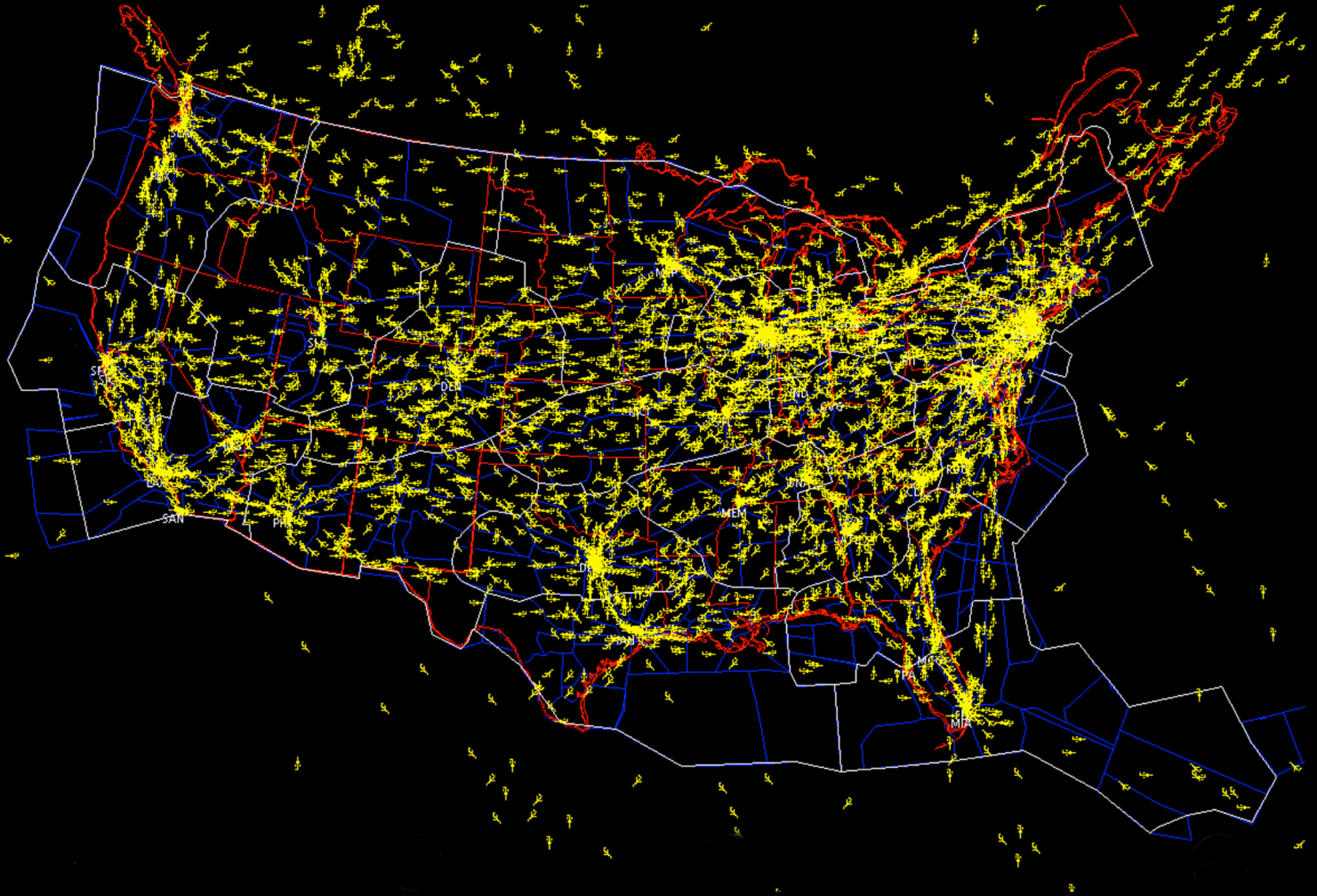


Airspace Systems Program Newsletter

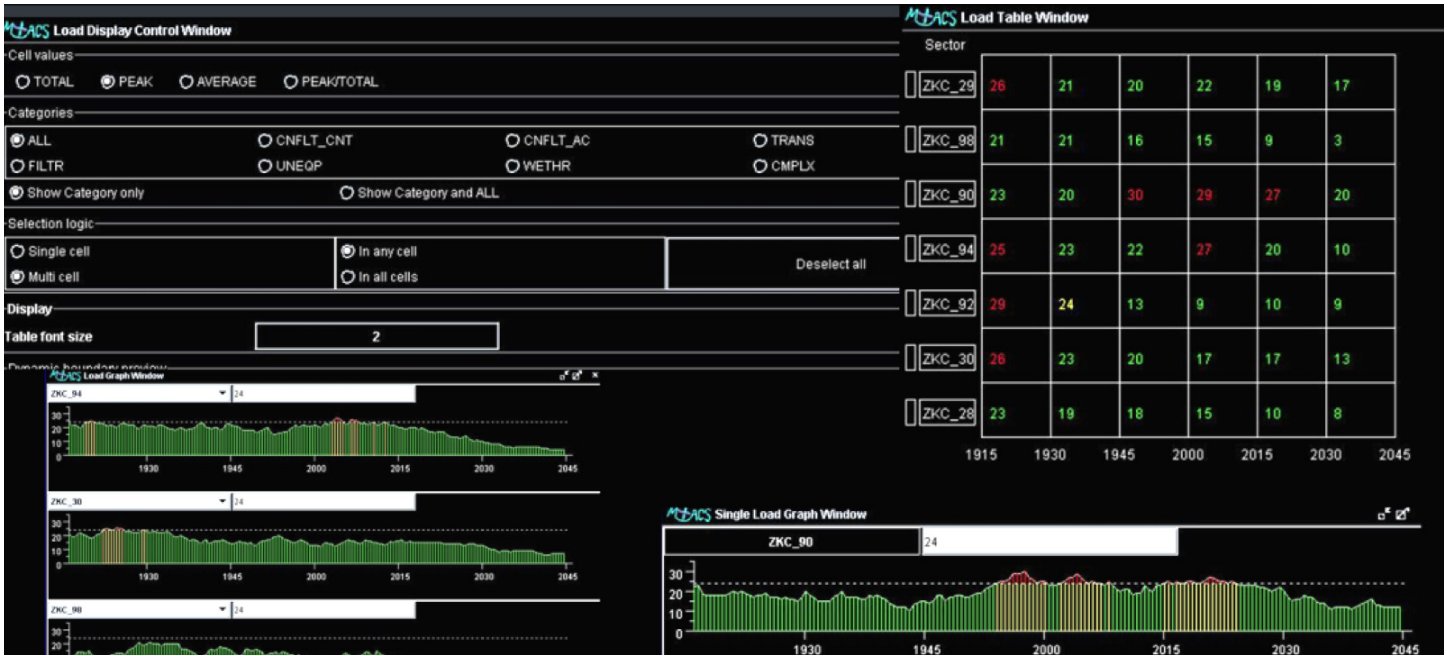
QUARTER 3: APR-JUNE 2011



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// Technical/Programmatic Highlights



Detail view of several of the FBTM automation tools: Interactive Load Tables and Graphs, and control window.

Flow-Based Trajectory Management Research Transition

Washington, DC

The Flow Based Trajectory Management Research Transition Team, a successful 3-year project jointly sponsored by NASA and the FAA, and coordinated by the JPDO, recently completed its work. Technical transfer and a close-out meeting were held July 14, 2011, at NASA Headquarters in Washington, DC.

Research Summary: Prototype tools and methods for in-flight “flow-based trajectory management” (FBTM) in the NextGen Mid-Term were developed and evaluated by NASA researchers in a series of human-in-the-loop (HITL) simulations. These FBTM capabilities support more “tactical” traffic flow adjustments than are feasible today by modifying the trajectories of in-flight aircraft. These operations provide a practical way to maintain efficient operations in the face of changing local and downstream constraints



Figure 1. Flow-based trajectory management operations adjust traffic flows in response to local area constraints or disturbances (e.g., traffic congestion, convective weather), by modifying the trajectories of aircraft that are already in flight. A NextGen “best-equipped, best-served” policy for rewarding early adopters of key new technology can be used to determine who should receive priority access to constrained airspace (blue aircraft).

[Figure 1]. Research results and tool requirements were delivered to the FAA, who will use them to help refine many of their Next-Gen Operational Improvements, and to guide the development of NextGen traffic management and controller tools.

Research Description: NASA’s involvement in FBTM research began in 2006, with an FAA-funded HITL evaluation conducted in NASA Ames Airspace Operations Lab (AOL), a high-fidelity simulation environment for prototyping and testing advanced air traffic management (ATM) concepts. This simulation indicated that a new “multi-sector planner” (MSP) position could effectively help manage the task load of several sectors by coordinating changes to local area traffic flows. This reimbursable

effort continued in 2007, with NASA researchers developing the MSP concept in terms of roles and responsibilities, operational procedures, information and communication requirements, and decision support tool requirements. A series of cognitive walk-throughs were conducted by AOL researchers, with a team of FAA en route and system operations personnel from across the country. These exercises supported the development of a greatly expanded prototype of MSP operations, with powerful new automation tools designed by Dr. Thomas Prevot for the AOL’s simulation test bed.

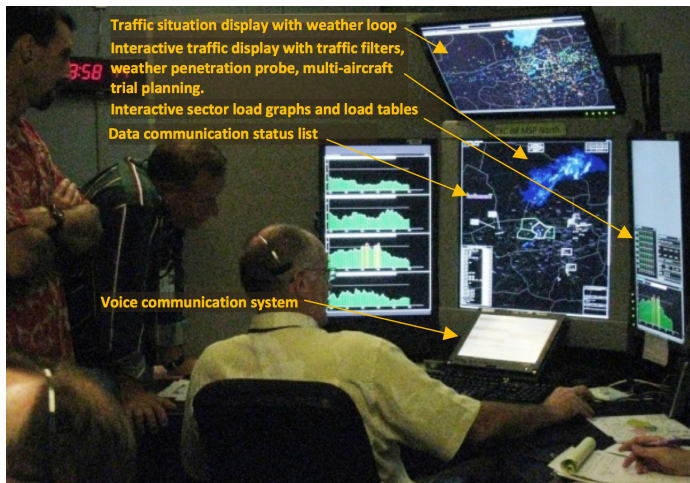


Figure 2. FBTM tools support situation assessment (load tables, load graphs, traffic display with weather and filters), multi-trajectory trial planning, and ground-to-ground coordination of plans and clearance requests. These tools can be configured for TMU, MSP or area supervisor positions.

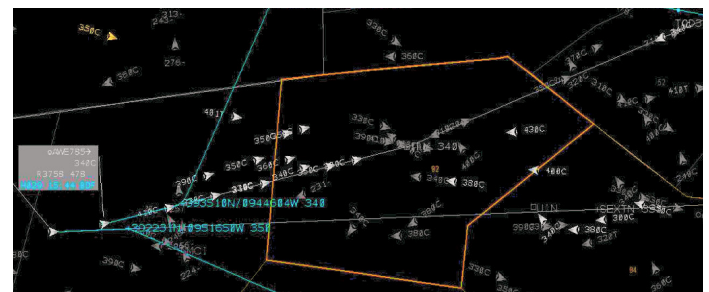
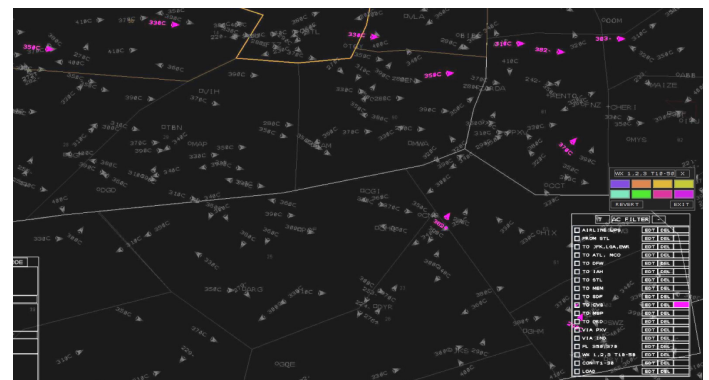


Figure 3. Detail view of several of the FBTM automation tools: Traffic filter highlighting Cincinnati arrivals in pink (top); Multi-trajectory Trial Planning to reduce predicted complexity of gold-highlighted sector (bottom).



Figure 4. This figure shows each type of position that was included in the 2009 HITL. Clockwise from lower left: FBTM planning stations for TMU; MSP; area supervisor positions; and controller stations that support evaluation and delivery of requested clearances.

This enhanced simulation platform was used in 2009 to conduct a HITL evaluation to assess the feasibility and potential benefit of introducing this new position into the National Airspace System (NAS) [Figures 2, 3].

Ten participants (active FAA controllers, traffic management personnel and area supervisors) and eight “confederates” (retired

FAA personnel) staffed traffic management coordinator, air traffic controller, supervisor, and MSP positions in a large-scale simulation that spanned several air traffic facilities [Figure 4]. Results indicated that the MSP functions could enhance local area traffic flow management, but that these functions could be effectively performed by existing facility personnel. Based on these results, the

FAA decided not to invest further in developing the new position, and instead to determine how best (and when) to incorporate the MSP’s FBTM functions into the NAS.

A key question regarding introduction timing was the avionics equipage requirements for FBTM. A final 2010 simulation tested the feasibility and possible benefit of performing FBTM operations in an environment where not all aircraft were equipped for air-ground data link communications (DataCom), an important enabler for trajectory-based operations. FBTM operations were not only effective in this context, but provided a promising method for introducing a new NextGen “best-equipped, best-served” policy of tactical air traffic management that could reward operators who invested in DataCom, with little or no penalty incurred by the unequipped aircraft.

FAA Involvement and RTT Role: In 2008, the MSP research effort was selected to be the focus of a new NASA/FAA Research Transition Team co-led by Michele Merkle (FAA) and Nancy Smith (NASA). The objective of this particular RTT was to develop the multi-sector traffic management concept for the NextGen Mid-Term as a capability for “tactical” multi-sector or local area flow management, and as something to bridge the gap between (tactical) separation management at the sector level, and (strategic) flow contingency management from the Traffic Management Unit (TMU). Continued participation from the FAA at a number of levels was crucial to the success of this activity. The expertise of FAA participants during the walkthroughs and simulations

was essential to the operational validity of the products. Equally important was the continued input from the FAA sponsors, which insured that the results would remain relevant to their needs, and consistent with their developing vision for NextGen. RTT status provided a framework to support this collaboration, and made the activity an important component of both agencies’ portfolios. This assured an ongoing commitment – from both management and researchers—to devote important resources from both agencies to see the work to its successful completion.

Benefits: While the primary purpose of this effort was to use some of NASA’s unique capabilities to address the FAA’s needs, the work also provided substantial benefit to NASA. The AOL simulation testbed was expanded to include realistic TFM operations and new FBTM functions. These capabilities played a significant role in several recent AOL simulations conducted for three of the Concepts and Technology Development Project’s research focus areas (separation assurance, super-density operations, and dynamic airspace configuration). Equally important, the cross-agency relationships, as well as the insights and expertise gained by NASA researchers—about the FAA’s plans for NextGen; their changing expectations for available infrastructure and avionics technologies in future operational environments; and perhaps most significantly, of the complex team interactions that support both current and future operations within FAA facilities—greatly enhance NASA’s ability to develop satisfactory and effective solutions for NextGen. *(POC: Nancy Smith)*

Final Reviews for Metroplex NASA Research Agreement, June 2011

NASA Langley Research Center

On Thursday, June 2nd and Monday, June 20th, 2011, the final reviews were held for the four one-year Metroplex-related NASA Research Agreements (NRAs) that were awarded last year, with Recovery Act funding. The technical monitors for the NRAs are Rosa Oseguera-Lohr, Michael Sorokach and Lakisha Crosby. Although the mid-term meetings were conducted jointly over two consecutive days in February, it was more difficult to coordinate all four final reviews to take place at the same time, due to differences in the dates of contract signing and kick-off (and subsequently, contract end). Many of the attendees from the mid-term review also attended the final reviews, either in person or remotely.

All four NRA teams showed good results from their analyses which generated good discussions, and technical feedback from other interested researchers was mostly very positive. Two of the teams presented concepts that are considered good candidates for transfer from SAIE (Systems Analysis, Integration, and Evaluation) to CTD (Concepts and Technology Development), since they are at a more mature technical stage, and could readily be integrated with other existing terminal area scheduling concepts that are currently being investigated as part of the CTD portfolio. The potential application of these concepts will be discussed as part of the milestone completion report that is due in September 2011, and discussions with project managers on this topic have been initiated.

9th USA/Europe Air Traffic Management Research & Development Seminar (ATM2011), June 14-17, 2011

Berlin, Germany

Aviation Systems Division researchers presented several papers at the prestigious USA/Europe Air Traffic Management Research and Development Seminar, the ninth in a series of seminars that was jointly organized by the FAA and EUROCONTROL to focus on air traffic management research and development. The conference was well-attended by both European and US researchers. A list of all presented papers follows. Two featured papers are highlighted after the list.

Bloem, M., and Huang, H., "Evaluating Delay Cost Functions with Airline Actions in Airspace Flow Programs," 9th USA/Europe ATM R&D Seminar (ATM2011), Berlin, Germany, 14-17 June 2011.

Hoang, T., Jung, Y., Holbrook, J., and Malik, W., "Tower Controllers' Assessment of the Spot and Runway Departure Advisor (SARDA) Concept," 9th USA/Europe ATM R&D Seminar (ATM2011), Berlin, Germany, 14-17 June 2011.

Jung, Y., Hoang, T., Montoya, J., Gupta, G., Malik, W., Tobias, L., and Wang, H., "Performance Evaluation of a Surface Traffic Management Tool for Dallas/Fort Worth International Airport," 9th USA/Europe ATM R&D Seminar (ATM2011), Berlin, Germany, 14-17 June 2011.

Lauderdale, T.A., Cone, A.C., and Bowe, A.R., "Relative Significance of Trajectory Prediction Errors on an Automated Separation

Assurance Algorithm,” 9th USA/Europe ATM R&D Seminar (ATM2011), Berlin, Germany, 14-17 June 2011.

Mueller, E., McNally, D., Rentas, T., Aweiss, A., Thippavong, D., Gong, C., Cheng, J., Walton, J., Walker, J., Lee, C., Sahlman, S., and Carpenter, D., “Controller and Pilot Evaluation of a Datalink-Enabled Trajectory-Based Operations Concept,” 9th USA/Europe ATM R&D Seminar (ATM2011), Berlin, Germany, 14-17 June 2011.

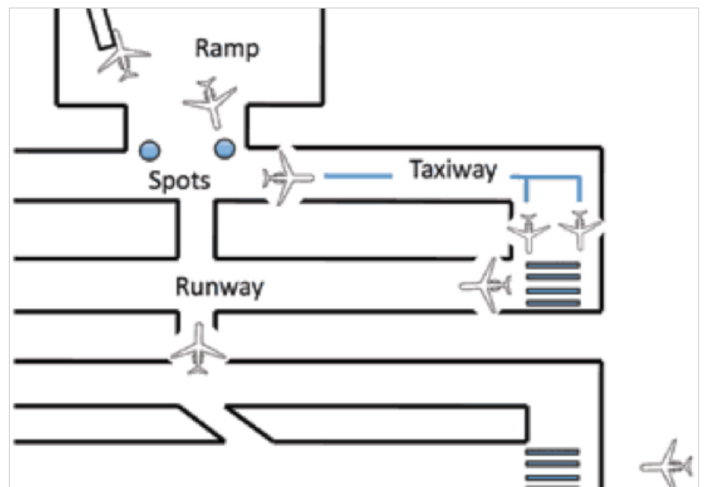
Sridhar, B., Chen, N.Y., Ng, H.K., and Linke, F., “Design of Aircraft Trajectories Based on Trade-offs between Emission Sources,” 9th USA/Europe ATM R&D Seminar (ATM2011), Berlin, Germany, 14-17 June 2011.

Stell, L., “Prediction of Top of Descent Location for Idle-thrust Descents,” 9th USA/Europe ATM R&D Seminar (ATM2011), Berlin, Germany, 14-17 June 2011.

Swenson, H.N., Thippavong, J., Sadovsky, A., Chen, L., Sullivan, C., and Martin, L., “Design and Evaluation of the Terminal Area Precision Scheduling and Spacing System,” 9th USA/Europe ATM R&D Seminar (ATM2011), Berlin, Germany, 14-17 June 2011.

Verma, S., Lozito, S., Kaneshige, J., Ballinger, D., Sharma, S., Martin, L., Kozon, T., Cheng, L., and Subramanian, S., “Integrated Pilot and Controller Procedures: Aircraft Pairing for Simultaneous Approaches to Closely Spaced Parallel Runways,” 9th USA/Europe ATM R&D Seminar (ATM2011), Berlin, Germany, 14-17 June 2011.

Berlin Paper Highlight: “Performance Evaluation of a Surface Traffic Management Tool for Dallas/Fort Worth International Airport” NASA Ames researchers earned the best paper in the “Airport” track for their paper describing the development and testing of airport surface scheduling algorithms. The paper described results from a human-in-the-loop evaluation of the Spot And Runway Departure Advisor (SARDA) decision support tool. SARDA is designed to aid ground and local controllers in managing aircraft surface operations, based on two optimization algorithms, the Spot Release Planner and the Runway Scheduler. The Spot Release Planner provides sequence and timing advisories to the ground controller for releasing departure aircraft into the aircraft movement area to reduce taxi delay while achieving maximum throughput. The Runway Scheduler provides take-off and arrival runway crossing sequences to the Local controller to maximize runway usage. Performance metrics from the simulation study included



The Spot and Runway Departure Advisor (SARDA) helps to improve the efficiency of airport surface operations involving the ramps, spots, taxiways, and runways.

delay, number of aircraft stops, fuel consumption, and aircraft engine emissions. High traffic scenarios demonstrated the average departure delay and number of aircraft stops in the movement area were reduced by 64 and 68 percent, respectively. Such results would lead to potential fuel consumption and engine emissions reductions of as much as 38 percent. However, for normal traffic scenarios there was little change in any of performance metrics mainly due to low traffic volume. (POC: *Yoon Jung*)

Berlin Paper Highlight: “Evaluating Delay Cost Functions with Airline Actions in Airspace Flow Programs”

Traffic management research and simulation use delay cost functions that attempt to quantify the cost of delay to airlines. To better understand these costs, a study was undertaken in which seventeen delay cost functions from previous research were evaluated with airline actions in operational Airspace Flow Programs. The results, presented at the ATM2011 in Berlin, identify delay cost functions in which costs increase in discrete steps as delay increases as most consistent with airline actions. Additionally, delay costs that are proportional to the length of delay, but with larger proportionality constants for flights bound for hub airports, were also found to be consistent with airline actions. (POC: *Michael Bloem*)

Berlin Paper Highlight: “System Oriented Runway Management”

The System Oriented Runway Management (SORM) presentation was well received, and the need for effective runway management was underscored by the positive comments and discussion generated. Several organizations expressed interest in sharing information with the objective of advancing the state of runway management, including the German Aerospace Center and the National Aerospace Laboratories of the Netherlands. The SORM

concept was developed to address all aspects of runway management for airports of varying sizes and to accommodate a myriad of traffic mixes. SORM, to date, addresses the single airport environment; however, the longer term vision is to incorporate capabilities for multiple airport (Metroplex) operations as well as to accommodate advances in capabilities resulting from ongoing research. The paper presented provides an update of research supporting the SORM concept including the results of a TRCM simulation and a benefits assessment.

(POC: *Gary Lohr*)

Interval Management with Spacing to Dependent Parallel Runways Human-in-the-Loop Simulation, June 2011

NASA Langley Research Center

The Crew Systems and Aviation Operations Branch conducted a human-in-the-loop (HITL) simulation on Interval Management (IM) with Spacing to Dependent Parallel Runways (IMSPiDR1) from June 6 through June 23 for the NextGen Airspace Program. This experiment had 24 current commercial airline pilots assess the performance of the IM spacing algorithm; assess flight crew’s ability to conduct IM with spacing (IM-S) procedures to dependent parallel runways and maintain high runway throughput; obtain pilot feedback regarding the IM-S procedures, controls, displays, and responsibilities; and explored some off-nominal operations. The HITL used the Air Traffic Operations Lab (ATOL), the Development and Test Simulator (DTS), and the Integration Flight Deck (IFD) to create high-density arrival operations into the Dallas Fort-Worth airport. This was the first use of the DTS (originally built as the aft-flight deck for the B-757 aircraft) for research activities. The IM procedure and IMSPiDR1 experiment

are conducted with and supported by the FAA Surveillance and Broadcast Services office and FAA Air Traffic Organization office.
(POC: Brian Baxley)

Intelligent Automation, Inc., Visits Langley Research Center, June 2011

NASA Langley Research Center

On Tuesday, June 21, 2011, Intelligent Automation, Inc. (IAI), of Rockville, Maryland, updated Langley researchers on their SBIR Phase II work, 'Integrated Testbed of Environmental Analysis of NextGen Concepts Using ACES.' This technology is directly applicable to the development of next-generation air traffic management for the FAA and commercial airlines. As the skies become more crowded, increases in delays, pollution and costs are also expected.

The work being done during Phase II will allow NASA and IAI to jointly conduct combined performance and environmental benefits analyses of NASA NextGen concepts building on the analysis tool developed under Phase I of the SBIR award. In the cases where there are multiples ways of implementing a concept, the analysis will help researchers know which one performs best.

San Francisco International Airport Ground Delay Program Operational Trial Begins, June 2011

NASA Ames Research Center

The operational shadow assessment of the San Francisco International Airport Ground Delay Program Selection model at the FAA's Air Traffic Control System Command Center began on

June 8, 2011. The shadow mode of operation will continue for roughly 30 stratus events during which time the modeled and actual Ground Delay Program parameters will be analyzed by the Quality Assurance Department at the FAA's ATCSCC.

(POC: Shon Grabbe)

NASA Presents Research to American Airlines Executives, June 2011

Dallas/Fort-Worth, TX

NASA researchers met with American Airlines executives to discuss areas of possible collaboration. The June 29th meeting was held at the American Airlines Headquarters near the Dallas/Fort-Worth (DFW) Airport in Texas. The participants included leaders of various areas within American Airlines and a senior leader of the DFW airport. Personnel from NASA Headquarters, Ames and Langley represented NASA's Airspace Systems Program. The presentations included a wide range of topics such as the ATD-1 project, surface management research, tactical runway configuration management, aircraft-based conflict detection and resolution, dynamic weather routes/ground-based trajectory based operations, and weather integration and translation. The NASA's North Texas Field Site and its role in potential collaborations were also reviewed. Both NASA and American Airlines expressed interest in pursuing some of these projects and discussions are underway on how to best proceed to develop new collaborations.

(POC: Tom Davis)

Another Successful Efficient Descent Advisor Simulation with FAA Controllers in the Loop, June 2011

NASA Ames Research Center

A human-in-the-loop simulation of the Efficient Descent Advisor (EDA) was successfully conducted the week of June 20, 2011, in the NASA Ames Crew-Vehicle Systems Research Facility. This was the sixth simulation carried out under the 3D-Path Arrival Management (3D-PAM) technology-transition effort. Participants included active-duty controllers from Denver Center representing the National Air Traffic Controllers Association. The simulation objectives were twofold: 1) evaluate the impact of an active, radar-side conflict probe on EDA operations and controller acceptance, and 2) demonstrate the ability of EDA to support mixed avionics equipage, meaning a large proportion of the arrival traffic featured less-advanced flight management systems, typical of regional jet aircraft, for example. Anecdotal feedback from the controller subjects indicated that the conflict probe was beneficial to EDA operations. A mixed-equipage arrival stream presented no observable issues or concerns. Detailed results are forthcoming. The simulation was well-attended by government and industry stakeholders, including representatives from the FAA, Boeing and MITRE. FAA attendees included the 3D-PAM project lead along with representatives from the En Route Automation Modernization and Time-Based Flow Management project offices interested in discussing field integration and deployment strategies. Of particular interest was how 3D-PAM/EDA might be leveraged to address the FAA's requirement for Ground-based Interval Management, slated for deployment in the 2014 timeframe. (POC: Rich Coppenbarger)

NASA Software Used in Georgia Tech Dissertation, June 2011

NASA Langley Research Center

The NASA Langley-developed Stratway algorithm, a strategic conflict detection and resolution (CD&R) program, was used in a recently completed Georgia Tech dissertation by Matt Bigelow, a student of Dr. Amy Pritchett. In his dissertation entitled "Examining the Relative Costs and Benefits of Shifting the Locus of Control in a Novel Air Traffic Management Environment Via Multi-agent Dynamic Analysis and Simulation," Matt Bigelow configured the Stratway program to be used in both a centralized and decentralized manner in order to study the relative advantages and disadvantages of these approaches. This was possible because the Stratway program was developed as a highly configurable program with several dozen user-definable parameters. Although there are many competing approaches to strategic conflict detection and resolution, the vast majority are developed within a large simulation and hence are not available for outside use. The Stratway program is the first (that we know of) strategic CD&R program that has been designed in a modular manner to enable reuse in other environments. Although this has required much additional work in designing, testing, and documenting these interfaces, the value of this is seen in the fact that seven external organizations have already requested Stratway. The advantages and disadvantages of this modular approach will be presented in an upcoming Conference: the 11th AIAA Aviation Technology, Integration, and Operations Conference, in a paper entitled "Stratway: A Modular Approach to Strategic Conflict Resolution." (POC: Jeff Maddalon)

Digital Traffic Management Initiative Meeting with the FAA, May 2011

NASA Ames Research Center

In support of the TFM component of the Efficient Flow into Congested Airspace RTT, a meeting was held with Richard Jehlen (FAA/Director, Planning & Performance) at NASA Ames Research Center on May 20, 2011. During the meeting, updates were provided on NASA's Traffic Management Initiative (TMI) Cube, Digital TMI and Learning Automation activities. An early software prototype of the TMI Cube software was also demonstrated to Mr. Jehlen. (POC: *Joseph Rios*)

FAA Collaborative Decision-Making Meeting, May 2011

Atlanta, GA

The FAA Collaborative Decision-Making meeting was held during the May 2-4 at Delta Air Lines Headquarters in Atlanta, Georgia. The meeting was attended by about 180 members of the airline, cargo and general aviation community, the FAA, NASA and other support industry personnel. The general presentations on May 4 provided information on NY-Area Airspace redesign, New Wind Routes, National Special Activity Airspace Project, Unmanned Aircraft Systems, etc. (POC: *Kapil Sheth*)

Statistical Design and Analysis of Experiments for NextGen Presented, May 2011

NASA Langley Research Center

Dr. Sara Wilson, of the LaRC Aeronautics System Engineering Branch, presented a brief on statistical design and analysis of experi-

ments for Next Generation Air Transportation research at the 2011 NASA Statistical Engineering Symposium, which was held May 3-5, 2011, in Williamsburg, Virginia. The symposium was co-sponsored by the NESC and LaRC Engineering Directorate. Engineers, statisticians, scientists, managers and project leaders shared lessons learned, techniques and strategies for improving awareness of the value of statistical engineering across NASA. Statistical engineering is a discipline that utilizes statistical thinking and tools to improve decisions early in design development, analysis, experimental testing, verification, validation, and certification projects.

JPDO Environmental Working Group Operations Standing Committee 2011 Workshop and Meeting, May 2011

NASA Langley Research Center

Dave Williams, Crew Systems and Aviation Operations Branch, attended the JPDO workshop and panel meeting held at MITRE Corporation headquarters in McLean, Virginia, on May 3-4, 2011. The workshop consisted of a series of presentations on recent activities related to environmental impacts of aircraft operations. Presentations were made by representatives from FAA, Boeing, MITRE, GE Aviation, US Airways, and Georgia Tech, on the status of ongoing environmental activities. At the end of the second day, the Operations Standing Committee (OSC) panel members met to discuss the work plan of the committee and share ideas on potential FY11/12 activities. Dave Williams from Langley and Everett Palmer from Ames are the NASA representatives on the committee.

Highlights from the workshop included an update from the FAA RNAV/RNP program office on the widespread deployment and

testing of RNAV procedures with Optimized Profile Descents. Members of the OSC panel, including NASA, have been instrumental over the past several years in sponsoring and conducting research on new terminal arrival procedures that enable full RNAV arrivals from cruise to landing without the need for controller radar vectoring. These procedures are now being implemented at airports throughout the National Airspace System. Boeing presented an overview of the new technology incorporated in the latest Boeing commercial air-planes designed to save fuel and reduce the environmental impact of their airplanes. Several presentations focused on new capabilities for analyzing radar flight data to extract fuel, noise, and engine metrics for environmental impact. The FAA also presented the current status and planned updates to the Aviation Environment Design Tool, which will be used for environmental impact analyses of flight operations at all U.S. airports.

Beyond the planned workshop agenda, separate discussions were held with representatives of Boeing and GE Aviation regarding potential collaboration with NASA on future flight demonstration projects being planned by Boeing. In particular, Boeing is interested in testing the Low Noise Guidance concept developed by Dave Williams at NASA on a flight demonstration planned for 2014 using a new production 737 airplane. Boeing had been provided an early prototype of LNG in 2005 for testing, and has expressed renewed interest in the concept. Mr. Williams agreed to assist Boeing with documentation on the latest version of LNG and results of recent NASA simulation testing of Energy Navigation, which is an extension to the original LNG concept. Further discussions are planned to explore additional NASA collaboration with Boeing on their planned flight demonstrations.

Participation in the JPDO EWG OSC is of significant benefit to the Airspace Systems research efforts at NASA. It provides a unique forum to discuss and present NASA research to other key government and industry representatives, and also keeps NASA informed about the latest developments in environment-related flight operations. *(POC: Don Williams)*

Aeronautics Research Mission Directorate Associate Administrator Awards for 2010 *Washington, DC*

Congratulations to all winners of the 2010 Awards! Winners from the Aviation Systems Division include:

- John Robinson (AFH)
Technology and Innovation (Individual)
- SimLabs (AFS)
Program and Mission Support (Group)



The winner of the Individual award for Technology and Innovation, John Robinson, Ames Research Center (center) is pictured with Tom Irvine, Deputy Associate Administrator for ARMD (left) and Dr. Jaiwon Shin, Associate Administrator for ARMD.



The winner of the Individual award for High Potential, Maryam Kamgarpour (center), Ames Research Center, is pictured with Tom Irvine, Deputy Associate Administrator for ARMD (left) and Dr. Jaiwon Shin, Associate Administrator for ARMD.

- Maryam Kamgarpour (AFH intern)
High Potential (Individual)

More information and photos from the April 27th awards ceremony are available at http://www.aeronautics.nasa.gov/aa_awards.htm.

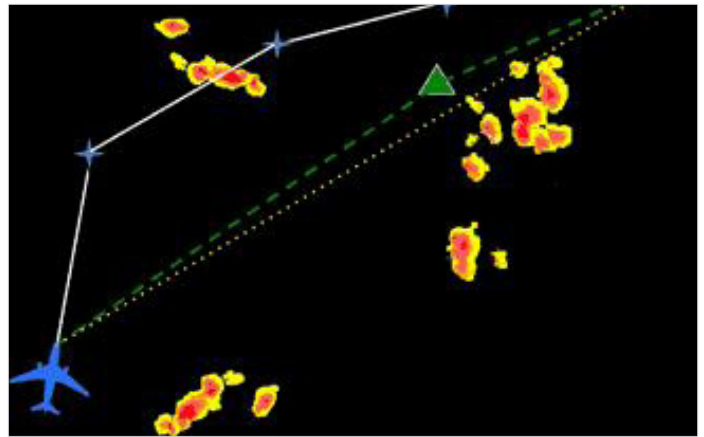
Study Finds Dynamic Weather Reroutes Save an Average of 4 Minutes per Eligible Flight, April 2011

NASA Ames Research Center

An initial study was conducted to explore the benefits of time-saving route amendments that avoid weather, called dynamic weather reroutes, using a dataset of flights that operated during twelve hours of severe weather that occurred over four days in the Fort Worth (Texas) Air Route Traffic Control Center. NASA's Direct-To decision support tool was used to select flights with

direct routes that saved at least 5 minutes. Dynamic weather reroutes were generated from those direct routes that crossed convective weather and which were extended to traverse around the weather. The dynamic weather reroutes were found to save an average of four minutes per flight when compared to the original flight plan. The preliminary results were presented at the Airspace Systems Program Technical Interchange Meeting (San Diego, CA) in March 2011. Although the time-savings found in this study are noteworthy, the study only investigated a small number of flights. A new study investigating a larger sample is needed to substantiate the benefit and efforts are underway to expand the dataset.

(POC: Walter Johnson)

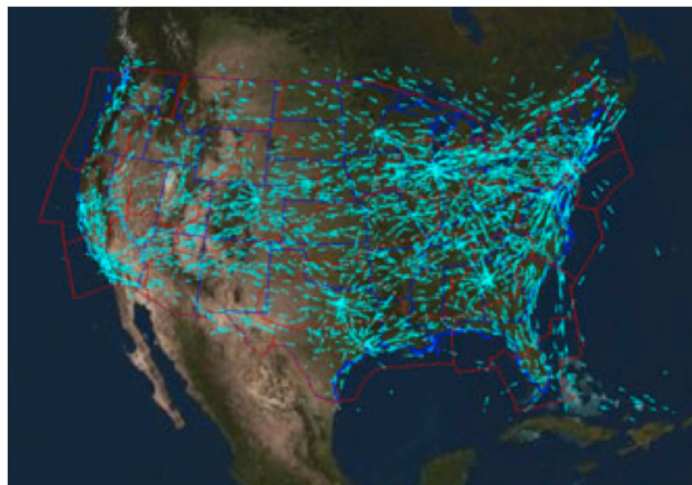


This figure represents an example of a dynamic weather reroute. The white solid line represents the aircraft's current flight plan. The image shows that the aircraft must be rerouted due to convective weather. The yellow dotted line shows an initial direct route to its downstream fix that reduces flight time, but this route also encounters convective weather. The green dashed line shows a new dynamic weather reroute that avoids weather and decreases flight time.

Researchers Get Tips on Modeling Airspace Concepts using Airspace Concept Evaluation System at Ames Workshop, May 2011

NASA Ames Research Center

The Systems Modeling and Optimization Branch hosted a 2-day workshop May 18-19, 2011, at Ames Research Center to share NASA's research experience using the Airspace Concept Evaluation System (ACES). Forty-nine researchers and software developers attended the workshop, representing the William J. Hughes (FAA) Technical Center, NASA Ames Research Center, NASA Langley Research Center, Aerospace Computing Inc., Intelligent Automation Inc., Mosaic ATM Inc., Raytheon, and the University Affiliated Research Center. Researchers from the FAA Technical Center used ACES in their benefit assessment studies and were interested in using ACES to study the effects of trajectory uncertainty.



The Airspace Concept Evaluation System (ACES) is used to model the flow of traffic across the U.S. This snapshot shows all of the flights over the U.S. at a given time.

Researchers at Ames gave presentations on how to set up and use ACES to assess benefits and interactions of several ATM concepts, including separation assurance, interaction between traffic flow management and dynamic airspace configuration, and precision departure release capability. Researchers from NASA Langley Research Center explored using ACES as a system cost and benefit analysis tool in particular to study terminal area merging and spacing. Representatives from the Joint Planning and Development Office presented their work on system-wide portfolio assessment and Unmanned Aerial System integration in the National Airspace System. The latter focuses on communication bandwidth using the Communication Navigation and Surveillance component of ACES. (POC: Kee Palopo)

Airspace Concept Evaluation System Users Group Grows by Three, May 2011

NASA Ames Research Center

Three external organizations have recently requested Airspace Concept Evaluation System (ACES) to support their research. The first organization, the U.S. Department of Transportation/Volpe National Transportation Systems Center/Traffic Flow Management Division (RVT-73), is evaluating a Dynamic Meter Point concept for consideration as a future functional enhancement to the FAA's Time Based Flow Management so that meter points can be placed at any location in the airspace, not necessarily tied to existing fixes. The second organization, the Human Performance Modeling group of the National Information and Communication Technology Australia's Queensland Research Lab, is developing an air traffic management model in partnership with Air Services Australia. Their main goal is to analyze Australian air traffic management

and find solutions that would reduce the workload of air traffic controllers. The third organization, Czech Technical University, is considering using ACES in their unmanned aerial vehicle research. (POC: Kee Palopo)

New Ground-Based Capability that Dynamically Finds Time-Saving Weather Avoidance Routes is Prototyped, May 2011

NASA Ames Research Center

A new function that automatically finds alternative convective weather routes that save time and fuel for en-route aircraft has been implemented in the Center/TRACON Automation System. Convective weather is the biggest cause of delay in the National Airspace System, and automation does not exist to help airline dispatchers and FAA traffic managers to continuously reevaluate today's static weather avoidance routes, which are typically put in place before an aircraft departs. Dynamic Weather Routes integrates trajectory-based automation designed for Center radar controllers, convective weather modeling that predicts the growth and movement of storms, and algorithms to automatically compute minimum-delay routes around weather cells. Simple route changes that save flying time—10 min. per flight is typical—and avoid downstream weather are automatically computed. The user interface enables quick visualization and modification of the route, if necessary. The route changes are automatically formatted for voice or data link clearance delivery using currently available air/ground data communication capabilities. The next step is to run the automation in the lab to determine benefit potential using actual traffic over several weather days and to quantify the difference in benefit for aircraft with and without data link equipage.

Preliminary results suggest a potential savings of 350 minutes flying time over 5 hours of weather-impacted operations in one en route Center. (POC: Dave McNally)

New Capability for the Terminal Area Precision Scheduling and Spacing System Developed for Off-Nominal Conditions, May 2011

NASA Ames Research Center

The Terminal Area Precision Scheduling and Spacing (TAPSS) system, which has shown in high fidelity simulations the ability to simultaneously achieve both capacity increasing and environmental benefits for high density airports, has added a new capability. To ensure the robustness of the TAPSS technology for the demonstration and eventual technology transfer to the FAA, automation to address off-nominal conditions is required. These conditions include problems as simple as schedule non-conformance and as complex as re-scheduling for aircraft that are conducting go-around



NASA researchers evaluate the performance of NextGen ATM technologies using TAPSS.

procedures after aborted landings. Initial human-in-the-loop simulations in April and May have tested the new go-around simulation capability and the automation algorithms for both the re-conformance and re-scheduling functionality. Formal experiments are being planned for June and September of 2011 for a thorough evaluation of these new capabilities. TAPSS is a key component in the first Air traffic management Technology Demonstration.

(POC: Harry Swenson, Jane Thippavong)

NASA Summer Intern Wins Second Place at AIAA Student Conference, April 2011

Dayton, OH

Charles Schultz placed second in the Undergraduate Technical Paper category at the Region III AIAA Student Conference held at the University of Dayton on April 2nd, 2011. Mr. Schultz conducted his research on an adaptive trajectory prediction feedback algorithm for climbing flights while interning with the Aviation Systems Division at NASA Ames Research Center in the summer of 2010. As a proof of concept, he demonstrated how his algorithm could enhance trajectory prediction accuracy by a factor of at least two for a sample of 18 climbing flights. Both the paper and presentation were well received by the judges and other conference participants. After completing his undergraduate degree this month in Aerospace Engineering at the University of Michigan, Mr. Schultz will be returning to NASA Ames for the summer to apply the feedback he received at the student conference to further improve the performance of his adaptive climb algorithm.

Planning Meeting Completed for Air Traffic Management Technology Demonstration, May 2011

NASA Langley Research Center

On May 3-5, the ATD-1 team, together with researchers and project managers from NASA Ames and Langley Research Centers, held a 3-day planning meeting at NASA Langley to finalize the first version of a project plan. ATD-1 was selected as the first technology demonstration in a series of ARMD air traffic management Technology Demonstration activities. These activities are aimed at accelerating airspace technology transition in general and adoption of ADS-B technology in particular. ATD-1 combines advanced time-based scheduling in terminal airspace, controller managed spacing tools, and flight deck interval management to achieve sustained fuel efficient operations during periods of high traffic demand. In coordination with the FAA and industry partners, ATD-1 will conduct a series of high-fidelity human-in-the-loop simulations and operational demonstrations of advanced terminal operations. *(POC: John Robinson)*

Arrival Conformance Monitoring Tool to Lower Simultaneous Offset Instrument Approaches Minima Demonstrated to the FAA, April 2011

NASA Ames Research Center

FAA personnel from the Northern California TRACON and San Francisco International Airport (SFO) were shown a conformance-

monitoring tool that was developed as part of NASA's research to improve procedures for parallel approaches to closely-spaced parallel runways. This tool could help controllers assess if a following aircraft was traveling at a correct speed to couple or pair with a lead aircraft for simultaneous landings to runways 750 feet apart. This tool has potential for lowering the cloud ceiling for simultaneous offset instrument approaches operations at SFO from 2100 feet to 1600 feet.

Human-in-the-Loop Simulation of the Efficient Descent Advisor, April 2011

NASA Ames Research Center

A human-in-the-loop simulation of the Efficient Descent Advisor (EDA) was successfully conducted the week of April 4, 2011, in the NASA Ames Crew-Vehicle Systems Research Facility. This was the fifth such simulation carried out under the 3D-Path Arrival Management (3D-PAM) technology-transition effort. Participants included active-duty controllers from Denver Center representing the National Air Traffic Controllers Association. The primary objective was to evaluate a new EDA design that provides advisories for all arrival aircraft at all times of day, regardless of demand-capacity constraints, thereby creating consistent arrival procedures. New procedures were also evaluated for minimizing the impact of top-of-descent uncertainty by delaying descent authorization until aircraft were within the sector in which the descent clearance was issued. Preliminary results suggest that the new designs and



Efficient Descent Advisor Simulation.

procedures evaluated in this simulation were viewed favorably by controllers. Representatives from various FAA offices and Boeing visited NASA Ames to observe the simulation and to discuss strategy and requirements for technology transfer.

(POC: Rich Coppenbarger)

Simulation of a Tactical Aircraft Separation Tool for Terminal Airspace Completed, April 2011

NASA Ames Research Center

Two weeks of human-in-the-loop simulations to evaluate a terminal tactical aircraft separation tool were successfully completed at NASA Ames in March and April 2011. The tool, called the Terminal Tactical Separation Assured Flight Environment (T-TSAFE), is a derivative of a previously-tested conflict detection and resolu-

tion tool for the en-route phase of flight. Evaluations of en route T-TSAFE show it has fewer false alerts (as low as 2 per hour) and better prediction to conflict time than NASA's implementation of the FAA's Conflict Alert prediction tool. The simulation was conducted using the airspace around the Los Angeles International Airport and had two general objectives: first, to verify fast-time simulation results that show benefits of T-TSAFE over Conflict Alert, including reduced false/missed alerts and increased time to predicted loss of separation; and second, to define the controller procedures and information requirements for the tool's use. Eight retired Southern California TRACON controllers, 11 pseudo pilots and 2 subject matter experts participated in the study where T-TSAFE provided conflict detection alerts and the controllers were required to resolve conflicts in a manner similar to current-day procedures. Data were collected to evaluate the tool's impact on controller workload, intervention, and situation awareness and data analysis is underway. (POC: *Verma Savvy*)

NASA Researchers Assist FAA with Initial NextGen Deployment, April 2011

NASA Ames Research Center

The FAA Traffic Management Advisor (TMA) Program Office recently requested NASA's assistance in improving features within the operationally deployed TMA, which is an important component in the achievement of NextGen goals. NASA originally developed TMA as part of the Center-TRACON Automation System (CTAS) and transferred the technology to the FAA in the late 1990s. NASA continued to develop significant enhancements over the last decade to address evolving NextGen objectives. NASA researchers visited the FAA's Oakland Air Route Traffic Control Center (Oakland Center) to better understand improvement opportunities for TMA. Oakland Center has a comparatively high rate of TMA metering delay events and employs two adjacent-center metering operations. The Oakland Center FAA managers were appreciative of the visit and will work with NASA to accomplish future observation and validation of analysis results.

National Aeronautics and Space Administration

Headquarters

300 E. Street, SW
Washington, DC 20024
www.aeronautics.nasa.gov

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