An analysis of passenger delays using flight operations and passenger booking data

Stephane Bratu and Cynthia Barnhart

The performance metric used to evaluate on-time performance in the US airline industry is flight-based, measuring the number of flight legs with arrival delay of 15 minutes or more. We analyze airline passenger operations and schedule performance and conclude that this flight-based performance metric does not accurately reflect delays to passengers, primarily because it does not recognize the long passenger delays resulting from flight leg cancellations and missed connections. Using passenger bookings and flight operations data from a major US airline, we develop a Passenger Delay Calculator to compute passenger delays and to establish relationships between passenger delays and cancellation rates, flight leg delay distributions, load factors, and flight schedule design. Using the insights gained in our analysis, we define new passenger-centric metrics to address the shortcomings of existing flight-based metrics and more accurately evaluate schedule reliability.

Classification of Days in the National Airspace System Using Cluster Analysis

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Scientific methods can describe the National Airspace System (NAS) in ways that provide intuitive insights into its operation and performance. One such method is classification and analysis of historical data. In this study we identify key metrics representing the NAS as a whole, and use cluster analysis techniques to classify days in the NAS spanning a four-year time period. Data are analyzed and compared before and after the September 11, 2001 national tragedy. Through classification, we reduce this data into manageable and meaningful subsets. Each subset has dominant characteristics that exemplify typical behaviors in the NAS, primarily based on traffic volume and weather. The data are then analyzed within and between subsets in order to gain information and knowledge from an otherwise unwieldy superset. The results of such an analysis can be utilized for efforts such as the testing and validation of NAS simulations, NAS trend analysis, cost/benefit annualization, and quality assurance.
Common Trajectory Modeling For National Airspace System: Decision Support Tools

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Federal Aviation Administration air traffic operations utilize several types of Decision Support Tools (DSTs) to provide for separation and management of air traffic in the National Airspace System (NAS). Some DSTs include the Enhanced Traffic Management System (ETMS), User Request Evaluation Tool (URET), and the Center-TRACON Automation System (CTAS) Traffic Management Advisor (TMA). A common element of these DSTs is a trajectory modeling function that predicts flight status (e.g., aircraft position and altitude) over time. Modeling techniques vary among the tools because modelers were custom made for the tools, which have different operational requirements.

Despite differences in operational requirements, there are some common functional components within these trajectory modeling functions. Flight plan route processing, for example, is performed similarly among the DSTs. Airspace adaptation data, such as airway definitions, are used by all DSTs. Identification of the common functional components and underlying data elements opens the potential for their consolidation as common services in a NAS infrastructure that supports all DST applications, or at least more than a single tool. Common services and data are expected to provide several benefits to subscribing DSTs, including compatible decisions, increased interoperability, and development and maintenance cost savings.

Research was conducted to identify common trajectory modeling components within a selected set of NAS DSTs. This paper reports the results of the research. The paper introduces the topic of common trajectory modeling; identifies a set of trajectory modeling services, characteristics, and data found to be common across the DSTs studied; presents architectural alternatives for implementing the common services; and defines a process for selecting a common approach for implementing the services.

Tactical Conflict Detection Methods for Reducing Operational Errors

Russell A. Paielli and Heinz Erzberger

Operational error rates in the U.S. have increased significantly over the past few years. This paper presents a new decision support tool called TSAFE (Tactical Separation Assisted Flight Environment) that could eventually replace Conflict Alert, the legacy software that is intended to detect and warn controllers of imminent conflicts. To account for uncertainties in pilot intent, TSAFE generates two predicted trajectories for each aircraft and checks all four combinations of trajectories for each pair of aircraft. One of the trajectories is synthesized based on the flight plan, tracking data, and atmospheric data. The other is a "dead-reckoning" trajectory, a short-range projection based on the current velocity. Methods were also developed to predict critical leveloff maneuvers and to detect and model unplanned turns. Official reports and tracking data were obtained for 58 actual operational error cases, and an automated system was set up to test TSAFE by replaying the tracking data for each case. The results indicate that TSAFE can provide timely warnings of imminent conflicts more consistently than Conflict Alert.