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EUROCONTROL
Software User Manual – WinGPSALL

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Sheet **1 of 37**

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Module WinGPSALL

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Sheet **2 of 37**

DOCUMENT IDENTIFICATION SHEET

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Abstract

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GLONASS	EGNOS	Satellite selection	Data processing
SBAS	PEGASUS	Protection levels	Positioning
GBAS	ESTB	Processing configuration	Error models

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1 Introduction

1.1 Purpose of this document

This document is intended to serve as a handbook for the users of the PEGASUS module WinGPSALL. As the purpose of the PEGASUS is mainly based on the processing of data collected in-flight and on-ground with satellite navigation systems, especially the EGNOS Satellite Test bed (ESTB), a background in the fields of satellite navigation and air traffic management is also necessary for every user working with the PEGASUS software programs. The tools developed allow experimental use of satellite navigation and augmentation systems, notably the EGNOS and ESTB, ranging and (wide-area)-differential ranging processing of GPS and SBAS and combinations.

The purpose of the document is to describe the use of the software program WinGPSALL used either as module in the PEGASUS Project or as a standalone program. It should be noted that the current PEGASUS module WinGPSALL is intended for use with the ESTB Signal-In-Space V1.2, which is based on a combination of the specifications [7] and [8]. The PEGASUS Technical Notes [4] illustrate the currently existing specifications which are applied to the ESTB SIS V1.2. The relevant parts of the ESTB SIS V1.2 are as well described in [9].

In order to use the prototypes correctly, it is recommended that the user should read the Interface Control Document ICD [1] (which describes an important part of the data formats used) and the Technical Notes TN [4] (which describes the algorithmic implementation). It will be helpful to read the ESTB User Interface documentation [10], although this document describes the ESTB Signal-In-Space V1.0, which is based in the specification contained in [6].

1.2 Definitions, Acronyms and Abbreviations

AAIM	Aircraft Autonomous Integrity Monitoring
ASCII	American Standard Code for Information Interchange
Doc. No.	Document Number
DD	Design Document
EEC	EUROCONTROL Experimental Centre
EGNOS	European Geostationary Navigation Overlay System
ESTB	EGNOS Satellite Test Bed
ICD	Interface Control Document
GBAS	Ground Based Augmentation System
GLONASS	Global Navigation Satellite System by Russia
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
MT	Message Type

PEG	PEGASUS
PEGASUS	Prototype EGNOS GBAS Analysis System Using SAPPHIRE
PRN	Pseudo-Random Noise – Satellite Identifier
RAIM	Receiver Autonomous Integrity Monitoring
RINEX	Receiver Independent Navigation Exchange
RTCA	Radio Technical Commission for Aeronautics
SAPPHIRE	Satellite and Aircraft Database Project for System Integrity Research
SARPS	Standards and Recommended Practices
SBAS	Satellite Based Augmentation Systems
SIS	Signal In Space
SUM	Software User Manual
TBD	to be determined / defined
TN	Technical Notes
URD	User Requirements Document
UTC	Universal Time Co-ordinated
WAAS	Wide Area Augmentation System
WGS84	World Geodetic System 1984

1.3 References

- [1] PEGASUS Interface Control Document, Doc. No. PEG-ICD-01
- [2] PEGASUS User Requirement Document, Doc. No. PEG-URD-01
- [3] PEGASUS*PLUS User Requirement Document¹, Doc. No. PEG+-URD-01
- [4] PEGASUS Technical Notes, Doc. No. PEG-TN-SBAS
- [5] PEGASUS Software User Manual Frame, PEG-SUM-01
- [6] RTCA: Minimal Operational Performance Standards for GPS/WAAS Airborne Equipment. Doc. No. Do 229, June 1996, Including Change 1, July 1997
- [7] RTCA: Minimal Operational Performance Standards for GPS/WAAS Airborne Equipment. Doc. No. Do 229 A, June 1998
- [8] RTCA: Minimal Operational Performance Standards for GPS/WAAS Airborne Equipment. Doc. No. Do 229 B, October 1999
- [9] ESTB-CPF Improvements and Corrective Maintenance ESTB-UPG, Analysis of compliance with MOPS DO-229B, Doc. No. GMV-ESTB_UPG-TN-001/01

¹ The PEGASUS*Plus project established an extension to the original PEGASUS project that decodes, processes and evaluates the GNSS / SBAS data. Recent developments have integrated all these modules into a PEGASUS frame and the necessary documentation has been modified accordingly – except for the URD where it has been decided not to generate a new issue.

- [10] ESTB SIS User Interface Description, ESA, Doc.-No. : E-TN-ITF-E31-0008-ESA, issue 0, revision 1, 20-06-00
- [11] NAVSTAR Global Positioning System, System Characteristics, NATO-MAS-STANAG 4294, May 1995
- [12] OEM4 User Manual - Volume 2 Command and Log Reference, NovAtel Inc., Pub-No OM-20000047 Revision Level 7, 2001/06/21
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- [14] Aquarius 5000 Series User's Manual, Dassault-Sercel Navigation Products DSNP, Doc.-No.: 0311374 Rev B, Jan 1999
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- [17] Portable MEDLL Receiver, Installation and Operation Manual, NovAtel OM-20000065 Rev. 0C, 26.09.2001
- [18] SAPPHIRE I Integrity Monitoring, Technical Note, 1996
- [19] SAPPHIRE II Integrity Monitoring, Technical Note, 1998
- [20] SAPPHIRE DUAU User Manual, Doc. No. DUAU-TN-2472-002, Issue J, May 1999
- [21] PEGASUS Receiver Integration Description Document Ref PEG-RID-01

1.4 Overview

The PEGASUS frame and modules are based on several main software programs allowing the user to decode GNSS data that are then used to perform a GNSS navigation solution. The user is then able to perform further calculation described in the complete set of PEGASUS Software User Manuals (the interested reader is referred to the Software User Manual of the PEGASUS FRAME programme, which is described by [5]).

This document contains the Software User Manual for the PEGASUS module WinGPSALL. This section contains a short introduction to the PEGASUS approach of GNSS data processing.

In chapter 2 of this document, a short description for the installation and de-installation of the WinGPSALL module is given when they are used as stand alone programs. Chapter 3 will describe the use of the WinGPSALL software.

The Appendix A contains a short summary of the output files of the WinGPSALL program, whereas the Appendix B provides a list of possible error warnings and the associated recovery procedures for the WinGPSALL module and the Appendix C contains a description of the initialisation file which is associated with the WinGPSALL module.

1.5 Receiver Implemented

The PEGASUS tools developed allow experimental use of GNSS systems, notably the European Satellite Test bed, ranging and (wide-area)-differential ranging processing of GPS and ESTB and combinations. Data recorded from the following receivers and receiver families can be used:

receiver used to collect data	name of “receiver” implemented
NovAtel OEM2 receiver (GPS only) NovAtel GPS/WAAS Millenium (OEM3) NovAtel TestBed Receiver (OEM3/5)	NovAtel OEM3
DSNP Aquarius 5000 DSNP Aquarius 5001	DSNP Aquarius 5000
Septentrio PolaRx-1 Septentrio PolaRx-2	Septentrio PolaRx
NovAtel OEM-4	NovAtel OEM-4
NovAtel MEDLL Receiver	NovAtel MEDLL (CONVERTOR module only, limited functionality in other modules if interpreted as OEM2)

Table 1: Receivers Implemented in PEGASUS

Although the CONVERTOR module of the PEGASUS Project had been designed to implement a generic interface so that software developers are able now to develop their own dynamic link libraries that implement conversion routines for particular receivers, the current WinGPSALL module does not provide that capability.

2 Installation and System Requirements

2.1 Installation

The WinGPSALL program does not need to be installed. In order to use the WinGPSALL, the user has just to copy the delivered files (i.e. the executable and the help file) into the selected directory. In order to preserve the user-selected options, the WinGPSALL program writes an INI-file into the directory in which the executable is located. The provided INI-file in the delivery can be copied into the appropriate directory. However, if no such INI-file is found when the WinGPSALL is run, this file is created. In order to completely de-install the WinGPSALL program, the user just has to delete the delivered files and the INI-file in the installation directory.

2.2 System Requirements

The WinGPSALL program has been successfully tested on both WinNT 4.0 SP 5/6, Win95, Win2000™ and WinXP™. It is expected to run, as well, using Win98™ and WinXP™. The minimum system requirements are 16 MB RAM and a processor with a performance similar to Pentium I with 133 MHz. A graphical display of 1024X768 pixel is sufficient to run the program.

The evaluation of the recorded data can result in two output files. For a 2hr binary recording, the PEGASUS-related output file is expected to be approximately 1.5 MB large, whereas the SAPPHIRE-related output file is expected to be approximately 19 MB large. The evaluation of the 2h data recording should take approximately 3 minutes using a minimum requirement PC.

3 WinGPSALL

3.1 Introduction

The WinGPSALL program will use GNSS range measurements and satellite position data in order to determine a position solution. If SBAS correction data is available for the selected data, then the correction and ranging data can be applied as well. At the moment, the following receivers have been implemented:

- the NovAtel OEM3 receiver
- the DSNP Aquarius 5000 series receiver
- the Septentrio PolaRx receivers
- the NovAtel OEM-4 receiver

However, since the WinGPSALL prototype is based on earlier developments in the context of the SAPPHIRE project, additional receivers can be used for standalone or local area differential positioning. Further information can be found in the relevant project documentation ([20]), notably on the following receiver types:

- the Litton TSO-129 8 channel receiver
- the Honeywell TSO-129 16 channel receiver
- the Rockwell Collins D920 S-CAT ground station 12 channel receiver

3.2 Managing a Position Computation

3.2.1 Starting the WinGPSALL

The user is able to access the main WinGPSALL dialog by double clicking on the icon shown in figure 1 or by calling the program in a shell environment. The main screen of the WinGPSALL is displayed in the following figure 2.



Figure 1: Screenshot of the WinGPSALL Icon

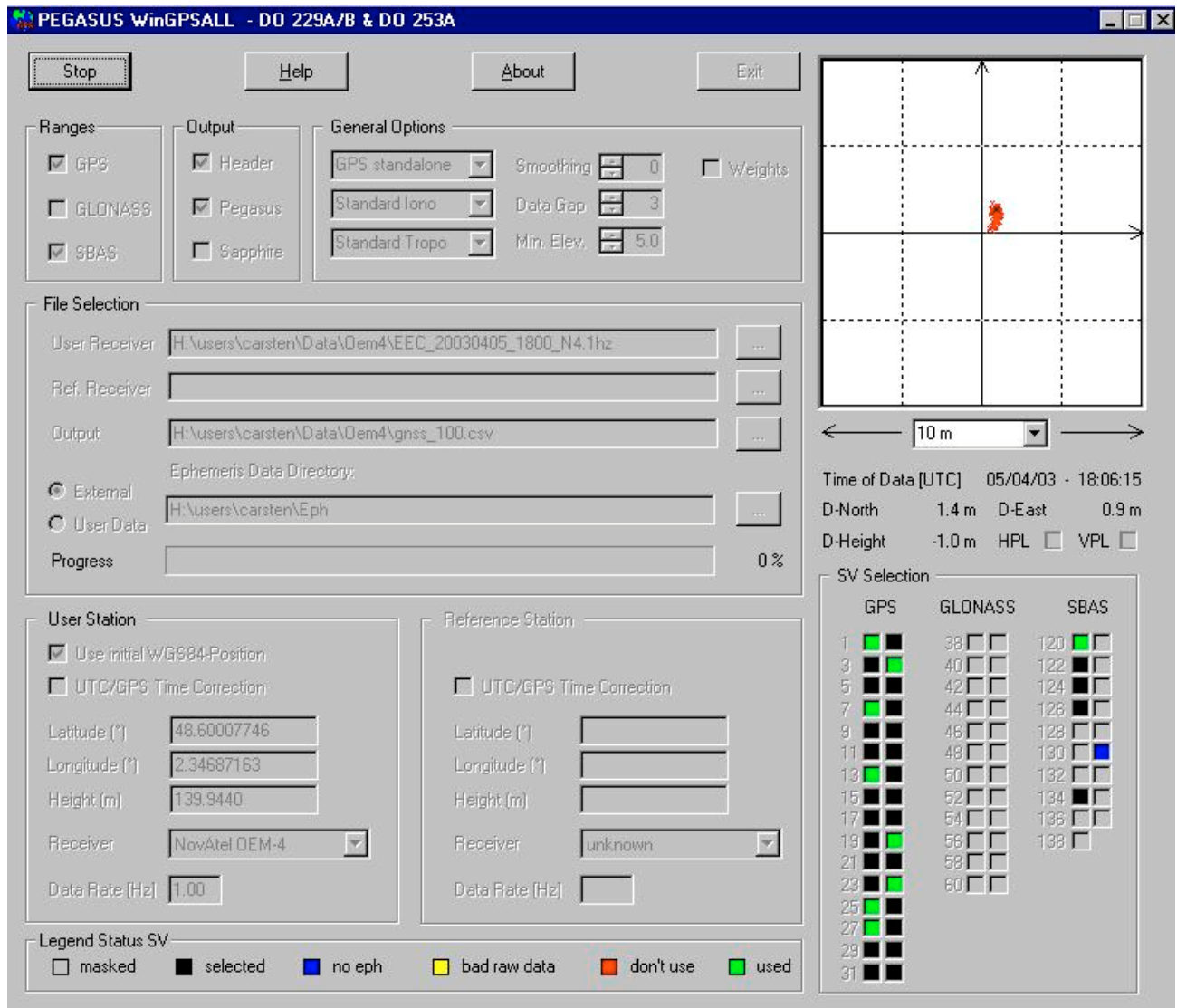


Figure 2: Screenshot of the WinGPSALL screen

The program allows the use of two command-line parameters, which are:

‘-ini <inifilename>’: This parameter assigns a specific INI-file to be used to configure the WinGPSALL program. The content of the INI-file is described in appendix C.

‘-b’: The WinGPSALL program runs minimised (in the background).

The following command line together with its arguments provides an example of how to call the WinGPSALL in background mode using a specific INI-file:

WinGPSALL -b -ini e:\wingpsall\wingpsall.ini

If no parameter '-ini ...' is provided, the program searches for a file named 'WinGPSALL.INI' in the directory which contains the executable. If present, this file will be taken for configuration. If not, a message box is displayed (shown in figure 3) and all option- and data fields of WinGPSALL are left blank or filled with standard values.

If an appropriate INI-file is either provided by the operator or found in the appropriate directory, a check on the settings of the parameters contained in the INI-file will be made. The format and the settings of the INI-file is described in detail in appendix C.

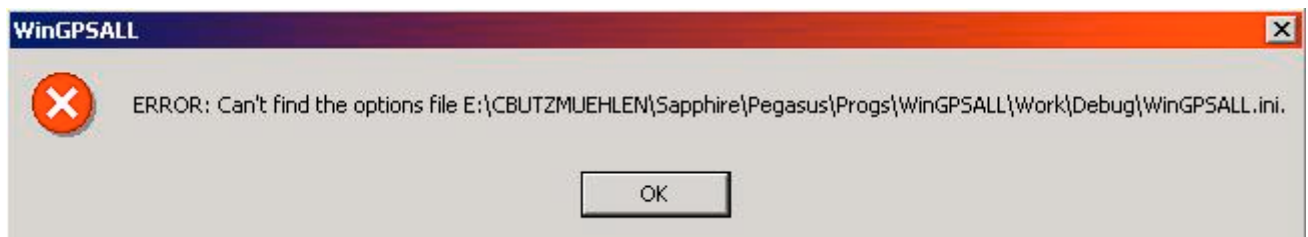


Figure 3: Screenshot of the Error Message “Missing INI-File”



Figure 4: Screenshot of the Error Message “Erroneous Parameter Setting”

In the case of an error in the INI-file when called in interactive mode, a message box will notify the operator about the erroneous parameter (shown in figure 4). The WinGPSALL interface will then appear with default settings for the faulty parameters and the operator is able to change the settings.

In the case of an error in the INI-file when called in background mode, a log-file created will contain the appropriate error message. The name of the log-file is determined by the name of the input-file provided in the INI-file (if specified). If no input-file is specified, then the standard “WinGPSALL.ERR” will be used as a log-file.

If the two parameters are used in combination and if no error is detected in the INI-file, the program automatically starts automatically and, when finished, terminates. If the program is started in interactive mode (this means the parameter '-b' is not provided), the WinGPSALL program will show its main window like presented in figure 2. The screen can be divided into several different sections. These sections will be described in detail in the chapter 3.4.

3.2.2 Starting a Sequence

The WinGPSALL program uses input files which have been generated by the CONVERTOR program (see the appropriate Software User Manual for the PEGASUS Module CONVERTOR). However, externally supplied data (e.g. ionospheric correction data or satellite ephemeris information) can be used as well, if the format of the input files and their naming correspond to the convention which has been provided in the Interface Control Document ([1]).

A number of steps must be performed in order to start the position computation process. The user should perform the following sequence of steps.

1. selection of the input file name (see chapter 3.4.2)
2. selection of the output file name (see chapter 3.4.2)
3. selection of the evaluation mode: standalone, local area, basic wide area, precise wide area (see chapter 3.4.1)
4. selection of the reference file name, if local area differential mode is chosen (see chapter 3.4.2)
5. selection of user and reference receiver, if applicable, chosen (see chapter 3.4.3)
6. specification of the user and reference, if applicable, data rate (see chapter 3.4.3)
7. selection of, at least, one source of ranging (see chapter 3.4.1)
8. selection of a source for the ephemeris files (see chapter 3.4.2)
9. specification of the minimum elevation angle (see chapter 3.4.1)
10. selection of the tropospheric correction model (see chapter 3.4.1)
11. selection of the ionospheric correction model (see chapter 3.4.1)
12. specification of a smoothing time constant (see chapter 3.4.1)
13. specification of a value for the maximum allowable data gap (see chapter 3.4.1)
14. specification of an appropriate initial position, if chosen (see chapter 3.4.3)
15. selection and de-selection of individual satellites (see chapter 3.4.4)

When the information on these essential configuration data is supplied by the user, the **Start** button will be enabled and the user can start a data evaluation run. But before the position calculation process is started, the consistency of the selected options is checked. During this check, the user is notified that the current version of WinGPSALL is processing the GPS/SBAS data according to the current ESTB SIS V1.2, which is a mix of two different standards: RTCA DO 229B for most of the correction and integrity information, except the following two items:

- the ionospheric corrections (i.e. MT 18 and MT 26) are processed according to RTCA DO 229A (since this signal and processing standard is identified by the ESTB as applicable for the current SIS, see [9]).

- the service region indications (i.e. MT 27) are processed according to RTCA DO 229A (since this signal and processing standard is identified by the ESTB as applicable for the current SIS, see [9]).

During the position computation process, the actual progress is displayed and the results are shown. After the position computation process has finished, the user will be notified. The main dialog of the WinGPSALL will disappear. The user has to re-call the executable in order to start a second position computation process.

3.3 Data Input

In order to facilitate the processing with the PEGASUS Project, the name base of all input files is identical and can be selected by the user with the “...” button next to the User field. The files then selected by WinGPSALL are the output-files of the CONVERTOR. The format of the output files of the CONVERTOR and their naming convention is described in chapter 3.5 and in detail in the Interface Control Document ([1]).

The files generated by the CONVERTOR (i.e. for the receivers implemented in the context of the PEGASUS project) must contain a header, since WinGPSALL performs a naming checking on all used and necessary acronyms. The delimiter that has been used by the CONVERTOR program will be recognised automatically by WinGPSALL. This delimiter will as well be used for the writing of the output files.

If data files for one of the receivers implemented in the context of the SAPPHIRE project are used, it is important to notice that the sequence of the input parameters must be fixed and must follow a certain standard. Further information can be found in the relevant project documentation ([20]).

It is important to notice that programs of the newest PEGASUS modules version should be used in combination. The use of older versions of the parts of the PEGASUS project might result in unpredictable performance.

3.4 Use of Software

3.4.1 General Options

The general options section is displayed in the next figure 5. The **Exit** button will close the dialog, just as the standard windows message handlers. The **About** button will display some useful information about the WinGPSALL program. The **Help** button will display a help similar to this chapter of the Software User Manual SUM.

Pressing the **Start** button will launch the position computation process. However, it will only be enabled, when all the necessary option in the WinGPSALL interface has been selected and specified.



Figure 5: Screenshot of the General Options

The user can select the ranging sources by checking the appropriate checkboxes **GPS**, **GLONASS** and **SBAS**. At least one ranging source must be chosen for the position computation process. However, it should be noted that choosing only the **SBAS** as a ranging source will not lead to a position solution. Individual satellites can be selected and de-selected using the Satellite Selection Option. In the current version of PEGASUS, the GPS and GEO ranging sources are enabled. Due to the fact that the current SBAS systems do not transmit correction and integrity information for the GLONASS system, the development of the GLONASS part of the PEGASUS project has been postponed until further notice.

There are four different pre-set modes for the data evaluation run provided in the GPS mode drop-down list.

GPS standalone: The position is determined using only the range measurements from the GPS

GPS local area: The position is determined using the range measurements from the GPS. Correction data is determined using range measurements from a local area reference station.

SBAS NPA: The position is determined using the range measurements from the GPS. Correction data is determined using the fast and slow corrections provided by the ESTB.

SBAS PA: The position is determined using the range measurements from the GPS. Correction data is determined using the fast, slow, ionospheric and tropospheric corrections provided by the ESTB which are described in the documents [4] or by [7] and [8].

GBAS PA: The position is determined using the range measurements from the GPS. Correction data is determined using the corrections of a GBAS ground station. It should be noted that this additional processing capability is under development.

The result of the position computation consists of one or two data files containing the range data and the computed position data of WinGPSALL. These data files can be written with or without a header. The writing of the header can be selected by the user by clicking the appropriate check box **Write Header**.

The user has the option to create one or two output files. The PEGASUS-related output file (option **PEGASUS**) will only contain PEGASUS-relevant information, i.e. position-and time-solution, protection levels and position errors. The complete format of the PEGASUS-related output file is provided in the appendix A.1. The SAPPHIRE-related output file (option **SAPPHIRE**) will contain the original SAPPHIRE-relevant information, i.e. position-, velocity-

and time-solution and range-related information for every satellite. The complete format of the SAPPHIRE-related output file is provided in the appendix A.2.

A weighted position solution is implemented in the ***precise wide area*** mode. In the basic wide area mode, the user can select a weighted position solution by checking the box ***Weights***.

In the current version of WinGPSALL, a standard range smoothing is implemented. The time constant for the smoothing filter can be modified by the spin-button ***Smoothing***. A range of values between 0 and 100 is provided, where a selection of the value 0 implies no smoothing.

In order to be compliant with the current version of the GNSS SARPS, the carrier smoothing will be applied in all positioning modes before any of the (system inherent or externally provided) corrections are applied to the range measurements.

In previous versions of WinGPSALL, every instance where there had been an interruption in the data stream for one (or more) satellite(s), the carrier phase range smoothing filter had to be restarted, thus resulting in a transition period for that particular satellite in which the measurements could not be used for positioning. This was the case even if the carrier phase measurements for this satellite after the data interruption had been consistent with those before the data interruption (e.g. in the situation of telemetry problems, etc.). This feature proved to be very disadvantageous in local area differential applications.

In the current version of WinGPSALL, the user can specify a “***Max DataGap***” period, during which the carrier phase range smoothing filter will not be restarted, if there are interruptions in the data stream for one satellite. IT IS IMPORTANT to notice that

- There will be no interpolations and extrapolations for missing data sets (i.e. missing input data epochs will result in missing output data epochs)
- After the data interruption, the carrier phase measurements of that satellite will have to pass a consistency check (as is always the case). Only if this consistency check is passed using the current and last (i.e. previously) received phase measurements, then the carrier smoothing filter for that satellite will not be reset. In all other cases, the filter will be reset and thus the range measurements for that satellite will not be available for positioning.
- If the specified period in “***Max DataGap***” has been exceeded, the carrier phase smoothing filter for the satellite in question will be reset regardless of the quality of the (then to be) received carrier phase measurements.
- The default value is consistent with the GNSS SARPS requirements.

During the ESTB test period, the SIS contains the message type MT 0 “Do Not Use”, since the SIS can not be used officially for ranging purposes. However, the SIS using EGNOS will contain a message type MT 0, with which certain alarm conditions for the SBAS satellite tracked can be transmitted. Thus, the current version of WinGPSALL has all the necessary algorithms for the evaluation of the MT 0 implemented and will read in the relevant data (if

present), but will – until further notice – disregard any potential application of that message type.

The drop-down list ***Tropospheric Corrections*** contains a list of implemented tropospheric correction models.

- No Tropo: no tropospheric corrections are determined
- Standard Tropo: the standard GPS tropospheric corrections are determined (HOPFIELD model, [11])
- RTCA Do 229B Tropo: tropospheric corrections using the specifications [8] are determined.

If an inappropriate correction model has been selected by the user, either the ***Start*** button will be disabled or the user will be asked if the evaluation should continue.

The drop-down list ***Ionospheric Corrections*** contains a list of implemented ionospheric correction models.

- No Iono: no ionospheric corrections are determined
- Standard Iono: the standard GPS ionospheric corrections are determined (KLOBUCHAR model, [11]).
- RTCA Do 229A Iono: ionospheric corrections using the specifications [7] are determined (for more information, refer as well to chapter 3.2.2).

If an inappropriate correction model has been selected by the user, either the ***Start*** button will be disabled or the user will be asked if the evaluation should continue.

The elevation of an individual satellite is the angle of that satellite above a plane which is horizontal to the earth's surface at the user location. The information about the selected minimum elevation angle must be provided by the user in the field ***Min. Elevation***. If an inappropriate choice has been selected, the user is asked if the evaluation should continue.

3.4.2 File Selection

The file selection section is displayed in the next figure 6. The user must select an input file for the navigation process which contains the GNSS range measurements collected by the user receiver.

This can be done by pressing the “...” button next to the ***User*** field. A standard windows file selection box then appears. Alternatively, the user can enter the input file directly into the ***User*** field. The selected file is displayed in the ***User*** field.

If the local area differential GNSS mode is selected (see chapter 3.3.1), then the file for the reference station must as well be selected. This can be done by pressing the “...” button

next to the **Reference** field. A standard windows file selection box then appears. Alternatively, the user can enter the reference file directly in the **Reference** field. The selected file is displayed in the **Reference** field.

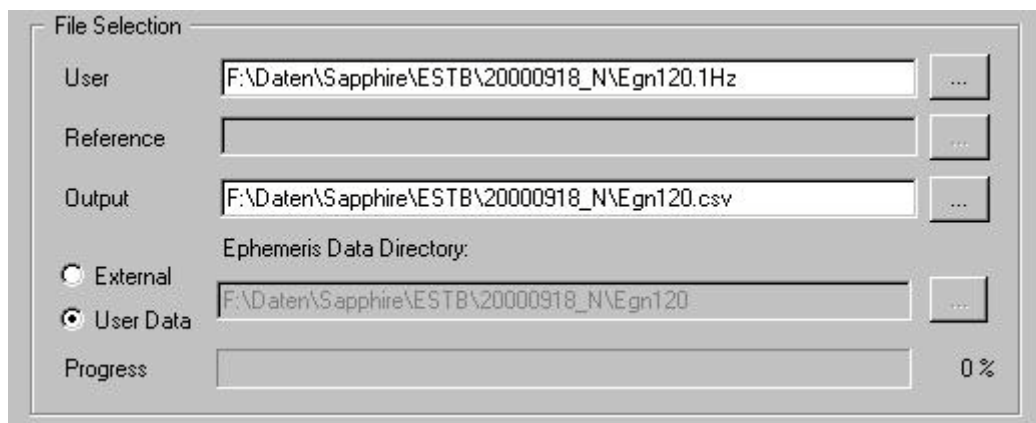


Figure 6: Screenshot of the File Selection Option

If the basic wide area GNSS mode or the precise wide area GNSS mode is selected (see chapter 3.3.1), then it will be assumed that the other files that contain the SBAS correction and ranging processing will follow the naming convention that is provided in the Interface Control Document (see [1]). If an important file is not found (e.g. it is missing, has a different name, etc.), an error message similar to the following figure 7 will appear and the program will not start.

It should be noted that – due to the current implementation of the ESTB SIS V1.2 – the presence of message type 10 data in the precise wide area mode is considered to be essential and the appropriate file containing the data must be present. However, in the current version of the ESTB SIS, the message types MT 6 and MT 27 are considered to be optional (see as well [4]). The current version of WinGPSALL will consider files containing MT 6 and MT 27 data to be optional (i.e. if the files are present, the data will be evaluated).



Figure 7: Screenshot of the Error Message “File Not Found”

Additionally, if the NovAtel™ OEM3, the DSNP Aquarius™, NovAtel™ OEM4 or the Septentrio™ receiver is used in the *user receiver* option (see chapter 3.4.3), the selected input files will be checked whether all needed parameters are contained in these files. If certain important parameters can not be found in any of the specified files, then an error message similar to the following figure 8 will appear and the program will not start.

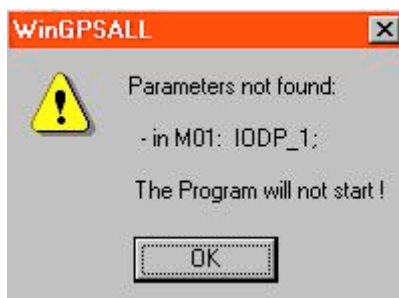


Figure 8: Screenshot of the Error Message “Parameter Not Found”

- The data files generated by the CONVERTOR (i.e. for the receivers NovAtel™ OEM3, DSNP Aquarius™, Septentrio™ and NovAtel™ OEM4) must contain a header in order for WinGPSALL to be able to check the acronyms for the individual parameters. It is assumed that the naming of the acronyms is done following the Interface Control Document ([1]).
- For the other receivers contained in the user receiver option (i.e. for the receivers Litton, Honeywell and D920), which had been implemented during the SAPPHIRE phases I and II, this checking of parameter names has not been implemented.

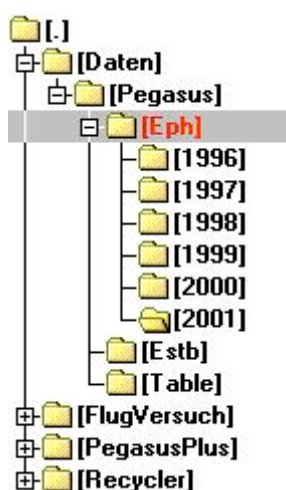


Figure 9: Directory Structure for the Externally provided Ephemeris Files

The user must select an output file for the navigation process in which the results are stored. This can be done by pressing the “...” button next to the **Output** field. A standard windows file selection box then appears. Alternatively, the user can enter the name of the output files directly into the **Output** field. The selected file is displayed in the **Output** field. The specified path and file-name are valid for the PEGASUS-related output file (see chapter 3.4.1). If the user has selected additionally the SAPPHIRE-related output file, this file is generated using the file-name specified, concatenated with an “_s”.

The user must select a source for the satellite position information. The ephemeris data is contained in standard RINEX navigation files for the GPS. For the ESTB GEO, a format only slightly different from the GLONASS RINEX navigation files has been defined in the Interface Control Document (see [1]). The user has the option of either selecting externally supplied RINEX data files or selecting user data RINEX ephemeris files. This can be done by checking the appropriate box **External** or **User Data**.

- If the **User Data** ephemeris option is checked, then the **Ephemeris Source** field will display the name base including directory structure for the ephemeris files. The ephemeris files are assumed to follow the naming convention provided in the Interface Control Document (see [1]).

- If the **External ephemeris** option is checked, then the **Ephemeris Source** field will display a path in which the externally supplied ephemeris data is assumed to exist. The directory structure and the naming convention for the externally supplied ephemeris data is contained in [20]. The user can change the file path by pressing the “...” button next to the **Ephemeris Source** field.

It should be noted that if the option External Ephemeris is specified, the naming of the ephemeris file and the existing directory structure must follow a particular convention. The ephemeris file shall be named “BRDCddd0.yyN” with “ddd” being the julian day of the year and “yy” being the year. The directory structure must be specified to a base directory, where the individual ephemeris files themselves are contained in a subdirectory “YYYY” with “YYYY” being the year. The appropriate directory structure is shown in figure 9 and described in the relevant documentation ([20]).

3.4.3 User Receiver Options

The User Station options and the Reference Station options are shown in the next figure 10. The Reference Station options will only be enabled, if the local area differential GNSS mode is selected (see chapter 3.4.1).

When the box **Use Initial WGS84 Position** is checked, the user is able to provide the position of the antenna in a static measurement set-up or the starting point of a dynamic measurement set-up. This position then will be used in the determination of the deviations in east-, north- and up-directions (see chapter 3.4.5).

This initial position must be given in WGS84 co-ordinates, i.e. latitude and longitude in degrees and altitude as Height above ellipsoid (not above MSL). If no initial position is specified by the user, the first receiver-computed position will be used to initialise the process and to determine the position errors. This position will be displayed in the appropriate field.

The receiver can be selected using the drop-down list **Receiver**. In WinGPSALL, the following receiver types can be used.

- <Automatic>: The receiver type will be automatically detected looking in the convertor .mif file. Only the NovAtel™ OEM-3, DSNP™ Aquarius 5000 series, Septentrio PolaRx and NovAtel OEM-4 receiver types can be detected.
- NovAtel™ OEM-3: **GPS standalone mode, GPS local area mode, SBAS NPA mode, SBAS PA mode** and **GBAS PA mode**.
- DSNP™ Aquarius 5000 series: **GPS standalone mode, GPS local area mode, SBAS NPA mode SBAS PA mode** and **GBAS PA mode**.
- Septentrio PolaRx: **GPS standalone mode, GPS local area mode, SBAS NPA mode, SBAS PA mode** and **GBAS PA mode**.
- NovAtel OEM-4: **GPS standalone mode, GPS local area mode, SBAS NPA mode SBAS PA mode** and **GBAS PA mode**.

- Litton 8 channel: **GPS standalone mode**, **GPS local area mode** (implemented in SAPPHIRE phases 1 and 2)
- Honeywell 16 channel: **GPS standalone mode**, **GPS local area mode** (implemented in SAPPHIRE phases 1 and 2)
- D920 12 channel: **GPS standalone mode**, **GPS local area mode** (implemented in SAPPHIRE phases 1 and 2)

If the GNSS mode is set to **SBAS NPA mode** or **SBAS PA** and a receiver type other than the NovAtel™ OEM3/OEM4, DSNP Aquarius™ or Septentrio™ receivers are selected, then the Start button will not be enabled until the user selects the appropriate mode or appropriate receiver.

Figure 10: Screenshot of the User and Reference Station Options

The information for the field **Data Rate** must be provided by the user, since the nominal update rate of the range measurement data will be used to check the consistency of the data internally. It is recommended that the receiver set-up described in the Interface Control Document ICD [1] is used, where the data rate is set to 1 Hz as a default value. However, if other data rates are used, the user must provide the appropriate value in the field **Data Rate**.

The checkbox **UTC/GPS Time Transformation** is provided for consistency and compatibility reasons only. The receivers implemented in SAPPHIRE phases I and II use a time synchronisation scheme which is based on UTC time, whereas the receivers implemented in the PEGASUS development will use a time synchronisation scheme which is based on the receiver delivered GPS time. Thus, this box will only be enabled when an appropriate receiver is selected. For more information, please refer to the relevant documentation ([20]).

If the **GPS local area mode** is selected, then the operator must specify an initial position for the antenna of the reference station in order for the program to be able to start. Additionally, if no initial position for the user receiver is provided in the local area differential mode, then

the position of the reference station will be as well used for the user receiver (i.e. to start the positioning and to compute the errors / flight track).

3.4.4 Satellite Selection Options

The **satellite selection** options are displayed in the following figure 11. Individual satellites can be selected / de-selected for the use in the position computation before the start of a particular data evaluation.

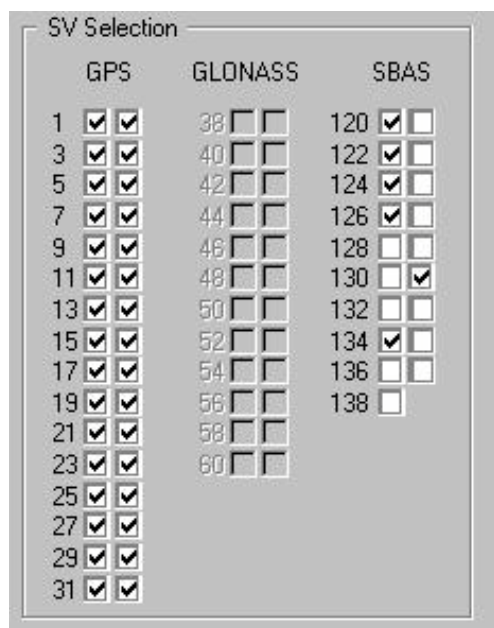


Figure 11: Screenshot of the Satellite Selection Option

The checkboxes are organised by the PRN number of the satellites. If a satellite is to be used in the position solution, the box for the appropriate PRN number must be checked. Conversely, if a satellite is to be masked and not used in the position solution, the appropriate box must be unchecked.

The SBAS PRN numbers will be enabled (and thus can be checked and unchecked), if the range option **SBAS** (see chapter 3.4.1) is checked. The GLONASS PRN numbers are disabled for the WinGPSALL, since this option will not be available until further notice.

After the Start button has been pressed and a position computation run is launched, the Satellite Selection options will be disabled. Thus, the user is not able to select / de-select satellites during a run. Instead, the Satellite Selection option will be used to display the status of each individual satellite during a position computation run (chapter 3.4.5).

3.4.5 Display of Progress

The progress for the WinGPSALL program will be displayed by two indications. As one means, there is the progress bar, as shown in the following figure 12. It also includes a numerical presentation of the progress.



Figure 12: Screenshot of the Progress Bar

Additionally, the current achieved position solution will be shown in the graphical display (see figure 13). If an initial WGPS position is provided by the user (see chapter 3.4.3), then this position will be used to determine the difference in north-, east- and up-direction.

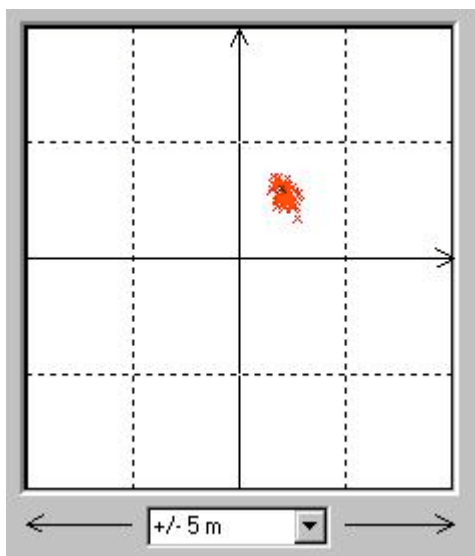


Figure 13: Screenshot of the Position Deviation

If an initial position is not supplied (only possible in standalone mode, basic wide area mode and precise wide area mode, see section 3.4.3), then the first position solution of the receiver will be used to determine the difference of the further computed positions.

The current position deviation will be shown using a black cross, whereas the history of the position solution is displayed using red crosses. Thus, if a static measurement set-up had been used to collect the data and the real position of the antenna is provided, then the display will show the current error in the position estimation. If a dynamic measurement set-up had been used to collect the data and the starting point of the measurement activities is provided, then the display will show the covered distance during the measurement.

The deviations in east- and north-direction are displayed additionally as numeric values in the field below the graphical display (see figure 14). Furthermore, the date and time of the evaluated data is displayed.

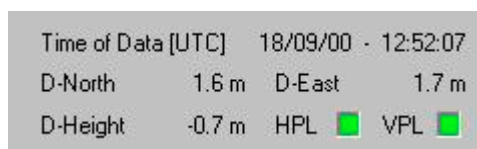


Figure 14: Screenshot of the Position Deviation Display

Additionally, the user will find a "traffic light" display of the horizontal and vertical protection level situation. The following colours are used:

- grey: HPL / VPL can not be determined
- red: HPL / VPL are above the relevant alarm limit
- green: HPL / VPL are below the relevant alarm limit

In order to determine the relevant alarm limits, for the **SBAS NPA mode** (see chapter 3.4.1), the flight phase "Non Precision Approach" is assumed, whereas for the **SBAS PA** (see chapter 3.4.1), the flight phase "CAT I" is assumed.

The scale of the graphical window is equal in both directions and can be selected from the following range :

$\pm 5 \text{ m}, \pm 10 \text{ m}, \pm 50 \text{ m}, \pm 100 \text{ m}, \pm 500 \text{ m},$

$\pm 1 \text{ km}, \pm 5 \text{ km}, \pm 10 \text{ km}, \pm 50 \text{ km}, \pm 100 \text{ km}, \pm 500 \text{ km}$

by using the drop-down list **Scale**. If the determined position deviations are greater in magnitude than the scaling would allow them to be displayed, a cross on the frame of the window is drawn in the direction of the position deviation (i.e. a clipping is implemented). The scaling can be changed during one data evaluation run. If the user changes the scaling

during one run, the last thousand position solutions (i.e. the deviations in north- and east-direction) will be redrawn.

During a particular position computation run, the status of each individual satellite is displayed using a colour-coding scheme (see figure 15). A legend for the colour-coding is as well included in the program (see figure 16).

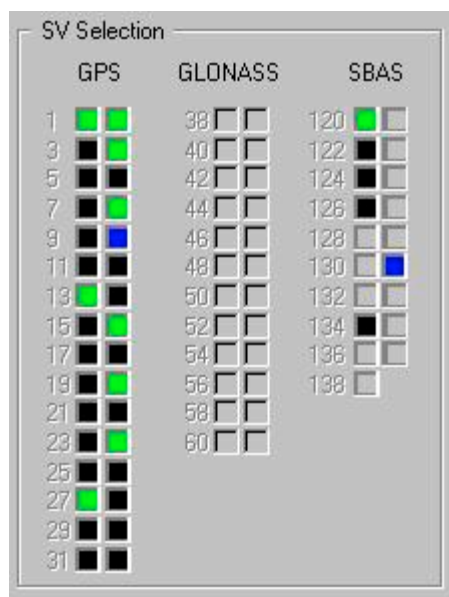


Figure 15: Screenshot of the Satellite Status Display

- **grey:** satellite is de-selected
- **black:** satellite is selected
- **blue:** raw data from satellite is available, however, there are no ephemeris data for that satellite
- **yellow:** raw data and ephemeris data are available, however, the satellite is flagged as unusable due to range data inconsistency
- **red:** satellite is flagged as unusable by either GPS or SBAS
- **green:** satellite is used for position computation

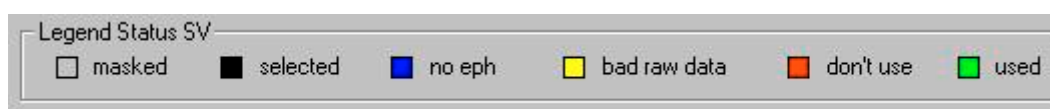


Figure 16: Screenshot of the Satellite Status Legend

3.5 Data Output

The output of the WinGPSALL program consists of several files in which the relevant data is provided.

A configuration file (".wif") is written to the data directory specified, which contains the user-specified options. In particular, the used initial position / reference position is contained in that log-file.

There are two output files. These data file can be written with or without a header (see chapter 3.4.1). The delimiter that has been used by the CONVERTOR program will be recognised automatically by WinGPSALL. This delimiter will as well be used for the writing of the output file.

- The PEGASUS output file (chapter 3.4.1) will contain PEGASUS-relevant information, i.e. position- and time-solution, protection levels and position errors. A detailed description of the file format can be found in appendix A.1
- The SAPPHIRE output file (chapter 3.4.1) will contain the original SAPPHIRE-relevant information, i.e. position-, velocity- and time-solution and range-related information for every satellite. A detailed description of the file format can be found in appendix A.2

If the input file for the conversion has been recorded on the 30th October 2000 and named EGNOS.BIN, the output files generated by the CONVERTOR are described in the in the Software User Manual for the PEGASUS Module CONVERTOR in the relevant chapter. Using these files as an input for WinGPSALL, the following output files of the position computation process will be created:

EGNOS.WIF:	the log-file for the position computation process
EGNOS.CSV:	the PEGASUS-related output file
EGNOS_S.CSV:	the SAPPHIRE-related output file

Appendix A: Output Format of WinGPSALL

The output of the WinGPSALL program consists of two files in which the relevant data is provided. The format of the output file is based on the existing output file format for SAPPHIRE (in particular, the format specified in [20], but is extended to contain additional information.

Appendix A.1 PEGASUS Output

The description of the complete format for the PEGASUS-related output file can be found in the following table.

Number	Parameter	Units	Format	Note
1	Sample	N/A	integer	sample number in the file
2	ACUTC_year	year	integer	year of data set in UTC time
3	ACUTC_month	month	integer	month of data set in UTC time
4	ACUTC_day	day	integer	day of data set in UTC time
5	ACUTC_hrs	hrs	integer	hour of data set in UTC time
6	ACUTC_mins	min	integer	minute of data set in UTC time
7	ACUTC_secs	s	integer	second of data set in UTC time
8	VALID_POS	N/A	integer	GPS standalone mode: 0: range measurements, but invalid position 1: range measurements, valid position GPS local area differential mode : 0: range measurements, but invalid position 1: range measurements, valid position 2: gap in reference data, invalid position 3: gap in user data, invalid position SBAS Non-Precision Approach mode: 0: range measurements, but invalid position 1: range measurements, valid position SBAS Precision Approach mode: 0: range measurements, but invalid position 1: range measurements, valid position
9	GPS_WN	N/A	integer	week number GPS time
10	GPS-T	s	float	seconds GPS time of measurement (uncorrected for receiver clock errors)
11	GPS-LAT	1°	float	latitude computed position (WGS84)
12	GPS-LON	1°	float	longitude computed position (WGS84)
13	GPS-ALT	m	float	altitude computed position (WGS84)
14	GPS-H	m	float	altitude computed position (mean sea level)
15	NSV	N/A	float	number of satellites used for position computation
16	D-NORTH	m	float	north/south deviation of computed position
17	D-EAST	m	float	east/west deviation of computed position
18	D-UP	m	float	up/down deviation of computed position
19	D-HOR	m	float	horizontal deviation of computed position
20	D-POS	m	float	deviation of computed position

21	VALID-XPL	N/A	integer	GPS standalone mode, GPS local area differential mode 0: no valid position 1: valid position SBAS Non-Precision Approach mode, SBAS Precision Approach mode: 0: XPL can not be computed 1: XPL computed
22	XPL-TYPE	N/A	integer	0: no 1: protection levels, MT 10, SBAS ionospheric corrections 2: protection levels, MT 10, standard ionospheric corrections 3: protection levels, no MT 10, standard ionospheric corrections
23	HPL	m	float	horizontal protection level
24	HAL	m	float	horizontal alarm limit
25	VPL	m	float	vertical protection level
26	VAL	m	float	vertical alarm limit
for each tracked satellite for 24 channels				
27	GPS-SVN	N/A	integer	PRN number of satellite

Table A.1: Output Format of WinGPSALL

Appendix A.2 SAPPHIRE Output

The description of the complete format for the SAPPHIRE-related output file can be found in the following table.

Number	Parameter	Units	Format	Note
1	Sample	N/A	integer	sample number in the file
2	ACUTC_year	year	integer	year of data set in UTC time
3	ACUTC_month	month	integer	month of data set in UTC time
4	ACUTC_day	day	integer	day of data set in UTC time
5	ACUTC_hrs	hrs	integer	hour of data set in UTC time
6	ACUTC_mins	min	integer	Minute of data set in UTC time
7	ACUTC_secs	s	integer	Second of data set in UTC time
8	GPS_t	s	float	GNSS seconds in week (uncorrected for receiver clock errors)
9	GPS_ClkErr	ss ⁻¹	float	Receiver clock error
10	GPS_CkErrDr	ss ⁻²	float	receiver clock drift
11	GPS_Lat	1°	float	latitude computed position (WGS84)
12	GPS_Lon	1°	float	longitude computed position (WGS84)
13	GPS_Alt	ft	float	altitude computed position (mean sea level)
14	GPS_VNS	ms ⁻¹	float	north/south computed velocity
15	GPS_VEW	ms ⁻¹	float	east/west computed velocity
16	GPS_Vup	ms ⁻¹	float	up/down computed velocity
17	GPS_GDOP	N/A	float	GDOP
18	GPS_PDOP	N/A	float	PDOP
19	GPS_HDOP	N/A	float	HDOP
20	GPS_VDOP	N/A	float	VDOP
21	GPS_TDOP	N/A	float	TDOP

Number	Parameter	Units	Format	Note
22	GPS_SATV	N/A	integer	number of satellites visible to the receiver
23	GPS_SATT	N/A	integer	number of satellites tracked by the receiver
for each tracked satellite for 24 channels				
24	GPS_SVN	N/A	integer	PRN number of satellite
25	GPS_STAT	N/A	integer	status of satellite tracking 0 no raw data 1 raw data 2 no last raw data satellite not used 3 no last doppler satellite not used 4 raw data check ok 5 raw data check not ok satellite not used 6 low elevation satellite not used 7 masked by extern satellite not used 8 no ephemeris satellite not used 9 ephemeris too old satellite not used 10 used for pos 11 no differential corrections satellite not used 12 flagged by SBAS satellite not used 13 range step detected satellite not used
26	GPS_PRres	m	float	pseudorange residuum
27	GPS_SVX	m	float	satellite position x (WGS84)
28	GPS_SVY	m	float	satellite position y (WGS84)
29	GPS_SVZ	m	float	satellite position z (WGS84)
30	GPS_R	m	float	Pseudorange
31	GPS_AZIM	1°	float	azimuth of satellite
32	GPS_ELEV	1°	float	elevation of satellite
33	dHDOP	N/A	float	Delta HDOP – availability indicator for receiver autonomous integrity monitoring
34	dVDOP	N/A	float	Delta VDOP – availability indicator for receiver autonomous integrity monitoring
35	RCxgeo	N/A	float	element x of design matrix
36	RCygeo	N/A	float	element y of design matrix
37	RCzgeo	N/A	float	element z of design matrix

Table A.2: Output Format of WinGPSALL SAPPHIRE

Appendix B: Errors, Warnings and Recovery Procedures

This appendix contains a list of errors and warning that are generated by the programs of the PEGASUS module WinGPSALL. Additionally, for each error message and warning, a possible cause is given and an appropriate recovery procedure is proposed.

In this context, errors are considered to be fault conditions that do not allow the associated program to run and to produce an output file. Warnings are considered to be fault conditions that allow an associated program to run, however, due to the fault condition, the result output file may be incomplete or less useful.

In contrast to that, user notifications are considered to be conditions where the user has selected an option which may seem to be inappropriate for the associated program. The user is presented at the time of the execution with a notification of the condition and the program proposes a suitable procedure to change the selected option. These user notifications are not included in this appendix.

Error Message: Could not find options file

Cause: The INI-file could not be found, since it was not in the specified directory. If no INI-file was specified at the start, the program assumes the file "WinGPSALL.INI" to be present in the directory where the executable is located. Either the file was not found or the user had no reading access rights to open the file. The user should ascertain that the specified input file does exist. Additionally, it may be necessary to check (in co-ordination with the system administrator, if needed) that the user has the necessary rights to access the file.

Recovery: In the interactive mode, the user interface will appear filled with blanks and default values (where appropriate). The operator can fill in the particular fields and start the program. In the background mode, a log file "WinGPSALL.ERR" will be created which contains the appropriate message.

Warning Message: Wrong Parameter Setting

Cause: The INI-file contains at least for one parameter erroneous settings. The appropriate values for each parameter are specified in the appendix C of this document..

Recovery: In the interactive mode, the user interface will appear filled with default settings for that particular parameter and the operator can fill in the particular fields and start the program. In the background mode, a log file will be created which contains the appropriate message. The name of the log file will be determined by the name of the input file (if provided) or will be the standard "WinGPSALL.ERR".

Warning Message: Sorry. Could not open file for MT Exiting now the process.

Cause: The ESTB message type data file specified could not be opened. Either the file was not found or the user had no reading access rights to open the file. The program stops the execution.

Recovery: The user should ascertain that the specified input file does exist. Additionally, it may be necessary to check (in co-ordination with the system administrator, if needed) that the user has the necessary rights to access the file.

Warning Message: Sorry. Could not open navigation input file.

Cause: The GNSS range- and position data file could not be opened. Either the file was not found or the user had no reading access rights to open the file.

Recovery: The user should ascertain that the specified input file does exist. Additionally, it may be necessary to check (in co-ordination with the system administrator, if needed) that the user has the necessary rights to access the file. In the interactive mode, the user interface will appear and the operator can specify an appropriate input file. In the background mode, the program will create the log file "WinGPSALL.ERR" which contains the appropriate error message and will terminate.

Warning Message: Sorry. Could not open reference input file.

Cause: The GNSS range- and position data file could not be opened. Either the file was not found or the user had no reading access rights to open the file.

Recovery: The user should ascertain that the specified input file does exist. Additionally, it may be necessary to check (in co-ordination with the system administrator, if needed) that the user has the necessary rights to access the file. In the interactive mode, the user interface will appear and the operator can specify an appropriate input file. In the background mode, the program will create the log file which contains the appropriate error message and will terminate. The name of the log file will be determined either by the name of the input file (if provided) or will be "WinGPSALL.ERR".

Warning Message: Sorry. Could not open output file for PEGASUS.

Cause: The output file for PEGASUS could not be opened. Either the file was not found or the user had no writing access rights to open the file.

Recovery: The user should ascertain that the specified input file does exist. Additionally, it may be necessary to check (in co-ordination with the system administrator, if needed) that the user has the necessary rights to access the file. In the interactive mode, the user interface will appear and the operator can specify an appropriate input file. In the background mode, the program will create the log file which contains the appropriate error message and will terminate. The name of the log file will be determined either by the name of the input file (if provided) or will be "WinGPSALL.ERR".

Warning Message: Sorry. Could not open output file for SAPPHIRE.

Cause: The output file for SAPPHIRE could not be opened. Either the file was not found or the user had no writing access rights to open the file.

Recovery: The user should ascertain that the specified input file does exist. Additionally, it may be necessary to check (in co-ordination with the system administrator, if needed) that the user has the necessary rights to access the file. In the interactive mode, the user interface will appear and the operator can specify an appropriate input file. In the background mode, the program will create the log file which contains the appropriate error message and will terminate. The name of the log file will be determined either by the name of the input file (if provided) or will be "WinGPSALL.ERR".

Warning Message: Parameters not found The program will not start.

Cause: WinGPSALL performs a name check on the parameters contained in one file. For the evaluation of the positioning and integrity information, certain parameters are of essential importance. If these parameters are not found, then the program stops the execution.

Recovery: The user should ascertain whether the specified file contains a header (i.e. the CONVERTOR program must be run with the option of creating a header). If the ESTB data file was not created by the CONVERTOR program, the user should ascertain additionally, if the parameter name is provided correctly (the relevant information on the parameter names can be found in the ICD ([1]))

Warning Message: Delimiter not found.

Cause: A delimiter character for the parameter fields could not be determined in the input file. The program stops the execution.

Recovery: The user should ascertain that the parameters and values in the input files are delimited by a correct field delimiter (specified in the ICD([1])). It is of importance to notice that the GNSS range- and position data file determines the delimiter character used in all other input files. Thus, the ESTB data files or the reference station input data file must contain the identical delimiter.

Warning Message: No fields were found, but the end of line was reached. Maybe the ... is a wrong field separator. Terminating.

Cause: A delimiter character for the parameter fields could not be determined in the input file. The program stops the execution.

Recovery: The user should ascertain that the parameters and values in the input files are delimited by a correct field delimiter (specified in the ICD ([1])). It is of importance to notice that the GNSS range- and position data file determines the delimiter character used in all other input files. Thus, the ESTB data files or the reference station input data file must contain the identical delimiter.

Appendix C: Format and Description of the INI-Files

The user options and settings for the WinGPSALL program will be kept in corresponding initialisation files. They will be saved on program exit so that they will be available on the next start. The files may, however, also be edited manually or generated externally, e.g. by the PEGASUS frame (for more information, the interested reader is referred to [3]). Therefore, the following sections describe the initialisation file contents and shows a sample file.

The WinGPSALL default initialisation file is named "WinGPSALL.INI" and located in the WinGPSALL working directory. A different file may be specified though as described in chapter 3.

Appendix C.1 File Contents

The description of the complete format for the WinGPSALL initialisation file can be found in the following table. Any parameter that is not specified takes its default value, as is the case when no initialisation file can be found at all.

Key name	Description	Type	Limits & Specifications	Default
[System] section				
Outputfile	name of the output file	string	max. 255 characters	(empty)
GNSS GPS	flag whether GPS ranging is to be used	int	0 = no, 1 = yes	1 = yes
GNSS GLONASS	flag whether GLONASS ranging is to be used	int	0 = no, 1 = yes	0 = no
GNSS ESTB	flag whether ESTB ranging is to be used	int	0 = no, 1 = yes	0 = no
Write Header	flag whether header for output files is to be generated	int	0 = no, 1 = yes	1 = yes
Output Pegasus	flag whether the PEGASUS output file is to be generated	int	0 = no, 1 = yes	1 = yes
Output Sapphire	flag whether the SAPPHIRE output file is to be generated	int	0 = no, 1 = yes	0 = no
Differential GPS	DGPS mode	int	0 = GPS standalone, 1 = GPS local area, 2 = SBAS NPA, 3 = SBAS PA, 4 = GBAS PA 5 = GPS (using SBAS satellites) 6 = GPS (using GBAS satellites)	0 = standalone
Smoothing Time	time constant [s] for range smoothing	int	$0 \leq \text{Smoothing Time} \leq 100$; 0 implying no smoothing	0 [s] = no smoothing
Max DataGap	maximum allowable interruption in the data stream before the carrier smoothing range filter will be re-initialised for a satellite	int	$0 \leq \text{Max DataGap} \leq 10$	3
Weighted Pos	flag whether weighted position solution is to be used	int	0 = no, 1 = yes	0 = no

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Key name	Description	Type	Limits & Specifications	Default
Decoding of Ephemeris	flag whether ephemeris is read in from receiver generated files or from externally supplied files	int	0 = no, 1 = yes	0 = no
Directory Name	name of directory where ephemeris data can be found	string	max. 255 characters	(empty)
Min. Elevation	Minimum satellite elevation [°] to be considered in the positioning	float	$0.0 \leq \text{Min. Elevation} \leq 90.0$	0.0 [°]
Iono Correction	Ionospheric correction model	int	0 = none, 1 = standard GPS corrections, 2 = RTCA Do 229A corrections	0 = none
Tropo Correction	Tropospheric correction model	int	0 = none, 1 = standard GPS corrections, 2 = RTCA Do 229B corrections	0 = none
ScaleGraph	Scaling factor for the position solution display window	int	0 = 5 m, 1 = 10 m, 2 = 50 m, 3 = 100 m, 4 = 500 m, 5 = 1km, 6 = 5 km, 7 = 10 km, 8 = 50 km, 9 = 100 km, 10 = 500 km	3 = 100 m
[User Station] section				
Filename	name of navigation input file	string	max. 255 characters	(empty)
Initial Pos	flag whether provided initial position is to be used (otherwise first position solution will be taken)	int	0 = no, 1 = yes	1 = yes
Latitude (°)	user station initial latitude [°]	float	$-90.0 \leq \text{Latitude (°)} \leq 90.0$	0.0 [°]
Longitude (°)	user station initial longitude [°]	float	$-180.0 \leq \text{Longitude (°)} \leq 180.0$	0.0 [°]
Ellip. H (m)	user station initial elliptic height [m] above geoid (<i>not</i> above MSL !)	float	$-457.2 \leq \text{Ellip. H (m)} \leq 39950.7456$	0.0 [°]
Receiver type	Definition of user station receiver type	int	0 = unknown 1 = Litton 8 channel 2 = Honeywell 16 channel 3 = D920 12 channel 4 = DNSP Aquarius 5000, 5 = NovAtel WAAS/Millennium, 6 = Septentrio PolaRx, 7 = NovAtel OEM4	0 = unknown
Data Rate [Hz]	data rate for user receiver ranging data [Hz]	float	$0.0 < \text{Data Rate [Hz]}$	1.0 [Hz]
UTC/GPS Time Correction	flag whether user station UTC to GPS time transformation is to be enabled	int	0 = no, 1 = yes; NOTE: this value will always be set to 0 for Receiver types 4, 5, or 6	1 = yes for Receiver type 0, 1, 2, or 3; 0 = no otherwise
[Reference Station] section				
Filename	name of reference station input file	string	max. 255 characters	(empty)
Latitude (°)	reference station initial latitude [°]	float	$-90.0 \leq \text{Latitude (°)} \leq 90.0$	0.0 [°]
Longitude (°)	reference station initial longitude [°]	float	$-180.0 \leq \text{Longitude (°)} \leq 180.0$	0.0 [°]

Key name	Description	Type	Limits & Specifications	Default
Ellip. H (m)	reference station initial elliptic height [m] above geoid (<i>not</i> above MSL !)	float	$-457.2 \leq \text{Ellip. H (m)} \leq 39950.7456$	0.0 [°]
Receiver type	definition of reference station receiver type	int	0 = unknown 1 = Litton 8 channel 2 = Honeywell 16 channel 3 = D920 12 channel 4 = DNSP Aquarius 5000, 5 = NovAtel Millennium, 6 = Septentrio PolaRx, 7 = NovAtel OEM4	0 = unknown
Data Rate [Hz]	data rate for reference receiver ranging data [Hz]	float	$0.0 < \text{Data Rate [Hz]}$	1.0
UTC/GPS Time Correction	flag whether reference station UTC to GPS time transformation is to be enabled	int	0 = no, 1 = yes; NOTE: this value will always be set to 0 for Receiver types 4, 5, 6 or 7	1 = yes for Receiver type 0, 1, 2, or 3; 0 = no otherwise
[Satellite Selection] section				
Select SV 1(#)	flag whether GPS SV # 1 is to be used for the positioning process	int	0 = no, 1 = yes	1 = yes
... (#)
Select SV 32(#)	flag whether GPS SV # 32 is to be used for the positioning process	int	0 = no, 1 = yes	1 = yes
Select SV 38(#)	flag whether GLONASS SV # 38 is to be used for the positioning process	int	0 = no, 1 = yes	1 = yes
... (#)
Select SV 61(#)	flag whether GLONASS SV # 62 is to be used for the positioning process	int	0 = no, 1 = yes	1 = yes
Select SV 120(#)	flag whether ESTB SV # 120 is to be used for the positioning process	int	0 = no, 1 = yes	1 = yes
... (#)
Select SV 138(#)	flag whether ESTB SV # 120 is to be used for the positioning process	int	0 = no, 1 = yes	1 = yes

Appendix C.2 Sample File

[System]

Output Filename=j:\pplus\data\esa_20021125_0810_N4.csv

GNSS GPS=1

GNSS GLONASS=0

GNSS ESTB=0

Differential GPS=1

Smoothing Time=5

Max DataGap=3

Weighted Pos=0

Write Header=1

(#) SV number must have a field width of 3 characters with right aligned numbers ("%3i" format specifier in C++).

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Output Pegasus=1
Output Sapphire=0
Decoding of Ephemeris=0
Directory Name=j:\ppplus\data\esa_20021125_0810_N4
Min. Elevation=15.0
Iono Correction=1
Tropo Correction=1
ScaleGraph=8

[User Station]

Filename=j:\ppplus\data\esa_20021125_0810_N4.1Hz
Initial Pos=1
Latitude (°)=52.3458326
Longitude (°)=10.5765667
Ellip. H (m)=145.4354
Receiver type=4
Data Rate [Hz]=1.000
UTC/GPS Time Correction=0

[Reference Station]

Filename=j:\ppplus\data\esa_20021125_0810_N4_ref.1Hz
Initial Pos=1
Latitude (°)=52.31767337
Longitude (°)=10.55311378
Ellip. H (m)=203.4578
Data Rate [Hz]=1.000
Receiver type=0
UTC/GPS Time Correction=0

[Satellite Selection]

Select SV 1=1
Select SV 2=1

(... keys for SVs 3 to 30 deleted here)

Select SV 31=1
Select SV 32=1
Select SV 38=1
Select SV 39=1

(... keys for SVs 40 to 59 deleted here)

Select SV 60=1
Select SV 61=1
Select SV 120=0
Select SV 121=0

(... keys for SVs 122 to 136 deleted here)

Select SV 137=0
Select SV 138=0

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