Advanced Noise Abatement Approach Activities at a Regional UK Airport

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Advanced noise abatement procedures incorporating Continuous Descent Approach, Precision Area Navigation and Low Power/Low Drag elements have been developed for a regional UK airport in partnership between academia and key stakeholders. The procedures were designed for a wide variety of aircraft types and equipages using a combination of advanced academic research tools, industry simulators and stakeholder input. Interactions between airspace constraints and procedure design were found to be critical. Flight trials of the procedures have demonstrated significant environmental benefits compared with non-trial flights: 3–6 dBA peak noise reductions and 10–20% fuel burn/carbon dioxide emissions reductions have been observed. However, the importance of aircraft automation level, air traffic control coordination and the need for effective environmental performance metrics have been highlighted.

Incremental, Probabilistic Decision Making for En Route Traffic Management

Craig Wanke and Daniel Greenbaum

En route airspace congestion, often due to convective weather, causes system-wide delays and disruption in the US National Airspace System (NAS). Present-day methods for managing congestion are mostly manual, based on uncertain forecasts of weather and traffic demand, and often involve rerouting or delaying entire flows of aircraft. An incremental decisionmaking approach is proposed, in which prediction uncertainty is explicitly used to develop effective and efficient congestion resolution actions. The incremental approach makes explicit use of the fact that future adjustments to the plan can be made, and thus some or all congestion resolution activity can be delayed until more information is gained. Decisions are made based on a quantitative evaluation of the expected delay cost distribution, and resolution actions are targeted at specific flights, rather than flows. A massively-parallel simulation of the proposed method has been developed, and results for an operational-scale congestion problem are presented. The best approach for this problem was to solve part of the congestion 90 minutes before problem onset, and to solve the rest 30 minutes prior. More problem types will be addressed in future work.

Prediction of Operational Failure States at Airports by Means of Stochastic Transition Matrices

Daniel Schaad

Airports are complex multivariate systems where a large number of interdependent parameters contribute to the overall operational performance. Consisting of many structurally different subsystems, airports tend to lack functional transparency and thereby impede proper situational awareness for operational management. This is specifically critical in conditions where system malfunctions cause operational irregularities which require ad-hoc recovery action.

Transition matrices are a mathematical description of dynamic changes between system states. They can be generated from a given set of state observations to reflect the dynamic behavior of complex multivariate systems. In connection with airside process monitoring initiatives as part of the Collaborative Decision Making concept, transition matrices can provide decision support to assess and predict critical failure states at airports. A decision support tool based on transition matrices may then be embedded into other applications used for the operational management at airports.

The transition matrix methodology has been described and applied to several test scenarios in order to demonstrate the matrix learning effect and its derived forecasting capability.
New Air Traffic Management Concepts Analysis Methodology: Application to a Multi-Sector Planner in US Airspace

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Several developments in the technologies supporting air traffic management (ATM) such as digital communication and improved positioning accuracy for aircraft, have enabled consideration of new organizational and functional operations. In order that these new organizational and functional operations be properly evaluated, efficient and effective methods need to be developed in support of systematic analysis of the new ways of managing air traffic. This paper provides such an evaluation method using Cognitive Systems Engineering (CSE) and discusses its application to new controller-team processes. One such consideration of a new controller-team process is a modification of the standard air traffic control team to include a multi-sector planner (MSP) position. This MSP is being investigated in several research and field studies both in Europe and in the US. The feasibility and effectiveness of two of these concept variations were investigated in the current study. The experiment consisted of a pair of one-week human-in-the-loop studies in which the two concepts (Multi-D, in which multiple R-sides are supported by a single D side; and Area Flow, in which the MSP manages flow through their target sector by coordinating with adjacent MSPs) were tested separately with two different five-person teams. A baseline condition that assumed traditional radar-data roles but with access to advanced decision support tools was also run. Overall, the data suggest feasibility of both variations in the MSP, and workload was manageable for both MSP operations. However, Area Flow operations were found to be more compatible with advanced air traffic operations concepts and were shown to be more acceptable to the controllers (both Radar and Data functions).