Models and Algorithms for an Integrated Fleet-Assignment, Aircraft-Routing and Crew-Pairing Problem

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Abstract

We study an optimization problem of a regional airline company. The problem integrates three stages of the planning process that are typically solved in sequence: fleet assignment, aircraft routing and crew pairing. Aircraft maintenance is also taken into account.

We present two mathematical formulations for the integrated problem. One formulation could be considered the natural model where both the crew pairing and the aircraft routes are represented by path-based variables. The other formulation is a novel model where the aircraft routes are represented by arc-based variables. The objective function aims at minimizing the numbers of the aircraft routes and crew pairings, and the waiting times of crews between consecutive flights. It also aims at maximizing the *robustness* of the solution, i.e. minimizing the number of times that crews need to change aircrafts, which lead to delay propagation.

We propose heuristic algorithms based on Linear Programming relaxation of the proposed formulations. Computational results on real-world instances are given and compared to solutions currently used at the airline. The results show that the proposed algorithms provide better solutions than the current ones in short computing times.