An Airspace Planning and Collaborative Decision Making Model Under Safety, Workload, and Equity Considerations

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ABSTRACT

We develop a detailed, large-scale, airspace planning and collaborative decision-making model (APCDM), that is part of an $11.5B, 10-year, Federal Aviation Administration (FAA)-sponsored effort to increase U.S. National Airspace (NAS) capacity by 30 percent. Given a set of flights that must be scheduled during some planning horizon, we use a mixed-integer programming formulation to select a set of flight plans from among alternatives subject to flight safety, air traffic control workload, and airline equity constraints.

Novel contributions of this research include three-dimensional probabilistic conflict analyses, the derivation of valid inequalities to tighten the conflict safety representation constraints, the development of workload metrics based on average (and its variance from) peak load measures, and the consideration of equity among airline carriers in absorbing the costs related to re-routing, delays, and cancellations. We also propose an improved set of flight plan cost factors for representing system costs and investigating fairness issues by addressing flight dependencies occurring in hubbed operations, as well as market factors such as schedule convenience, reliability, and the timeliness of connections.

The APCDM model has potential use for both tactical and strategic applications, such as air traffic control in response to severe weather phenomenon or spacecraft launches, FAA policy evaluation, Homeland Defense contingency planning, and military air campaign planning. The model is tested to consider various airspace restriction scenarios imposed by dynamic severe weather systems and space launch Special Use Airspace (SUA) impositions. The results from this model can also serve to augment the FAA's *National Playbook* of standardized flight profiles in different disruption-prone regions of the National Airspace.