A new MIP model for the Air Traffic Flow Management Problem

David García Heredia, Elisenda Molina
Universidad Carlos III, Madrid (Spain)
{dgheredi,emolina}@est-econ.uc3m.es

Antonio Alonso-Ayuso
Universidad Rey Juan Carlos, Madrid (Spain)
antonio.alonso@urjc.es

A new Mixed Integer Linear Program model for the Air Traffic Flow Management Problem based in network flows is proposed. The problem considers a set of aircraft flights between a set of airports through an air space which is divided in sectors. Since each aircraft can perform more than one flight sequentially, the set of aircraft flights determine an air network. The arrival and departure capacities at the airports are considered, as well as the capacities of the different air space sectors. All those capacities are allowed to vary along the time horizon. So, the model is aimed to help for better decision-making regarding ground holding and air delays imposed on flights in an air network, on a short term policy for a given time horizon. Valid decisions are ground and air delays, flight cancelation and rerouting, if necessary.

We draw attention to the work presented in [4], in which a mathematical model is proposed for the study of ATFMP. Based on this model, [1, 3] present two different extensions that consider rerouting. In this presentation, we extend the model presented in [1] allowing, among others, a more realistic representation of the decisions and the cost function. Furthermore, the proposed model has a very amenable structure for applying decomposition strategies as Lagrangean Relaxation and thus, it is able for solving real-life instances that involve thousands of flights. A directed network is defined for each aircraft and its route is represented by a dynamic flow from the departure airport to the final airport in its planning. Capacity constraints are relaxed and then, a Lagrangean Decomposition scheme is used for solving for the problem. A preliminary computational experience is reported as well as an extension for considering the uncertainty in the capacities of the system.

References

[1] A. Agustín, A. Alonso-Ayuso, L.F. Escudero and C. Pizarro, On Air Traffic Flow Management with Rerouting. Part I: Deterministic. European Journal of Operational Research 219 (2012) 156-166.

[2] A. Agustín, A. Alonso-Ayuso, L.F. Escudero and C. Pizarro, On Air Traffic Flow Management with Rerouting. Part II: Stochastic case. European Journal of Operational Research 219 (2012) 156-166.

[3] D. Bertsimas, G. Lulli and A. Odoni, An integer optimization approach to large-scale air traffic optimization flow management, Operations Research, 59 (2011) 211-227.

[4] D. Bertsimas and S. Stock Patterson, The air traffic flow management problem with enroute capacities, Operations Research 46 (1998) 406-422.