EGAST
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European General Aviation Safety Team

Using Advanced Navigation Technology Safely

FOR GENERAL AVIATION PILOTS

SAFETY PROMOTION LEAFLET

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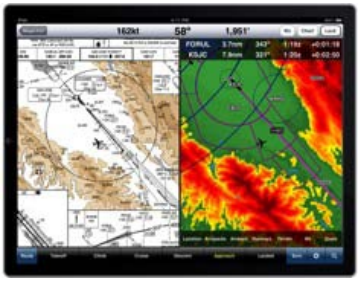
Do you know a pilot still flying without GPS? General Aviation Pilots flying in Visual Flight Rules (VFR) have been using satellite navigation (SATNAV) technology for over 15 years. The number of pilots flying without SATNAV continues to reduce.

The use of SATNAV is increasingly combined with additional features such as moving maps, terrain awareness warning and performance computation. A single piece of equipment such as a wPDA or SmartPhone may even provide Enroute Charts, Airport Charts and runway information. If a 3G-network is available on ground, you can submit your flight plan, check NOTAMs, read TAFs and METARs in clear text and get real-time weather information. Everything is generally nicely integrated and well presented.

Technological evolutions are intended to improve safety. This will only happen if they are properly integrated in pilot's practices.

This leaflet provides tips to better use advanced technology for navigation in day VFR, for example iPad®, Android Tablets®, and iPhone® for light aircraft pilots.



Becoming a better pilot is a constant process of improving understanding of the aviation environment to recognise and manage risks. This Leaflet intends to raise awareness on potential traps and share good practices for better and safer use of advanced technology for navigation in day VFR.

The market for onboard navigation software is very active and evolving quickly. The immediate potential safety benefits are numerous: reduce workload, reduce the risk of airspace infringement and facilitate precise navigation, which is of great help in complex airspace. It provides unprecedented information to enhance situational awareness. However, these benefits may come with some hidden costs. These costs can be negative human performance consequences, such as overreliance on systems, overconfidence in our basic navigation skills, and distraction.

Portable units cannot replace any system or equipment that is required by type certification and must not be used to control or operate the aircraft or as primary means of navigation. In addition, the International Telecommunications Union (ITU) has strict rules on making transmissions.

Structure of the leaflet

1. Becoming familiar with the equipment

A safe flight starts long before you even get in the aircraft

Changing from one manufacturer's equipment to another is not so easy. Standardisation is limited and the same information may be presented in a lot of different ways. There may also be major differences between individual equipment from the same manufacturer. Therefore users must become familiar with the equipment, it's functions, it's modes and it's configuration. It will prevent unwanted surprises in flight. So before attempting to use the equipment in the air, you should learn about the system in detail, including:

- Principles of satellite navigation,
- System installation & limitations,
- Pre-flight preparation and planning,
- Cross-checking data entry,
- Use of the system in flight,
- Confirmation of accuracy,
- Database integrity,
- Human error,
- System errors and malfunctions.

Essential learning, preferably with guidance from a manufacturer's representative or an instructor experienced on the individual equipment, should include at least the following:

- Switching on and setting up,
- Checking the status of receiver, satellites, battery, and any database used,
- Loading and selecting waypoints, route and alternate routes,
- Using "Direct" or "GO-TO" functions,
- Regaining the last screen when you pressed the wrong button (undo function)
- Information on the validity of the data presented.

Some manufacturers offer programmes to teach the handling of a GPS-navigation system. With this kind of simulator you can train yourself on all the functions of SATNAV equipment, at home, long before you fly.

Invite another pilot to fly and navigate for you until you have got sufficiently familiar with the equipment. If you fly a single-seater, ask someone else to fly you in their aircraft while you practise.

The instructions for use supplied with your GPS equipment may not be fully adequate for use in the air. Personal checklists may help you use the equipment. Caution: self developed checklists should be cross-checked by at least one qualified user, ideally an instructor.

2. Avoid distractions in flight

Modern equipment offers much information presented in a colourful and attractive way. However, this visual attraction may distract you from flying the aircraft and reduce the time that you are looking outside. At all times, but especially in a busy circuit pattern, keep your head up and avoid focusing on your equipment.

3. Over confidence, overreliance

Increased technical capabilities may tempt pilots to operate outside of their personal limits. They may plan for instance a challenging cross-country flight that they would not have planned otherwise. Your personal minimums must not be changed because you have equipment onboard.

4. Interference and jamming of the SATNAV signal

The signal received from the satellite is at very low power and is vulnerable to different types of interference. Sources of unintentional interference include, among others, UHF and microwave television signals, some DME channels, mobile phone transmissions and harmonics from some VHF RT transmissions. In addition jamming devices are available which can easily disrupt signal coverage across a wide area.

Military exercises and trials which include deliberate GPS jamming may take place, and are notified. Check NOTAMs for any areas likely to be affected.

5. Installation aspects

When operating under VFR outside controlled airspace, there is no requirement to carry any radio navigation equipment and there is no installation standard for GPS used only as an aid to visual navigation. However, equipment permanently installed (in any way) in an aircraft must be fitted in an approved manner.

- If a hand-held unit is carried, care should be taken to ensure that it, the antenna and any cables and fittings for them are secured in such a way that they cannot interfere with the normal operation of the aircraft's controls and equipment and do not inhibit the pilot's movements or vision in any way. Consideration should also be given to their possible effect on the aircraft occupants if the aircraft comes to a sudden stop or has to be abandoned. Ensure you have a working power supply, with spare batteries if needed. Remember that NiMH batteries have to be stored charged, NiCD batteries have to be stored discharged. Before using the device after a long storage period, perform a charge-discharge cycle.

6. Keep your software and databases up-to-date

Navigation software, the basic operating system, the maps, the aviation database (if any), and charts need to be kept up-to-date.

If you have an aviation database installed, ensure that it is current, and is valid for the area over which you intend to fly. Aerodromes seldom move far, but their serviceability, airspace, frequencies, reporting points and other information change often. An out-of-date database can lead (at best) to embarrassing and possibly expensive error. At worst, it could be catastrophic. Do not rely on an out of date database.

Even a current database cannot be automatically assumed to be error free, and a map display is likely to be less accurate than the raw GPS position. Instances of database errors have been recorded, and only careful checking against current charts and the AIP may identify these. In addition, NOTAMs must still be consulted before flight.

7. Learn from other users

Other pilots will have already used the same software and equipment. Their experience could be useful. The problems they may have encountered and the solutions that they developed could be of great help. Therefore do not hesitate to consult online aviation forums and discuss at your club with other fellow pilots. Remember, you can ask questions to the manufacturers or their agents.

8. Using advanced navigation technology before flight

Route planning software is available in many forms. Even mapping software can be used to measure distances and bearings, including tracks. A computer can calculate headings and times from a wind input. Double check all inputs, and cross-check with at least deduced reckoning calculations. A check of the total distance or time can often identify an input error.

NOTAMs and weather information is published on official websites, as are notified approach and departure procedures, and many devices can receive those. Some may be able to submit or activate flight plans, but do not transmit from the equipment in the air. Other aerodrome information is also available from websites; however, the information requires regular updating, usually by humans, and may be out-of-date. Do not trust automatic inputs because the inputting equipment will have its own possible errors.

9. Using advanced navigation technology in flight

First, pilots should be aware that the GPS based navigation system must not be taken as the primary means of navigation, but rather serve in a support role. That means, if the system suddenly crashes, how precisely could you locate your position and what should you do?

The equipment should **NEVER** be used in isolation. You should always keep in mind the risk of loss or degradation of the signal, with the attendant possibility of a position error. More importantly, there is a high risk of human error in data input and display reading, which can go unnoticed for some time.

If the SATNAV display agrees with everything else you know, including dead reckoning, the navigation log, map reading and general situational awareness, then the SATNAV display is likely to be providing the most accurate information. However, that is not guaranteed.

SATNAV devices intended primarily for aviation use usually have bright displays which update quickly. Other devices are likely to be either dimmer or slower, or both.

The accuracy of SATNAV will often show the operational error of other navigation aids. Errors of up to 5° are normal in a VOR display (even more on an ADF), and DME is only accurate to about half a mile. DME indicates slant range but SATNAV displays

horizontal range, giving rise to a further small disparity, which increases as you approach the DME station overhead. Some apparent errors may be due to magnetic variation.

On VFR en-route flights you may be asked to report over a specific point such as a 5-letter IFR waypoints. Be sure that you know how to enter coordinates or how to activate an IFR waypoint.

It is easiest to cross-check your SATNAV position with a recognisable feature on the ground. You could also compare indications from a radio aid station with the GPS range and bearing to that station. Any difference greater than the normal error associated with the radio aid indicates a problem with one or other aid. If you cannot cross-check with a third system, especially if short of fuel or near controlled airspace, consider asking an ATS radar unit for a position fix.

When using SATNAV to navigate between two database waypoints such as aerodromes, radio navigation aids or visual reference points, do not try to keep the course deviation indicator (if any) in the centre. Maintain the track marker a little to the left of centre to minimise the risk of collision with other aircraft coming the other way. A similar technique is advised when

approaching any database waypoint. However, that will keep you right of your direct track so ensure that avoids controlled or restricted airspace. When using the 'direct to' function, study the area (restricted or obstacles) in-between.

To avoid becoming totally dependent on the SATNAV, ask yourself two questions regularly throughout the flight:

1) Does the display agree with at least one other independent source of navigation information?
2) If the SATNAV quits completely, right now, can I continue safely without it?

If the answer is yes to both questions, you may continue to use the equipment for guidance. However, if the honest answer to either one of the questions is "No", then you must establish navigation by some other means.

Navigation information isn't usually coupled with terrain, obstacle and weather information, and if it is, databases may not include full information. Depending on the route selected, GPS navigation can lead you to fly into terrain or obstacles such as cables, wind farms or into adverse weather such as haze, fog, heavy rain, snow or thunderstorms.To avoid the risk of in-flight collision, controlled flight into terrain and loss of control in flight, carefully prepare your flight on the ground including terrain, obstacle and weather recognition. Refresh weather information during the flight.

10. Telephone equipment in flight

It is not permitted to transmit on the telephone frequencies in flight, and transmitting systems must be switched off. However, you should carry a device with telephone facility so you can close flight plans on landing, or call for assistance after a forced landing. In a serious airborne emergency situation, if you are unable to contact anyone by radio, you may try an emergency telephone call, but cockpit noise may make communication very difficult.

Summary

Good practices and tips from the use of advanced technology for navigation in day VFR

Be aware that those equipments are not certified nor qualified as aeronautical product and therefore no guaranty could be given on the safety and reliability. GPS based systems must not be relied upon as a sole navigation reference. Keep ready at any time to resume your own navigation with terrain maps that remains your primary mode of navigation.

At home and before the flight

- Plan the flight and prepare maps and log in the normal way.
- Get familiar with the equipment. If it is portable, practise at home with it. Understanding your equipment is key.
- Check for software updates and keep the databases up to date. Only use the latest the reliable source of information.
- Check your batteries or the power cable installation.
- Before departure, check all information programmed while on the ground.
- Use standard settings and check lists.
- Double check your route before flight.
- Check any computer produced flight planning carefully.
- Load possible alternative routes.
- Perform obstacle, terrain, airspace and weather recognition.

In flight

» Keep looking out for the ground, other aircraft and navigation features.
» Fly the Aircraft!
» Be critical of the information provided.
» Always consider the possibility that your tool could become unserviceable.
» Always know where you are, and keep your written flight log up to date.
» Never try new modes or options in flight!
» Fly and navigate visually, only use the GPS once you have verified its accuracy against something else, and cross-check regularly.
» Only carry out instrument approaches if you are trained and can comply fully with the requirements.
» Do not invent your own GPS instrument approaches, or rely on 'overlays'.
» Check the status and displayed receiver position on start-up.
» Keep in mind that apparent accuracy does not mean reliability. Accuracy is not guaranteed.

Acronyms:

- TAF — Terminal Aerodrome Forecast
- METAR — Meteorology Aerodrome Report (Current weather)
- NOTAM — Notice to Airmen
- GPS — Global Positioning Service (US Satellite Navigation System)
- VFR — Visual Flight Rules

Sources:

- UK CAA Safety Sense Leaflet 25 – Use of GPS
- EASA Safety Information Bulletin 2010-23 : Use of Portable Devices in Aircraft by the Flight Crew

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