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Papers & Analysis

Air traffic demand is anticipated to grow substantially in the coming decades. This increase can only be achieved if the capacity for managing much higher traffic densities than today can be provided.

During the Separation session, topics such as ground-based automated separation assurance, how changes in contributing factors could affect current standards, estimation of separation buffers for wind-prediction, and a new wake turbulence re-categorization were presented as contributing factors focused on increasing today's capacity.

During the first presentation entitled: Initial Evaluation of NextGen Air/Ground Operations with Ground-Based Automated Separation Assurance (paper 138, presented by Thomas Prevot, NASA Ames), controller workload associated with providing safe separation was considered as the main factor limiting en route capacity. For this reason, a ground-based automated separation assurance system was simulated with human controllers and pilots. For the Next Generation Air Transportation System (NextGen), it is envisioned that trajectory-based operations will replace clearance-based operations in many parts of the airspace. New automated separation assurance functions are intended to help overcome the aforementioned limitations of controllers in manually maintaining safe separation between aircraft. At twice today's traffic demand, more than 99% of the conflicts were solved in the simulation, with 95% of the up-linked trajectory resolutions deemed acceptable by the flight crews.

Certain parts of the separation assurance automation are ready to be tested in an operational context. The concept of automated tactical conflict resolutions appears appropriate. However, the automated resolutions must account for an execution delay as high as 20 seconds and should provide a conflict free manoeuvre over that period. The predictability and stability of the algorithm's manoeuvre selection should also be improved. These modifications to the automation are underway, partly based on the feedback gathered from the study.

Research needs to continue focusing on short-term conflict prevention and human/automation interaction in conflict resolution, in particular for near-term conflicts. Finally, it should be noted that the comprehensive problem of coordination and cooperation was not addressed between controllers, traffic managers, airline operators, and other stakeholders within and across facilities. The concept needs to be evaluated in a larger multi-operator environment, and integrated with arrival and departure management, to start addressing some of the larger coordination issues that need to be investigated before implementation.

Wind-prediction errors affect the performance of trajectory prediction tools and ground based conflict probes. While the accuracy of wind field forecasts has improved in recent years and has proven satisfactory for most applications, it is known that occasional large errors can occur with a potentially unacceptable impact to safety critical applications. For this reason, the paper Estimation of Separation Buffers for Wind Prediction Error in an Airborne Separation Assistance System (paper 148, presented by Maria Consiglio, NASA Langley) presented a study whose objective was to measure the magnitude of the separation violations to determine the appropriate separation distance required to preserve safe separation. Until now, safety evaluations of separation assurance applications have, for the most part, been based on studies using simulation tools that seldom include models of system uncertainties and often make simplifying assumptions such as perfect navigation performance and absence of prediction errors or off-nominal conditions. This research will continue with the testing and validation of the estimated buffers in upcoming safety evaluation experiments.

The presentation Separation Minima Model (paper 94, presented by Allan Ross Groskreutz, Aena) focused on the potential impact that technological advancements could have on separation minima that were defined decades ago. The RESET project created a single source for locating separations minima standards from various regulating bodies and developed a model that allows quick comparative analysis to understand what effect changes in contributing factors would have on Separation Minima before investing in a safety case. The separation minima list is ready to be used on the RESET website (http://reset.aena.es). The model is currently limited to the horizontal plane, and it needs to be extended to the vertical dimension.

Since the existing separation standards based on wake turbulence are significantly different between the US and ICAO, the last paper, Progress on Joint FAA/Eurocontrol Effort to Develop an ICAO Wake

<u>Turbulence Re-Categorization (paper 158, presented by Jeffrey Tittsworth, FAA; Catalin Lepatadu, EUROCONTROL and Don Delis, NorthWest Research associates)</u> described a joint methodology for developing and evaluating new candidate wake turbulence categories. Separation standards and air-traffic-control procedures have been designed for the worst-case conditions within a specific category based on aircraft weight. In the last decade, wake vortex studies have been performed, which have greatly increased the knowledge of wake vortex evolution. This new knowledge was applied to the proposed methodology for developing new wake turbulence categories and associated separation minima.

The re-categorization effort is on-going and the next steps will be: complete the analysis for all 60+ aircraft, perform all trade-off analyses for multiple wake encounter models, perform a trade off analysis for multiple decay models, develop the business case for the resulting proposed recommendations to ICAO, evaluate existing controller decision support tools for suitability in supporting implementation of the recommendations to ICAO and complete the safety cases. This re-categorization will pave the way to NextGen and SESAR common objectives which is dynamic pair-wise separation supported by trajectory based operations.

General Aspects

The Separation session had one European, two US and one joint paper. The overall quality of papers and presentations was satisfactory. Participants were proactive. Many questions were addressed to the speakers and interesting debates were held.

It is interesting to note that NextGen and SESAR are paving the way to develop a common US and European approach to solve air-traffic-management problems. This was reflected during the presentation where the obtained results were applicable to both US and Europe. The average audience size was estimated to be 40 participants. Several presentations agreed that, in order to reach NextGen and SESAR objectives, reducing separation minima would help.

High-level Recommendations

Two papers had a strong link with SESAR. The Reduced Separation Minima (RESET) effort is a project of Seventh Framework Programme pointed out by the SESAR Joint Undertaking as SESAR alignment. The separation minima presentation summarised the main results of RESET project. The last paper (n° 158) proposed an intermediate state in wake vortex separation between the current situation and the final goals of NextGen and SESAR.

Future increases in traffic demand will require capacity enhancements and infrastructure improvements worldwide. There is a need for an immediate assessment of those enhancements that could be applied in a harmonised, safe and cost-effective manner.

NextGen and SESAR will ensure safety through use of technology and procedures while satisfying necessary separation constraints so as to optimise capacity.

Under the Separation theme of this Seminar, the following questions were addressed:

- How could ground-based separation automation manage the trajectories for all aircraft at 2x and 3x densities without controller involvement?

- How can we reduce the impact of wind prediction errors in automated separation assistance tools?

- What potential impact could technological advancements have on separation minima, which were defined decades ago?

- How can new Wake Turbulence Re-Categorization harmonise separation standards?

Some important stakeholders were missing in the seminar, such as airlines and airports. Moreover, from a conceptual point of view, there is an important convergence between NextGen and SESAR, but the divergence can be placed with the technical implementation of the solution (e.g., data link). For this reason the participation of industry is more than desirable.