AVOIDING THE CONFLICT

By Anne Isaacs and Victoria Brooks

Anne's early experience in ATM and airline operation was followed by six years with the Human Factors team at EUROCONTROL where she was associated with the development of tools and techniques to help identify human error and risky performance in the ATM environment, as well as developing the Team Resource Management (TRM) concept for European ATM. Anne now heads a team in Human Factors integration within the Division of Safety in NATS, UK.

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It would seem strange to an outsider that ANSPs spend an enormous amount of time and resources on selecting and training professionals to separate aircraft, only to have increasing numbers of incidents which involve STCA and TCAS intervention. This is not unique to Europe and it is almost impossible to calculate how many conflicts are not resolved in a timely manner, but the estimate is somewhere in the region of 10 for every 100,000 movements. This is exactly why the air traffic control system finds it so difficult to implement further safety strategies and often struggles to find the balance between safety and service. If controllers got it wrong more often we would be in a better position to implement more robust safety nets.

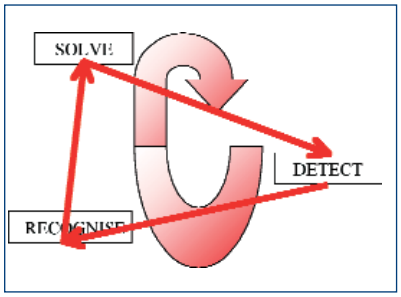
But why do controllers get it wrong at all? The answer in some part lies in the often difficult balance between conflict resolution and conflict avoidance.

- Conflict resolution, which is the most obvious skill of controllers, is demonstrated when measures are taken in order to prevent the further development of a conflict situation.

- Conflict avoidance, is used to prevent the situation in the first place by using proactive control actions such as heading or level assignments.

When analysing these two strategies it is easy to recognise how complex avoiding the conflict can be.

Conflict resolution can be described simply as a three-stage activity, although at each stage there are several things that may go wrong.



Conflict resolution firstly relies on detection, which means the controller must know what to look at and for, when to look and actively 'see' what is being searched. Here we have the first problem, since incident statistics demonstrate that one of the reasons for the highest number of errors in ATC incidents is to 'not see' the information at all. There are many reasons for this:

- Firstly if the technology does not display the relevant information in an intuitive way, controllers may fail to scan the most relevant data.

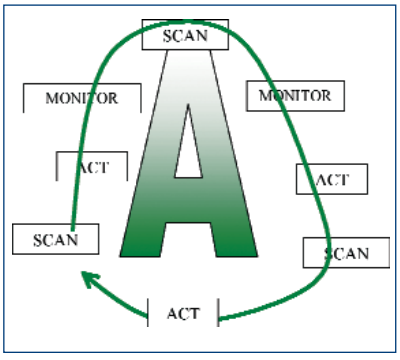
- Secondly, controllers may fail to recognise the important information.

- If the relevant information is detected the controller then needs to recognise it as a problem or risk.

The main problem with these activities for experienced controllers is the issue of time, often requiring tasks to be prioritised. High workload also increases the risk of reacting to situations instead of anticipating them.

The existence of monitoring aids and conflict-detection tools such as medium-term conflict detection (MTCD) also invite controllers to not actively scan for conflicts but depend on the tools to warn them. Even safety nets such as short-term conflict alert (STCA) may have this effect, which should be prevented.

Conflict avoidance, on the other hand, is potentially a more robust technique; however it does require the controller to control defensively and proactively, that is to set up the traffic in such a way that should a plan fail, separation would be maintained. This technique is illustrated in the following figure.

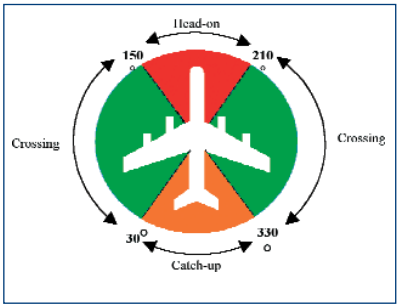


Comparing this with the conflict resolution model, it can be seen that controllers would be expected to invest more time in monitoring the situation, which of course means a trade-off with other activities or in some cases deferring other activities until the original task is complete. However if a clear set of roles and responsibilities is given and practiced by the controlling team, the investment would ultimately mean less risky and more proactive controlling.

One challenging factor is the year-on-year increase of traffic. It is not surprising that this increase in demand decreases the possibilities of using conflict avoidance techniques. Another area that hampers the use of conflict avoidance is the complexity of airspace, one of the leading contextual factors in ATM incidents. This is a highly challenging area to tackle and demands highly collaborative decision-making, learned over a lengthy period of time.

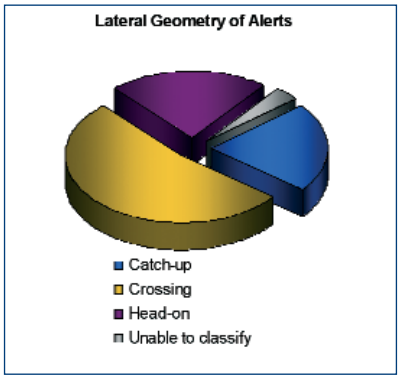
So what do we know about conflict resolution at the moment? Recent work with regard to STCA has revealed some interesting trends, although how robust these are and how they can be generalised is too early yet to assess. The analysis described here is taken from a small sample of STCA alerts in one area of our airspace, and focuses on the geometry of encounters.

The analysis of STCA alerts requires the lateral and vertical geometries to be defined. The lateral geometry in this work is based on the relative heading of two aircraft; the alert is then classified as head-on, crossing or catch-up as the following diagram indicates.

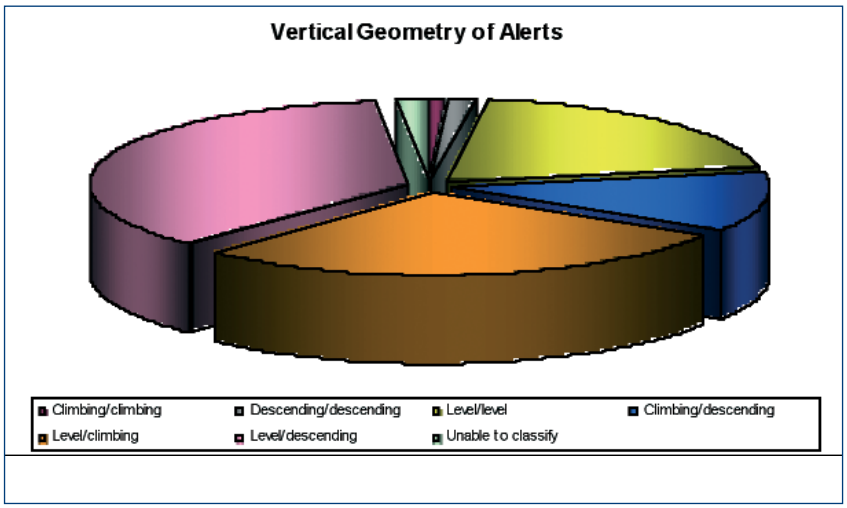


The vertical geometry is based on the altitude change over the last five radar cycles before an alert. The geometry of each aircraft is then classified as climbing, descending or level.

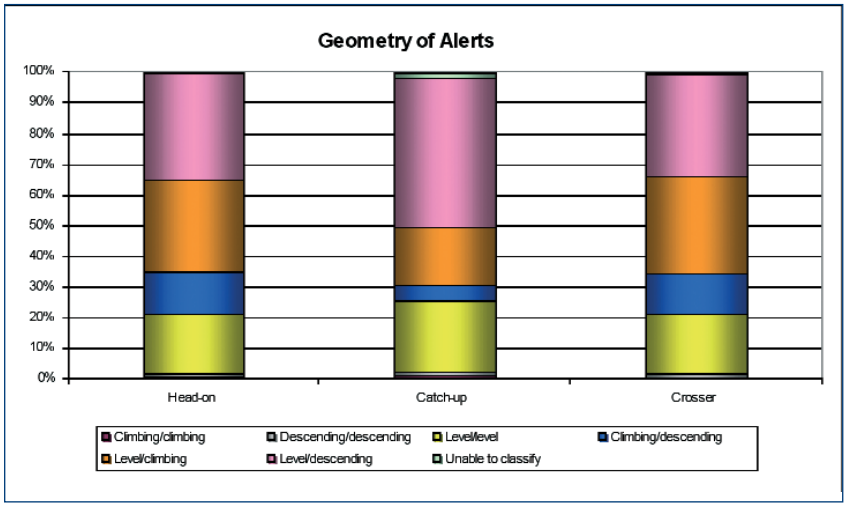
In terms of the lateral geometries of the alerts studied, 55% were crossing, 22% were catch-up and 23% were head-on.



In terms of the vertical geometries of the alerts; 65% of encounters were where one aircraft was level and the other was either climbing or descending.



Combining the lateral and vertical geometries of the alerts shows that approximately 80% of crossing encounters involved one or both aircraft that were climbing or descending.



The above figure illustrates the findings of these geometries.

The version of STCA used in this study uses a two-stage alert, changing from white to red. It is assumed that in the first stage of the alert, white, controllers will acknowledge the alert and act to resolve the potential conflict as required; indeed 97% of alerts that were white remained white until they were resolved. A small percentage of alerts went straight to red, which meant there was little pre-warning; possibly the result of a 'pop-up', for example, either a fast moving military encounter, an encounter with a sudden change in lateral or vertical geometry, or an airspace infringement. And the remainder of the alerts began white before becoming red.

It is difficult to make any substantial claims from one set of data, but further analysis will add to the understanding of what controllers do, particularly when the alert goes white and what, if anything, changes their strategy when the alert becomes red.

If we return to the original discussion of conflict resolution versus conflict avoidance, it would seem that developing techniques to allow controllers to exploit conflict avoidance strategies within their time constraints would be a more proactive approach to ATM safety. How we do this, of course, is another story - watch this space!