

Interval Management Concept of Operations

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(presented by Bryan Barmore)

The Federal Aviation Administration's Surveillance and Broadcast Services Program Office considers Interval Management (IM) to be one of the three key, near-term applications to make use of ADS-B-In, the receiving and processing of Automatic Dependent Surveillance – Broadcast data on-board an aircraft. Interval Management is used to describe a wide range of operational applications and uses of airborne spacing technology. Interval Management makes use of improved scheduling and sequencing capabilities for the air traffic controllers (ATC) and precise, relative spacing of aircraft, to improve airport throughput, increase the use of Optimized Profile Descents (OPD), and reduce tactical controller workload. The IM applications are subdivided into two categories: one where the flight crew is authorized to manage their speed to achieve the IM goal while the controller retains separation responsibility and a second where the flight crew takes responsibility for both managing speed but also for separation from the specified target aircraft. The former is referred to as Interval Management-Spacing (IM-S) and the latter as Interval Management-Delegated Separation (IM-DS).

For the past 10 years NASA has been working on a specific IM application called Airborne Precision Spacing (APS). This concept has focused on increasing runway throughput while enabling OPDs. It is seen as a specific application within the IM class of applications. This talk will present the current state of the APS concept including support for dependent parallel runway operations and how NASA is working to have APS support the broader IM activities. Planned development and testing of APS, including extensions to support IM-DS and FAA-planned flight trials will be presented along with several up-coming simulations.

Quantifying the Performance of Airborne Precision Spacing under Realistic Operating Conditions

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(presented by Frederick Wieland)

Accurate and precise delivery of aircraft to the runway threshold is one of the goals, and a major challenge, for NextGen, due in part to the two to three fold increase in aircraft operations predicted for the National Airspace System by the year 2025. One technique to meet this goal is through time-based metering, as embodied in NASA's Airborne Precision Spacing (APS) concept. The concept of APS is to use an on-board system, the Airborne Spacing for Terminal Arrival Routes (ASTAR), to generate the speed commands that enable flight crews to achieve the required spacing interval issued by Air Traffic Control (ATC). ASTAR makes use of information from other aircraft via ADS-B messaging in order to calculate the speeds needed to maintain assigned aircraft spacing intervals and ensure precise and efficient delivery of aircraft to the runway threshold.

Understanding how APS performs under realistic wind conditions and limited ADS-B range is critical to assessing its ability to adhere to its concept of operation under realistic conditions while maintaining arrival stream integrity. Previous studies have shown that spacing performance is highly dependent on the strength of the wind and the quality and accuracy of the wind forecast used for scheduling and trajectory (i.e. flight path) calculations. In particular, large wind forecast errors along with limited ADS-B range can lead to inappropriate spacing. This presentation describes the results of an APS experiment using actual winds from atmospheric sounding data collected over seven days of varying months at the Dallas-Fort Worth airport in 2009, as well as wind forecasts from Rapid Update Cycle (RUC) data from the same location and days.

Plans and Progress toward System Oriented Runway Management

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The runway configuration used by an airport has significant implications with respect to its capacity and ability to effectively manage surface and airborne traffic. Aircraft operators rely on runway configuration information, as it can significantly affect an airline's operations. Current practices in runway management are limited by a relatively short time horizon for reliable weather information and little assistance from automation. Wind velocity is the primary consideration when selecting a runway configuration; however, when winds are below a defined threshold, discretion may be used to determine the configuration. Other considerations relevant to runway configuration selection include such things as airport operator constraints, weather conditions (other than winds), traffic demand, user preferences, surface congestion, and navigation equipment limitations. The future offers an increasingly complex landscape for the runway management process. Concepts and technologies that hold the potential for capacity and efficiency increases for both operations on the airport surface and in terminal and en-route airspace are currently under investigation. Complementary advances in runway management are required if capacity and efficiency increases in those areas are to be realized. The System Oriented Runway Management (SORM) concept has been developed to address this critical part of the traffic flow process. The SORM Concept was developed to address all aspects of runway management for airports of varying sizes and that accommodates a myriad of traffic mixes. SORM currently addresses the single airport environment; however, the longer term vision is to incorporate capabilities for multiple airport (metroplex) operations, as well as accommodating advances in capabilities resulting from research currently underway. This presentation provides an update on the SORM concept, updates on selected areas of SORM research (single airport decision support tool development, benefit assessment, and technology transition), and planned future activities.

Assessment of fast-time wake vortex prediction models

Fred Proctor

Fast-time wake prediction models are semi-empirical, and are designed to predict aircraft wake vortex information behind a generating aircraft. They are developed using theoretical concepts and often calibrated with data obtained from field measurements, laboratory studies, or numerical simulations. They rely upon inputs representing the generating aircraft (such as weight, airspeed, wingspan, lateral position, and altitude) and atmospheric environment (such as ambient winds, turbulence, and temperature lapse rate). Other input may include the type of aircraft (e.g., B-747-400). Output from these models may include time histories of the wake vortex strength, and position, as well as a prediction of the uncertainties in strength and position. Fast-time models should provide solutions in a fraction of a second, and hence is an enabling technology able to perform in a real-time operational system, such as dynamic spacing systems envisioned by the Aircraft Vortex Spacing System or other Super Density Operations concepts. Other applications of fast-time models include 1) guidance for wake separation standards for new aircraft, 2) optimization of separation standards for existing aircraft, 3) guidance for setting vertical separation standards during cruise, 4) accident reconstructions, and 5) testing of new concepts for safe increases in airport capacity for both single and multiple runway configurations. Fast-time models are based on a number of assumptions which limit their accuracy and range of application. For example, they do not predict the meandering vortex paths that can result from the wake interaction with atmospheric turbulence. However, these models should account for the mean vortex position and may predict the level of uncertainty.

This presentation describes a study in which comparative evaluations of fast-time wake transport and decay models were conducted using data sets from previous field programs taken at MEM (1995), DFW (1997, 1999, 2000), and Denver (2005, 2006) airports. These data sets contain, meteorological data, lidar measurements of wake vortices, and the aircraft parameters associated with these vortices.

Assessment of wake vortex measurements using a Lidar Simulator

Fred Proctor

A lidar simulator tool has been developed to simulate the existing Lockheed Martin Coherent Technologies (LMCT) pulsed lidar that is currently used in field measurements of aircraft wake vortices. The simulator tool generates realistic raw signal data from velocity input data as measured by the lidar. The raw lidar data is processed and the resulting product files are input into the existing LMCT's Wake Vortex Processing Algorithm for determining position and circulation strength versus wake vortex age. Outputs from the Wake Vortex Processing Algorithm are then compared to the truth data that is derived from input velocity data. Accuracy of the lidar measurements of lateral and vertical vortex positions is evaluated by utilizing the lidar simulator, using input velocity fields based on analytical vortex models and time-dependent wake fields generated from 3-D numerical Large Eddy Simulations. Time-dependent wake vortex fields for different aircraft, lidar and environment conditions are assumed. This presentation describes a study that shows that the mean biases for the lidar measurements for vortex positions are small, about 4-7m for the lateral position and 1- 3 m for the vertical positions.

(for use if second slot is available for Wake presentation – otherwise this will be a poster)