Experimental testing of 3D display techniques in ATC training

Problem outline

Air traffic control is an information management problem based within a 4D space. Aircraft can be considered in terms of trajectories through this space and the ATCO’s job is, conceptually simple: to identify when two of those trajectories will intersect in 4D space and modify the trajectories to prevent this from happening within some finite tolerance specified by the effective ATC safety regulations.

In practice humans are quite bad at making such predictions and are hindered by the need to construct a complex internal 3D model of the airspace based on the 2D radar display and altitude and direction information with which they are provided in the standard ATC workstation. This need to hold a lot of information in their head restricts the number of flights each ATCO can manage simultaneously, and so constrains the aircraft density which can be supported.

It is hoped that 3D representations, supplemented by additional orientation cues, will reduce the need for the ATCO to hold so much information in their head, reducing the load and enabling them to manage more aircraft with no reduction in safety.

Experimental goals

To compare the 2D and 3D approaches we have conducted a series of trials with ATCO trainees, using 2D and 3D representations in a pair of comparable scenarios to determine what differences are seen between the two displays. Trainees are used for this experiment as they have less experience and have formed less of the practical ‘tricks’ which more experienced ATCOs use to help them manage the flights. In this way we hope to determine real results measuring the performance of the displays for the ATCO.

The experiment has been carried out using a two strand crossover approach to eliminate learning effects between the two scenarios and to avoid any discrepancies between the two scenarios. 9 student trainees took part in the experiment at the Eurocontrol training centre in Luxembourg.

Several possible goals are being examined:

1. To identify any differences in the way the controllers resolve the conflicts which are designed into the scenarios. Do they resolve the conflicts in the same way, with the same solutions applied at the same time?

2. Do they apply more three-dimensional changes, adjusting rates of climb or descent, when using the 3D display rather than the 2D?

3. Are any safety issues involved? Are there more close passes or less in 3D compared with 2D?

The results of the experiments are currently being analysed and results will appear in a paper to be presented at the ICAS conference, in Nice during September 2010.

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