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The Gliding Federation of Australia Inc.

Operations

Operational Safety Bulletin

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See-and-Avoid for Glider Pilots

Introduction

'See-and-avoid' is the primary means of collision avoidance in aviation and, at one time, was the only means for avoiding collision. Today, 'see-and-avoid' is complemented by technological advancements, the most common of which in gliding is radio and Flarm.

Unalerted see-and-avoid

Unalerted see-and-avoid relies totally on the pilot's lookout for aircraft separation. It is commonplace in gliding where the potential horizontal and vertical closure rates between aircraft are slow enough for human reaction. Nevertheless, while gliders generally have unhindered visibility in most directions where conflict is likely, there are still many blind arcs impeding the pilot's vision. Also, where traffic densities are high, the ability of pilots to identify and process all the traffic is diminished and the risk of collision becomes higher.

Therefore, technology such as radio and Flarm assist visual acquisition by alerting the pilot to other traffic. However, in spite of its limitations, unalerted see-and-avoid is still the primary defence against mid-air collisions, and for aircraft without a radio it is the only defence. Good airmanship therefore dictates that pilots should be looking out and not solely rely on the radio or Flarm for traffic separation. It is also worth noting that gliders can be difficult to spot when not in straight and level flight.

Alerted see-and-avoid

The primary tool of alerted see-and-avoid that is common across aviation is radio communication. A functioning radio enables pilots to communicate information to others that may be useful in building situational awareness.

Effective lookout

The primary method for implementing 'see-and-avoid" is lookout[1], which involves seeing potential hazards and assessing information prior to reacting. The primary source of information is vision. Whether it is aircraft attitude, position, physical hazards or other traffic, what a pilot sees is processed by the brain and used to build up situational awareness.

[1] Refer also to Operational Safety Bulletin OSB 02/12 - Lookout for Glider Pilots

Consequently, lookout is not just scanning the skies to locate other traffic, it also involves the internal and external environment of the aircraft. Vision is used inside an aircraft to interpret flight instruments, flight controls and aircraft systems, and externally to observe and interpret weather, terrain, aircraft attitude and position.

Seeing and interpreting

Traffic separation by radio

Not only is seeing important but being able to accurately interpret what is seen is equally vital. However, while it undoubtedly prevents many collisions, the principle is far from reliable[2]. Nevertheless, by employing an effective scanning technique and understanding how to enhance visual detection of other traffic, a pilot is more likely to reduce the likelihood of collision.

Accurate provision and interpretation of traffic information for the purposes of separation to or from another aircraft is an essential pilot skill. Some commonly used methods of providing and interpreting traffic information by radio communication for the purpose of airborne separation follow:

- ***Separation by 'clock code'***

  'Clock' terminology probably has its roots in the military, where a long-winded description of the direction of an enemy attack meant you'd probably be dead before you'd finished giving it. Using clock terminology is a quick way of describing the position of other aircraft relative to yours. Pilots maintain traffic separation by reference to the central axis and numbers of an analogue clock face. Particular care must be given to identifying which aircraft is the central axis of the clock. You are at **my** 2 o'clock and low has the opposite meaning to I am at **your** 2 o'clock and low. Many glider pilots use a variation on this, with reference to the other pilot's aircraft; e.g. I am behind and above **your** left wingtip. The weakness of this method of separation is that it requires at least one pilot to have seen, identified and made contact with the other aircraft.

- ***Separation by ground reference***

  Pilots can use the radio to maintain separation by either identifying that each is in different places relative to a ground feature, or by agreeing to remain on different sides of a readily identifiable ground feature such as a runway extended centreline, road, town or railway line. The advantage of this method of separation is that it does not require either aircraft to have actually seen each other (although this is desirable). The weakness of this method of separation is that ground features could be misidentified. The uncertainty or confusion can distract from the effort of retaining separation through see-and-avoid.

- ***Separation by altitude reference***

  Pilots can also use the radio to maintain separation by identifying that each is at a different altitude or by one aircraft descending/climbing to another level. Provided that both aircraft altimeters are set to the correct subscale reference (QNH) this method should provide separation for both aircraft regardless of visual contact.

- ***Separation by navigational or avionic reference***

  Pilots can also maintain separation by identifying that each is in a different place relative to a known navigational point or line (radial), or separated by distance from a fixed point (e.g. global positioning system or a radio navigation aid). This method of separation does not require either aircraft to have actually seen each other (although this is desirable). The

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2 ATSB Report Limitations of the See-and-Avoid Principle

weakness of this method of separation is that differing avionic equipment or pilot navigational skill can lead to incorrect assumptions being made about the usability of the separation information offered. Pilots who offer instrument flight rules reference points as separations to gliders, ultralights or small GA aircraft may not be offering information that is readily usable.

All separation by radio is subject to possible misinterpretation or filtering when a pilot is overloaded. Under conditions of excessive workload or stress, or excessive fixation on another sensory input, the overloaded pilot may not perceive nor comprehend audio inputs. They will often turn the volume down on their radio to reduce the sensory overload[3].

Alerted search

An alerted search is visual scanning when air traffic information has been provided and a pilot knows where to look. Outside controlled airspace, this information is provided by other pilots giving position reports. Flarm also aids in alerted search by notifying the pilot of the direction of a potential threat, thereby allowing them to ‘see’ other aircraft and take evasive action if necessary.

The effectiveness of a search for other traffic is eight times greater under alerted circumstances than when just unalerted [ATSB].

As threats are external to the aircraft, an effective lookout must be maintained. The pilot must:

- consistently look outside the aircraft;
- search the available visual field to detect threats that will probably appear in the peripheral vision;
- shift vision directly to the threat and, if identified as a collision risk, decide on what effective evasive action to take; and
- manoeuvre the aircraft to avoid collision or an airprox event.

It is important to realise that this process takes time; and human deficiencies can reduce the chances of a threat being detected and avoided. The factors affecting lookout may not be errors or poor airmanship, but limitations of the human visual and information processing systems which are present to various degrees in all humans.

There are two main elements to effective traffic avoidance. Firstly, to see an ‘object’, and secondly, to react appropriately to what has been seen. An object could range from looking like a speck in the windscreen that is actually an aircraft at long range, to a large feature. The next step would be to determine if the object is a threat, and then take avoiding action.

Situational awareness

Simply defined, situational awareness is knowing what is going on around you, and being able to predict what could happen. It is not just a theoretical notion and is pertinent to most accident or incident cases. It is real, and its absence causes accidents.

Monitoring and gathering information from both within the cockpit and outside the aircraft is required to build and maintain comprehensive situational awareness.

Situational Awareness is[4]:

- The perception of the elements in the environment within a volume of time and space
- The comprehension of their meaning
- The projection of their status in the near future.

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[3] ATSB
[4] Mica Endsley – 1988

This can be described in simple terms as[5]:

- What is happening now;
- What has happened recently; and
- What is expected to occur in the future.

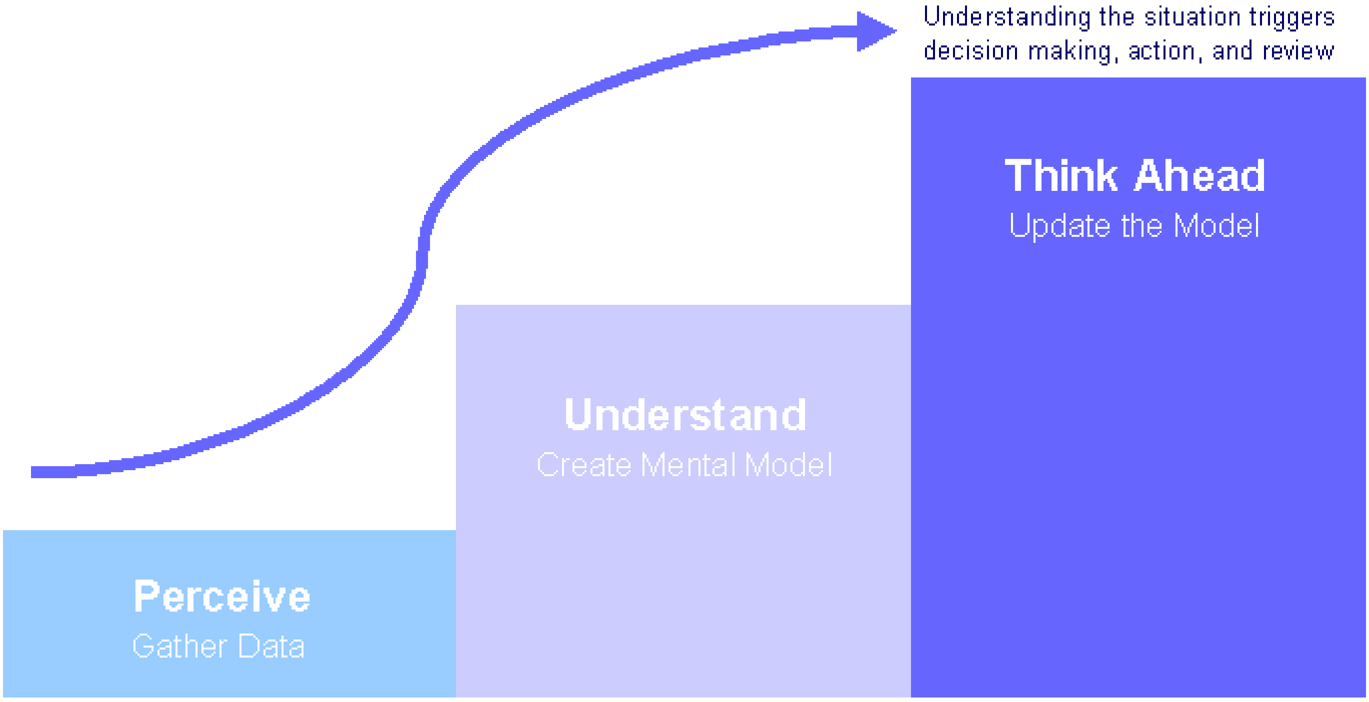
The main components of situational awareness are:

- Environmental Awareness: Awareness of other aircraft, communications between Air Traffic Control and other aircraft, weather or terrain.
- Mode Awareness: Awareness of aircraft configuration and flight modes. The latter includes such aspects as current speed, altitude, heading, and flight planning functions.
- Spatial Orientation: Awareness of geographical position and aircraft attitude.
- System Awareness: Awareness of status of aircraft systems.
- Time Horizon: Awareness of time management (e.g., fuel status / monitoring).

Gaining and Maintaining Situational Awareness

As shown below[6], situational awareness includes three processes:

- The perception of what is happening (Level 1)
- The understanding of what has been perceived (Level 2)
- The use of what is understood to think ahead (Level 3).



To build a mental model of the environment, it is necessary to gather sufficient and useful data by using our senses of vision, hearing and touch to scan the environment. We must direct our attention to the most important and relevant aspects of our surroundings and then compare what we sense with experience and knowledge in our memory.

It is an active process that requires significant discipline, as well as knowing what to look for, when to look for it and why.

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5 ATSB
6 Adapted from Endsley's definition.

Our understanding is built by combining observations from the real world with knowledge and experience recalled from memory. If we successfully match observations with knowledge and experience, we have developed an accurate mental model of our environment. This mental model has to be kept updated with inputs from the real world by paying attention to a wide range of information.

Our understanding enables us to think ahead and project the future state of our environment. This step is crucial in the pilot's decision making process and requires that our understanding, based on careful data gathering, is as accurate as possible. It simply is "Flying ahead of the aircraft".

Situational Awareness and Decision Making

Situational awareness is strongly related to the decision making process. Situational awareness must precede decision-making because the pilot has to perceive a situation in order to have a goal.

Our actions are driven by goals. To help us act to achieve our goals, we use our mental models to anticipate the outcome of our action. The more we anticipate accurately, the more efficient we become in our tasks, the more energy we save, and **the more we can preserve resources for unexpected situations**. Conversely, by comparing the results of our actions with set goals, we can modify our actions or, if necessary, our goals. This feedback is vital to the success of the process.

Feedback and anticipation help keep our mental picture of the world aligned with the real world.

A major loss of situational awareness occurs when inappropriate mental representations are activated in spite of real world evidence. People then act "in the wrong scene" and seek cues confirming their expectations, a behaviour known as confirmation bias.

In other words, situational awareness influences our decision making and allows us to stay ahead of the aircraft:

- It helps us develop a mental picture of the world around us and use that mental picture to anticipate the future, to feed-forward
- Because of the close coupling of real-world feedback, mental anticipation and adaptation of actions, we adjust our mental picture and modify our actions. If what we expect to happen and what is really happening does not coincide, we may even adjust our goals. This is often coupled with a feeling that we have lost "control".

Losing Situational Awareness

Many factors can cause a loss of situational awareness. Errors can occur at each level of the process previously described. The following table lists a non-exhaustive series of factors related to loss of situational awareness and conditions contributing to these errors.

Level 1: Perception
• Data is not observed, either because it is difficult to observe or because the observer's scanning is deficient due to: o Tunnel vision (or cognitive tunnelling) o Passive, complacent behaviour o High workload o Distractions and interruptions • Visual Illusions E.g. Focusing on the landing area and not monitoring airspeed.

Level 2: Understanding
• Use of a poor or incomplete mental model due to: o Deficient observations (Level 1 problem) o Poor knowledge / experience. • Use of a wrong or inappropriate mental model. • Confirmation bias: perceived information is misunderstood. Expecting to observe something and focusing our attention on this belief can cause seeing what you expect rather than what is actually happening. E.g. Retracting undercarriage during downwind by not realising it was already down. • Failure to integrate information
Level 3: Thinking Ahead
• Over-reliance on the mental model and failing to recognise that the mental model needs to change. E.g. Expecting an approach on a particular runway only to realise operations have changed to another runway.

Situational awareness is essential for flight safety and its influence and impact are pervasive. It is gained by using the senses to scan the environment and compare the results with mental models. Inattention, distraction and high workload threatens situational awareness.

To prevent the loss of situational awareness, implement proven best practices: sterile cockpit, standard radio calls, proper instrument and external scans, and strictly follow GFA Rules and Regulations.

Interaction with other aircraft at, or in the vicinity of, a non-controlled aerodrome

Rules of the air regarding right of way and rules for prevention of collisions should always be respected [CARs 161 and 162]. Pilots of powered aircraft should not normally seek right of way from non-powered aircraft, although the offer of right of way may come if conditions are favourable.

So as not to impede commercial aviation, pilots flying recreational or sport aircraft for their own enjoyment, or pilots flying GA aircraft for their own leisure, should consider giving way to aircraft being used for ‘commerce’ provided that the inconvenience to their own operation is not great and it can be done safely. Operators of commercial flights should never expect a give way offer to be assumed or automatic. Any offer to give way must be explicit and its acceptance acknowledged. Glider pilots may consider using spatial and time separation techniques to reduce potential for impediments to commercial operators.

Although the conduct of a non-standard circuit join (such as conducting a modified circuit or straight-in approach[7]) may have operational advantages, pilots should be aware that any variations to the recommended circuit join may carry increased collision risks. When varying any standard procedure, it is essential that situational awareness is assessed and maintained, and appropriate radio calls made.

Pilots should be mindful that transmission of information by radio does not guarantee receipt and complete understanding of that information. Misunderstanding of radio calls, over-transmissions, or poor language/phraseology will undermine the value of the information being transmitted. High standards of radio use and discipline on CTAF frequencies by all operators, glider pilots inclusive, are therefore important to achieving safe and hassle-free operations.

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[7] CAAP 166-1 provides more details on straight-in approaches and joining the circuit on the base leg.

Without understanding and confirmation of the transmitted information, the potential for alerted see-and-avoid is reduced to the less safe situation of unalerted see-and-avoid.

There are also practical limits on how much voice traffic a VHF-band frequency can efficiently carry. Excessively long radio broadcasts or broadcasts that do not add value to situational awareness have the potential to block transmissions being made by other pilots. Radio communications should be to the point, clear, accurate, and necessary. An unnecessary radio transmission that over-transmits another transmission is as hazardous as making no transmission at all.

Note: Airband radio is an aid to alerted see-and-avoid. This aid is compromised by pilots using the radio for personal chatter.

Under no circumstances should a pilot attempt to direct other traffic. Direction of air traffic (as opposed to alerting, requesting or advising) is an Air Traffic Control function and should not be performed by pilots in flight or on the ground. Pilots who seek to direct other pilots as a pseudo-air traffic controller, either innocently or to obtain expedited traffic movement, are acting beyond common courtesy and are potentially operating outside the law. Such actions may expose pilots to liability if their direction results in an accident.

Summary

Pilots are expected to operate in a courteous and professional manner at all times. Aviation safety relies upon a cooperative approach between all pilots, particularly on and in the vicinity of aerodromes in times of busy traffic.

So give yourself the best chance to find traffic targets by spending more time looking outside than gazing at the instrument panel, and ACTIVELY listen to radio calls and respond when necessary.

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