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Papers & Analysis

Paper 67: SmartNodes – Towards supporting time-critical decision making in aviation security. presented by Alex Tarter, Communication & Integrated Systems

Describes a method for early identification of alerts for security incident management. This paper describes the use of “Fuzzy logic” inputs from a series of SmartNodes for large, dynamic and diverse data sets (behaviour of aircraft systems, human operators etc.) in order to detect trends that could imply security issues. The paper appears comparable with studies in the US, and could form the basis of an implementable system. However, validation of such an approach using real data will be very difficult – security events are rare, and false alerts and conclusions from assimilated data must be minimised. Security-related requirements for SWIM were described, and these might be useful immediately. There was no clear indication as to whether the selected optimisation techniques were the best ones for the job.

Analysis: This paper applies known techniques to the security domain. However, it does go beyond the normal research by tying several concepts together to employ a decision support system. It is also innovative in that papers on security are rare: there is little evidence of much work being done on the subject. In particular it was, perhaps not surprisingly, unclear what is going on in the US in this area, so comparison of Europe-US work is difficult.

Paper 15: Regional GDP – extending ground delay programs to regional airport systems, presented by Yu Zhang, University of South Florida

The paper proposes to modify the application of ground delay programs as used in the U.S. to exploit neighbouring airports when the original planned destination has reduced availability. Broad and unverified assumptions are made with regard to the capability of regional ground infrastructure to support such a concept; the paper also considers potential passenger acceptance levels. Prime example of where the concept could be applied is the San Francisco Bay area (fog at SFO, but OAK and SJC remain available) but it was otherwise unclear how many other opportunities might exist. Nevertheless, there seems little reason in principle why the concept should not work assuming the business arguments prove positive.

Analysis: The ideas in the paper link to ‘metroplex’ concepts that form part of NextGen (collaborative resource allocation in metroplex areas). In its basic form the approach is not directly usable in Europe (no ground delay program) but some ideas might be applicable e.g. in London or Paris metropolis’s, particularly since ground infrastructure, e.g. rail, is sometimes better developed. This particular study is new, but does follow previous work on metroplex areas and regional GDPs, and the limited work that has been completed on intermodality.

Paper 59: Near-term terminal area automation for arrival coordination, presented by Jeffrey Shepley, Mitre

This reports on a controller tool to facilitate arrival sequencing where P-RNAV procedures are being used. The work has been going for a few years, and it is to be installed in two tracons for live trialling later this year.

Analysis: This is a controller tool that is apparently nearing the end of its research phase, so it’s not really a future, innovative capability (maybe it was placed here in the absence of a ‘controller tools’ track). During questions, and by lack of references in the paper itself, it was not clear that related studies, particularly those in Europe (point-merge, ASAS S&M, SARA ...) had been considered. This illustrates that, even for near-term capabilities, coordination with other on-going work, including future concepts must be encouraged.

Paper 110: Evaluation of triple closely-spaced parallel runway procedures for off-nominal case, presented by Savita Verma, NASA Ames

Closely spaced two-runway operations have been widely investigated, and triple parallel runway operations are common in the US, but this is the first time that these two aspects are combined into one study. The emphasis of the work was safety: hazards due to wake and aircraft drift were introduced, and a detailed examination of the effect of applying breakout procedures was carried out. In this respect it was principally a cockpit-based exercise, with ground procedures ‘hard-coded’ into the experiment.

Analysis: This is new work. No closely-spaced triple runway configurations exist anywhere, so the study serves as a first look at issues that might arise should planners decide that this is an option when considering airport expansion (e.g. by paving between). The application itself is probably not directly usable in Europe, but the approach and methodologies may be re-usable.

Paper 52: Ant colony optimisation for air traffic conflict resolution, presented by Nicolas Durand, DSN

The authors of this paper have been researching global conflict resolution algorithms for some years. Previous techniques have included neural networks, simulated annealing and various integer and mixed programming techniques, but the key difficulty is always the combinatorial explosion leading to intractability with even quite small numbers of aircraft. This research applies an evolutionary algorithm that mimics the behaviour of ants leaving their colony and seeking food, and with the application of certain heuristics partly solves the size problem. A 30-aircraft solution is presented.

Analysis: This research is highly innovative and, for that reason alone, is to be commended. Its nature means that there is much scope for further work to improve the algorithms and apply them to more realistic air traffic data, and to define operational applications (strategic and/or tactical) for its use. The paper would have benefited from providing some initial estimates of computer resource and performance requirements.

Paper 146: ERASMUS strategic conflict detection to benefit SESAR, presented by Fabrice Drogou, EUROCONTROL

The ERASMUS project uses small, automatic speed adjustments, supposedly imperceptible to controllers (subliminal), to solve conflicts around 20 minutes ahead. It is reportedly able to solve 80% of conflicts in this way. The technique is highly dependent on longitudinal prediction accuracy but in this respect feedback loops, incorporating the FMS, are built into the system. A comprehensive set of validation metrics were described including: TP precision; efficiency (tool performance); workload; capacity; situation awareness; controller acceptance; traffic complexity and safety.

Analysis: A few years ago ERASMUS presented some innovations, particularly with its notions of subliminal control. Today the initial investigation is complete and the results will be picked up by the SESAR programme for further validation. This was a joint Europe-US presentation with Honeywell providing the avionics expertise. ERASMUS was presented in Barcelona, also in the 'innovation' track. The relatively weak list of references in the paper itself made it unclear as to whether the considerable body of prior research in this area, e.g. by the FAA and NASA, had been considered. Future work might consider issues such as applicability to mixed equipage environments and failure conditions related to autonomous automation.

General Aspects

No. of US/European/mixed papers: 3/2/1.

Overall quality of presentations: Good.

Other observations: 20 minute discussion period was filled for each presentation.

Average number of participants: 50.

High-level Recommendations

The title of this track was 'innovation', but it seems that some of the papers were included here because there was no other place for them. In particular two of the papers (59 and 146) presented controller support tools that have already passed through the early stages of validation and are approaching live trials.

Paper 67 presented a new approach to identifying potential security threats - was this the first ever paper on security to be presented at one of these seminars? This would suggest that either levels of funding and interest for security research are low, or maybe that the work is not widely publicised due to its sensitive nature. [Note: Several other security related papers were submitted but apparently did not pass acceptance criteria.]

Recommendation: Given the critical nature of security in NextGen and SESAR, try to understand why more papers were not accepted, and encourage stronger submissions for future seminars.

Only three papers in the track presented innovative research with potential for application in the long-term, and this indicates a worrying trend that is reinforced by current tendencies in both SESAR and

NextGen, namely a shift towards near-termism. This is difficult to criticise per se: the ATM community has for some years been demanding that research output be transformed into practical application. However, if by the same token this means substantially diminishing investment in long-term and innovative research, then this would be a grave mistake.

A rapid survey of the seminars leading up to Napa reinforces this concern. Recently we have seen an increasing number of papers that emphasise metrics, data collection and analysis (for example in tracks on performance and environment that did not exist three seminars ago). On the other hand there are far fewer papers on new controller methods and paradigm-shifting research (for example, we no longer have tracks on air-ground integration, ASAS and controller tools, with implementation perspectives of 10 – 15 years. Note also that it's almost 10 years since Napoli!). If, and here we might be optimistic, the work presented in these sessions at previous seminars has now moved on out of the research sphere towards implementation, where is the new research that addresses the *next* timeframe? Recent JPDO documents have shown that the average innovation cycle, that is, the time from naissance of an idea to its implementation, is 18 years. At Napa we should have been exposed to new ideas, with an implementation perspective of 2027 (already after the nominal SESAR and NextGen timeframes). They were not evident.

Recommendation: Whereas the need for tangible short-and mid-term improvement is recognised, the ATM community should be alert to the danger of reducing funding for long-term and innovative research - this seminar provides some evidence that this is already happening.