Air Traffic Flow Management under Uncertainty in Terminal Maneuvering Area

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Abstract— In the air traffic control system, the Terminal Maneuvering Area (TMA) is one of the most complex area in which the flight operations are easily influenced by the inevitable uncertainties such as inaccurate aircraft performance, navigation accuracy, pilot operations. This research addresses the sequencing problem in TMA under uncertainty and aims to improve air transport safety and efficiency at a tactical level. The uncertainty is managed by introducing probabilities to the temporal information at specific points for each flight. Flight by flight conflict is then measured with probability on each designated point taking all the possible arrival times into consideration. By minimizing the total probability of conflict in the network, appropriate safety margin can be imposed. A meta-heuristic simulated annealing optimization algorithm is proposed, and the solution is obtained based on the real flight data of 2 hours in Paris Charle-De-Gaulle airport. A simulation is conducted to verify the performance of our proposed model while considering the deterministic model as a baseline case. Both the candidate solutions are disturbed in terms of TMA entry time and the timestamp for each flight are conditionally deviated from the predicted ones. Final results show the advantage of the proposed model in absorbing the conflicts while experiencing the disruptions.