AGIFORS

Airline Group of the International Federation of Operational Research Societies

Operations 2020

How to restore and recover airline operations at minimal cost and with maximum efficiency as quickly as possible

Online Conference

01 – 05 June 2020

AGIFORS Operations and Maintenance Conference Schedule 2020

Technical presentations offered twice to cater for more time zones.

Time Slot	01. Jun Monday (HOLIDAY)	02. Jun Tuesday	03. Jun Wednesday	04. Jun Thursday	05. Jun Friday	Time Slot
14:45 - 15:30 (CEST) 07:45 - 08:30 (CDT) 05:45 - 06:30 (PDT)		Prof. Dr. Christoph Brützel, International University Bad Honnef **Impact of Outsourcing Flight Operations on Operations Control Management**	**Airline Updates** Cathay Pacific, Patton Chan Oman Air, Ziad Abuawad	Anna Hess, FZI Research Center for Information Technology **The Weight and Balance Optimization Journey**	**Airline Updates**	14:45 - 15:30 (CEST) 07:45 - 08:30 (CDT) 05:45 - 06:30 (PDT)
15:30 - 16:00 (CEST) 08:30 - 09:00 (CDT) 06:30 - 07:00 (PDT)	**Conference Start** 15:45 (CEST) 08:45 (CDT) 06:15 (PDT)	Valentin Weber & Mohamed Rbaia,, Amadeus **Robust and Practical Tail Re-allocation**	**Airline Updates** American Airlines, Tolou Esfandeh GoIndigo, Jason Herter	Jose Ramirez-Hernandez, American Airlines **Maintenance Planning with Center of Excellence (CoE) Stations: A simulation Approach**	**Lufthansa Consulting** **M2P Consulting** **ELP Aviation** **Tata Consultancy Services** **Pricewaterhouse Coopers Advisory**	15:30 - 16:00 (CEST) 08:30 - 09:00 (CDT) 06:30 - 07:00 (PDT)
16:00 - 16:45 (CEST) 09:00 - 09:45 (CDT) 07:00 - 07:45 (PDT)	**Keynote** James Sarvis, Executive Vice President & Chief Operating Officer (COO), AeroMexico	Davide Bardelli, Lufthansa Systems and Tim Nickel, Lufthansa Aviation Training **Operations control in (and beyond) a state of pandemic**	Sebastian Heger, m2p **Is the corona-crisis just a giant disruption or will it introduce a radical change? - The future of disruption management solutions**	Gesine Varfis, APSYS **Predictive Maintenance (PDM) is not an emerging technology**		16:00 - 16:45 (CEST) 09:00 - 09:45 (CDT) 07:00 - 07:45 (PDT)
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17:00 - 17:30 (CEST) 10:00 - 10:30 (CDT) 08:00 - 08:30 (PDT)	**IBM Update**	Panel Discussion: **Why have there been no major new approaches to disruption management in the past 20 years? What can we do now?**	**FlightAware Update**	**SlickOR Update**	**Dassault Systems** **Amadeus** **Jeppesen** **Sabre** **ZeroG** **Lufthansa Systems**	17:00 - 17:30 (CEST) 10:00 - 10:30 (CDT) 08:00 - 08:30 (PDT)
17:30 - 18:00 (CEST) 10:30 - 11:00 (CDT) 08:30 - 09:00 (PDT)	Marc Brittain, Iowa State University **A Deep Multi-Agent Reinforcement Learning Approach to Autonomous Separation Assurance**	Michael Clarke, John Paul Clarke, Ira Gershkoff, Mike Irrgang, Anna Sauer, Gesine Varfis	Jack Troutt, Utah Valley University **Perceptions of Fuel Conservation Programs at a U.S. Air Carrier**	Darren Macer, Boeing **Maintaining a Digital Twin for Aircraft During Operation**		17:30 - 18:00 (CEST) 10:30 - 11:00 (CDT) 08:30 - 09:00 (PDT)
18:00 - 19:00 (CEST) *11:00 - 12:00 (CDT)* *09:00 - 10:00 (PDT)*	***Social Hour***	***Social Hour***	***Social Hour***	***Social Hour***	***Social Hour***	*18:00 - 19:00 (CEST)* *11:00 - 12:00 (CDT)* *09:00 - 10:00 (PDT)*
19:00 - 19:30 (CEST) 12:00 - 12:30 (CDT) 10:00 - 10:30 (PDT)	Max Z. Li, Massachusetts Institute of Technology **Conservative selective redistribution of airport delays**	Martin Sedlacek, Lufthansa Consulting **Airline Operational Excellence - what should be the priorities now?**	Luis Delgado, University of Westminster **Crew multi-criteria decision support tool estimating performance indicators and uncertainty (30)**	**Airline Panel** What has COVID-19 done? How can software and service vendors & consultancies help to restore airline operations? Tim Niznik (American Airlines) Jeff Meaney (Air Canada) Daan Debie (KLM) Jason Herter (GoIndigo) Bolivar Dominguez (Copa)	**Inform** **IBS** **To70** **Collin Aerospace**	19:00 - 19:30 (CEST) 12:00 - 12:30 (CDT) 10:00 - 10:30 (PDT)
19:30 - 20:00 (CEST) 12:30 - 13:00 (CDT) 10:30 - 11:00 (PDT)	Sujeevraja Sanjeevi, Sabre Airline Solutions **Decomposition Techniques for Aircraft Recovery**	Dr. Clemens Wolf, zeroG **Increasing flight plan stability on the day of operations by using reinforcement learning**	**Sita Update**		**Maintenance Study Group Update** **Start**:19.40 (CEST), 12:40 (CDT), 10:40 (PDT)	19:30 - 20:00 (CEST) 12:30 - 13:00 (CDT) 10:30 - 11:00 (PDT)
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20:15 - 21:00 (CEST) 13:15 - 14:00 (CDT) 11:15 - 12:00 (PDT)	Maarten Tielrooij, to70 **Decision Support based on Runway Use and Capacity Predictions for Airlines and ANSPs**	Xianfei Jin, Sabre Airline Solutions **Recent advancements in effective disruption management**	Lukas Glomb, University Erlangen-Nürnberg **A rolling horizon approach for multi-time-period tail-assignment problems**	Soufiane Bouarfa, ADPoly **Automated aircraft visual inspection**		20:15 - 21:00 (CEST) 13:15 - 14:00 (CDT) 11:15 - 12:00 (PDT)
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Marc Brittain, Iowa State University

A Deep Multi-Agent Reinforcement Learning Approach to Autonomous Separation Assurance

A novel deep multi-agent reinforcement learning framework is proposed to identify and resolve conflicts among a variable number of aircraft in a high-density, stochastic, and dynamic sector in en route airspace. In order to scale up to a high-density airspace, we investigate the feasibility of autonomous separation assurance using multi-agent reinforcement learning. We propose the concept of using distributed vehicle autonomy to ensure separation, instead of a centralized sector air traffic controller. Our proposed framework utilizes an actor-critic model, Proximal Policy Optimization (PPO) that we customize to incorporate an attention network. This allows the agents to have access to a variable number of aircraft information in the sector in a scalable, efficient approach to achieve high traffic throughput under uncertainty. Numerical results show the proposed framework significantly reduces the offline training time without sacrificing performance.

Marc is a Ph.D. Candidate in the Dept. Aerospace Engineering at Iowa State University. He currently works under Dr. Peng Wei who leads the Intelligent Aerospace Systems Laboratory. He received his B.S. degree in Physics with a minor in mathematics from the University of North Carolina at Wilmington. His research interest include Deep Reinforcement Learning and Air Traffic Management.

Max Z. Li, Massachusetts Institute of Technology

Conservative selective redistribution of airport delays

The network-level redistribution of airport delays reflects an aggregation of microscopic, tactical actions (e.g. airline schedule adjustments) in response to airport capacity constraints. We investigate the problem of optimizing delay redistribution control policies for an air transportation network under delay-conserving constraints, reflecting the fact that incurred delays cannot be removed in the absence of mechanisms such as flight cancellations. We demonstrate our framework on historical hourly sequences of US air transportation network disruptions, comparing the optimal selective redistribution policies against actual operations. We also provide an estimate of the redistribution cost, resulting in a disruption-specific ranking of least- to most-costly delay-absorbing airports. Our control policies can be implemented as constraints in a standard air traffic flow management problem, ensuring that its solution conforms to delay redistribution requirements.

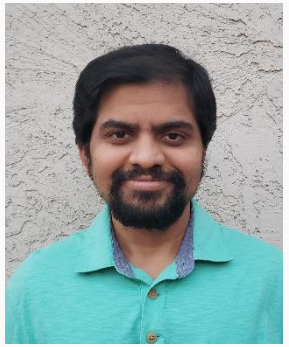
Max Z. Li is a PhD Candidate in the Department of Aeronautics and Astronautics at the Massachusetts Institute of Technology. His research interests include air traffic flow management, aviation systems modeling, and applied mathematics, particularly geometric and topological methods. He is a recipient of the 2018 FAA RAISE award, and a NSF Graduate Research Fellowship.

Sujeevraja Sanjeevi, Sabre Airline Solutions

Decomposition Techniques for Aircraft Recovery

Aircraft recovery is the problem of resolving disruptions in aircraft schedules with minimal impact to operations while respecting a diverse variety of operational constraints like maintenance requirements and runway closures. Such constraints and the need to find solutions quickly make large-scale aircraft recovery a highly complex problem to solve. In this talk, we present an overview of some approaches to decompose aircraft recovery problems and details about their practical usage.

Sujeevraja Sanjeevi is currently part of the Airline Solutions Product Engineering group at Sabre, and lead the development of "Recovery Manager Ops", a solver for aircraft schedule recovery.



Maarten Tielrooij, To70

Decision Support based on Runway Use and Capacity Predictions for Airlines and ANSPs

To70 presents a decision support system that supports airline and ANSP in making pro-active decisions by providing a robust 30-hour forecasts of risks of weather impact on runway use and capacity. Machine learning is used to derive a predictive model to forecast probabilistic runway use. Combining runway use model with stochastic meteorological forecasts results in a probabilistic forecast that accounts for both uncertainty in the weather forecast and runway selection. Additional contributors such as runway maintenance and confirmed cancellations of flights are implemented to use the most actualized fact base. The end result is be used by operational staff in airline operations and pre-tactical experts at ATC and supports proactive decisions to balance supply and demand in both general and less predictable situations. By supporting both airline and ANSP, a common understanding of risks to capacity is created leading to more collaborative mitigations.

As part of his PhD research ATM simulations at TU Delft, Mr. Tielrooij worked with LVNL in designing their Arrival Manager. Through that and other projects, he has extensive knowledge of TMA operations and the design and validation of models. He is an experienced user of programming software, modelling and simulation techniques, large databases and statistical techniques.

Prof. Dr. Christoph Brützel, International University Bad Honnef

Impact of Outsourcing Flight Operations on Operations Control Management

Driven by decentralized home base models of LCCs and inefficiency of rotation patterns of hub carriers when it comes to night stops at spokes to serve shoulder waves at hubs and operate decentral point-to-point-services, outsourcing of operations to wet leasing operators (ACMI) has become popular since liberalization of European airspace.

ICAO Annex 6 and EU-Ops respectively require independent and effective control of operations remain with the operating AOC. Coordination of CAME, maintenance operations control (MOC) and Crew Dispatch must not be under control of the lessee. In consequence, central operations control of ACMI subcontracted services implies additional interfaces to be managed an integrated information system supporting optimization of network operations.

Challenges will increase once SWIM concept will become real and task sharing as well as interaction between AOC, airports, and ANSP will have to develop accordingly.

Christoph Brützel is a FT Professor in Aviation Management at IUBH International University Bad Honnef. He has been a consultant to the aviation industry for 22 years. Before he had been Managing Director of LTU airlines and spend 10 years with Lufthansa in various management assignments. His background includes hub integration projects as well as ACMI management.

Valentin Weber & Mohamed Rbaia, Amadeus

Robust and Practical Tail Re-allocation

Network scheduling's main goal is to maximize the utilization of the fleet and build a resilient schedule that would limit the impact of disruptions. Then, the OCC Network Coordinator will adjust that schedule by allocating it to the actual tails according to their specific restrictions, and maintain it in an operable state and up to date with the on-going operations until the flights reach the day of operations.

We designed an algorithm based on problem decomposition to optimize those decisions. It relies on flight, crew, passenger, maintenance and airport information and considers a vast set of feasibility, robustness and business preference criteria. Then we compared the quality of the optimized solutions against user's for a large fleet with a planning window of multiple days. We also did a study to evaluate the benefits of improving robustness criteria once the schedule is operated.

Mohamed has been with Amadeus since 2014. He joined Airport IT team as an intern to work on the Fixed Resource Management optimizer. In 2015, he joined Airline IT and Schedule Recovery team where he contributed to various activities around optimization such as OR presales activities, Ops Business Rules Engine implementation and Scrum Master role for a distributed OR team. He is currently focusing on the implementation of ops planning and recovery optimizers for Qantas.

After a PhD in Operations Research, Valentin joined the OR department of Amadeus in 2013, where he worked on different topics related to airline operations (e.g. disruption recovery, load control). He moved to Australia in 2015 to join the Amadeus Schedule Recovery project, leading the development on optimization topics. He is a first-time dad of a gorgeous Sophia since April 2020.

Davide Bardelli, Lufthansa Systems and Tim Nickel, Lufthansa Aviation Training

Operations control in (and beyond) a state of pandemic

The Coronavirus crisis will last for long. We need to accept this and initiate solutions to manage the implications for the business. Securing workforce and passengers health together with business continuity is key. Ops control executives need to take actions along this path. As well, they need to treasure from the learnings of these days to shape the future beyond this crisis: some changes are not reversible and further crisis will come. Gaining a clear sense of what solutions work is likely to take time. Yet, a 2-tier ops control already looks a relevant answer to build a border between the virus and the business and fix current issues of “integrated” ops control at once.We will: a) discuss the 2-tier ops control as a pragmatic model to minimize the risk of infectivity while preserving operational decision-making. b) Review limits of current integrated model. c) Propose the 2-tier model joint to competence-based training as a way to overcome the limits.

Davide Bardelli is Director Consultant at Lufthansa Systems Airline Consulting. Aeronautical engineer and MBA, his focus is on flight planning processes, airline operations control, ATM and management of change. Former Head of Dispatch in a few European airlines, he is experienced in developing operational organizations and in SESAR R&D and SESAR deployment.

Tim Nickel brings with him +24 years of operational aviation experience in different fields of flight and ground operations, being an aircraft engineer, a flight crew member, a senior manager in operations control, crewing, dispatch and hub control in Germany, Belgium & the Middle East. Tim worked closely with Davide Bardelli in Lufthansa Systems Airline Consulting before taking over the position of Head of Flight Operations Academy in Lufthansa Aviation Training.

Martin Sedlacek, Lufthansa Consulting

Airline Operational Excellence - what should be the priorities now?

In late 2019, Lufthansa Consulting conducted a survey to understand where airlines stand in the areas of operations planning, steering and performance management. Although the environment has changed significantly due to COVID-19 crisis, it is clear that the airlines and their service and system partners will have to continue making the complex operations more robust, while being even more efficient. To do so, it is important to ask how are we using the data and communicate? How deep is it worth to go in the integrated planning process? And how far we in reality are with the new technologies? We also need to understand the importance of the provider management within the planning and steering framework. This speech will show what priorities should be considered in the current environment and how to learn from the past successes and mistakes.

Martin Sedlacek is an Associate Partner in Lufthansa Consulting, specializing on projects related to the OCC and Flight/Ground Operations. His experience includes high-profile projects within Lufthansa Group, as well as externally across the globe. Prior Lufthansa Consulting, he worked over ten years at the Operations Control and Dispatch of Czech Airlines and easyJet.

Dr. Clemens Wolf, zeroG

Increasing flight plan stability on the day of operations by using reinforcement learning

Indisputably, flight ops controllers have a significant influence on the daily airline operation performance since they are responsible for stabilizing the flight plan which is usually disrupted by countless micro-changes. They base their decisions on information gathered from an ever growing number of sources, leading to a potential information overload in the near future. Together with an European airline, we decided to tackle this challenge by developing an AI based on reinforcement learning which collects all data, evaluates the overall situation, asses the potential long term influence on all possible actions and finally suggests a simple action recommendation. After two years of research, the AI assistants' suggestions improve the flight plan stability demonstrably. Besides presenting the main challenges of the last two years, we will also discuss the next steps to improve this technology even further in the next years.

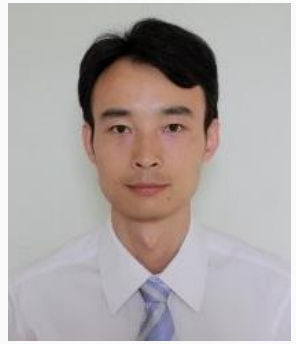
Clemens Wolf is a 30 years old German data scientist with a focus on airline operation (flight operation and ground operation). Started professional carrier 2 years ago by joining zeroG directly after finishing his Phd. Before research in the field of nuclear astrophysics (PhD research was about the determination of a reaction which occurs on the surface of neutron stars).

Xianfei Jin, Sabre Airline Solutions

Recent advancements in effective disruption management

This presentation will focus on some emerging trends on flight schedule disruption management, including advanced flow rate control in a hub airport and customized tail assignment. Firstly, the new industrial requirements are discussed in details with examples. New technical methods will be introduced on how to resolve these complexed problems efficiently. Finally data analysis and insights will be presented with detailed scenario cases.

Xianfei Jin is a team lead from Operations Research Product Engineering team in Sabre Airline Solutions. He has many years development experiences with flight recovery solutions and airport management solutions. He obtained his PhD degree from Nanyang Technological University, Singapore on 2012.

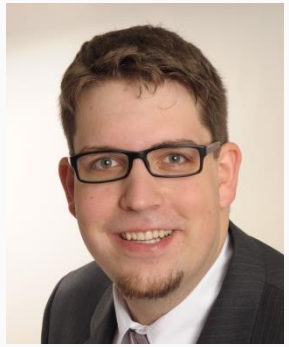


Sebastian Heger, m2p

Is the corona-crisis just a giant disruption or will it introduce a radical change? - The future of disruption management solutions

Within a few weeks the corona-crisis has caused nearly a full-stop of the worldwide air traffic. Experts are now discussing, until (and even if) the pre-crisis level will be reached again. Nevertheless, there will a longer time period of a so-called “recovery phase”. Inevitably the question arises, if existing disruption management solutions in the airline industry will be capable and valuable to support them during this crisis. Might there be the need for modifications to existing solutions or any demand to equip with such solutions to be armed for the upcoming, changed situation?

This talk will dive into supposable, operational concepts within the “recovery phase”, take a look on future challenges and altered characteristics in airline operations as well as how regular disruptions will affect the “recovery phase”. Finally, an outlook of possible strategies to optimally use disruption management solutions within and continuative after the crisis is given.



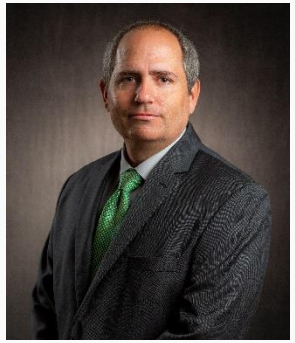
Sebastian Heger is working as a Consultant and Technology Specialist at M2P Consulting since 2017. He is mainly responsible for designing decision support systems within the aviation industry. He holds a doctoral degree in economic sciences (joint work with DLH) and a master's degree in mathematics. His main interests are in the field of Airline Operations, OR, Decision Support and Data Mining.

Jack Troutt, Utah Valley University

Perceptions of Fuel Conservation Programs at a U.S. Air Carrier

Fuel prices have been a major cost factor to air carriers around the world since the 2008-2009 market turmoil. As such, any carrier must constantly look at steps that can be taken in order to conserve and reduce the amount of fuel used on a daily basis. While most carriers have some form of fuel conservation program implemented, efforts should be focused on trying to maximize any fuel conservation program in place. To maximize any potential fuel conservation program, a better understanding of employee perceptions with regards to these types of programs is beneficial. As such, a study was performed to understand the perceptions that certain employee groups (operation and maintenance) have about fuel conservation programs utilizing a mixed method approach. The study consisted of a likert scale based series of questions, along with several open-ended questions, and was distributed via an anonymous survey.

Jack Troutt attended Oklahoma State University, where he graduated with a degree in Aviation Management. Upon graduation he served as an officer in the U.S. Air Force. He has worked at Omni Air International holding various positions. He has earned his Doctorate in Aviation Sciences, and has taught as an Adjunct at OSU-Tulsa, before becoming a full time faculty member for Utah Valley University.

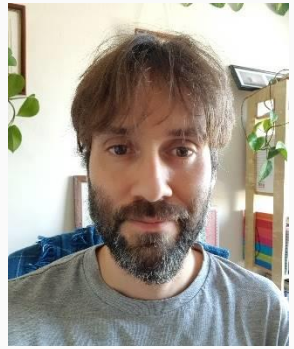


Luis Delgado, University of Westminster

Crew multi-criteria decision support tool estimating performance indicators and uncertainty

When a flight's operational conditions change (e.g., an updated weather forecast), various alternative trajectories may be computed. These usually require trade-offs between expected fuel burn and delay. The pilot, or the dispatcher, considers these expected values to decide how to operate the flight. This approach has two main challenges. Firstly, it requires the translation of arrival delay into parameters that are relevant for the airline (on-time performance and cost of delay). Secondly, uncertainties in the system need to be estimated (e.g., holding at arrival). These estimations rely on airline staff expertise. Pilot3 sets out to overcome these issues by developing a new, multi-criteria decision-support tool, which incorporates explicit estimators for performance indicators and ATM operational parameters. These estimators will be developed incrementally, from simple heuristics to advanced machine-learning models, building on previous experience.

Luis Delgado is Senior Research Fellow at the University of Westminster where he works on Air Transport Management research. He specialises on the modelling of the ATM system with particular interest on delay management, and the consideration of different stakeholders (passengers in particular) and their trade-offs.



Lukas Glomb, University Erlangen-Nürnberg

A rolling horizon approach for multi-time-period tail-assignment problems

The so called tail-assignment problem describes the task of calculating an optimal assignment of a set of available aircraft to cover a set of scheduled flight legs, taking specific maintenance constraints into account. Calculating an optimal tail assignment of a single time period has already been studied extensively. The major drawback of calculating optimal tail assignments for single, isolated time periods is that from a holistic point of view, the sequences of tail assignment solutions for subsequent time periods could be suboptimal. Thus, we investigated the behaviour of the sequential approach and furthermore developed an improved approach for solving sequences of timely consecutive tail-assignment problems using forward-looking information generated by the subsequent time periods' tail-assignment solutions. In a computational study we demonstrate the efficacy of the approach using real-world large-scale instances from a larger carrier.

Lukas is PhD student at the Friedrich-Alexander University Erlangen-Nürnberg. Since 2018 I participate in the project OPs-TIMAL, where we want to integrate mixed-integer program techniques in airline operations. The focus lies on robust approaches and holistic optimization. Currently I am working on combining Fleet- and Tail-Assignment with relevant maintenance aspects.

Anna Hess, FZI Research Center for Information Technology

The Weight and Balance Optimization Journey

On the way to digitized, integrated and optimized planning procedures in the area of cargo operations, weight and balance (WaB) can be a worthwhile first starting point. We talked to WaB planning experts and understood the challenges they face with current procedures. Based on that, we developed an OR-based optimization model and are now on a journey of bringing the model into practice while gaining many benefits along the way, saving time and money and increasing transparency. In this talk we will summarize the steps from discovering current challenges, show methods how to easily estimate the optimization potential, explain the model and modeling questions and give an insight how WaB planners and scientists can collaborate to bring WaB planning to the next level. Further, we present ideas how WaB optimization can leverage further improvements in cargo operations. As we are in the middle of our journey, we seek for any kind of feedback and discussions.

Anna Hess is a Research Scientist in the Logistics and Supply Chain Optimization Group at FZI Research Center for Information Technology in Germany. She is interested in solving complex real-world optimization problems. Currently, she works on optimization problems in air cargo, most of the time on weight and balance planning.