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Title:

Future management approaches for efficient airspace, aircraft turnaround, and airport operations

Abstract:

To meet the future challenges in the air traffic management, the 4D aircraft trajectory in the air (airspace) and on the ground (airport) has to be focused. This presentation introduces new concepts for the dynamic airspace sectorization, approaches of machine learning in the context of airport management, and aircraft turnaround with a specific focus on the passenger boarding process.

The future airspace has to provide a reliable infrastructure and operational concept to ensure efficient and safe operations considering both flight-centric operations and the integration of new entrants. An approach is introduced, which allows for a dynamic sectorization to manage the air traffic demand and flow appropriately. The dynamic sectorization results in enhancements of the current operational structure (less deviation in controller task load) and leads to a significantly lower controller task load for the newly created airspace. Since future 4D trajectory management demands an efficient consideration of operational (e.g. temporally restricted areas), ecological (e.g. contrail prevention) and economic (e.g. functional airspace blocks) constraints, the dynamic sectorization contributes to the highly flexible use of current and future airspace. An overview of several use cases is given, as well as description the working principle of this approach: fuzzy clustering of air traffic, Voronoi diagram for initial structures, and evolutionary algorithms for optimization.

Beside a full implementation of a comprehensive sensor environment to enable an A-SMGCS (advanced surface movement guidance and control system) or A-CDM (airport collaborative decision making) system, machine learning approaches could provide an sufficient analyses of the current airport operations on an aggregated level (e.g. by using ADSB data). These analyses could be used to derive an appropriate situation awareness and operational milestones to enable an efficient management of small and medium-sized airports. The presentation will provide some initial conceptual ideas and first results to point out the capabilities of this approach.

A reliable prediction of all aircraft-related processes along the specific trajectories is essential for punctual operations. The necessary change to an air-to-air perspective, with a specific focus on the ground operations, will provide key elements for complying with the challenges over the day of operations. Mutual interdependencies between airports result in system-wide, far-reaching effects (reactionary delays). The ground trajectory of an aircraft primarily consists of the handling processes at the stand (deboarding, catering, fueling, cleaning, boarding, unloading, and loading), which are defined as the aircraft turnaround. To provide a reliable prediction of the turnaround, the critical path of processes has to be managed in a sustainable manner. The turnaround processes are mainly controlled by the ground handling, airport or airline staff, except the aircraft boarding, which is driven by the passengers' experience and willingness or ability to follow the proposed procedures. In this paper a reliable, validated, stochastic aircraft boarding model is introduced, as well as results from three different research activities: application of Side-Slip Seat, interference potential as metric to evaluate the boarding progress, and capabilities of a future connected cabin.