Air traffic conflict resolution optimization methods including time conformance objectives

Background

The future European Air Traffic Management (ATM) system is expected to use 4D trajectory management concepts respecting airspace user’s individual business cases. Trajectory based operations will have a significant impact on Air Traffic Control (ATC) and particularly on the methods used for conflict management. The objective will be to shift from tactical intervention towards strategic de-confliction by redistribution of tasks between ATM partners and by improved system automation support. Nevertheless there will still be a need for tactical conflict resolution to manage conflicts due to errors and delays or other unpredictable events. It will be necessary however to adopt conflict resolution techniques and procedures that will seek to minimize their impact on flight conformance to the planned 4D trajectories.

ATC Conflict Resolution with time conformance objectives

A key assumption of the future ATM system is that aircraft will fly along planned 3D routes and respect the time schedule (including target times for departure, fly-overs for specified waypoints, sector and FIR entries and exits, and arrival) specified in their flight plan. At tactical level ATC must facilitate the execution of the plan while ensuring that separation constraints are respected. Flight plans will not be guaranteed to be conflict free and some variance relative to time schedule can always occur due to unforeseen circumstances (e.g. airport congestion, weather, previous conflicts, etc).

ATC (or in self separation mode, flight crew) can resolve conflicts at tactical level through speed constraints and vertical or lateral path extensions, however any such resolution manœuvres may impact the time schedule of the aircraft concerned and may cause further conflicts in downstream sectors.

Research Issues to be addressed

- Identify and evaluate optimization methods applicable to air traffic conflict resolution in order to meet time related objectives while satisfying current and future safe separation constraints in ECAC. Departure, en route, and arrival phases of flight must be considered. Conflict resolution optimization may be considered under either ATC or self separation modes of operation.
- Compare candidate methods concerning critical aspects such as efficiency, resilience, safety and indeed their limitations.
- Assess their feasibility as a means of generating conflict resolution advisories to sector tactical and planning controllers.
- Identify their equipage requirements concerning aircraft and ATC infrastructure.
- Evaluate promising optimization methods in more detail in order to verify their safety and feasibility for supporting SESAR operational concepts (in particular 4D trajectory management) and quantify, through modeling, their potential impact on ATC performance notably air traffic predictability, efficiency, capacity, and complexity. These more detailed evaluations will focus on busy ECAC airspaces and consider traffic growth to 2020+.
- Identify and make contacts with research teams working on relevant optimisation methods notably from the domains of Control Theory, Stochastic Processes, Queuing Theory, Gaming Theory and Clusters-Distributed Processing.
The EEC ATC Research Area

The successful candidate will work alongside the performance assessment cell of the ATC Research Area (ATC RA) team. The ATC RA carries out research and development into all aspects of air traffic control which involve controller-centred sector-level operations contributing to the validation and implementation of SESAR, the future ATM system for Europe.

ATC RA is involved in concept clarification, execution of experiments and studies, and the study of transition and implementation issues to generate data in support of:

- Proof of usability and operational coherence. These are key issues since all systems developed by ATC will remain human-centred, with the controller and pilot as key actors.
- Business Case development. ATC will provide data to indicate where benefits may be expected, and their magnitude.
- Standardisation and regulation processes. With greater emphasis on air-ground co-operation and coherent system-wide solutions, an end-to-end understanding of operations and interdependencies is increasingly important.
- Safety assessments. Data will feed development of safety cases and hazard assessments and support the evaluation of risk levels.
- Overall implementation decisions, which should be based on a combination of the above elements.

References


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