u> rbits/EOP <u>P</u> rocessing <u>S</u> ervic	e Con <u>v</u> ersion <u>B</u> PE <u>U</u> ser <u>H</u> elp
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⊙ 0 Bernese GNSS Sottware XP <@sedna> Con <u>fig</u> ure <u>C</u> ampaign <u>R</u> INEX	Orbits/EOP <u>P</u> rocessing <u>S</u> ervice	Con <u>v</u> ersion	<u>B</u> PE <u>U</u> ser	<u>H</u> elp		
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Flexible handling of observation types is necessary:

- All observations types from RINEX3 are kept together in one Bernese observation file per station and session.
- A complex set of modern F90 modules guarantees a flexible access to the measurements with individual linear combinations for each GNSS.
- The use of these modules simplifies the observation handling within the processing programs.
- New linear combinations may be easily implemented at one place for the entire software package.
- \Rightarrow M. Meindl et al., Developing a Generic Multi–GNSS Software Package, IGS Workshop, Miami, June 2008.



New file formats are necessary:

Bernese observations files

(may contain all types of observations in one (common) file)



New file formats are necessary:

Bernese observations files

(may contain all types of observations in one (common) file)

Bernese residual files

(considering the new linear combinations)

Differential code biases

(many new DCBs have to be expected with the new signal types)

Receiver information file

(which receiver type is capable to receive which signal and priority lists for the observation selection)

Antenna phase center corrections

(GNSS-dependent receiver antenna PCV information)



increase the number of satellites that can be processed together (32 GPS + 24 GLONASS + 36 Galileo = 92 satellites)



increase the number of satellites that can be processed together (32 GPS + 30 GLONASS + 36 Galileo = 98 satellites)



■ increase the number of satellites that can be processed together (32 GPS + 30 GLONASS + 36 Galileo ≈ 100 satellites)



- increase the number of satellites that can be processed together ($32 \text{ GPS} + 30 \text{ GLONASS} + 36 \text{ Galileo} \approx 100 \text{ satellites}$)
- correct input and output codes for each GNSS for all external files (e.g., precise orbit file, clock RINEX file, ...)
- GNSS dependent parameter setup (e.g., receiver antenna phase center offsets/variations, Earth rotation parameters, ...)
- requires the dynamic allocation of several arrays in many of the processing programs



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(use these options for special test applications only)	
MAXLOC: Maximum number of parameters to be processed	
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MAXFLS: Maximum number of files simultaneously processed	
MAXSAS: Maximum number of satellites simultaneously processed	
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- requires the dynamic allocation of several arrays in many of the processing programs
- \Rightarrow Version 5.1 will be declared as "Galileo-ready".



1. a new coordinate/velocity file containing time intervals

IGS05 COORDINATES E	XTRACTED FROM IGS0	5.SNX		09-MAY-	2008			
 FORMAT: 1								
DATUM : IGS05								
TYPE 001: STATION C	OORDINATES							
STATION NAME	X (M)	Y (M)	Z (M)	FLG	EPOCH	VALIDITY INTERVA	L (FROM -> TO)	
* * * * * * * * * * * * * * * *	********	*****	*****	* * * * *	YYYY MM DD HH MM SS	YYYY MM DD HH MM SS	YYYY MM DD	
ABPO 33302M001	4097216.75080	4429118.87830	-2065771.49240	PPP	2000 01 01 00 00 00			
ADE1 50109S001	-3939181.98450	3467075.28480	-3613220.74210	PPP	2000 01 01 00 00 00		2004 12 23	
ADE1 50109S001	-3939181.98450	3467075.28480	-3613220.74210	PPP	2000 01 01 00 00 00	2004 12 24 00 00 00		
ADIS 31502M001	4913652.94450	3945922.49800	995383.14420	PPP	2000 01 01 00 00 00			
AJAC 10077M005	4696989.50620	723994.38050	4239678.47430	IGS05	2000 01 01 00 00 00			
TYPE 002: STATION V	ELOCITIES							
STATION NAME	 VX (M/Y)	VY (M/Y)	VZ (M/Y)	FLG	VALIDITY INTERVAL	(FROM -> TO)	RMS VX	
* * * * * * * * * * * * * * * *	********	*****	*****	* * * * *	YYYY MM DD HH MM SS	YYYY MM DD HH MM SS	****.	
ABPO 33302M001	-0.01100	0.01790	0.01660	NUVEL				
ADE1 50109S001	-0.04600	0.00570	0.04170	NUVEL				
ADIS 31502M001	-0.01850	0.01840	0.01870	NUVEL				
AJAC 10077M005	-0.01460	0.00370	-0.00530	IGS05				
••••								

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- 1. a new coordinate/velocity file containing time intervals
- 2. a section on local ties is added to the station information file

TYPE 001: RENAMING OF	STATIONS									
TYPE 002: STATION INFORMATION										
TYPE 003: HANDLING OF	TYPE 003: HANDLING OF STATION PROBLEMS									
TYPE 004: STATION EVENTS AND ECCENTRICITIES (INCLUDING TROPOSPHERE)					LOCAL T	TE (2 MINUS	1) (M)	CONS	TRAINTS (M)
CORRELATIONS										
STATION NAME 1	STATION NAME 2	FLG	EPOCH	SYS	DN/DX	DE/DY	DU/DZ	DN/DX	DE/DY	D
****	* * * * * * * * * * * * * * * *	* * *	YYYY MM DD HH MM SS	* * *	****.***	****.***	****.****	** . * * * * *	**.****	**
AIS1 49998S001		001	1996 04 17 00 00 00							
ALBH 40129M003		001	1994 04 14 00 00 00							
ALBH 40129M003		001	2003 09 08 00 00 00							
ZIMJ 14001M006	ZIMM 14001S007	001	1998 07 06 00 00 00	XYZ	3.1340	13.750	-1.785			
TYPE 005: HANDLING ST	ATION TYPES									

- 1. a new coordinate/velocity file containing time intervals ("station ABC" no longer necessary)
- 2. a section on local ties is added to the station information file (discontinuities and local ties may be specified considering an uncertainty)
- 3. FODITS: Find Outliers and Discontinuties in Time Series (presented by L. Ostini et al. at the EUREF Symposium in Brussels, June 2008)

4. improved SINEX support

(e.g., several equipment setup per coordinate interval, GNSS–dependent antenna corrections directly from the NEQ)

5. derive periodic functions for parameters in ADDNEQ2 (under development, not sure whether this feature will be a part of version 5.1)



Other new features/models of a version 5.1*:



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* The final list of features and models provided with the delivery of version 5.1 to the user community will be defined later.



Other new features/models of a version 5.1*:

selection with a potential relevance for EPN-processing

- GLONASS ambiguity resolution (not for all strategies)
- ADDNEQ2 supports SINEX containing NEQ (instead of COV).
- support of individually calibrated antennas in ANTEX in an automated processing scheme (Keywords: RINEX, SINEX)
- troposphere modelling: GMF/GPT, VMF1
- ionosphere modelling: higher order ionosphere correction
- ADDNEQ2: refinemened support for regional networks (e.g., repeatability computation with Transformation parameters)
- ORBGEN: Stochastic pulses for orbit fitting

introducing corrections for atmospheric pressure loading

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- The main developments shall be finished in 2009.
- Define a list of further implementations to finalize a deliverable version.
- Review of the on-line help.
- Update the processing examples.
- Develop and test the installation procedure.
- Update the initial "README"—files.
- Update and complete the user manual.





