

Project:
PEGASUS

EUROCONTROL
Procedure Visualisation Module
Software User Manual

Doc. No.: PEG-SUM-PVI
Issue: A Date: 17/06/2003
Sheet **1 of 27**

Title:

PEGASUS
Software User Manual
Procedure Visualisation Module

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Sheet **2 of 27**

Change Record

Issue	Date	Chapter	Description of Changes
1-	15/05/2003	All	First Issue, Software Version 1.2
A	17/06/2003	All	Relabeling and minor editorial corrections for PEGASUS release

Table of Contents

1. INTRODUCTION	5
1.1. Intended Readership	5
1.2. Applicability Statement.....	5
1.3. Purpose.....	5
1.3.1. Purpose of the Document	5
1.3.2. Purpose of the Module	5
1.4. Document Structure.....	5
1.5. Related Documents.....	6
1.6. Reference Documents:	6
2. OVERVIEW.....	7
2.1. Objectives	7
2.1.1. Concepts.....	7
2.1.2. Approach	7
2.2. Components	7
3. INSTALLATION	8
3.1. System Requirements	8
3.1.1. Hardware	8
3.1.2. Software.....	8
3.2. Installation Procedure	8
3.3. De-installation Procedure.....	9
4. PROBLEM REPORTING INSTRUCTIONS.....	10
5. GENERAL USE	11
5.1. Graphical Interface	11
5.1.1. Main Dialog Window	11
5.2. Step-by-step Overview	12
5.2.1. Start and Initialise M5 Software.....	12

5.2.2. Select Input and Output Files	13
5.2.3. Select GBAS Approach Procedure	14
5.2.4. Start and Check Calculations of Desired Flight Path (DFP).....	15
5.2.5. Visualise Approach procedure and DFP	16
5.2.6. Visualise GBAS messages	17
5.2.7. Exit Software	18
5.2.8. About Procedure Visualisation.....	18
5.3. Help	19
5.4. Operating Modes.....	19
5.4.1. The Embedded Mode	19
5.4.2. The Command-Line Mode.....	19
6. SERVICES.....	21
6.1. Service 1 Approach Procedure Building.....	21
6.1.1. Input Data	21
6.1.2. Options.....	21
6.1.3. Output Data.....	21
6.2. Service 2 Desired Flight Path (DFP) Calculation	21
6.2.1. Input Data	21
6.2.2. Options.....	22
6.2.3. Output Data.....	22
6.3. Service 3 Approach Procedure Visualisation	22
6.3.1. Input Data	22
6.3.2. Options.....	22
6.3.3. Output Data.....	22
6.4. Service 4 GBAS Message Type 2 and 4 Visualisation	23
6.4.1. Input Data	23
6.4.2. Options.....	23
6.4.3. Output Data.....	23
APPENDIX A: ERROR MESSAGES AND RECOVERY PROCEDURES	24
ANNEX B INITIALISATION FILE EXAMPLE.....	25
APPENDIX C: GLOSSARY.....	26

1. Introduction

This document is the user manual of the Procedure Visualisation module for the PEGASUS Software Version 3.0. It provides all information needed to install and use this module.

1.1. Intended Readership

Please refer to the Main Software User Manual for PEGASUS [3].

1.2. Applicability Statement

This Software User Manual is to be used as reference for the version 1.2 of the PEGASUS Procedure Visualisation Module. Each reference to the current version of PEGASUS in this document is a reference to version 3.0.

As the PEGASUS software is based on integration of individual modules, the full documentation contains multiple PEGASUS module documentation items. To profit from the modular structure of the software, this version of the Software User Manual contains references to the relevant main Software User Manual only. It should be used in conjunction with the other User Manuals referenced in that main User Manual.

1.3. Purpose

1.3.1. Purpose of the Document

This document contains the necessary information related to the use of the PEGASUS Module Procedure Visualisation.

It describes the installation and de-installation procedures, the different functionalities of the module, as well as what the user has to do in order to perform the individual processing tasks.

1.3.2. Purpose of the Module

The Procedure Visualisation module objective is to support the definition of the GBAS approach and present the results of approach path.

1.4. Document Structure

This manual shall be used as reference for the use of the PEGASUS Module Procedure Visualisation.

Section 1: Introduction contains a brief introduction to the PEGASUS software.

Section 2: Overview contains a general description of the module functionality.

Section 3: Installation describes the procedures needed to install the module on a new machine.

Section 4: Problem Reporting contains information on additional means to obtain support on the software and provides points of contact for the reporting of issues linked to the use of the software.

Section 5: General Use gives a step-by-step introduction to the module

Section 6: Services contains a more detailed presentation of the possible functionality of the module, describing the necessary input data, user actions and the obtained results. It is designed as a reference section.

Appendix A contains a list of error messages that might be encountered by using the module, together with the procedures to apply for correction.

Appendix B provides an example of an procedure.ini file.

Appendix C is a glossary of all the terms in use within this Software User Manual.

1.5. Related Documents

- [1] MARS-2 Technical Note, Doc.-No. PEG-TN-MARS2, current issue
- [2] MARS-2 PEGASUS Interface Control Document Addendum, Doc.-No. PEG-ICD-01Add, current issue
- [3] "Software User Manual", EEC PEGASUS User Manual PEGSUM-01 current issue

1.6. Reference Documents:

- [R1] "Guide to applying the ESA software engineering standards to small software projects", ESA, BSSC(96)2 Issue 1
- [R2] Eurocontrol Experimental Centre Software Engineering Unit (SEU)

This Software User Manual corresponds to the user part of the PEGASUS documentation set.

2. Overview

2.1. Objectives

2.1.1. Concepts

The objective of Procedure Visualisation module is to provide a comprehensive interface to ATC operational experts for the validation and safety assessment of GBAS approach procedures.

2.1.2. Approach

The module supports the definition of the GBAS approach, the introduction of flight trial data and present the results of simulated or reference aircraft approach path processed by PEGASUS.

The main functionality is the visualisation of approach procedures and desired flight path (way points, horizontal and vertical profile, significant points, radius turns, runway alignment, geographical information) as well as the content of GBAS messages type 2 and 4.

The module interfaces with PEGASUS component, notably “ Aircraft Dynamics” and “Truth Reference” modules.

2.2. Components

The Procedure Visualisation module consists of three parts

1. The core processing module (procedure.exe)
2. The visualization scripts, called from the M-File runner module
3. The GUI dll for PEGASUS integration (procedure.dll)

This SUM just covers the GUI.dll and the procedure.exe.

3. Installation

3.1. System Requirements

3.1.1. Hardware

This section describes only requirements differing from those in the main User Manual [3].

3.1.2. Software

This section describes only requirements differing from those in the main User Manual [3].

3.2. Installation Procedure

This section describes only the procedure for stand-alone use.

Currently no automatic installation procedure is provided to install the different components.

Therefore the different parts have to be installed manually by copying the delivered components. Special directory structures have not to be taken into account.

In case that the M5 is foreseen to be run embedded in the PEGASUS framework, the following components should be installed into the same directory as the PPlus.exe (the framework executable):

- procedure.exe
- procedure.dll
- procedure.hlp (for online help information)

When running as standalone software, the files below can be copied to every desirable directory:

- procedure.exe
- procedure.hlp (for online help information)

Additionally also a procedure.ini file will be provided with default values. This procedure.ini file shall be copied into the same directory as the procedure.exe. If no 'ini' file is specified as command line argument, the procedure.exe will search for the procedure.ini in the installation directory. If not available, default parameter values will be used (specified inside the software).

After installation of the procedure.exe core program, the user will see the following icon in the Windows explorer (large symbol view):

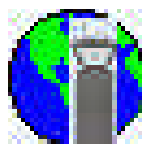


Figure 3.2-1: procedure.exe program icon

Double-click on this icon will start the procedure.exe.

The same icon can be seen from the 'Standalone' part of the PEGASUS framework program (which allows start of the procedure.exe in standalone mode from inside the PEGASUS framework).

3.3. De-installation Procedure

This section describes only the procedure for stand-alone use.

In order to completely uninstall the software all installed modules have to be deleted. As the modules do not generate any entries into the 'Windows 'system registry', there are no other delete actions necessary.

4. Problem Reporting Instructions

PEGASUS is a software prototype under development for Eurocontrol in support of the SBAS and GBAS activities. The Eurocontrol Experimental Centre has been defined as a focal point for User Feedback Reporting.

Today a web-site for PEGASUS is already operational inside the Eurocontrol GNSS-Programme SBAS Project web-site and can be consulted for questions related to the software: <http://www.eurocontrol.fr/projects/sbas/pegasus/>

The different steps in problem investigation should be the following:

- 1) Use of information in the documents provided:
 - This User Manual for software operation issues ;
 - The Error Recovery Procedures in Annex A of this Manual for operating errors and warnings;
 - The ICD [2] for issues related to data formats and parameter limitations;
 - The Technical Note [1] for issues related to the algorithms employed for processing.
- 2) Review of the information provided on the website cited above, especially the "Frequently Asked Questions".
- 3) Establishing contact with the development team via the following methods (explained in more detail in the main User Manual [3]):
 - E-mail: eec.pplus.support@eurocontrol.fr (preferred)
 - Fax: +33-1-6988-7307 (in exceptional cases)

5. General Use

The following chapters give an overview how to use the procedure visualisation module.

As the usage of the procedure visualisation module is foreseen just for one straightforward task, the general use is very simple:

- Start the procedure.exe (embedded or standalone)
- Provide the necessary input data using a procedure type ini file (see Annex B). The contents of this ini' file can be either edited using the PEGASUS framework (using the procedure.exe) or the procedure visualisation module main window.
- 'Start' processing via control or automatic (in embedded mode)
'Stop' processing manually or wait till the complete input files re processed.

5.1. Graphical Interface

The following section provides an overview of the graphical user interface of the module.

5.1.1. Main Dialog Window

Initialisation and configuration of Procedure Visualisation module is performed using the main GUI presented the following figure:

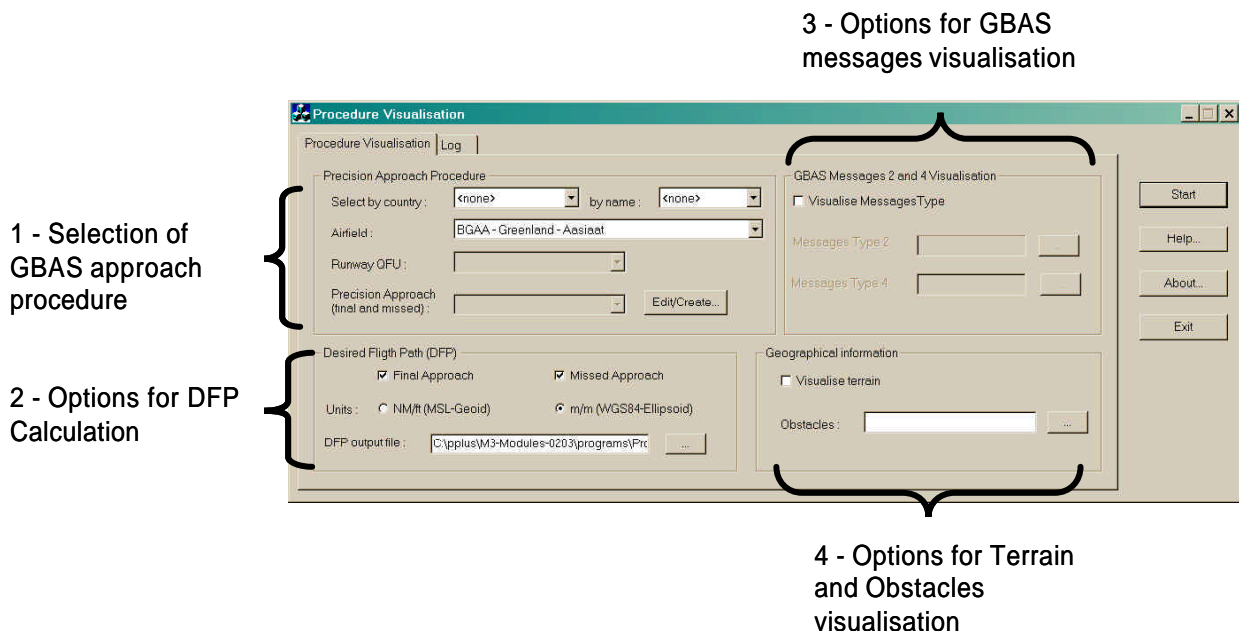


Figure 5.1-1: M5 main window in standalone mode

From the main window the 4 different parts can be seen:

1. Selection of GBAS approach procedure

The user selects in pre-defined list the airfield (either using Country / City or ICAO code), the runway QFU and selects the GBAS approach procedure from a pre-defined set of recorded procedure or by creating a new procedure (button Edit/Create ...).

2. Options for DFP Calculation

The user selects the option for precision approach segment extend (final approach and / or missed approach), the reference units for distance (NM or m) or altitude (MSL geoids in ft, WGS84 ellipsoid in m), as well as the location of the DFP calculation output file (format .csv).

3. Options for GBAS Message Calculation

The user selects the message types to be visualised (type 2 and / or type 4) and inputs the location of message files.

4. Options for Terrain and Obstacles Visualisation

The user select the geographical information to be displayed together with flight paths

The log tab presents the intermediate results of the calculation.

5.2. Step-by-step Overview

In the following sections the main steps 'how-to-use' the procedure.exe software in **standalone** mode are described.

5.2.1. Start and Initialise the Procedure Visualisation Software

In general the procedure.exe core module will be started manually by double-clicking the procedure.exe (then the main dialog window of Figure 5.1-1 appears on the screen) or from inside the PEGASUS framework.

In any case, the framework/user can determine the behavior of the procedure visualisation module through 2 'command line' parameters:

MEDLL.exe [-b] [-ini xxx.ini]

The [-b] option determines, whether the module is running embedded (command [-b] is given in command line) or standalone (no option). Usually the [-b] option is used when called from the PEGASUS framework.

The second option [-ini xxx.ini] tells the procedure.exe, that a 'xxx.ini' file shall be used. The xxx means that every name can be used here for the 'ini' file. The 'ini' determines all necessary data for processing.

When the procedure module is running embedded ([-b] is given at command line), also the provision of a valid [-ini xxx.ini] command option is mandatory (the data from the 'ini' file are necessary to initialize all necessary processing input data). If the second option is not provided, the procedure module will terminate.

If running standalone, the provision of a 'xxx.ini' file is not mandatory. As the user has the option to set necessary processing data from the dialog window. However as a standard,

the module will look for a 'procedure.ini' in the installation directory. If it is found, this 'ini' file will be used.

If no 'ini' file is available, default values will be used as far as possible for the processing. But at least the input data files must be selected (see next section).

5.2.2. Select Input and Output Files

Independent of embedded/standalone mode, the selection of the input processing files is the most important step.

In general the name of the input file will be selected by the user inside the 'File I/O' group box using the 'Input File' edit fields. If the user does not want to type path and name of the input files, it is also possible to select the right file using the 'Button' right to the edit field (see next figure) This selection of input file name is mandatory.

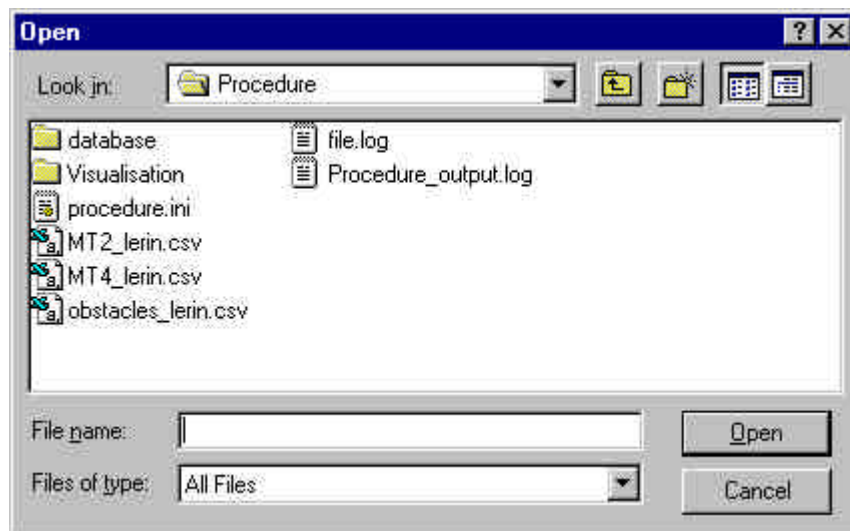


Figure 5.2-1: Select Input File Path and Name (here under Windows NT)

From the selected file, just the file name without extension is used. For procedure, no input file is mandatory but GBAS messages and obstacles visualization necessitate to enter input files (.csv format) .

In case of embedded processing inside the PEGASUS framework, the framework will provide the user the input selection edit box and file browsing capability. The selected file name is then written (using the procedure.ini) to a 'xxx.ini' file. Finally the framework will start the procedure.exe with the 'xxx.ini' as argument on the command line.

For the output file, the user also can write a filename in the 'Output File' edit box of the DFP group (or using the browsing capability via the button right of the output edit field).

In case the user just gives a name without path, procedure.exe will search the file in the installation directory.

When no output file name and path is specified, the output will be written also to the installation directory.

5.2.3. Select GBAS Approach Procedure

While airfield and runway have been selected, as depicted in Figure 5.1-1, the user may edit a pre-defined approach procedure or create a new one. The corresponding user interface is presented in Figure 5.2-2.

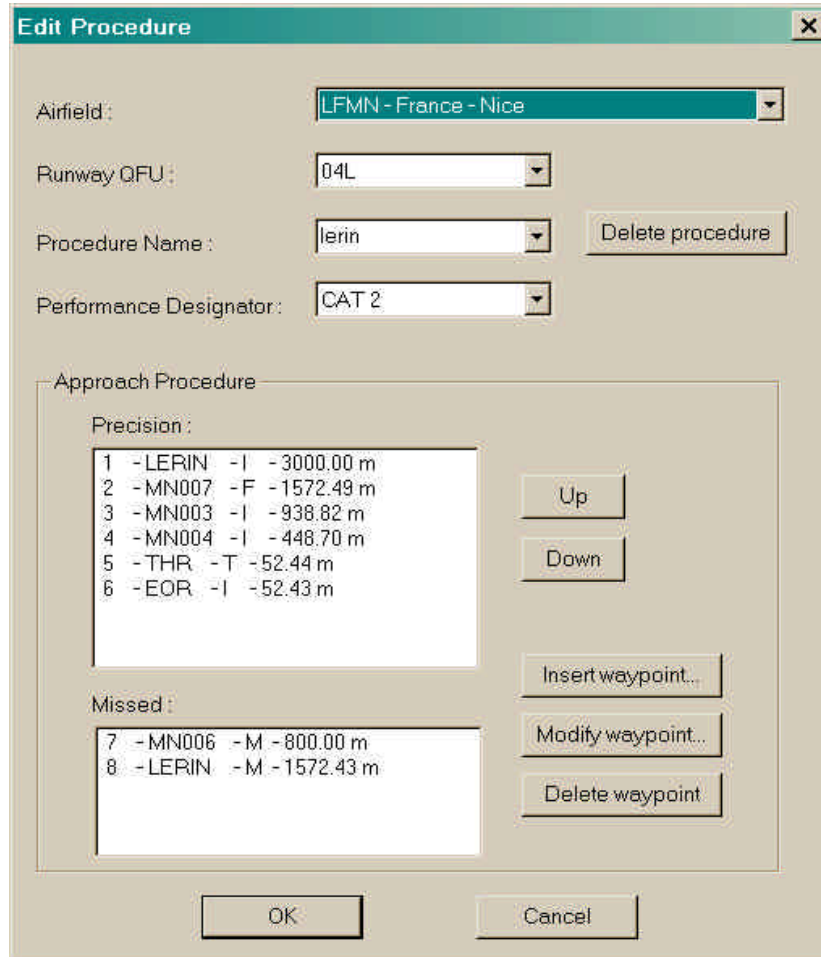


Figure 5.2-2: GUI Approach Procedure Edition

The choices made by user for airfield / runway / procedure name are reported from actions with the main GUI or modifiable. The Performance Designator NPA / CAT 1 / CAT 2 / CAT 3 is optional information.

The approach procedure is defined by selecting several waypoints from a predefined set as shown on Figure 5.2-2 and Figure 5.2-3.

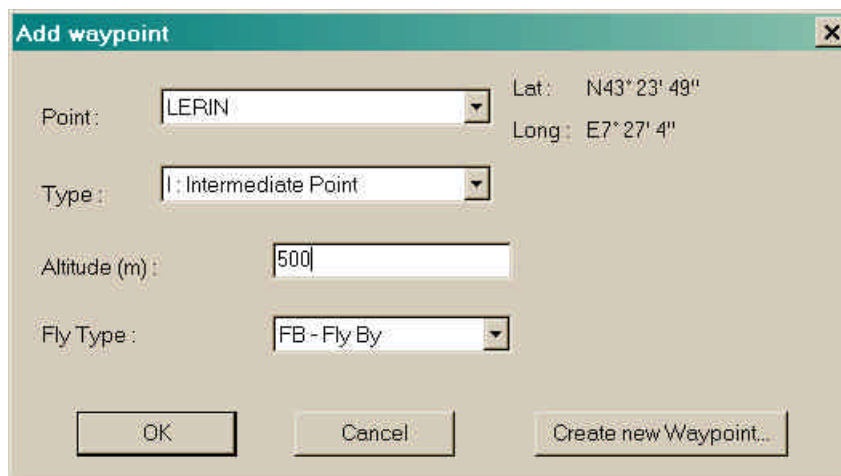


Figure 5.2-3: Waypoint Selection

User selects the following items :

- Waypoint Name via its ICAO name
- Type with respect to the precision approach segment : final approach point (F), Intermediate point (I), runway threshold (T), missed approach point (M), mandatory
- Altitude at the waypoint : mandatory
- Fly Type : RNAV path (“Fly-By” or “Fly-Over”) and the altitude at waypoint, mandatory

5.2.4. Start and Check Calculations of Desired Flight Path (DFP)

Once the approach procedure and visualisation options have been defined, the user triggers the DFP calculation via the “Start” button (see Figure 5.2-3).

Information about the calculations status is provided to the user, an example of such message is provided in Figure 5.2-4.

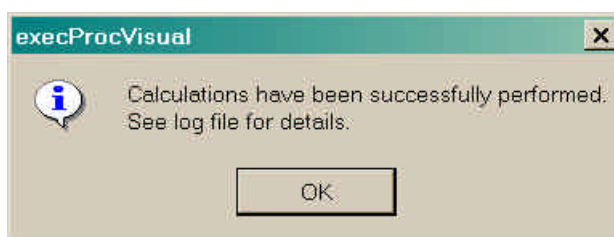


Figure 5.2-4: DFP Calculation status message

Intermediate results of the calculation are presented in the Log window, in particular the value of radius for turns at procedure waypoints that result of module calculation.

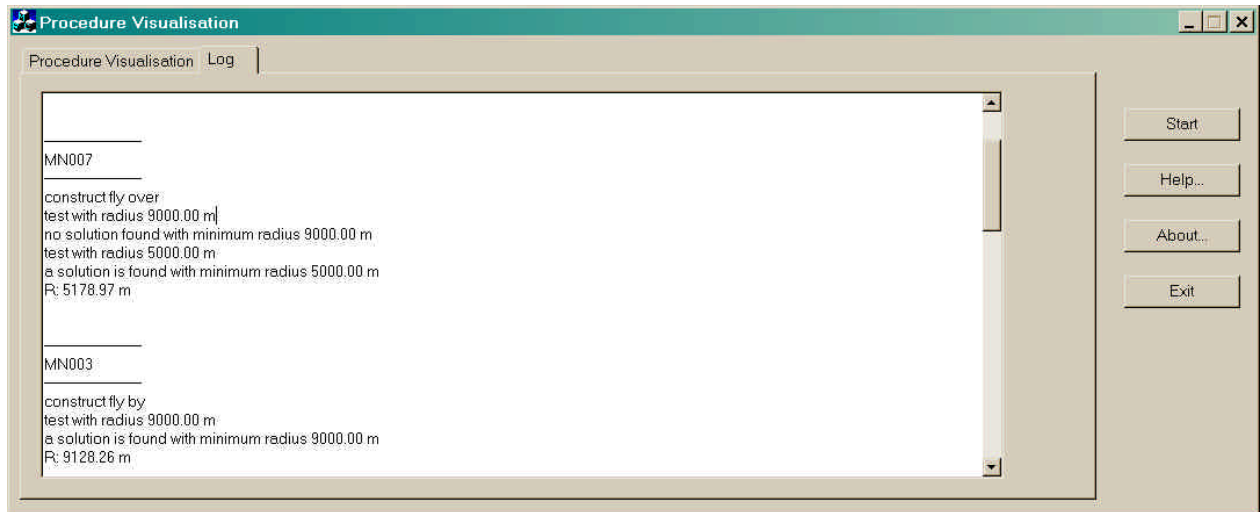


Figure 5.2-5: DFP Calculation Log Window

5.2.5. Visualise Approach procedure and DFP

Approach procedure and DFP calculation are visualized using MATLAB. An example of the routine launched via the M-File runner display is presented in Figure 5.2-6.

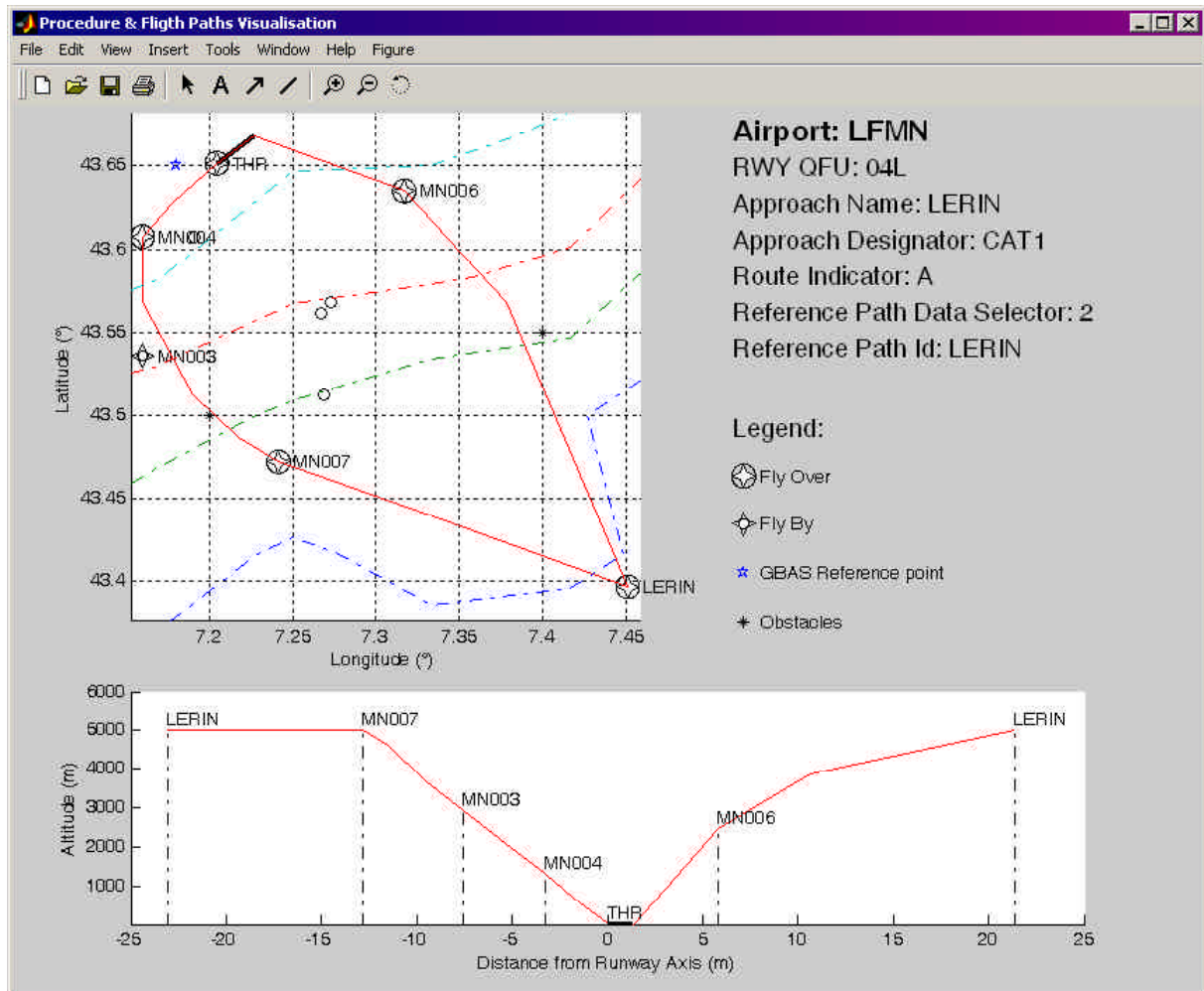


Figure 5.2-6: Approach Procedure and DFP Visualisation

The display contains the horizontal and vertical profile of DFP, waypoints defining the approach procedure are plotted with relevant ICAO symbol.

The user may record the display via the “Figure” menu, in particular graphics may be exported to a vector format.

Information concerning GBAS station are provided on the display Figure 5.2-6 and further detailed via the display of GBAS message types 2 and 4 (see 5.2.6).

5.2.6. Visualise GBAS messages

Selected files for GBAS messages type 2 and 4 are processed in order to determine for a set of parameters :

- the maximum occurrence value
- the maximum deviation value
- the maximum deviation in % : red colour is used to highlight significant deviations

Examples of such visualisations are provided in Figure 5.2-7 and Figure 5.2-8.

Message Type 2 Parameter Name	Maximum occurrences value	Maximum deviation value	Maximum Deviation (%)
Number of GBAS reference receivers	1	0	100
GBAS Accuracy	1	1	0
GBAS Continuity/Integrity	1	2	100
GBAS receiver latitude (deg)	7.18	7.18	0
GBAS receiver longitude (deg)	43.65	43.65	0
GBAS receiver height (m - WGS84)	50	60	20

Figure 5.2-7: GBAS Message Type 2 visualisation

Message Type 4 Parameter Name	Maximum occurrences value	Maximum deviation value	Maximum Deviation (%)
FAS Vertical Alert Limit (m)	12	12	0
FAS Lateral Alert Limit (m)	20	20	0
LTP/FTP Latitude (deg)	43.6518	43.6518	0
LTP/FTP Longitude (deg)	7.204	7.204	0
LTP/FTP Height (m - WGS84)	67.374	67.374	0
Delta FPAP Latitude (deg)	0.1	0.1	0
Delta FPAP Longitude (deg)	0.05	0.05	0
Approach Threshold Crossing Height (m)	0	0	0
Glide Path Angle (deg)	3.2	3.2	0
Course Width (m)	544	544	0
Delta length offset (m)	1	1	0

Figure 5.2-8: GBAS message Type 4 visualisation

5.2.7. Exit Software

By pushing the 'Exit' button, the software will terminate.

In case that the module is in a processing run, the processing will be stopped and the output data will be written to file.

In embedded mode, the module will terminate itself, when the input file was completely processed.

5.2.8. About Procedure Visualisation

By pushing the 'About' button of the 'Control' group, a information dialog will be shown to the user, providing information concerning version, copyright and purpose of the software (see next figure):

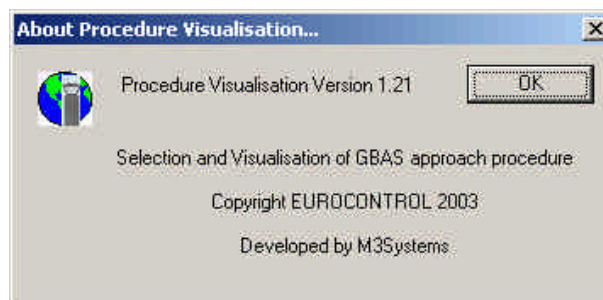


Figure 5.2-9: About M5 module

5.3. Help

In addition to this Software User Manual, a Helpdesk covering all the aspects of the tool is available. The can be activated by clicking on the 'Help' button of the command control group of the main user interface.

5.4. Operating Modes

Each Module for PEGASUS must be able to be operated in three modes:

1. As stand-alone executable
2. Embedded in the PEGASUS frame
3. In command-line Mode

While the stand-alone mode is described as the baseline mode in this User Manual, the two following sections describe the specific elements of operation in the other two modes.

5.4.1. The Embedded Mode

When the module is running in the embedded mode, i.e. called by the PEGASUS framework, it allows parameter values to be set from inside the framework. That means that only the parameter GUI part of the module software is visible in the parameter selection window of the Frame GUI. The Frame will automatically create the INI-File which is passed then as a command line argument to the core module processing executable, containing the selections made inside the framework. Equally, the invocation of the module processing is automatic through the Scheduler provided in the Frame. Detailed descriptions of this mechanism and a short description of the module GUI in Embedded Mode are contained in the main User Manual [3].

5.4.2. The Command-Line Mode

The core processing functions of the Module can be started in command line mode by typing:

```
<Module Name>.exe [-b] [-ini xxx:ini]
```

The [-b] option instructs the software not to display the GUI and to take all the inputs from an INI-file provided. The -ini option is mandatory if the -b option is used, if no valid INI-file is provided, the module execution will terminate.

Usually the [-b] option is used when called by the scheduler from the PEGASUS framework.

The option [-ini xxx.ini] tells the executable, that the 'xxx.ini' file shall be used. The xxx stands for an user-defined name for the 'ini' file. It must contain all necessary data for processing.

Project:
PEGASUS

EUROCONTROL
Procedure Visualisation Module
Software User Manual

Doc. No.: PEG-SUM-PVI
Issue: A Date: 17/06/2003
Sheet **20 of 27**

This option may also be used without the `-b` option, to invoke the GUI with pre-defined settings that can be changed interactively.

6. Services

6.1. Service 1 Approach Procedure Building

6.1.1. Input Data

The user select from a navigation database (PET dev. by Davidson Ltd) the waypoints that form the approach procedure and specifies the altitude, type (Final Approach Point, Missed Approach) and rank of such waypoints.

6.1.2. Options

Reference and units for altitudes displayed to the user are either WGS 84 ellipsoid meters or MSL geoids feet.

6.1.3. Output Data

Output is a table containing the description of the approach procedure, i.e. the different waypoints selected by the user and automatically completed with the runway threshold (THR) and end of runway (EOR).

Latitude, Longitude ate in deg, Altitudes refers to WGS84 ellipsoid and are expressed in meters.

WP_RK	"WP_NAME"	"WP_ID"	"WP_TYPE"	"TRAJ_TYPE"	"WP_LAT"	"WP_LON"	"WP_ALT"
1	LERIN	I	FO	S	43.397	7.451	3000
2	MN007	F	FO	S	43.472	7.2415	1572.49
3	MN003	I	FB	S	43.536	7.1601	938.82
4	MN004	I	FO	S	43.608	7.16	448.70
5	THR	T	FO	S	43.651505	7.204583	52.44
0	EOR	I	FO	S	43.668156	7.226592	52.43
7	MN006	M	FO	S	43.635	7.3169	800.00
8	LERIN	M	FO	S	43.397	7.451	1572.43

Table 6.1-1: Example of Approach Procedure Description Table

6.2. Service 2 Desired Flight Path (DFP) Calculation

6.2.1. Input Data

The input is the Approach procedure description file, an example is provided in 6.1.3.

6.2.2. Options

Calculation may be performed for the final approach and / or the missed approach.

6.2.3. Output Data

Output is a table containing the waypoints of the approach procedures completed by intermediate points that correspond to start / end of aircraft turns as computed by the module.

Latitude, Longitude are in deg, Altitudes refers to WGS84 ellipsoid and are expressed in meters, Distance to Threshold (D_THR) and Radius are in meters.

WP_RK	WP_NAME	WP_ID	WP_TYPE	TRAJ_TYP E	D_THR	WP_LAT	WP_LON	WP_ALT	TURN_CT _LAT	TURN_C T_LON	TURN_C T_ALT	TURN_F ADIUS
1	LERIN	I	FO	S	-42765.3	43.397	7.451	3000	0	0	0	0
2	MN007	F	FO	C	-23806.6	43.472	7.2415	1572.49	43.5139	7.26963	1615.91	5178.97
0	INTER	I	FO	S	-21253	43.4869	7.21752	1395.33	0	0	0	0
0	INTER	I	FO	C	-17629	43.5125	7.19001	1169.75	43.5682	7.27299	982.826	9128.26
3	MN003	I	FB	N	-14063.2	43.536	7.1601	938.82	0	0	0	0
0	INTER	I	FO	S	-10497.5	43.568	7.16006	719.539	0	0	0	0
4	MN004	I	FO	C	-6047.89	43.608	7.16	448.699	43.608	7.19096	375.764	2500.38
0	INTER	I	FO	S	-3308.77	43.6286	7.17855	266.534	0	0	0	0
5	THR	T	FO	S	0	43.6515	7.20458	52.44	0	0	0	0
0	EOR	I	FO	S	2564.06	43.6682	7.22659	52.43	0	0	0	0
7	MN006	M	FO	C	10762.7	43.635	7.3169	799.999	43.562	7.26685	187.155	9086.87
0	INTER	I	FO	S	19665.8	43.5685	7.37821	1221.62	0	0	0	0
8	LERIN	M	FO	S	39618.6	43.397	7.451	1572.43	0	0	0	0

Table 6.2-1: Example of DFP calculation Table

6.3. Service 3 Approach Procedure Visualisation

6.3.1. Input Data

The input is the Approach procedure description file, an example is provided in 6.2.3.

6.3.2. Options

Reference and units for altitudes displayed to the user are either WGS 84 ellipsoid meters or MSL geoids feet.

Addition of geographical information : terrain database or obstacles

6.3.3. Output Data

Please see Figure 5.2-6: Approach Procedure and DFP Visualisation.

6.4. Service 4 GBAS Message Type 2 and 4 Visualisation

6.4.1. Input Data

GBAS message type 2 and 4 extracted from GBAS station of receiver in .csv format

6.4.2. Options

Visualisation of message type 2 and / or type 4 or none

6.4.3. Output Data

Please see Figure 5.2-7: GBAS Message Type 2 visualisation.

Please see Figure 5.2-8: GBAS message Type 4 visualisation.

Appendix A: Error messages and recovery procedures

The following error messages may be written during the processing of input data.

ID	Error	Solution
1	Error : No data to save	Enter a procedure
2	Error : No point ID specified	Specify a point ID
3	Error : Incorrect Latitude	Enter a correct latitude [2]
4	Error : Incorrect Longitude	Enter a correct longitude [2]
5	Error : Incorrect Altitude	Enter a correct altitude [2]
6	Error : database not opened yet	Re-install the module
7	Error : no record found	Database is not available : Cf. ID.6
8	The output file has not been created	See log file
9	The file could not be located	Input file could not be opened. Ensure that input file is available.
10	The file is already open by another process	Close the other process
11	There is a problem with this file	An additional message will be written
12	All or part of the path is invalid	Ensure that the path is correct
13	There is an unknown problem with the file	Input file could not be opened. Ensure that input file is available.
14	No ini file found	Provide correct ini file on command line in embedded mode.

Additionally information messages will be provided. But they are not provided in the table above.

Annex B Initialisation file example

The following ini file is part of the Procedure Visualisation module provided files. It contains typical default values:

```
[PROCEDUREVISUALIZATIONSystem]
AIRFIELD_ID=LFMN
RWY_QFU=04L
PROC_NAME=lerin
MT2_FNAME=.\MT2_lerin.csv
MT4_FNAME=.\MT4_lerin.csv
DFP_OUTPUT_FNAME=.\Procedure_output
OBSTACLES_FNAME=
[PROCEDUREVISUALIZATIONOption]
FINAL_APP=1
MISSED_APP=1
UNITS=1
TERRAIN=0
```

Appendix C: Glossary

This appendix contains the list of all the specialised terms used within this Software User Manual, together with their definition.

ADD	Architectural Design Document
AFP	Actual Flight Path
ASCII	American Standards Committee for Information Interchange
CF	Course to Fix
CMN	Control Motion Noise
D/U	Desired/Undesired
dB	Decibel
DF	Direct to Fix
DFP	Desired Flight Path
DLL	Dynamic Link Library
DO	Document
ECEF	Earth-Centered-Earth-Fixed
EDOP	East Dilution Of Precision
EEC	EUROCONTROL Experimental Centre
EGNOS	European Geostationary Navigation Overlay Service
ESA	European Space Agency
FB	Fly By
FO	Fly Over
GBAS	Ground-Based Augmentation System
GDOP	Geometric Dilution Of Precision
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GUI	Graphical User Interface
Hz	Hertz
ICD	Interface Control Document
ID	Identifier
IFEN	IfEN GmbH
INS	Inertial Navigation System
M3S	M3 Systems
MARS	Modular Analysis and Research System
MAT	Multipath Assessment Tool
MEDLL	Multipath Estimating Delay Lock Loop
MHz	Megahertz
MOM	Minutes Of Meeting
MPM	Multipath Meter
MSL	Mean Sea Level
NANU	Notice Advisory to Navstar Users
NDOP	North Dilution Of Precision
NED	North/East/Down
NOTAM	Notice To Airmen
NSE	Navigation System Error
NSFP	Navigation System Flight Path
PDIL	Products Deliverable Item List
PDIL	Products Deliverable Item List
PDOP	Position Dilution Of Precision
PEGASUS	Prototype EGNOS and GBAS Analysis System Using SAPPHIRE
PFE	Path Following Error
QFU	Runway in Use (e.g. 04L)
RAD	Requirements Analysis Document
RF	Radio Frequency
RINEX	Receiver Independent Exchange format
RINEX2	Receiver Independent Exchange format, version 2
RLD	Rear Left Down
RNAV	aRea NAVigation
RTCA	RTCA, Inc. (formerly Radio Technical Commission for Aeronautics)
SAPPHIRE	Satellite and Aircraft Database Project for System Integrity Research

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Procedure Visualisation Module
Software User Manual

Doc. No.: PEG-SUM-PVI

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Sheet **27 of 27**

SBAS Satellite-Based Augmentation System
TDOP Time Dilution Of Precision
TF Track between Fixes
TSE Total System Error
WGS World Geodesic System