FAI Navigation Expert Group

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The report below is the result of discussion within the FAI navigation expert group. Contributions were made by the following: Günther Bertram, Graham Brown, Heinrich Leuthold, Andreas Peus, Bernald Smith, Carl Stålberg, Ian Strachan, Chiel Wijnheijmer. Paragraphs are numbered for ease of future reference.

TASK 1. Avionics

Provide a report with recommended FAI guidelines regarding the different cockpit avionic systems (tools) for sports aircraft - such as navigation systems, airspace systems, collision warning systems etc. This report should include the main advantages and disadvantages of such equipment for the user/pilot in technology, ease of installations in small cockpits. It should also include evaluation of important operational aspects such as:

a. Userfriendly handling.
b. Operational values.
c. Ease of situation awareness.
d. Safety aspects

1.1 First, we should establish what we mean by "avionics" within FAI. The word literally means "aviation electronics", but within FAI the instrument fit of balloons and paragliders is quite different to that used in gliders and microlights, or aircraft which fly not only in VFR but under IFR and in controlled airspace.

1.2 In addition to instrument panels, pilots can carry handheld devices such as GPS, smart phones, blue-tooth head set, portable radios, and so forth. Tablet computers with touch screens can also be carried.

1.3 In many FAI aircraft, modern avionics have replaced the older generation of analogue aircraft instruments. Flight information is presented on flat screens and some aircraft have head-up displays (HUDs) like those in military fighter aircraft. The first electronic flight information systems (EFIS) for primary flight information appeared in the 1980s and were installed in new commercial aircraft and later also in general aviation (GA) aircraft. The introduction of EFIS has led to new approaches to training, crew coordination and the human-machine interface. On the negative side, there are examples of aircraft accidents where contributing factors include lack of understanding of the complexities of modern avionics.

1.4 Since the 1980s global navigation satellite navigation systems (GNSS) became available in the form of the US GPS system and Russia's GLONASS. In a few years there will be the European Galileo GNSS and in the 2020s China's Beidou 2 GNSS system. It is the US GPS system that is most used today.

1.5 The U.S. Federal Aviation Authority (FAA) is introducing its NextGen system which uses GPS-based ADS-B (Automatic Dependent Surveillance

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- Broadcast). Here, accurate GPS positions are reported by aircraft in the air. This will replace the system where Air Traffic ground stations and other aircraft obtain aircraft positions by interrogating a transponder in the aircraft. Over 700 ADS-B ground stations are already in place between the Gulf of Mexico, Continental USA (including Alaska) and Canada, and Australia has had ADS-B ATM at high altitudes for several years. By year 2020, all aircraft flying in Controlled Airspace in North America must have FAA-approved ADS-B equipment. Some believe that the nations of Europe and others must follow with GNSS-based ADS-B systems, although EASA's future SESAR system does not include an array of ADS-B ground stations in the same way as the FAA's NextGen. This is unfortunate for Sport Aircraft because it is probably easier and lower-cost to fit GPS-based ADS-B than Mode S transponders, particularly in Sport Aircraft without electrical generators such as Balloons, Gliders, Hang- and Para-Gliders.

1.6 The Air Sport community already benefits from GPS and many sport aircraft carry GPS receivers and cockpit map displays. As long ago as 1995 IGC formed a GPS Flight Recorder committee and photographic evidence is no longer used for certifying glider badge, record and competition flights.

1.7 Modern avionic instruments have lower maintenance costs and lower power demand compared to older electromechanical and vacuum driven systems. Other advantages are increased reliability, lower weight, and a smaller size. More user-friendly cockpit displays include moving map displays, and displays showing the locations of nearby aircraft. However, the potential of modern avionics to have many different modes of operation and display can make it difficult for amateur Sport Aviation pilots to fully understand the avionic system that they are using.

While airlines and other commercial air operators have standardized procedures and regular training to maintain crew performance, Air Sport and recreational pilots often have limited resources and time available to maintain their knowledge of complex electronic systems.

2. Devices for Proximity Warning.

2.1 The Swiss FLARM company (FLARM = Flight Alarm) developed a GPS-based system which transmits and receives GPS positions from other FLARM-equipped aircraft over a range of about 5 km, displaying the angle of nearby aircraft on a cockpit display. Audio warning is also included when a potential collision trajectory is calculated. It was originally designed as a proximity warning aid for gliders flying over areas such as the Alps, but is now in extensive use in the world gliding movement and in some other sport aircraft. It is understood that some logging industries in the Alps have agreed to install FLARM transmitters on obstacles such as winch towers that carry cables hazardous to aircraft.

2.2 The principle of the basic Swiss FLARM is similar to the air-to-air function of GPS-based ADS-B but with lower power, shorter range, and different frequencies. Some operators and aviation authorities have recognised the usefulness of FLARM and its operation in sport and other aircraft outside controlled airspace. However, it is not certificated (ETSO-approval in Europe, TSO-approval in the USA) for use in Controlled Airspace or by Commercial Air Transport or military aircraft, which require either transponder-based or GPS-based ADS-B for proximity warning systems to have Regulatory approval. A longer-range version called PowerFlarm, also made by the Swiss FLARM company is claimed to be compatible with transponders and ADS-B, but its certification status with Regulatory bodies such as EASA and the FAA is not known. Further investigation into low-cost ADS-B systems designed for light GA and Sport Aircraft is recommended.

3. Portable equipment

3.1 Portable equipment is becoming increasingly popular with sport pilots. This includes tablet computers, cell phones, stand-alone GPS units, etc. A tablet can have information such as flight manuals, instrument landing charts, airport charts, flight planning, NOTAMs, meteorological information etc. The information can be updated over an internet connection.

3.2 Aviation authorities generally allow the Operator to decide which equipment is suitable for use in the cockpit. For Air Sports it is up to the pilot to decide what is used in the cockpit, and pilots need to ensure that there is enough room, to reduce loose-article hazards, and how to use the equipment in flight.

3.3 It is more difficult to try out new software while flying, or to change settings of a portable GPS unit during flight (compared to a panel-mounted unit designed with good cockpit ergonomics in mind). Cell or mobile phones emit radio signals and can disturb other avionics and R/T communication unless they are turned off or set to flight mode.

4. Airworthiness and Certification

4.1 Airworthiness and aircraft certification procedures are designed to ensure safety. Aspects such as user-friendly handling, operating procedures, situation awareness, and safety generally, are often covered in aircraft certification documents. Installed equipment in commercial and military aircraft has to be certificated, normally having a Technical Standard Order (TSO) or equivalent, meaning that the equipment meets published standards. In GA and Sport Aircraft, equipment not considered vital to safety does not need to be certified by the Aviation Authority.

4.2 National airworthiness regulations depend on the category of aircraft. Commercial Air Transport (CAT) aircraft that carry the general public, are highly regulated. As are business jets and passenger-carrying helicopters. General Aviation (GA), particularly light and sport aircraft, is subject to less rigorous regulation. Finally, some experimental category and amateur-built aircraft are allowed to operate without the usual Full Airworthiness Certificate and have a special one known as either a Permit-to-Fly or Experimental Certificate.

5. Remotely Piloted Aircraft or UAVs.

*Task 2: Monitor the development of **„see and avoid“ co** ncept vs the UAS integration in civil airspace. Evaluate the threats to air sports and recreational aviation by the increase in the number of midsize UAS aircraft. Provide a report of how this issue is handled; include advice and recommendations as appropriate.*

5.1 The generic term is UAS (Unmanned Aerial System) and the air vehicle itself is a UAV (Unmanned Aerial Vehicle), sometimes loosely called a "Drone". Some UAS are pre-programmed and have no input by a remote pilot. A Remotely Piloted Aircraft System (RPAS) is a UAS where a remote pilot is controlling the UAV for all or most of the sortie. The remote pilot is generally at a ground station which for small RPAS can have a direct line-of-sight to the Vehicle. For large military RPAS, the ground station can be thousands of kilometres from the UAV itself, such as Creech AFB in Nevada for control of RPAS in Afghanistan, except for takeoff and landing which is controlled locally at the military base at Bagram. In some cases the UAV operator is in an aircraft such as the AWACS military surveillance platform.

5.2 UAS have evolved from small model aircraft with cameras and expendable target drones, to large long endurance surveillance platforms under abbreviations such as MALE (Medium Altitude Long Endurance) and HALE (High Altitude Long Endurance).

Some military UAVs are capable of launching weapons against ground targets. There are many small UAVs both fixed-wing and small helicopters with one or more rotors. Many are un-regulated which is proving a problem for Aviation Authorities.

5.3 From the view of air traffic control and management (ATC/ATM), there should be no difference between air traffic clearances for UAVs or a conventional aircraft, other than taking the performance category into account. The air traffic controller must also be able to issue clearance based on visual separation between RPAS and conventional aircraft, for example in the circuit of an airport.

5.4 EASA and other Authorities make a distinction between UAVs and model aircraft. The Model Aircraft category is solely for sport and recreational use (under the FAI Aeromodelling Commission), and a payload such as a camera should not be carried. If a payload is carried, the aviation authority will classify the vehicle as a UAV rather than a model aircraft, and UAV rules will apply. For instance, UAV operators are generally required by national aviation authorities to have a flight permit, which defines their operations. A key issue for UAV operation in non-segregated air space is anti-collision sensor technology (FLARM/ADS-B etc). Several programs are trying to resolve the problems of UAVs in ATM (controlled) air space, and even in Class G un-controlled airspace.

5.5 The European Defense Agency has a programme for UAVs called Mid Air Collision Avoidance System (MIDCAS). Currently, collision avoidance is handled by air traffic management, electronic collision avoidance systems, and the "see & avoid" capability of a human pilot. The MIDCAS goal is develop a similar capability for UAS. MIDCAS needs to: detect when the aircraft is the vicinity of a UAV; make the UAV/RPAS operator aware of other aircraft, and, if needed, automatically manoeuvre the UAV to a safe situation. Similar programs are ongoing in the United States and the administration has issued a bill to introduce RPAS in its national airspace by year 2016.

5.6 Most small UAVs fly at low altitude. Generally, unless the UAS operation has an ATM clearance, the UAV is only allowed to fly up to 100 or 120 metres AGL and within line-of-sight of a human operator. Also such operations must not be close to airfield circuit and other aircraft patterns. Legitimate operations of small UAVs with cameras include inspections of farmland for progress in crop growth, inspections of electricity pylons and high-voltage cables, inspections of other technical facilities, and so forth. However, there is much un-regulated and unofficial flying of small and very small UAVs by amateurs and members of the general public, some at heights well over 100 metres, and there have been legal prosecutions of such people in France, UK, and the USA. It is unlikely that the trend for flying small UAVs at low levels will decrease.

5.7 From an air sport view it is unlikely that safety threats from UAV operations will exceed the risks from conventional aviation, except perhaps in FAI activities close to the ground such as hang gliding and para gliding. It is difficult to know what action FAI could take other than promoting awareness, lookout, checking NOTAMs for UAS operations, and having good standards of airmanship.

Task 3. Tasks for NEG in 2015.

6.1 The issue of maintaining access to airspace for Sport Aircraft should be constantly monitored. The difficulty is the near-universal trend of aviation authorities to extend Controlled Airspace both in area and in the lowering of bases, particularly near airports. In some parts of the world the number of airports is increasing, for instance in the Middle and Far East, particularly China. Another factor for us is the

language issue, because ICAO rules mandate Air Traffic Controllers to use international aviation English, whereas many Sport pilots may speak only their national language.

6.2 Equipment such as mode-S transponders, radios with 8.33 kHz spacing, and GPS-based ADS-B are expensive to install. For instance, ADS-B installation is estimated at between 2500 – 3000 Euros. In addition there are electrical power supply problems in non-powered sport aircraft such as balloons, gliders, hang gliders. Some microlights also have limited electrical power. This situation should be studied from a Sport Aircraft viewpoint, for instance the PowerFlarm system mentioned earlier, also other systems that might be suitable such as by the Garmin company.
Low-cost systems are particularly important for the light GA and Air Sports sector, and battery-powered variants are needed for aircraft without electrical generators. It should be recognised that in many countries, more Sport Aircraft are registered than commercial and military aircraft, and Aviation Authorities should not impose rules appropriate to airliners on less complex aircraft flying outside Controller Airspace. There are some indications that EASA is starting to take this view, and Europe Airsports (EAS) has actively lobbied in this area. This situation should be monitored, as should what is happening with other Aviation Authorities.

6.3 Finally, we need to look at how Sport Aircraft gain access to airspace in different part of the world. For instance, are there good examples of cooperation between NACs and national authorities, for example setting up air sport sectors or temporary access to airspace and airfields for Competitions and Rallies? What are the possibilities for exemptions from installing expensive equipment?

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