

GPS-Vision-Air for Pocket PC

Version 1.1 beta

DISCLAIMER

Although this software has been used in my aircraft, and has been tested in several ways, no warranty, expressed or implied, is made by the author (Allan Emrén) as to the accuracy or functioning of the software and related software materials nor shall the fact of distribution constitute any such warranty, and no responsibility is assumed by the author in connection therewith.

The data bases are of **experimental nature**, and not complete. No warranty on correctness is given. Also, it is the responsibility of the user to make sure that correct data are used in real flights. Also, changes needed for customization purposes are made at the users responsibility.

Licence conditions

This software may be downloaded and used by anyone without any charge. A donation for covering of development costs is appreciated, but you do not have to give any. See website for details.

Anyone may distribute the software under the following conditions:

- * No charge of any kind is allowed, not even for distribution media (diskettes, CD-ROM etc)
- * The software, the Readme file, and the present user instruction file both have to be included.

User instructions

Installation of the program

Unzip the file, and copy the entire directory to your Pocket PC.

If you have a memory expansion card, place the program there.

Make sure that the following files are included:

Readme.txt

GPS-Vison-Air.exe

ESGO-ESSE.txt

NO-ROUTE.txt

port.txt

waypoints.txt

zones.txt

Probably, the file port.txt has to be modified. You have to know which port, baud rate, and other settings are used for communication with your GPS-unit. Normally, this information can be found in the GPS instruction book. Find the appropriate settings and enter correct data into the port.txt file.

Start of the program

In the File Explorer at the PDA

Click the file GPS-Vision-Air.exe.

The program starts, and you will see a white screen with a few buttons.

In the present (beta) version, you will find a button labeled 'Start'. Click that button.

Within five - ten seconds, a screen should appear, looking something like the illustration at the next page.

The program makes use of a simplified synthetic vision.

At the top, you have the blue sky.

Below the horizon, the (pale green) ground covers most of the screen.

Objects are positioned as they should be as viewed through the wind screen of the aircraft.

Red color means danger of some kind.

If nothing happens, connection to the GPS has failed. Common reasons are that another program is using the GPS-unit or that you are out of range for the Bluetooth transmitter. Go to the section 'Trouble shooting' for more information.

IMPORTANT!

The program cannot run more for than 35 minutes. After that time it is automatically shut down.

This is no serious limitation. After shut down, it is easily restarted. Within 30 seconds, it will be up and running again. It remembers the route you are following, so nothing happens except that you have to fly at constant heading for some half a minute.

With HP iPaq, you simply press the ENTER button two times, and the program is running again.

Sometimes, shutdown could be very inconvenient, Like when you are close to a reporting point. To handle that, a warning is displayed during the last five minutes of operation, e.g. "Will shut down in 220 seconds"

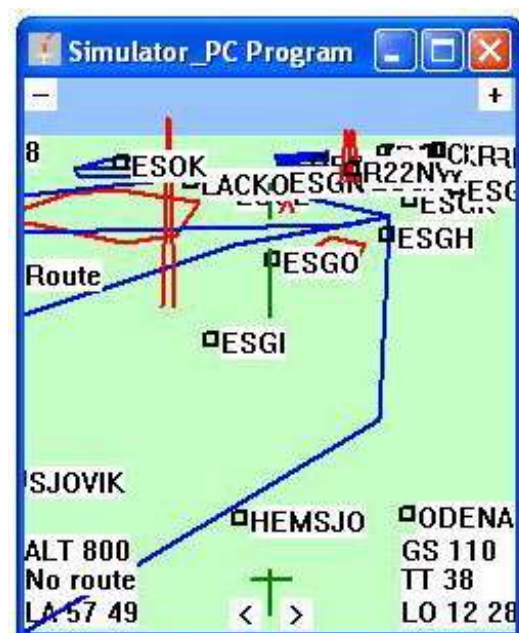
Thus, you may choose to shut the program down at a better (earlier) moment.

The reason for this little inconvenience is that there is some kind of memory leakage, that would cause the computer to crash if the program is allowed to run too long time. Work is going on to solve this problem.

Information displayed

To the right, an example is given, showing what the screen may look like.

An obstacle close to ESGI extends above the horizon. So it is higher than your present altitude. Collision hazard!



Another obstacle below 'O' in LACKO is lower than your present altitude. The red color means that its top is less than 250 feet below your own altitude.

Up to the left, Sätenäs CTR is drawn with red lines, meaning that at present altitude, you have to get a clearance to enter.

Göteborgs TMA (sector Sätenäs) is drawn with blue lines, meaning that you will pass below at your present altitude.

Above 'G' in ESGI, a vertical darkgreen line starts. It tells your estimated position in five minutes at present track and ground speed. The line ends at ten minutes.

Next line shows 15-20 minutes, and above that, there is a short line showing 25-30 minutes (just to the left of 'O' in LACKO).

At the lower corners, data on present status are shown. Knowing the position at once is good in case of an emergency.

The aircraft symbol is green, meaning that the GPS signal is OK. The accurate position of the aircraft is at the "pilot" position in the aircraft symbol (where wings and body crosses).

The aircraft symbol turns red in case of unreliable position data.

Finally, the screen resolution is shown to the left below the horizon. 8 means that the screen width is 8 nm at the bottom.

Modes of operation

The program has two modes of operation, 'On ground' and 'Airborne'.

If you are moving slowly, the program assumes that you are on ground. Then, limited information only is displayed.

When the speed exceeds 30 knots during 20 seconds, the airborne mode is entered.

If 'Airborne', the mode 'On Ground' is entered.

Heading line.

When airborne, a green line is shown, starting at estimated position in five minutes ahead and ending at ten minutes. Other lines cover the time intervals 15-20 minutes and 25-30 minutes respectively.

Airspace is shown if it is closer than about 60 - 120 nm. Borders are colored blue (like sky) if you are below. They are red if you could enter at present altitude (you will need a clearance), and if you are higher than the airspace in question, it is drawn black (like soil).

If you are flying in a zone, and the border changes color from blue or black to red, you might have entered the region from above or below. But before doing anything else, check the GPS-altitude vs your altimeter. It could be a result of inaccuracy from the GPS.

Waypoints are drawn as squares in the current program version. To the right of the waypoint, there is a label with its name.

Airports are shown as squares, like other waypoints. If, however, runway information is present in the data base, the runway is drawn when the distance is less than 5 nm. It is always drawn 100 m wide,

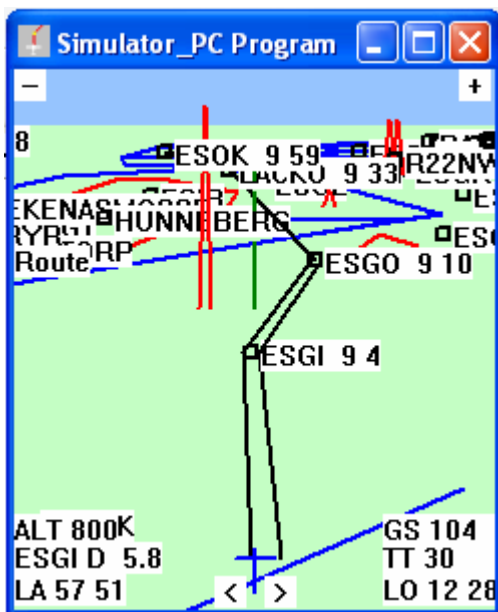
Controls

To change resolution, use the buttons at the upper corners.
Zoom in with [+] and zoom out with [-].

Road in the air

At the left edge, slightly above the mid point, there is a button labeled 'Route'. If you press that, you may load a route into the program.
Choosing a route will give you a screen looking to the picture below.

The two closest legs are drawn like a road. The width is 0.5 nm. Thus, you get an idea of scale at different parts of the picture. If you keep to right, particularly close to reporting points, the collision probability is decreased considerably.

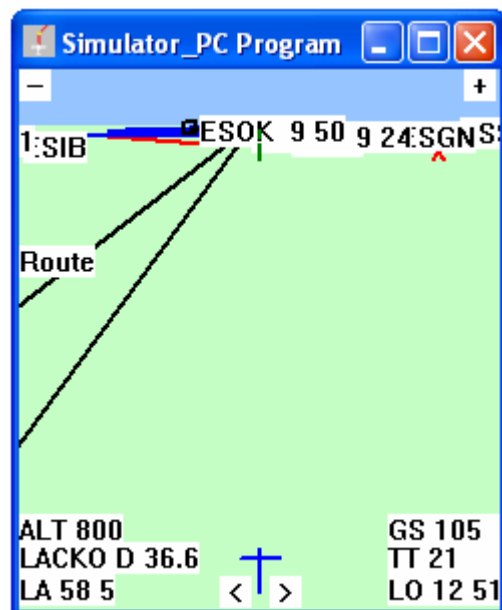


At the bottom left, the distance to next waypoint is given. May be of use for communication with ATC. If you are airborne, ETA:s for all waypoints along the route are displayed. The drawing order is arranged so that you always will be able to see ETA for your destination, even if there is a clutter when the remaining part of the route is long.

Sometimes, one might need a better overview, which may be accomplished by zoom out, as seen below. Although the screen width is merely one nm, You are able to see 10 minutes forward, and even the destination, 45 minutes away is clearly visible.

The screen is updated every four seconds. This is more seldom than common in GPS programs. I have tested this in flight competitions (e.g. The International Malta Air Rally), and in training for such, finding that the better accuracy given by a larger interval is beneficial. 4- 5 seconds appear to be optimal.

Similarly, one sometimes needs high lateral resolution. Then, zooming in gives the desired property. In common GPS programs, it may be difficult to follow the track at high resolution. It



simply goes away from the screen. This is no problem with the GPS-Vision-Air program. In the right hand picture, the screen width means 1.0 nm. Thus, one mm is equivalent to merely 30 m. Although, the flight is far to the right of the track, returning is very easy.

If an angle at a waypoint is less than 90 degrees, the program might not realize that you have passed that point. Particularly, this is the case if you make a shortcut while passing. See the section 'Trouble shooting' below.

You may load a new route at any time. The last route you used will be used next time you start the program, e.g. after a programmed shut down. If you do not want to have a route, load the route NO-WPTS. This is a file that is essentially empty.

Dead reckoning

If no position update is received from the GPS unit, or if the information is unreliable, the program switches to dead reckoning. This is indicated by red color in the aircraft symbol.

Satellite drop outs have a tendency to happen at inconvenient moments. For myself, it happened once just after ATC had told me to "Report when leaving control zone".

With dead reckoning, you will have a fairly accurate display of your position if you do not turn. So if you would see the aircraft symbol turn red, check your heading, and then keep that heading, if possible.

Normally, poor satellite positions do not last very long. So you could expect to get the signal back in some five or ten minutes. After ten minutes, your displayed (dead reckoning) position will typically be less 0.5 nm from the real one.

Programmed shutdown

As mentioned above, the program has to shut down each 35 minutes. It does not cause any real problem when the program is used. Shutdown and restart normally requires less than 30 seconds, and the required actions from the user is to press a button twice (or pressing the stylus to the screen twice). Without any complications, I have used the program with flights lasting from 30 minutes up to 1 hour 30 minutes.

This is a known bug, but so far, the direct cause has not been found. Probably, there is some buffer that is not properly reset after use.

Make sure that the shut down does not happen at a critical moment. So if you expect a busy period in the near future, make a shut down manually by clicking the X or by pressing the OK button at the PDA.

There are two ways to restart the program:

1. Use the stylus to click GPS-Vision-Air in the file explorer.

When the program is running, click the Start button on the screen.

Normally, the program should be tuning again within ten seconds.

2. Press the ENTER key at the PDA. This is the key at the bottom center. When the program displays the first screen, press ENTER again. Ten seconds later, the navigation screen should be visible.

Log book and flight log

When the speed exceeds 30 knots during more than twenty seconds, the the flight is considered to be airborne and the time is noted into the log book file (logbook.txt). Similarly landing is assumed to have happened when the speed is less than 20 knots during twenty seconds.

Each time a shut down happens, the program will generate a new start time when it finds itself to be in Airborne mode. So in the logbook file, you should ignore all start times except the first one.

The program does not give any information about date, so I suggest that you write current date into the logbook file manually before take off. (Or some other way to know which day the flight took place.)

Every eight seconds, the program writes flight data into a file (raw data from the GPS unit). This can serve as a silent witness in case of an incident or if you are accused for airspace intrusion. The file is easily imported to a spreadsheet program, and then a lot of data can be extracted. An example from real life could be viewed at the following site:

<http://www.nuchem.se/allan/EHWO-08.htm>

Track

Every eight seconds, the program makes a note of the present position in its memory. The remembered positions are displayed as a red track behind the aircraft symbol. Normally, you cannot see much of that track. If you turn, you you will be able to see a larger part of the track. This may be useful if you meet bad weather and want to return to a place where you recently had better conditions. Just turn 180 degrees, and then follow the red track backwards.

Known bugs

In addition to the suspected memory leakage mentioned above, there is another known bug in the present version. Sometimes the program accidentally flushes the serial port's buffer while the GPS unit is transmitting. If this happens, the received record is faulty, and no meaningful data can be extracted. So the program has to switch to dead reckoning. The text 'No GGA' is shown at the middle of the screen. This state can continue during an extended time. See Trouble shooting:E for diagnosis and cure.

The known bugs will be taken care of in later program versions.

Trouble shooting

A. Program fails to start

Within ten seconds after you press the 'Start' button at the screen, you should see the blue sky and green ground. If this does not happen, the most common reason is that the program is unable to connect to the GPS unit. There may be other causes, however. One is the the operative system does not really start the program properly. Here follows a suggestion of how to proceed.

1. Close the program and restart it.
2. If this does not solve the problem, reset the PDA and try again.
3. Make sure that the GPS unit indicates that it is started, and that it sends information.
4. Check that Bluetooth is on both in PDA and GPS. This should be indicated by a blinking blue LED.
5. Check that no other program uses the GPS unit. This could be checked in Settings/System/Memory/Running Programs at the PDA. If any program using the GPS is displayed there, stop it.
6. In Settings/System, there is a program named External GPS. Set the coorect port there.
7. If you are not sure about which port and settings to use, you could usually find information in the GPS manual. Often, there is also a program supplied with the GPS unit, that will help you connect to the GPS. Check out the settings it tells you, and copy them into the file port.txt. After that, make sure that the program mentioned is closed.

NOTE, closing it with the X at the top right of the screen, is not enough. You have to use the procedure described under item 5.

B. No screen updates

Every four seconds, you should notice a screen update. A tiny flicker makes that obvious. Should the screen stop being updated, something has happened with the display system. Note that longitude and latitude may be updated even if the sceen update stops.

First check the the aircraft symbol is green. If it is red, dead reckoning is used, and there is no change in displayed direction if you are turning.

If you suspect that the update is out of service (green aircraft symbol), make a little turn. If that does not become visible at the screen within four seconds, there is an update error. You then have to restart the program, or if it cannot be closed by clicking the X in upper right corner, you have to reset the PDA and then restart the program.

C. Old screens are nor properly erased, or colors are wrong

This is caused by memeory overload. The PDA has to be reset, and the program restarted.

D. Next waypoint is not updated properly

This could happen if the angle between two legs is less than 90 degrees. If the program does not detect that you have passed a waypoint, you are able to cure that by closing the program and open the file status.txt.

There, you find among others, two lines looking like

```
Next wpt  
3
```

The figure 3 here, is the number in your route. Increase that number with one unit, and start the program again. Then, it should display next waypoint correctly.

E. No GGA

If this text appears at the screen, the reason usually is that the serial buffer is flushed accidentally while data is received. Normally, this should be resolved automatically within half a minute. Meanwhile, dead reckoning is used to update your position. If the problem persists for more than a minute, try restarting the program.

Feedback

As you might understand, the GPS-Vision-Air program is still under development. (All programs are, more or less.) So if you find bugs, that are not mentioned here, or if you have suggestions on how to improve the program or its handling, please tell me. If I like the ideas, I will incorporate them in later versions.

Similarly, all data bases are experimental, and cover parts of Sweden only. If you prepare supplementary data, please make it possible for other users to take advantage thereof. With your permission, I will upload you data to the web site, to be downloaded by others free of charge.

My purpose with uploading the program and my own data is to prevent the usage of good navigation tools from being a question of the size of your wallet.

Good luck and wishing many nice flights

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APPENDIX

Data files

All data files are written as plain text, so the user is able to read and edit according to needs. Each object (waypoint, airspace sector etc) is written as a single line. Items are separated (blank space and TAB are recognized). Coordinates are given as degrees.decimals. Negative values mean south and west respectively. The program is case sensitive, so I recommend upper case for names. Examples and explanations are given below.

All fields are required, except when stated to be optional.

Waypoints

The current version of the program can handle 1000 waypoints. This number will have to be increased in later versions. The waypoints may be given in any order irrespective of type. Several waypoints may share the same name. If, however, a waypoint is used in a route, the name has to be unique. Otherwise, the program will choose the first entry in the list, that matches the name, and that could cause severe navigational errors.

Example

TOBO	59.3247	16.8639	E	ESSU
Name	Latitude	Longitude	Type	Info

In the example above, the type is airport, and the optional info is frequency. The following types are recognized by the GPS-Vision-Air program:

A	Airport	Info is optional frequency Runway coordinates are optional
E	Entry point	Info is optional, could be airport
N	NDB	Info is optional frequency
O	Obstacle	Info is compulsory height (MSL)
R	Reporting point	Info is optional frequency
U	User point	Info is optional
V	VOR	Info is optional frequency

A name may contain up to 19 characters.

A line may contain 399 characters or less

Lines starting with the # character are ignored (comment lines)

Coordinates are given as degrees.decimals

File name: waypoints.txt

Airports

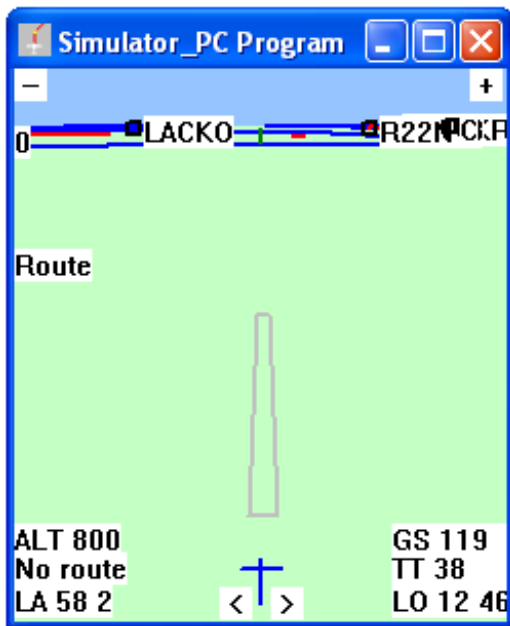
For name, it is recommended that the ICAO code is used. This makes the name require a limited space when displayed. As optional info, the frequency is suitable.

You may enter runway data, giving lat long lat long of its ends.

The present program version ignores runways given, except the first one.

Example

ESGO 58.0422 12.7900 A 123.65 58.04245 12.79048 58.0362 12.78117



If runway data are given, the program draws the runway if the distance is less than 5 nm. The runway is drawn as a gray rectangle. The picture to the left shows a simulated display at short final to ESGO. The highest possible resolution has been used, meaning that the screen width at bottom is 0.5 nm. The width of the runway is always a bit overestimated. To make it clearly visible, the runway is drawn as 60 meter wide.

Airspace

The current version of the program can handle up to 200 sectors of airspace. This number will have to be increased in later program versions. Each sector may have up to 25 corners. Circular sectors have to be approximated as polygons.

Example

Name	Type	Freq	Class	Upper limit	Info	Lower limit	Coordinates of corners
Oskarshamn	TIZ	*	122.15	G	0	1000	57.4233 16.4644 57.4169 16.5633 57.2822 16.5339

The star is used to give nonsense information into a compulsory field, meant for call sign etc.

Lines starting with the # character are ignored (comment lines)

Limitations: The fields for name and info may consist of up to 19 characters

File name: zones.txt

Port

The program is connected to the GPS unit via a serial port (typically Blue Tooth). The port settings are given in this file. Available options are described in separate lines followed by the actual value. All lines have to be present and order must not be changed.

Example

```
Comm Port 0 1 2 3 4 5 6 7 8
6
Speed 1200 2400 4800 9600 19200 38400 57600 115200
38400
Parity 0-4 = no, odd, even, mark, space
0
Data bits 4-8
8
#Stop Bits 0=1 1=1.5 2=2
0
```

File name: port.txt

Logbook

Start and landing times are noted in this file. During long flights, the program has to be restarted, perhaps a few times. Each time, the program will find that the speed is high enough for you to be airborne, and then the time is noted in the log book. So a flight may be recorded in the following way:

```
.....
Start 10.57
Start 11.27
Start 12.2
Landing 12.14
```

This means that the real start time was 10.57 and the real landing time 12.14. The log book file is never automatically erased, so when it becomes too large, you will have to erase it manually.

File name: logbook.txt

Flight log

Data on the flight are written every eight seconds. As mentioned above, it may be a rather big file, that can be useful for handling incidents, like accused airspace intrusion. An example of the usefulness is given here: <http://www.nuchem.se/allan/EHWO-08.htm>

The file grows rapidly, so you should delete it regularly. Make sure, however, not to delete it until you know the the information is not needed any more.
One way is to back up the file in a PC before deleting it.

A record might look like the following:

```
$GPGGA,155635.000,5743.2653,N,01258.3882,E,1,08,1.0,169.4,M,38.1,M,,0000*5C
```

There are several fields separated by comma signs. The meaning of the fields are:

\$GPGGA Type of record. This kind gives time, position and some additional info.

155635.000 Z time. The value is number of seconds since midnight.

5743.2653,N Latitude. Degrees minutes.decimals

01258.3882,E Longitude. Degrees minutes.decimals

1 Fix quality. 0=invalid, 1=GPSfix, 2=DGPSfix

08 Number of satellites

1.0 HDOP. Relative horizontal accuracy.

169.4,M Altitude (m)

38.1,M Height of geoid above WGS84 ellipsoid

,,0000 Fields not used here

*5C Checksum to verify correctness of data transfer

File name: raw-data.txt

Routes

The content of a route file is simply a list of waypoint names. All names have to be found in the waypoint list. The names are case sensitive. A route may contain up to 100 waypoints. The file should be a .txt file, and a descriptive file name is recommended.

An example is shown below

```
ESGO  
LJUNGA  
LANDSJOE  
VIBAR  
ESMZ
```

A suitable file name for this route would be ESGO-ESMZ.txt

When the program is started, it remembers the last route used. Sometimes, however, one does not want to have a route displayed. The synthetic vision makes it possible to navigate even comparatively long trips without having a route calculated. If only, one knows that there will be fuel i large excess of what is needed, one may travel without loading a route.

I such cases, one may load the file NO-ROUTE.txt. It is empty, and recognized by the program as nothing to display.

Status file

The file status.txt is automatically generated, and is used by the program to make a smooth restart. It contains information on the current route including path, and position along the route given as next waypoint. The content of the file might look in the following way:

```
Route  
\CF Card\ALLANAV\ESGO-ESMZ.txt  
Next wpt  
3
```