SCRSP/WGA

WPA/8-07

REVISED

2 June 2005

SURVEILLANCE & CONFLICT RESOLUTION SYSTEMS PANEL

AIRBORNE COLLISION AVOIDANCE SYSTEMS

WORKING GROUP A

(Surfers Paradise, June 2005)

Standards for traffic displays that include ACAS tracks

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SUMMARY

It is proposed that WGA adopt draft standards for displays that include ACAS tracks. Standards proposed now would act as a straw man, and focus debate on those aspects of combined displays that are of potential concern from an ACAS perspective. There is plenty of time between now and SCRSP/2 for validation, and for all parties to consider the standards we propose. Furthermore, it is a good time to do this, before ACAS hybrid surveillance MOPS and SC186 CDTI MOPS, which could be reaching maturity, are finalised.

1 Introduction

1.1 It is proposed that WGA adopt draft standards for displays that include ACAS tracks. Standards proposed now would act as a straw man, and focus debate on those aspects of combined displays that are of potential concern from an ACAS perspective.

1.2 There is plenty of time between now and SCRSP/2 for validation, and for all parties to consider the standards we propose. Furthermore, it is a good time to do this, before ACAS hybrid surveillance MOPS and SC186 CDTI MOPS, which could be reaching maturity, are finalised.

1.3 It is understood that the SC147 an SC186 groups that are developing MOPS for traffic displays could have different views from those adopted by WGA. If that proves to be the case, it is as well to force the debate before the MOPS are finalised, and while there is plenty of time to reach consensus before SCRSP/2. This implies that it is part of this proposal that any draft standards agreed now are subject to change in the light of arguments, facts and research presented.

1.4 Knowing the points made in 1.3, the author has not sought to hide his preferences. The draft standards proposed in the next section reflect his current opinions. His objective is to provide a target for people to shoot at.

1.5 The author has not considered the relationship between these proposed standards and those for hybrid surveillance. No comment on the standards for hybrid surveillance is intended. Certainly, a decision that it is not necessary to actively interrogate an intruder so as to form an ACAS track is very different from a decision that an ASAS track and an ACAS track are for the same aircraft so that (according to the standards that follow) the ACAS track would not need to be displayed.

1.6 This paper uses the language “ASAS tracks”. This is intended to convey aircraft tracks displayed on a traffic display and derived from any and all sources other than ACAS, although it is imagined that the principle source will be ADS-B. No comment is intended on whether or not these data should be fused, or compared, or anything. Nor is this paper regarded as an opportunity to discuss whether or not ACAS data should be used in any way to form the ASAS tracks; SCRSP has views on that issue, but they are not expressed nor implied here.

1.7 The paper refers to “ASAS applications”. For the purposes of this paper, these are authorised uses by flight crew of the information presented on the traffic displays other than the ACAS tracks. The only authorised uses of the ACAS track data are collision avoidance, as an aid to visual acquisition and situational awareness. (ICAO does not know about the ITC.)

2 Proposed standards

2.1 The proposals are made at two levels, simultaneously. For each main point, there is first proposed text for SARPs, and then proposed text for a Manual. “Notes” are potential notes for either document. “Comments” explain reasons for the precise proposals; they are not intended to be permanent.

2.2 All the material is presented for discussion, to reach consensus before MOPS are finalised and SARPs recommended, probably at SCRSP/2.

Proposed international standards for traffic displays that include ACAS tracks

This material is presented for discussion, to reach consensus before MOPS are finalised and SARPs recommended. It does not represent the final view of SCRSP WGA.

1 Requirement for one track per aircraft

SARPs

S1 Only one track shall be displayed for each distinct aircraft.

S1.1 Where there are data from two (or more) sources that cannot be positively identified as relating to a single aircraft nor positively identified as relating to two (or more) aircraft, flight crew shall be alerted to this fact.

Comments

C1.1 The requirement for only one track is for simplicity. Any concern that this might conceal the presence of a second aircraft should be addressed by S1.1, and M1.1 and M1.2 below. On the other hand, any concerns at the potential difficulty caused by displaying two symbols when the system can't decide are acknowledged, and could justify the development of further Manual material. Operational procedures and training are not under discussion here.

Manual

M1.1 ASAS and ACAS tracks shall be tested to determine whether they relate to common aircraft.

M1.2 An ASAS track and an ACAS track shall be considered to relate to the same aircraft if it can be determined that the probability that they do not do so is less than 1 in 10^7.

M1.3 An ASAS track and an ACAS track shall be considered to relate to different aircraft if it can be determined that the probability that they do not do so is less than 1 in 10^3.

M1.4 Where an ASAS and an ACAS track might or might not relate to the same aircraft, both tracks shall be displayed, together with a clear indication that they potentially relate to the same aircraft.

M1.5 Note: Information that can be used to test the probability that an ASAS and an ACAS track relate to the same aircraft includes the following:

a) for Mode S equipped intruders, the aircraft address;

   Note: Unfortunately, duplicated aircraft addresses have been observed and there are circumstances in which aircraft address can change in flight.

b) the 3D positions of the candidate intruders and potentially their 3D velocities;

c) the time evolution of the two tracks.

Comments

C1.2 The figure 1 in 10^7 in M1.2 was chosen on the basis that flight crew should not suffer the concealment of ACAS track, because it is mistakenly diagnosed as the same aircraft as an ASAS track, more frequently than once in 10^5 flying hours. To complete the calculation, it was assumed that up to 100 ACAS tracks per hour might be displayed to flight crew.

The figure 1 in 10^3 in M1.3 was chosen on the basis that showing pilots two tracks for the same aircraft raises issues of credibility and operational acceptability. It is supposed that flight crew could see it happen once a day.

2 Choice of track

SARPs

S2 Where there is an ASAS track and an ACAS track that have been determined to relate to the same aircraft, the ASAS track shall be displayed.

Comment

C2.1 This is to minimise the risk that the flight crew will manoeuvre on the basis of an ACAS track, contrary to the requirement that ACAS be a measure of last resort independent of separation provision. It also means that the better track will be displayed.

C2.2 It could be argued (it has been) that the ACAS track should be displayed for an RA. The treatment of RAs is discussed in section 4 below. At present, that discussion is consistent with S2, and it is currently unnecessary to add a redundant clause such as “subject to the provisions of S4” to S2.

3 TAs

SARPs

S3 An ACAS TA shall be indicated on the traffic display by modifying the symbol showing the ASAS track.

S3.1 Symbols representing other aircraft shall not be removed from the traffic display when there is a TA.

S3.2 Note: The purpose of the ACAS TA traffic display is to aid visual acquisition. Flight crew need a full picture, so far as is consistent with simplicity, so that they do not mistake a benign intruder for the potential threat.

Comment

C3.1 S3 is not intended to imply any particular manner of modification; it does not mean the shape must change (although it might). It is expected that the colour will change to yellow.

C3.2 It has always been considered important to inform flight crew of other aircraft that they might see and mistake for the potential threat, and this is why S3.1 is stated as a standard. Of course, if the aircraft is outside visual range and the needs of an ASAS application indicate that it should be removed, it is not intended that S3.1 means it should stay.

Manual

M3.1 Any ASAS application in progress at the time of a TA should continue.

M3.2 Note: The treatment of other information currently presented on the traffic display at the time of the TA can be determined according to the needs of any ASAS application in progress at the time and the need for simplicity. Heading information in particular can be a valuable aid to visual acquisition, but it could also increase the risk that flight crew will be enticed by the TA to manoeuvre inappropriately.

Comment

C3.3 SCRSP is not certain that there is a continuing need for ACAS TAs. Both version 7 and the advent of ADS-B has changed the circumstances since TCAS was first introduced, and the design compromises made when TCAS was first built might no longer be appropriate. Where there is an on-board ASAS, that might well provide a similar function but in a way that is better suited to the operations envisaged. SCRSP has always taken the view that it is the RAs that provide the collision avoidance function.

4 RAs

SARPs

S4 An ACAS RA shall be indicated on the traffic display by modifying the symbol showing the ASAS track.

S4.1 Subject to the absence of other alerts that are determined to have greater priority than an ACAS RA, the traffic display shall be consistent with the need to ensure that the first priority of flight crew is to follow the RA.

S4.2 Any ASAS application in progress at the time of an RA shall be aborted unless it has been previously determined that it is consistent with the imperative to follow ACAS RAs promptly.

Comment

C4.1 It has been argued that the occurrence of an RA calls the ASAS track into question. However, it must be remembered that the ACAS track and the ASAS track should be in very similar positions, because they have been determined to relate to the same aircraft with a high degree of confidence. (See section 1.) That leaves the possibility that there is an error in the correlation. Well, it does, but this is far from the most plausible reason for their being an RA, and this should probably be taken as reason for making sure that the software is sound and the level of confidence defined in M1.2 sufficiently demanding.

Manual

M4.1 All information that might distract the flight crew from compliance with the RA shall be removed from the traffic display.

Comment

C4.2 The design of ASAS applications needs to consider emergencies and contingencies, which should include ACAS RAs.