A data-driven approach to 4D-trajectories selection in the European Airspace

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The main aim of optimization models for Air Traffic Flow Management (ATFM) at the pre-tactical stages is to determine, for each flight, suitable trajectoriesthat allow reducing congestion of both airports and en-route sectors, and maximize the Air Traffic Management (ATM) system efficiency. Recent modelling developments in this domain try to be as accurate as possible by including a number of stochastic factors that regularly affect air traffic operations, e.g. weather conditions. Moreover, the SESAR program poses a "strong interest" in including Airspace Users (AU) route preferences within the models. To this end, the a-priori selection of possible alternative trajectories for each flight plays a crucial role. For example, models in [1] require a directed graph including all possible 2D-paths and further information on allowable flight levels and speed to build feasible 4D-trajectories; in [2] an assignment model chooses the optimal trajectory directly from a set of 4D-trajectories associated to each flight. The selection of the sets of alternative trajectories should consider many factors, such as length, time, en-route charges, fuel consumption etc., that are not always fully known. Moreover,quite often the actual operated route isdifferent from the planned one because ofweather conditions, congestion, direct routes available at flight time etc. We will present a data driven approach to determine a set of alternative 2D, 3D or 4D trajectories, considering the historical flight records available from Eurocontrol DDR2 data source. For each flight operated in the European Airspaces, DDR2 provides the initially filed trajectory, the regulated one (reporting the flight plan affected by ATM regulations) and the actual flown trajectory. We apply clustering methods to determine, for each origin-destination pair, a set of alternative trajectories, taking the 3D geometry and flight times into account. Further statistical analysis allows inferring the relations between the selected trajectories and possible choice determinants (e.g. aircraft type, airline category, departure/arrival time slot, weather forecast etc.). The output of our study is a set of flight trajectories for a given origin-destination pair and information on related preference and priorities to be used for the development of mathematical models for trajectory based operations.

References

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