PROJECT

iFly

Safety, Complexity and Responsibility Based Design and Validation of Highly Automated Air Traffic Management

**Funding:** European (6th RTD Framework Programme)

**Duration:** May 2007 - Aug 2010

**Status:** Complete with results

**Total project cost:** €5,245,900

**EU contribution:** €3,309,000

**Call for proposal:** FP6-2005-TREN-4-AERO

**CORDIS RCN:** 85665

**Background & policy context:**

One of the most innovative and promising paradigms in Air Traffic Management (ATM) is to transfer the responsibility of maintaining separation with other aircraft from sector air traffic controllers to the pilots of each aircraft. In short, such a complete transfer of separation responsibility is referred to as airborne self separation. Since the invention of Free Flight in 1995, airborne self separation research has seen a tremendous development worldwide.

Nevertheless, the current situation is of two schools of researchers holding different beliefs about airborne self separation:

- One school believes airborne self separation can be performed at sufficiently safe levels en-route and at traffic levels well above the current situation;
- The other school believes airborne self separation cannot be carried out at sufficiently safe levels above Europe.

In order to resolve this tie in beliefs held by two schools of researchers, iFly has first developed an advanced airborne self separation Concept of Operation for en route traffic, aimed to manage a three to six times increase in current en route traffic demand than high traffic demand in 2005. Subsequently iFly assessed this advanced concept of operations on safety and economy under three to six times the en route traffic demand over Europe in 2005.

**Objectives:**

For en route traffic, iFly has the objective to develop both an advanced airborne self separation design and a highly automated ATM design for en route traffic, which takes advantage of autonomous aircraft operation capabilities and which is aimed at managing a three to six times increase in current en route traffic levels. This incorporates analysis of safety, complexity and pilot/controller responsibilities and assessment of ground and airborne system requirements and which make part of an overall validation plan. The proposed iFly research combines expertise in air transport human factors, safety and economics with analytical and Monte Carlo simulation methodologies providing for 'implementation' decision making, standardisation and regulatory frameworks. The research is aimed at supporting SESAR and actively disseminates the results among the ATM research community.

**Methodology:**

iFly has performed two operational concept design cycles and an assessment cycle.

During the first design cycle, an Autonomous Aircraft Advanced (A3) en-route operational concept has been developed which is based on the current 'state-of-the-art' in aeronautics research. An important starting and reference point for this A3 ConOps development was formed by a systematic analysis of human responsibilities under current ATM and under airborne self separation.
During the assessment cycle, the A3 ConOps has been evaluated on cost-benefit and on safety as function of very high traffic demand.

During the second design cycle, the A3 ConOps was refined by taking advantage of iFly studies on:

- Advanced conflict detection and resolution algorithms.
- Managing Multi-Agent Situation Awareness (SA).
- Prediction of complexity of air traffic situations.

**Parent Programmes:**
**FP6-AERO-1.4 - Increasing Operational Capacity and Safety of the Air Transport System**

**Institute type:** Public institution  
**Institute name:** European Commission  
**Funding type:** Public (EU)

**Lead Organisation:**

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Key Results:

The achievements of the iFly project are twofold:

- Airborne Self Separation achievements
- Generic achievements

The airborne self separation achievements are as follows:

1. The A3 ConOps has been developed for enroute traffic which goes beyond the limits posed by the airborne self separation concepts in literature.
2. Study of the conflict detection and resolution problems of the A3 ConOps can be managed using algorithms that have modest computational requirements.
3. Study of shared situation awareness issues has stimulated the development of mitigating measures for some safety critical conditions.
4. Through conducting large scale rare event MC simulations for a model of this A3 ConOps it has been shown that it can safely accommodate 3x the 2005 European traffic demand.
5. Through conducting a cost-benefit analysis it has been shown that the introduction of this A3 ConOps is economically sound.
6. A vision has been developed how A3 equipped aircraft fit best within the SESAR thinking regarding future ATM.
7. By conducting an early cycle through the EUROCAE ED78A method, for this A3 ConOps preliminary safety and performance requirements have been derived on the applicable functional elements of the concept.
8. A human factors study has been performed, which has identified the principles for advanced cockpit design in A3 equipped aircraft.
9. Novel directions for traffic flow control in support of the A3 ConOps have been identified.

In addition to this the iFly project also had various more generic achievements:

1. Further extension of a powerful method in compositional modelling and analysis of complex socio-technical systems.
2. Development and initial performance evaluation of three novel complexity metrics for advanced ATM.
3. Development of four novel medium and short term conflict resolution algorithms some of which can guarantee conflict free resolutions.
4. Development of powerful extensions of the rare event Monte Carlo simulation method IPS.
5. An inventory of options for the possible refinement of the A3 ConOps.

All these achievements have been documented well. Moreover a steady stream of research papers has been produced in support of disseminating these achievements (available on the

Documents:

- iFly Publishable Final Activity Report (Final report)

STRIA Roadmaps:
Cooperative, connected and automated transport, Network and traffic management systems

Transport mode: Air transport

Transport sectors: Passenger transport, Freight transport

Transport policies: Digitalisation, Safety/Security, Societal/Economic issues
Geo-spatial type: Other