COLLISION AVOIDANCE FOR LIGHT AIRCRAFT

by Volker Huck

Imagine flying a small aeroplane, only equipped with a Mode-C or Mode-S transponder and all of a sudden you realise you are on collision course with a big airliner. Don't try to avoid it by climb or descent, because the airliner will (in 99 of 100 cases) have TCAS II on board and activated...

This guides pilots to avoid other aircraft using resolutions in the vertical direction and it works on the vertical speed of potentially conflicting aircraft so if you change your vertical speed, it has to modify the resolution given to the other aeroplane and may affect the miss distance (and your composure!). It is also often very hard to judge visually whether you should try to pass above or below.

Avoiding the other aircraft by turning left or right might be better, but maybe not. Yes, the small aircraft may well get visual contact with the big one earlier than vice versa – although the airliner crew will have a traffic display showing the 'intruder'. However, they will be prioritising the accurate flying of any avoidance manoeuvre over visual acquisition once they get one. And an airliner goes faster but consequently takes more space to turn, so it may be hard to believe, but it may be best to do nothing!

Effective collision prevention starts on the ground. If practicable, avoid designated "hot spots" and if you can't then be especially careful when near them - maybe involve your passengers in looking out for traffic. Clean the windscreen – and the side windows - and make sure your seat is properly positioned in height so that you can see everything – and if the adjustment is insufficient, then use a

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pillow. Absolutely don't put stuff on the glare-shield and mentally process radio transmissions even if you think you are not involved. Finalise all your pre-flight preparation before take-off. There is a lot of really useful guidance on the internet. Start with: http://www.skybrary.aero/index.php/Visual_Scanning_Technique

The collision hazard is a nasty problem for light aircraft even if mid air collisions do not contribute much to the risk of flying statistically. Whilst in theory, you could install TCAS II, it costs much more than the average light aircraft. Some aircraft owners install the earlier version of TCAS, TCAS I but this just gives traffic alerts without any guidance on what to do about it The many private pilots flying typical light aircraft will use either:

- **Passive collision avoidance systems or**
- **FLARM or**
- **ADS-B IN (mainly in the USA) or**
- **Combinations of the aforementioned or**
- **Nothing but "see and avoid" (the majority).**

Passive Collision Avoidance Systems

receive (but do not interrogate) active transponders in the vicinity. They have to rely on another source to interrogate the intruder's transponder which means that there must be either an SSR (Secondary Surveillance Radar) or a TCAS-equipped aircraft in the vicinity.

These systems display approximate distance (derived solely from signal strength, see photo!), relative altitude and vertical trend and may display the approximate direction of the intruder (like the one on the right side of the picture). Intruders without transponders will not be displayed at all.

FLARM

FLARM is amazing. It is small, smart and effective, but only works among FLARM-equipped aircraft. It was designed for gliders which fly much closer to each other than other GA-aircraft and are also slower. It is based on broadcasting GPS position, augmented with barometric altitude. The principle is similar to ADS-B (see below chapter), but the alerting logic is specially designed for gliders. Another difference is that FLARM uses frequency-hopping in an open public-use frequency band, which is unprotected. The legal restriction on the use of that band is mainly signal strength.

Automatic Dependant Surveillance – Broadcast (ADS-B)

ADS-B signals can be detected with portable receivers and displayed on many navigation displays, including navigation apps on portable phones and tablets.

Principally, ADS-B signals are only available from equipped aircraft. The ADS-B OUT mandate in Europe is limited to large aircraft. In the USA, ADS-B OUT equipment is mandated for all operations that currently require a Mode-C transponder - which roughly means operations above 10,000ft QNH, in Class B airspace and in and above Class C airspace - from Jan 1st 2020. However, it would be premature to expect ADS-B OUT equipage on all aircraft that carry a Mode-C transponder today due to the cost. Many light aircraft pilots may well decide to stay away from mandated airspace. However, at least in the USA, ADS-B will be the main system support for collision avoidance in

Passive Collision Avoidance System PCAS

Source: Wikipedia

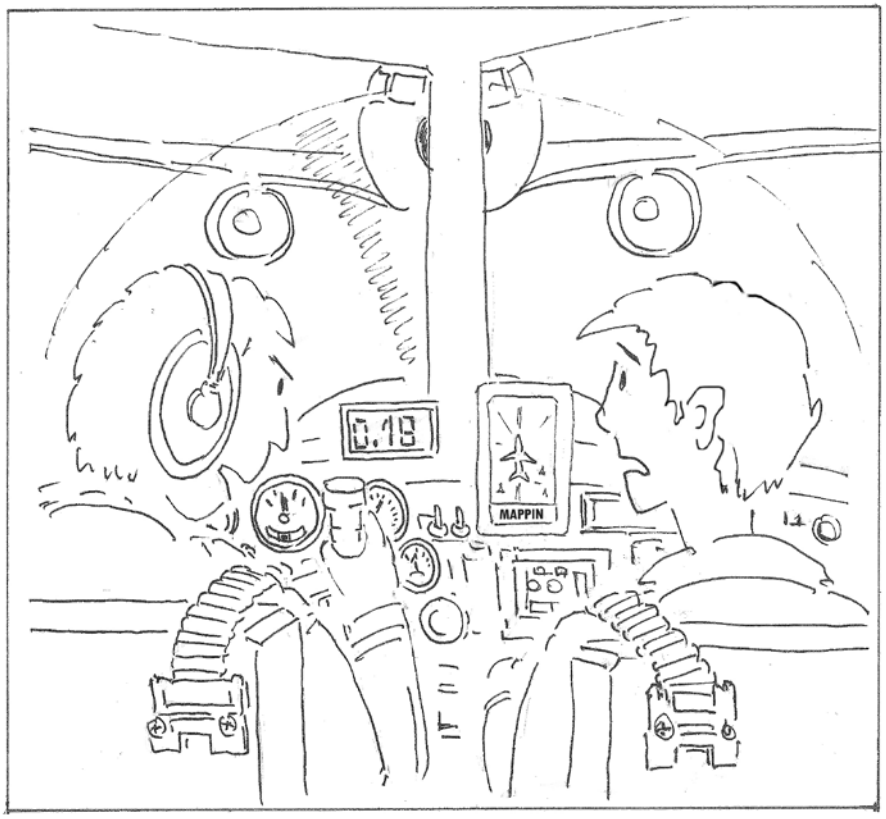
FLARM

the long term (for light aircraft). In some areas of the USA the position of Mode-C equipped aircraft without ADS-B OUT is rebroadcast and can be received by ADS-B IN.

Low Power ADS-B Transceiver (LPAT)

The installation cost for ADS-B OUT is to some extent due to the mandated system requirements for position accuracy and signal integrity etc. Other equipment is targeted below the standard and cost of the ADS-B out mandate. Flight trials are already under way with a Low Power ADS-B Transceiver (LPAT) being developed by UK NATS and Funke Avionics. This is a light-weight, battery powered carry-on device that is affordable and simple to use and which provides the minimum functionality you need to see and be seen by other traffic. It can also provide warnings against other suitably-equipped aircraft. It could become small enough to be carried also by remotely piloted aviation systems (RPAS).

Screenshot from a tablet using an ADS-B in device, displayed via an air navigation application (here: ForeFlight)



Let's play chicken, shall we!

Conclusions

Mid-air collisions do not contribute much to the risk of flying. The National Transportation Safety Board of the US has 116 fixed wing aircraft involved in a collision on record over the last 10 years before 2015 (http://www.aopa.org/asf/ntsb). Most of them happen in daytime VMC in the traffic pattern of an airport. (http://www.aopa.org/-/media/Files/AOPA/Home/Pilot-Resources/ASI/Safety-Advisors/sa15.pdf)

There are different technical solutions to avoid them, but none of them work with all other air traffic. The most comprehensive effort is being undertaken in the USA with the ADS-B OUT mandate in 2020.