Report on the 7th EUROCONTROL Innovative Workshop held at Eurocontrol Experimental Centre, Brétigny sur Orge, France, December 2008

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Abstract: The 7th EUROCONTROL Innovative Workshop on Air Traffic Management was held December 2nd – 4th 2008 at the Eurocontrol Experimental Centre, Brétigny-sur-Orge, France. This event gathered 250 scientists and innovators from throughout Europe and over 40 technical papers were presented together with several exhibits and posters in a dedicated exhibition area.

This paper briefly introduces some highlights from the workshop, and should be read alongside the associated PowerPoint presentations slides.

Full details are available on the website [1] that contains all papers and presentations from the workshop.

Keywords: ATM, air traffic management, innovation, environment, ASAS, communication, human-machine interaction

1. INTRODUCTION

This is a report from the 7th EUROCONTROL Innovative Research Workshop held at Brétigny-sur-Orge, France 2nd – 4th December 2008. Over 40 technical papers were presented covering a wide range of subject matter related to air traffic management. The workshop provided an ideal environment for contributors ranging from first-time doctoral students to researchers with many years of experience.

The workshop was organised as a single main session running through the three days plus three parallel tracks (one per day). The parallel tracks were: Constraint Programming, Future Communications and the CATS project [2]. Alongside the workshop were a number of live presentations and posters in a dedicated exhibition area.

The remainder of this paper, and the accompanying PowerPoint presentation, highlight some novel and promising subject matter from the workshop. The material here represents only a small portion of the totality, and the website should be consulted for full details of these and all the other topics [1].

2. SOME HIGHLIGHTED TOPICS

2.1 Machine interaction, collaboration and automation

Two papers are highlighted here that proposed innovative methods of visualisation and interaction for air traffic controllers.

Middlesex University's Interaction Design Centre is investigating a number of novel spatial and temporal display issues that arise from emerging operational concepts [3]. In particular they looked at representations to support visualisation and management of aircraft energy (potential/kinetic). Energy management is highly topical and is relevant to all phases of flight - this paper took particular interest in preparation for optimal descent profiles.

More generally, Middlesex developed 3D controller displays that encapsulate important invariant functions, rather then working with traditional perspective views. The new displays are capable of encoding factors that influence the physics of the flight such as energy and probability.

The work on visualisation and image manipulation is particularly evocative and also accessible since it was done using readily available interaction systems, such as Wii controllers and spatial pointing devices.

A consortium comprising Intuilab, Intactile Design, ENAC and Thales proposed new interaction devices and processes to support collaborative working and air traffic problem solving in the MAMMI project [4]. They took a broad view of man-machine interaction with key design objectives of: flexible workflow, creation of shared situational awareness and less specialisation in ATCO roles. After reviewing the required principles of collaboration, the consortium developed completely new human-machine interfaces.

Collaboration is a key theme within SESAR, and MAMMI's collaborative concept was built around the traditional roles of multi/meta sector planners and tactical controllers. The roles were, however, somewhat generalised into a 'dispatcher' (someone with global awareness and responsibility for task allocation) and an 'expert' (broadly responsible for solving the situation). The essential object of the collaboration was SESAR's reference business trajectory.

Physically, the MAMMI workspace was made up of a large vertical display, visible from all points in the operations room, a large interactive horizontal display table mainly for use by the dispatcher plus mobile interactive surfaces for use by the experts. Scenarios tested included flight deviations, conflicts, emergency situations and weather avoidance.

2.2 Airborne self-separation

Much has been done in recent years to research increasingly air-centric air traffic control, with airborne capabilities ranging from simple traffic situation awareness through to full autonomous airborne operations. iFly is the latest European project to build upon previous research, and it reported to the workshop on two important areas: avionics and safety.

The avionics aspect of iFly is assured by Honeywell, who described their proposal for an integrated airborne architecture [5]. This comprises three major components:

- Information management that processes data from sensors (surveillance, weather), communications interfaces and the new SWIM interface, and also monitors aircraft conformance.
- Trajectory synthesis and management including conflict detection and resolution. Conflict detection is done for the short- mid- and long-terms and resolution for short- and mid-terms.
- Human-machine interface to assure situational awareness and optimised degrees of automation and information.

As regards safety, a separate iFly paper [6] described a recent modelling exercise conducted by NLR that evaluated uncoordinated autonomous self-separation for high density operations using the TOPAZ[1] tool. Whereas uncoordinated separation actions, using only state-based information exchange, can be safe and effective in low density airspace, this study showed that in higher density airspace the requisite level of safety cannot be achieved. In other words, when traffic densities become higher it is necessary to have some degree of intent and/or coordinated or arbitrated actions.

A third topic that is important when considering ASAS[2] applications is that of authority. Specifically, when ground ATC delegates responsibility wholly or partly, who has the power to act and who is legally accountable – and these are not necessarily the same actor. A report from a group involving Eurisco, LORIA and Dassault Aviation [7] described a new socio-cognitive modelling approach and applied it to an ASAS sequencing and merging problem. Their model:

- Allows precise understanding of a multi-agent system in terms of structures and functions on both a local and a global level, especially the dynamic aspect of authority sharing.
- Supports iterative concept analysis, prototyping, and evaluation as the corner stone of the process between scenarios and simulations.
- Enables collaboration between users from different work domains and disciplines with different objectives.

The model allows different options to be systematically compared either in advance of more detailed study via, say, human in the loop simulations, or as an interpretive analysis tool applied after simulations.

[1] Traffic Organisation and Perturbation AnalyZer – a tool developed by NLR

[2] ASAS: Airborne Separation Assistance Systems

2.3 Economics and environment

The University of Westminster reported its work on dynamic cost indexing [8]. ATFM delays in Europe are estimated to cost €1.3bn per annum. Westminster has developed costing principles and algorithms that enable airlines' cost of delays to be calculated with a view to judging the value of tactical airborne recovery strategies. This provides a view of delay that is an evolution and improvement on one that is based on time alone. The following parameters are taken into account in the cost calculation:

- Costs of compensating passengers including soft consequences.
- Crew costs (using several operating models).
- Marginal maintenance costs.
- Reactionary effects (rotational and non-rotational).
- Impact of emission charging schemes (fuel burn to catch up, altitude profile for NOx).

Market-based mechanisms are being increasingly proposed as solutions not just to environmental challenges, but also to congestion. The SESAR concept proposes a UDPP (User-Driven Prioritisation Process) that, in case of exceptional capacity shortfall, places the burden on airspace users to collaborate and agree a scheme to best match demand to available capacity.

A PhD student from the University of Trieste has developed an algorithm of the kind that could support this collaboration process [9]. It is based on a relatively straightforward auctioning principle, where an initial value is assigned to resources (slots) as a function of their scarcity, and airlines then bid for them at the market price or accept a delay. Iteration then occurs with prices increased for over-demanded slots and reduced for empty ones.

Environment is fast becoming the major consideration for air transportation and ATM, and some of the potential consequences of climate change were addressed in the workshop.

Convective weather is becoming increasingly significant in Europe, possibly as a result of climate change. It is in any case already a major cause of delays in the US, and new algorithms for tracking and modelling convective weather systems [10][11] were presented. These are timely because the dynamic skeleton modelling techniques deliver objects that encode severe weather in a way that appears tailor-made for use in trajectory-based concepts such as those proposed by SESAR and NextGen.

There was a novel paper on the estimation of dust-mass ingestion by aero-engines [12]. Dust is a significant contributor to engine wear and maintenance costs, and there could be significantly increased amounts in the atmosphere if climate change increases the size and configuration of deserts on the surface of the earth.

2.4 Future communications

A special session was dedicated to future communications strategies. Much of the work reported was the result of coordinated actions between Europe and the US, who have presented a joint position paper to the 11th ICAO ANC.

It is not be possible to go into detail in this short paper but attention is drawn to studies in three essential areas:

- For continental datalink an L-band solution that does not cause interference with existing users of the band is being investigated. Two solutions are being studied [13][14] and an early decision as to which will be the system of choice is expected.
- There is a high level of agreement that WiMAX will form the basis of the next generation surface (airport) datalink [15] with implementation expected within a few years.
- ESA[3] brought a progress report on the IRIS project [16] that is designing the next generation satellite communications system to meet ATM requirements, taking into account both performance and cost. Current satcom systems are unusable and will in any case no longer be serviceable after 2020.

3. SUMMARY

This short paper has summarised some highlights from the 7th Innovative Research Workshop on Air Traffic Management that took place at EEC in December 2008. It should be read alongside the associated PowerPoint presentation.

[3] European Space Agency

Many other subjects were presented in areas such as airport operations, collaborative planning, flow management, safety and constraint programming. All proceedings and presentations are available online at the workshop website.

REFERENCES

Note: All references have a publication date of December 2008, and are available on the website [1]

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[10] F. Barbaresco, "Dynamic Rain Cloud Tracking/Forecasting by Radar Image Processing Based on Mathematical Morphology & Graph Matching Techniques: Weather Hazard Mitigation for Air Traffic Control & 4D Trajectory".

[11] C. Costes, R. Garello, G. Mercier, J-P. Artis & N. Bon, "Convective Clouds Modelling and Tracking by an Airborne Radar".

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[13] M. Schnell, "L-DACS 1 Development – Status and Preliminary Specification" (presentation only)

[14] L. Deneufchatel, "L-DACS 2 Development – Status and Preliminary Specification" (presentation only)

[15] A. Barba, "Airport Datalink based on WiMAX Technology" (presentation only)

[16] F. Ongaro, "Satellite Communication for ATM, the IRIS Project" (presentation only).

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