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Liability and Regulation

Design According to Liabilities: ACAS X and the Treatment of ADS-B Position Data
Hanna Schebesta and Giuseppe Contissa, European University Institute

This paper presents the results of the test application of the Legal Case on ACAS X, the new generation airborne collision avoidance system. The Legal Case is the novel methodology, recently developed by the ALIAS project, to address liability of innovative systems for aviation and ATM. The Legal Case application on ACAS X was conducted in cooperation with EUROCONTROL; IATA, air companies and industries. Results are meant to inform ACAS X’s future development.

ACCHANGE: Lessons Learned and Way Forward
Eef Delhaye, Transport & Mobility Leuven

This paper presents an overview of the main lessons learned during the ACCHANGE project1. We have structured the discussion along a number of institutional elements which we consider key for understanding and boosting change in the Air Traffic Management (ATM) sector. These are: collaboration, regulation and liberalization.

Towards a Performance Based Regulation for the Integration of Drones in the Civil Aviation System
Francis Schubert, skyguide

The proliferation of drones will fundamentally change the face of aerial activities. This development need not, however, been perceived as a threat to civil aviation but as a unique opportunity to implement in practice the still relatively abstract concept of a performance based regulatory approach. The main argument developed in this paper is that, in a performance based model, technology should and can be used as a substitute for hard regulation. Further the exploding drones sector offers the welcomed opportunity to develop and validate innovative air navigation solutions that can later be exported into the airspace open to civil aviation with the promise of a massive improvement of the performance of the legacy ANS system.

Human Factors

An Empirical Investigation into Three Underlying Factors Affecting Automation Acceptance
Carl Westin, CHPR

The MUFASA project showed benefits to controller acceptance and performance of a conflict detection and resolution decision-aiding system, when suggested resolution advisories were conformal with the controller’s own way of solving the conflict. Building on these results, this study investigated why controllers sometimes rejected their own previous solutions, when they (mistakenly) believed these came from automation. Three factors were independently investigated together with strategic conformance: problem-solving consistency, source bias, and interface representation. Fourteen controllers participated in a series of realtime simulations. While the impact of source and representation effects were small in simulations, questionnaire responses indicated that controllers perceived a human source favorably over automation, and thought the information richer triangle representation facilitated a better understanding of why the automation suggested a certain conflict solution. The degree of consistency varied among participants, and four different patterns of problem-solving consistency were observed.
The Sixth Sense of an Air Traffic Controller
Eva Eggeling, Fraunhofer Austria and Theodor Zeh, Frequentis

The project Sixth Sense postulates that the user’s body language is different at “good” and “bad” decisions. Therefore, in Sixth Sense we are looking for patterns or hidden data signs that allow us to detect moments of bad and good decisions that could be incorporated in an automated system in order to detect and predict the next actions of a user. In our case it is an Air Traffic Controller (ATCO). Specifically we intend to analyse the correlation of the change of the behaviour of an ATCO - expressed through his body language - with the quality of the decisions he is making. For that, an experiment was set up, data about the user behaviour was collected, explored and analysed. Results of our work may be used for an early warning for “bad” situations about to occur or decision aids for the ATCO.

Skill, Rule and Knowledge - based Behaviour Detection by Means of ATCOs’ Brain Activity
Gianluca Borghini, Sapienza University of Rome and Stefano Bonelli, Deep Blue

The aim of this work was to test a neuro-physiological methodology able to discriminate the Skill (S), Rule (R) and Knowledge (K) cognitive control levels by the analysis of the Air- Traffic-Controllers’ brain activity. Specific events have been designed associated with S, R and K behaviors and then integrated into realistic Air Traffic Management (ATM) simulations. A machine-learning algorithm has been used to differentiate the three different levels of cognitive control by using brain features extracted from the EEG rhythms of different brain areas, that is, the frontal theta and the parietal alpha activities. Twelve professional Air-Traffic-Controllers (ATCOs) from the Ecole Nationale de l’Aviation Civile (ENAC) of Toulouse (France) have been involved in the study. The results showed that the algorithm was able to differentiate with a high discrimination accuracy (AUC > 0.7) the three S-R-K cognitive behaviors during simulated air-traffic scenarios in ecological ATM environment.

Delays

Delay Assignment Optimization Strategies at Pre-Tactical and Tactical Levels
Luis Delgado, University of Westminster

This paper compares different optimization strategies for the minimization of flight and passenger delays at two levels: pre-tactical, with on-ground delay at origin, and tactical, with airborne delay close to the destination airport. The optimization model is based on the ground holding problem and uses various cost functions. The scenario considered takes place in a busy European airport and includes realistic values of traffic. Uncertainty is introduced in the model for the passenger allocation, minimum time required for turnaround, tactical uncertainty. Performance of the various optimization processes is presented and compared to ratio by schedule results.

TREE Model: A Tool to Explore Delay Reduction Scenarios in the ECAC Area
Carla Ciruelos Pardo, ISDEFE

Flight delays have important costs to airlines and impose a important strain on the network management. Such delays have usually their origins in primary events localized in limited areas of the network, but they can later multiply and magnify as the daily operations go along. In previous works, we have introduced a data-driven (TREE) model to simulate the propagation of delays in the network. The model predictions have been validated against empirical flight performance data. In this work, we use the TREE model to assess the effect on delay reduction in the network of two policies: dropping passenger connections if the delay goes beyond a given threshold or decreasing...
the service time of aircraft in the airports if they delay is larger than a given value. Our results show that there may exist optimal values of and for which the delay avoided is as large as possible while maintaining the cost in terms of connections dropped or interventions needed under control.

Controller Time and Delay Costs - a Trade-off Analysis
Luis Delgado, University of Westminster

Staff shortages remain a significant challenge in European ATM. Comparing different rules, we quantify the cost effectiveness of adding controller hours to Area Control Centre regulations to avert the delay impact on airlines. Typically, it is justified adding the controller hours. Distributions of delay duration and aircraft weight play an important role in determining the total cost of a regulation. Errors are likely to be incurred when analysing performance based on average delay values, particular at the disaggregate level.

HMI and Decision Support Tools

Human-automation Collaboration Strategies
Jonas Lundberg, Linköping University

This study describes human-automation collaboration strategies for detection and monitoring of conflicts in air traffic. Automation is represented by two medium term conflict detection tools in Air Traffic Management: the Conflict and Risk Display (CARD) and the Flight Leg Tool (FLEG). Qualitative and quantitative results from a field experiment during competence assurance are reported. A quantitative analysis based on eye tracking was conducted to examine the extent of visual attention to the tools. The qualitative analysis describes patterns of human-automation collaboration, of visual scan and tool usage. Implications of the human-automation collaboration strategies are discussed.

Self-Managing Conflict Resolution for Autonomous Taxiing Tugs: An Initial Survey
Zarrin Chua, ISAE-Supaero

Local conflict resolution, or designating priority to one vehicle over another, is a critical task necessary for managing safe and efficient airport ground movements. Air traffic controllers use a variety of information cues to inform this decision. New technologies such as autonomous taxiing tugs will likely be introduced to the ground operations problem in order to minimize aircraft fuel consumption. The introduction of such vehicles will create situations that have never been seen before, such as conflicts between two autonomous tugs. This research aims to solicit feedback from air traffic controllers on the decision cue strategy for prioritizing between two tugs. An online study featuring 73 different types of scenarios based on five different decision cues was designed. Seventeen participants from Europe and North America reporting evaluating one cue at a time until a decision was made. Results showed that participants typically always chose the tug that was closest to the intersection. If both tugs were of equal distance form the intersection, then participants would likely prioritize the tug with a trailing aircraft over a single tug. If this cue did not discriminate, then the tug that was closest to its parking destination was favored over that which was farther away. However, the order of these cues is not universal and as such, future work should continue investigating this strategy and other decision strategies. Furthermore, future research should account for participants’ origins, as slight differences between French and non-French air traffic controllers were observed. No significant changes were determined between participants from small or large airports, or with greater than or less than 15 years of ground controller experience. The results of this research could be applied to the operational policies of a multi-agent system or for decision support.
Experimental Quantification of Times Needed to Comply With Air Traffic Control Advisories
Markus Vogel, TU Dresden

This work describes the experimental quantification of pilots’ time requirements when making adjustments to the aircrafts navigation systems upon clearances from ATC, which was performed in order to calibrate a simulative safety assessment model for ATM procedures. The experiment, conducted on a A320 flight simulator with university students, was laid out as a part-task real-time HITL study following a microworld approach. A task analysis was performed in preparation, providing an estimate for typical time demands. The S386 measurements are WEIBULL-distributed both for device acquisition and device interaction time. Device acquisition times follow FITTS law. FCU device interaction times can be described with a parametric model dependent on input magnitude, and can be explained with a microscopic model, which segregates coarse and fine adjustments to the dial knobs with distinctly different rates and precisions. MCDU keypad interaction occurs with a typing rate much lower than computers and mobile phones (80-100 chars min-1). For all devices, a trend towards earlier and more normalized responses is apparent under higher task loads. All results are summarized in one table situated at the end of the text.

Economics

Price-Setting Auctions for Airport Slot Allocation: a Multi-Airport Case Study
Ricardo Herranz, Nommon

ACCESS (www.access-sesar.eu) is a SESAR WPE research project that addresses the study of market-based mechanisms for airport slot allocation from the perspective of agent-based computational economics. In this paper, we present the airport slot allocation simulation model developed by ACCESS and we apply it to the evaluation of primary slot auctioning in a multi-airport scenario. We show how combinatorial price-setting auctions can be used to balance capacity and demand in a decentralized manner, without the need for airlines to disclose sensitive information, so that the available capacity is used by those airlines able to make best economic use of it. The end prices of the auction reveal the economic value of each slot.

Modulation of En-route Charges to Redistribute Traffic in the European Airspace
Lorenzo Castelli, Università degli Studi di Trieste

Peak-load pricing (PLP), a two-tariffs charging scheme commonly used in public transport and utilities, is tested on the European Air Traffic Management (ATM) system as a mean for reducing airspace congestion. In particular, a centralised approach to PLP (CPLP) where a Central Planner (CP) sets en-route charges on the network is presented. CPLP consists of two phases: in the first, congested airspace sectors and their peak and off-peak hours are identified; in the second, CP assesses and sets en-route charges in order to reduce overall shift on the network. Such charges should guarantee that Air Navigation Service Providers (ANSPs) are able to recover their operational costs while inducing the Airspace Users (AUs) to route their traffic in a configuration that the network is able to sustain. The interaction between CP and AUs is modelled as a Stackelberg game and formulated by means of bilevel linear programming. Two heuristic approaches, based on Coordinate-wise Descent and Genetic Algorithms are implemented to solve the CPLP model on a data set obtained from historical data for an entire day of traffic on the entire European airspace. Results show that significant improvements in traffic distribution in terms of both shift and sector load can be achieved through this simple en-route charges modulation scheme.
Efficiency vs. Flexibility in ATM: Can Pricing Help?
Radosav Jovanovic, University of Belgrade

Driven by a number of uncertainties a considerable share of airspace users (AU) look for “last-minute” 4D route choice gains, and thus exercise a fairly late submission of flight plans. While orders of magnitude of such gains, from AUs’ perspective, are in the range of tens or hundreds of euros per flight, such flexibility granted to AUs creates uncertainty which is difficult to manage cost-efficiently from the air navigation service providers’ (ANSP) and network manager’s (NM) perspective. Due to low traffic load predictability, ANSPs tend to declare more conservative sector capacities, which effectively means that additional sectors need to be open sooner (at lower traffic loads) than if predictability was better. Against such a background, this paper revisits and extends the “Rewarding Predictability” (RP) mechanism, introduced in [1]. The original idea of the RP is to design a pricing scheme which incentivises AUs to reduce uncertainties imposed on ANSPs and NM by filing their flight intentions earlier and sticking with them as much as possible, aiming at improved network performance. In this paper, a stochastic module is incorporated into the RP mechanism, concerning route choice process, in line with recent findings presented in [2]. This arguably more realistic representation of AUs’ behaviour allows us to more credibly discuss the efficiency vs. flexibility trade-offs involved and the comparative performance of various ATM resource allocation methods in addressing those.

Applied Modelling & Optimization

Improvement of Pushback Time Assignment Algorithm via Stochastic Optimization
Ryota Mori, ENRI

Pushback time assignment is a promising method to reduce the fuel burn of departure aircraft on the ground. Departure aircraft can wait at the gate with engines off instead of waiting in a long queue before the runway. However, airport operation includes considerable uncertainties which often result in unexpected situations such as take-off time delays. This paper proposes a new algorithm to assign the optimal pushback time under uncertainty via stochastic optimization. Useful information sources on the ground are identified, and the pushback time is controlled based on the obtained information. The problem is formulated as a combinatorial optimization, and tabu search technique is applied to solve it. The simulation result shows that the proposed algorithm reduces negative effect by uncertainty while maintaining fuel burn savings.

Pre-Tactical Planning of Runway Utilization Under Uncertainty: Optimization and Validation
Norbert Fürstenau, DLR

Efficient planning of runway utilization is one of the main challenges in Air Traffic Management (ATM). In a previous paper, we developed a specific optimization approach for the pre-tactical planning phase that reduces complexity by omitting unnecessary information. Further, we investigated the impact of disturbances on our solutions, since in reality uncertainty and inaccuracy almost always lead to deviations from actual plans. In this paper, we now present approaches to incorporate uncertainty directly in our model in order to achieve a stabilization with respect to changes in the data. Namely, we use techniques from robust optimization and stochastic optimization. Further, we analyze real-world data from a large German airport to obtain realistic delay distributions, which turn out to be two-parametric -distributions. We describe a simulation environment and test our new solution methods against standard algorithms (e.g., First-Come-First-
Serve). The encouraging results show that our approaches significantly reduce the number of necessary replannings.

**ELSA Air Traffic Simulator: an Empirically Grounded Agent Based Model for the SESAR Scenario**

*Salvatore Micciche, Università degli Studi di Palermo*

This paper describes the Air Traffic Simulator produced by the ELSA project. It is based on interacting agents taking actions during strategic and tactical phases: air companies, network manager, pilots, and controllers. The simulator is highly modular and each part can be used independently of the others. The code is open source, ready to use and available for the research community. Some results concerning the future organization of the European Airspace (free-routing) are presented, using the full capabilities of the model. We found that the implementation of free-routing could have a positive impact on the safety event occurrences that will be reduced in number although spread over a larger area. The controllers behaviour will therefore move to a situation where they have to perform a smaller number of operations dispersed over a larger portion of the airspace. We also show that the number of operations performed by a controller quadratically depends from the number of aircraft present in the considered airspace and that such quadratic scaling law is modified when the airspace is partitioned in air traffic sectors with capacity constraints.

**Capacity and Airspace Design**

**A Framework of Point Merge-based Autonomous System for Optimizing Aircraft Scheduling in Busy TMA**

*Man Liang, ENAC*

In this article we present recent work towards the development of an autonomous system with point merge (PM) that performs sequencing, merging and spacing for arrival aircraft in the busy terminal area. This autonomous arrival management system aims to safely solve the major arrival flight scheduling problems currently handled by human controllers. With PM, it has the potential to handle higher traffic demands without more workload on controllers, consequently increasing capacity and reducing delay. The main objective of this paper is to introduce the framework of this autonomous system with PM. Based on analysis of classic PM route structure, a novel PM-based route network is firstly designed for Beijing Capital International Airport. Vertically, this PM system consists of multi-layers on the sequencing legs for different categories of aircraft with Heavy and Medium, horizontally, it is shaped as a lazy “8”. Then, a multiple-objectives function is discussed for this aircraft scheduling problem, operational constraints and conflict detection and resolution are analyzed in detail, a modelling strategy with sliding time window and simulated annealing algorithm is proposed for solving this real-time dynamic problem. Finally, a conclusion is made and future work is pointed out for further developing this system.

**A Baseline for Terminal Airspace Design Assessment**

*Valentin Polishchuk, Linköping University*

We report on initial steps in our joint work on redesign of Stockholm Terminal Maneuvering Area. We explore possibilities for optimizing assignment of flights to entry/exit points to/from the area under several models of traffic organization on approach/departure routes. Comparison of the distances flown in the optimal flights-to-points matchings under the different routing paradigms allows us to estimate the price of structuring and controlling aircraft within the airspace. In general,
our results may serve as a baseline for evaluation of current and future terminal airspace designs in terms of flight efficiency and costs incurred due to the need for control of the traffic flow.

Analysis of 2NM Separation for Minimal Pair Arrivals
Alan Groskreutz, CRIDA

This paper presents preliminary results regarding the conditions in which a 2NM arrival separation can be implemented taking into consideration the relationship between arrival separation, runway occupancy time, and exit location. The analysis was carried out through the use of expert workshops and Monte Carlo simulations, where the recommendations of the experts were put into simulated conditions. In order to better simulate various airport conditions, various traffic mix samples were used, varying the percentage of aircraft that could take advantage of the reduced separation between 50% and 80%. The proposed RECAT separation matrix was also used to better simulate future conditions. Average AROT times were given to the individual categories of aircraft and all groups of arrival Runway Occupancy Times (AROTs) were varied to simulate different exitway layouts. In addition to the fast-time simulations, a workshop on the relation between minimal-pair separations and AROT was held. Controllers, pilots and operational experts were in attendance. The objective was to discuss not only the factors that can limit the AROT, but also means to reduce it in order to take advantage of the reduced separations. It was then shown that these means are sufficient to reduce the AROT so that the 2NM separations can be used for the majority of aircraft pairs that are not wake turbulence limited. It was also shown that the arrival results show between a 6% and 30% capacity improvement depending on the scenarios compared, even without using intelligent sequencing of the aircraft. Further studies are warranted with the inclusion of this type of arrival sequencing.

3D Sectors Design by Genetic Algorithm Towards Automated Sectorisation
Marina Sergeeva, ENAC

The aim of this work is to develop a research prototype to support the validation of new airspace sector design methodology. To do this, an algorithm has been developed that manages main features of the sector design process. The proposed method is based on a mathematical modeling and heuristic optimization techniques. In order to run this algorithm efficiently a pre-processing step has been proposed, which creates an initial division of the airspace into Voronoi cells using k-means clustering algorithm. Then, due to the induced combinatorial complexity, a stochastic optimization algorithm based on artificial evolution has been applied to solve the sectorisation problem. An evaluation of the algorithm is presented as well, with a comparison to existing sectorisation with the support of the operational expertise.

Meteo

Recommendations on Trajectory Selection in Flight Planning based on Weather Uncertainty
Alan Hally, Météo-France

The chaotic nature of the atmosphere combined with limitations in modelling and an insufficient number of observations means that inaccuracies continue to exist even in the most state-of-the-art Numerical Weather Prediction (NWP) systems. In the world of aviation, Trajectory Predictions (TP) are currently based on deterministic meteorological forecasts and thus do not take into account the probabilistic information available from an Ensemble Prediction System (EPS). One of the main aims of the Investigation of the Optimal Approach for Future Trajectory Prediction Systems to Use
METeteorological Uncertainty Information (IMET) project is to improve the predictability of Air Traffic Management (ATM) systems by exploring the benefits of EPSs for TP. We herein describe a methodology for Probabilistic TP (PTP). This involves running a TP system n number of times with n depending on the number of members in the EPS. This allows an ensemble of trajectories to be created and thus give a degree of uncertainty when describing certain flight parameters such as flight time/fuel costs. We demonstrate using ensemble scores that the three state-of-the-art EPSs used within the IMET project are capable of capturing specific weather events observed from a large data sample of Aircraft Meteorological Data Relay (AMDAR) measurements 36 hours in advance of take-off. We use one of these EPSs to illustrate the methodology and show that if low uncertainty in the Required Time of Arrival (RTA) is required (e.g. at large congested airports) the total fuel cost may necessarily increase, whereas minimisation of cost at the expense of higher flight time uncertainties may be appropriate for some flights.

Analysis of the Effect of Uncertain Average Winds on Cruise Fuel Load
Rafael Vazquez, University of Seville

The required fuel load of an aircraft for a given cruise range with uncertain average wind (modelled by a uniform distribution) is studied in this work. The fuel mass probability density function is obtained using an approximate method previously developed by the authors. In addition, the Generalized Polynomial Chaos method is used to study the mean and typical deviation of the required fuel mass. The dynamics of mass evolution in cruise flight is defined by a nonlinear equation, which can be solved analytically to obtain the fuel mass; this exact solution is used to assess the accuracy of the proposed methods. Comparison of the numerical results with the exact analytical solutions shows an excellent agreement in all cases. The results are also compared with the Monte Carlo method, which requires a much larger computation time to obtain similar results.

Improving the Mitigation of Wind Hazards in ATM Operations with Ground-based Wind Doppler LIDARs
Ludovic Thobois, LEOSPHERE

Weather is one of the major causes of flight delays and accidents. Among all the weather conditions for aircrafts, wind and wind hazards like wake vortices and wind shears require to be monitored with high spatial and temporal resolution sensors in order to reduce their impact on air traffic for improving safety and / or for optimizing ATM. Among the different available sensor technologies, Doppler LIDAR sensors as remote sensors allow to obtain high spatial (5m to 200m) and temporal (1 Hz to 20 Hz) resolution and accurate wind measurements (typically 0.5m/s). But these sensors remain confidential and few are used for operational purposes in ATM. This paper presents the developments of a new generation of Doppler LIDAR systems for measuring wind and monitoring wind hazards around airports. Their intrinsic performances in terms of measurement range and accuracy are described. Several applications of such LIDAR technology are then presented like wind measurements, wind shears detection and wake vortices monitoring thanks to several experiments performed on airports. As perspectives the paper proposes the potential benefits of using such atmospheric LIDAR sensors for optimizing air traffic like airport capacities and for improving air traffic safety.

Safety and Security

Preliminary Experiments on the Relative Comprehensibility of Tabular and Graphical Risk Models
Katsiaryna Labunets, University of Trento
The ATM SESAR project has invested a significant effort to define graphical modeling constructs to capture ATM Architectural elements beside tabular representation. The key question is whether this is worth the effort for Security Risk Assessment. It is important to understand which representation provides better comprehension of threats, vulnerabilities, security countermeasures and relationships between them. We conduct a preliminary study on the comprehensibility of two risk modeling notation, involving students from Trento and Oslo Universities. Particularly, we assessed the effect of using graphical or tabular modeling notation on the actual comprehension of security risk models. The subjects were asked to answer 8 comprehension questions of a difference complexity about the risk assessment concepts (like threats, vulnerabilities or controls) represented using graphical or tabular notation. The results of the data analysis show no significant difference in actual comprehension that the subjects achieved using tabular or graphical risk models. However, the subjects who used tabular risk model show higher level of comprehension of simple questions, while for the complex questions there is no significant difference in the level of comprehensibility of graphical and tabular risk models.

**Real-time Simulations to Evaluate RPAS Contingencies in Shared Airspace**  
*Marc Pérez-Batlle, UPC*

This paper presents the work done within the second year of WP-E project ERAINT (Evaluation of the RPASATM Interaction in Non-Segregated Airspace) that intends to evaluate by means of human-in-the-loop real-time simulations the interaction between a Remotely Piloted Aircraft System (RPAS) and the Air Traffic Management (ATM) when the first is being operated in shared airspace. This interaction will be evaluated from three different perspectives. First, the separation management its results were profusely described in [1]. Secondly, the contingency management, also including loss link situations, its results are presented in this paper. Finally, the impact of the dynamic mission changes on the overall ATM system will be investigated over the rest of the year. The used simulation infrastructure allows to simulate realistic exercises from both the RPAS Pilot-in-Command (PiC) and the Air Traffic Controller (ATCo) perspectives. Moreover, it permits to analyze the actual workload of the ATCo and to evaluate several support tools and different RPAS levels of automation from the PiC and ATCo sides. Preliminary results and the usefulness of the support tools are presented for each selected concept of operations.

**A Flight Delay Reporting and Analysis Platform Through Secure Information Sharing**  
*Emre Koyuncu, Istanbul Technical University*

Considering the future needs of the seamless flow of information between the stakeholders, two important challenges rise. First, most ATM data are considered confidential and sensitive and, hence, private - both for their commercial value and for the political or social consequences some of the analyses may cause. Second, data should be stored and processed in a safe and efficient way. Therefore, applying secure information sharing and calculation that allows untrusted parties to perform computation over a data set will be a delicate issue for air transportation implementations. The basic principle behind this is that the input information is divided into a number of shares, which are transmitted to different computation server for certain operations, and the result is collectively calculated by the computation servers, while no one of them has enough information on its own to recover any input. In this work, we have developed a secure system that is specific to delay report gathering from different stakeholders and analysing based on secure multi-party computation. Considering the needs of a secure reporting system, we have developed a web-based portal enabling participants to manage their contributions. To demonstrate the feasibility of such reporting and secure analysis, we have utilized real-world examples through the historical data analysis. Moreover, we have also performed the cost-benefit analysis through the computational effort assessing of such SMC-based delay analysis solution for the realistic operational environment, provided results of these analyses, and given detailed discussed on them.
Posters

1. Smart Service Umbrella System for Airport Management
2. A Young Person’s Guide to the Reconstruction of Air Transport Networks
3. Electronic Flight Strips in ATC Tower Work
4. MoTa: Modern Taxiing
5. Aircraft Trajectory Prediction Based on Flight History
6. ForFog: a Proposal for Improving Forecast of Fog Through Remote Sensing Observations and Data Assimilation
7. Resilience Engineering (RE) Guidance Material in Design: Case Applications
8. Remote Tower
9. Improving the Mitigation of Wind Hazards in ATM Operations with Ground-based Wind Doppler LIDARs
10. Cooperative Air Traffic Structuring
11. PROuD (PBN Rotorcraft Operations under Demonstration)
12. RPAS in Controlled Airspace: INSuRE CONOPS Validation
13. Wind and Wake Vortices Simulation and Detection
14. Technologies for Long-Term Future Air Transport Scenarios
15. ALIAS II Software Tool
16. A Framework for Total Apron Safety Management (TASM)
17. ATM Security: the GAMMA Concept and its Technical Instantiation
18. The KLEAN Tool on the EFB NEXIS
20. JOINT - Joint Operational Incidents Training
22. SAFECORAM - Application and Validation of Resilience Engineering Approach in ATM
23. Business Models for Flight-Centric Air Traffic Control
24. SCALES Framework Validation
25. Suitability of Inertial Systems (INS/IRU) in Military Aircraft to Sustain Emerging Navigation Requirements