Chair of Transportation Systems Engineering
TUM School of Engineering and Design
Technical University of Munich

Contrail Mitigation through Flight Rescheduling: A Systematic Review and Exploratory Analysis of Operational Measures and Modelling Approaches

Master's Thesis

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Description

Contrail cirrus contributes significantly to aviation's non-CO_2 climate impact. Recent research has shown that rescheduling selected flights can reduce contrail-related climate effects; however, such adjustments may also influence several stages of the airline planning process (Barnhart et al., 2003), including airline network flows, fleet assignment, and schedule robustness (Kölker et al., 2024). This thesis aims to identify existing studies, classify the modelling approaches used, and assess at which stage of the airline planning process contrail-aware decisions may offer the greatest mitigation potential.

Special attention will be given to the assumptions, data requirements, optimisation methods, decision variables, constraints, and reported mitigation potential of existing approaches. Based on the review, the thesis will identify current research gaps and evaluate whether contrail-aware operational planning offers promising potential for further research in aviation scheduling and climate-impact reduction. This evaluation will be based on a structured comparison of existing approaches, considering their methodological scope, data requirements, operational feasibility, and reported climate-impact reduction potential.

Tasks

- Conduct a systematic literature review on existing approaches for contrail mitigation through operational measures in the airline planning process
- Analyse the identified modelling approaches with respect to their decision variables, constraints, objectives, data requirements, solution algorithms, and potential benefits across different stages of the airline planning process
- Use a test dataset provided by us to explore how rescheduling existing flight timetables could influence contrail formation potential or contrail-related climate impact
- Illustrate how contrail-aware considerations could be incorporated into airline scheduling models, for example through adjusted departure times, additional constraints, or modified objective functions

Requirements

- Strong programming skills, preferably in Python
- Experience with mathematical optimization, data analysis, or scheduling
- Self-reliance, reliability, and a high level of self-organisation

What you'll gain: hands-on experience with state-of-the-art airline scheduling models, a rigorous empirical methodology, and the opportunity to address a relevant gap in current research.

Starting Date

As soon as possible.

How to Apply

If interested, please submit your application through the official Bauhaus Luftfahrt career portal: Apply here. A brief cover letter explaining your interest in the topic and relevant experiences is encouraged.

References

Kölker, K., Zengerling, Z., Kühlen, M., Lütjens, K., & Linke, F. (2024). Assessing the impact of contrail avoidance through rescheduling on airline network flows: A case study of North Atlantic flights. *Transportation Research Part A: Policy and Practice*, 187, 104155. doi:10.1016/j.tra.2024.104155.

Barnhart, C., Belobaba, P., & Odoni, A. R. (2003). Applications of operations research in the air transport industry. *Transportation Science*, 37, 368–391. doi:10.1287/trsc.37.4.368.23276.