

A neighborhood search algorithm with dynamic search criteria to integrated optimization of the air traffic scheduling and operations

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Abstract

Many airports around the world face significant congestion due to a severe mismatch between airport capacity and air traffic demand. The schedule intervention serves as a crucial method in managing air traffic flow to mitigate this problem. In this paper, we introduce a two-stage stochastic model to manage air traffic flow at the network level. Considering the uncertainty in operational capacity, flight schedules across all airports in the network are optimized through strategic schedule intervention and tactical operation intervention during the pre-tactical phase. The objective function of the two-stage model includes strategic slot reallocations and expected tactical delays. Recognizing that large-scale two-stage models are challenging to solve, particularly in multi-day optimizations, we propose a heuristic algorithm with dynamic search criteria based on the neighborhood search algorithm. Our heuristic algorithm (the NS-DSC algorithm) leverages prior knowledge from the initial solution and dynamic information from the iterative process, allowing it to adapt its search criteria dynamically. The NS-DSC algorithm is applied to China's national airport network. The results indicate that, compared to direct Gurobi implementation and the simulated annealing algorithm, the NS-DSC algorithm converges rapidly and delivers higher-quality solutions.

Keywords: air traffic flow management, airport network, neighborhood search algorithm, stochastic optimization, capacity uncertainty

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Declaration of Interest statement

5 The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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