National Aeronautics and Space Administration

Airspace Systems Program

A quarterly update of accomplishments and upcoming activities from NASA's Airspace Systems Program.

JULY—SEPTEMBER 2010

Technical/Programmatic Highlights

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See inside for details

Technical/Programmatic Highlights

1 NASA and FAA Researchers Collaborate on Dynamically Managing Airspace, June 2010

Details: NASA researchers and FAA members of the Concept Development Group met with active airspace line managers from the FAA SPARC (Strategic Planning Advisory Review Cadre) team June 7-10 to discuss dynamic airspace configuration scenarios. SPARC team members provided feedback on acceptability, limitations, and coordination requirements for changing airspace boundaries in the FAA mid-term high altitude concept environment. They also provided positive and constructive feedback on the experiment plan for a NASA human-in-the-loop (HITL) simulation, planned for August 2010, exploring the role of the human operator in dynamic airspace configuration. Based on SPARC team feedback, the experiment plan for a fast-time mid-term DAC benefit analysis has been modified. They strongly recommended that airspace changes within mixed equipage airspace in the mid-term stay within controller areas of specialization. Dynamic airspace configuration within higher altitude generic airspace where all aircraft are trajectory-based operations (TBO) equipped should not be constrained to areas of specialization. The FAA concept development group will use the results of this modified fast-time analysis and the August HITL simulation to support their future research plan.

2 Generic Airspace Human-In-The-Loop Simulation Completed, July 2010

Details: Phase 4 of the Generic Airspace research effort was completed with a successful human-in-the-loop simulation led by Dr. Richard Mogford and the Generic Airspace Team, comprised of software developers and researchers from SimLabs and the Human Systems Integration Division at Ames. The human-in-the-loop simulation, hosted in the Radar Air Traffic Control Laboratory in the Crew-Vehicle Systems Research Facility (CVSRF), evaluated methods for providing important airspace information and reducing sector information requirements to allow future air-traffic controllers to manage air traffic in NextGen airspace with reduced training. The simulation also investigated the effect of segregation based upon aircraft equipage based segregation on the FAA's mid-term High Altitude Airspace Concept. The Controller Information Tool (CIT), an en-route auxiliary display developed and refined in previous phases of this research effort, was used to provide controllers with critical situational information. The Multi Aircraft Control System (MACS) software was used to realistically emulate the FAA's en-route air traffic control user interface and was configured to provide several NextGen automation tools including digital data communication between pilot and controller (datacomm), conflict probe, and manual conflict resolution. Four controller positions, staffed by experienced operational air traffic controllers, were configured to run the same traffic scenario under four different conditions (baseline, weather impacted, increased traffic flow, datacomm). Various levels of datacomm capabilities were also evaluated in the scenario. Controller performance data, impressions, and opinions were collected to evaluate system effectiveness. The simulation was successfully conducted over a one week period in July 2010 and the data are currently being analyzed.

3 Simulation of Trajectory-Based Operations with Data Link Produces New Insights, June 2010

Details: NASA Ames researchers are exploring a near-term concept for Trajectory-Based Operations (TBO) with air/ground data link communication that promises to dramatically improve the efficiency of operations in en-route and transition airspace. In over 100 hours of laboratory simulation, NASA's prototype ground automation system–comprised of several new algorithms integrated into the Center/TRACON Automation System (CTAS)–controlled full Fort Worth Center traffic during busy periods from 32 recent weekdays and involving over 37,000 individual flights. Prototype functionality included wind-favorable direct routes, minimum-fuel descent profiles, minimum-delay conflict resolutions, improved conflict detection for climbing flights, and independent tactical (0-3 minutes) conflict detection and resolution. The simulation environment modeled datalink delay characteristics and trajectory prediction uncertainty (aircraft weight, wind, and pilot execution delay). Analysis of the resulting data has identified several new and important automation and concept requirements for TBO with datalink. Top-of-descent prediction errors are the most significant contributor to loss-of-separation events, and improvements to descent predictions are required to achieve reliable minimum-fuel descent profiles in medium to heavy traffic. Under metering conditions, where aircraft are merging and descending to a common fix, the pilot's responsiveness in executing resolution maneuvers is especially critical; to reduce the variability, maneuver execution start points must be included as part of the trajectory clearance to the aircraft. Improvements to the climb detection logic have effectively enabled the automation to detect a majority of conflicts resulting from climb uncertainty, the second-largest cause of conflicts. Unlike today's operational system, Conflict Alert, ground-based tactical conflict alerting automation must alert when an altitude amendment is entered, but before the aircraft starts the maneuver. In every other loss of separation case in this analysis, tactical automation (TSAFE, the tactical separation assisted flight environment) prevented any loss of separation. The proposed concept and automation reduced the number of flight plan amendments by a factor of eight. A paper documenting the complete results will be presented at the 2010 Congress of the International Council of the Aeronautical Sciences, and the system is now being prepared for human-in-the-loop simulation testing in September/October 2010.

Research Events and Activities

- Jul. 27-29: Generic Airspace Phase 4 HITL Experiment, NASA Ames
- Aug. 2-5: AIAA Guidance, Navigation and Control Conference
- Aug. 2-5: AIAA Modeling and Simulation Technologies Conference
- Aug. 10-19: Flexible Airspace II Experiment, NASA Ames
- Sep. 8-9: Green Aviation Conference, NASA Ames
- Sep. 13-15: AIAA Aviation Technology, Integration and Operations Conference
- Sep. 19-24: International Council of Aeronautical Sciences (ICAS) 2010
- Sep. 22-23: Integrated Arrival and Departure Surface Research Transition Team Meeting, NASA Ames
- Sep.: Terminal Area Precision Scheduling Simulation (TAPSS) Completed
- Sep.: Collision Avoidance for Airport Traffic (CAAT) Fast-Time Simulation Study, NASA Langley
- Oct. 3-7: 29th Digital Avionics Systems Conference (DASC)
- Oct. 6-7: ASP Users Forum
- Oct. 11-22: Trajectory-based Operations with Datacom Simulation, NASA Ames
- Oct. 19-21: Partnership for AiR Transportation Noise and Emissions Reduction, Cambridge, MA
- Oct. 21: Friends and Partners in Aviation Weather Meeting, Atlanta, GA
- Oct. 24-27: Air Traffic Control Association (ATCA) Annual Conference, Washington, DC
- Oct. 26-28: JPDO/AFRL UAS Workshop, Dayton, OH
- Oct. 27-28: NASA/ONERA Workshop, NASA Ames
- Oct.: Separation Assurance Dynamic Weather Batch Study, NASA Langley

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4 Adaptive Climb Trajectory Prediction Feedback Algorithm Improves Conflict Detection Performance, August 2010

Details: Trajectory prediction for aircraft in climb is not as accurate as it is in the cruise or descent phases of flight, and the inaccuracy contributes to higher missed- and false-alert rates for conflict detection involving climbing aircraft. An algorithm to improve climb trajectory prediction accuracy by adapting trajectories based on observed radar track data has been developed and evaluated using a preliminary set of 18 actual Fort Worth Center departures. The algorithm utilizes rate-of-climb feedback to adjust the aircraft weight parameter used in trajectory predictions. Results indicate the adaptive algorithm reduces the standard deviation of altitude errors for a five-minute look-ahead time by a factor of four, from 2400 feet to 600 feet. In addition, it also halved the standard deviation of top-of-climb time errors from two minutes to one minute. When applied to a climbing conflict scenario in a real-time simulation, the adaptive climb algorithm improved the conflict detection lead time from one minute to 5.5 minutes. Further evaluation with additional flights and simulated loss-of-separation cases is planned.

5 User Preferences Research Presented at the JPDO Flight Prioritization Workshop, May 2010

Details: Dr. Kapil Sheth was an invited speaker at the Joint Planning and Development Office (JPDO) Flight Prioritization Workshop in Washington, DC during the week of April 26th. The three-day workshop was organized by Ms. Peggy Gervasi, JPDO Director of Strategic Interagency Initiatives, and was chartered to assess twelve concepts for prioritizing flights in the NextGen environment. The workshop participants included representatives from the airlines, general aviation, and the ATM research community. Dr. Sheth presented a concept he is researching that prioritizes flights based on credit points administered by the Federal Aviation Administration (FAA). The 10-member panel's initial feedback was that the credit points concept was the most thoroughly researched concept to date. Final recommendations from the panel will be provided after the third workshop, to be held in July 2010. A panel member has contacted Dr. Sheth, and additional experiments to further this research are being explored directly with the FAA's Technical Operations (FAA-ATO) organization.

6 Airspace Concept Evaluation System (ACES) Results Workshop, June 2010

Details: The Systems Modeling and Optimization Branch hosted a three day workshop to share research utilizing the Airspace Concept Evaluation System (ACES). ACES is a non-real-time, computer simulation of local, regional and nationwide flight operations from gate departure to arrival. ACES's overarching objective is to provide a flexible simulation and modeling environment that can assess the impact of future Air Traffic Management (ATM) tools and concepts. This workshop was attended by 47 researchers and software developers, which included representatives from the Joint Planning and Development Office (JPDO), the FAA Technical Center, NASA Ames Research Center, NASA Langley Research Center, Aerospace Computing Inc., Intelligent Automation Inc., Logistics Management Institute, Raytheon, Sensis, and the University Affiliated Research Center. Researchers presented completed or ongoing assessments of several ATM concepts. The concepts included integrated arrival and surface scheduling, separation assurance, terminal area merging and spacing, dynamic airspace configuration, and integration of traffic flow management and dynamic airspace configuration. Representatives from the JPDO were interested in using ACES as a system-wide cost and benefit analysis tool. Of particular interest were studies of the behavior and interactions of multiple ATM concepts in the presence of weather. The JPDO were also interested in using ACES in conjunction with other tools, such as tools for calculating noise and emissions. Representatives from the FAA Technical Center were using ACES to perform benefits assessments of planned upgrades scheduled for inclusion in their En-Route Automation Modernization (ERAM). Overall, the workshop feedback was positive and attendees requested to have similar workshops in the future on an annual basis and possibly

establishing an ACES user group.

7 NASA Ames Senior Scientist for Air Traffic Management Tours DLR Laboratories, July 2010

Details: Dr. Banavar Sridhar, the NASA Ames Senior Scientist for Air Traffic Management, completed a series of meetings and tours of several German Aerospace Center (Deutsches Zentrum fur Luft und Raumfahrt, or DLR) laboratories in Hamburg, Braunschweig, Cologne, and Oberpfaffenhafen, in July 2010. Dr. Sridhar met with DLR scientists and researchers and provided briefings of mutual interest on the topics of traffic flow management and optimization, as well as recent research efforts in modeling and developing operational strategies for dealing with persistent aircraft contrails. In turn, Dr. Sridhar was introduced to the various projects underway at DLR, including climate modeling and the impact of volcanic ash; arrival, departure and surface operations; conflict detection and resolution; engine technology; and airport operations. The Aviation Systems Division at Ames has had a number of extensive and productive collaborations with the DLR-Braunschweig laboratory over the past 20 years, and is currently hosting a visiting researcher, Mr. Joern Jakobi, who is an expert on airport surface operations.

8 FAA Aviation Rulemaking Committee for ADS-B Applications to NextGen Air Traffic Management, July 2010

Details: Mr. Brent Weathered was invited to be a member of the ADS-B IN Aviation Rulemaking Committee (ARC) and attended the kickoff meeting on the 1st of July. Automatic Dependent Surveillance-Broadcast (ADS-B) is a technology upon which NASA and FAA are currently basing efforts to modernize the Airspace System. Recently, the FAA issued a new Rule for ADS-B out (aircraft and ground targets sending info OUT to ground based Air Traffic Management facilities), and now FAA is planning to implement the IN portion (aircraft receiving IN information about other aircraft, messages, and possibly weather info). This implementation is crucial to realizing the vision of NextGen.

The ADS-B IN Aviation Rulemaking Committee, which includes industry, user and ATC representatives, both domestic and international, is tasked with providing a roadmap and technical recommendations for implementation of ADS-B IN in the National Airspace System, bridging the gap between research and implementation. Implementation of this roadmap may result in rulemaking, thus the requirement for designation as an Aviation Rulemaking Committee. The ARC has a two-year charter, with meetings expected monthly, to support FAA 2014 budget formulation. Full ADS-B implementation is planned for 2020.

9 Research Presented at NASA Green Aviation Summit, September 2010

Details: On September 9th, Dr. Banavar Sridhar, Dr. Yoon Jung, and Mr. Richard Coppenbarger presented their research in a panel on Environmentally Friendly Airspace Operations at NASA's Green Aviation Summit. Dr. Sridhar presented concepts and challenges for en route operations, including simulation and optimization techniques in the design of traffic flows to reduce the formation of contrails and the evaluation of tradeoffs between different types of aircraft emissions. Dr. Jung reported on his airport surface research to reduce the environmental impact of stop-and-go taxi operations. His team conducted a human-in-the-loop study whose initial results indicated that, with improved surface procedures and algorithms, the average number of stops made by each departure aircraft in the departure runway queue was reduced by more than half, consequently reducing departure taxi times. Mr. Coppenbarger presented a concept for fuel efficient, continuous descents, describing the simulations and flight testing that have been conducted to date to develop and refine the technology enabling such descents in busy traffic conditions. The Summit, held at NASA Ames on September 8 and 9, was attended by government, industry, and academic experts and was hosted by the Aeronautics Research Mission Directorate. The Summit webpage is *http://www.aeronautics.nasa.gov/calendar/20100908.htm*.

10 Human-in-the-Loop Airport Surface Scheduling Simulation Completed, April – May 2010

Details: The Spot and Runway Departure Advisory (SARDA) airport surface scheduling

Research Events and Activities Continued

- Nov. 3-5: International Conference on Human Computer Interactions, Orlando, FL
- Dec.: En Route Descent Advisor /3D Path Arrival Management Experiment, NASA Ames

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- Jan. 4-7: AIAA Aerospace Sciences Meeting, Orlando, FL
- Mar. 29-31: ASP Technical Interchange Meeting, San Diego, CA

About This Newsletter

The Airspace Systems Program issues this quarterly newsletter to report on completed research activities and to provide a record of current and upcoming events of interest to the community. If you have questions about any of the information in this issue, please contact John Cavolowsky at NASA-ASP@nasa.gov.

simulation was successfully conducted April 26 to May 7. SARDA is an airport scheduling system comprised of separate but integrated scheduling components. Two components of SARDA were investigated in this simulation, the Runway Scheduler, which provides the Local Controller with departure and active runway crossing sequence advisories and the Spot Release Planner, which provides the Ground Controller with times and sequences for releasing aircraft from the spot into the movement area. The two-week human-in-the-loop simulation explored a proof of concept where tower controllers metered ground departure traffic at a holding position short of the taxiway and at the queue feeding the departure runway. Data was collected on scheduling algorithm performance, concept feasibility, controller advisory usability, controller workload and situation awareness, and environmental impact (as measured by derived fuel consumption). Participants included two retired controllers, who controlled aircraft to the three east-side terminals of the Dallas-Fort Worth International Airport, and pseudo-pilots who maneuvered the simulated aircraft. The scheduling algorithms are expected to increase the efficiency of taxi operations by reducing the runway queue size and taxi delays, thus enabling fuel savings and reduction in engine emissions while maintaining maximum departure throughput. Data analysis is underway.

11 International Journal Publication on NextGen Research and Technology, June 2010

Details: A paper entitled "Evaluation of Mixed-Mode Data-Link Communications for NextGen 4DT and Equivalent Visual Surface Operations" was published in the journal "Air Traffic Control Quarterly" (Vol. 18, Issue 2, pp. 177-212, June 2010). The authors were Lawrence (Lance) J. Prinzel III, Kevin J. Shelton, Denise R. Jones, Angela S. Allamandola, Jarvis (Trey) J. Arthur III, and Randall E. Bailey of the Crew Systems and Aviation Operations Branch. The article discusses how the Next Generation Air Transportation System (NextGen) may create a radically different approach to air traffic management with dramatic shifts in the tasks, roles, and responsibilities for the flight deck by 2025. The paper describes human-in-the-loop simulation research examining the impact of one of the key enabling technologies for NextGen - data-link communications – on performance, safety, and flight crew awareness and workload during four-dimensional trajectory (4DT) operations and equivalent visual surface operations. Overall, the results indicate that retaining or replacing party-line information with a voice-by-exception data-link can have significant safety impacts for surface operations.

12 Successful Checkout of Integrated Departure Scheduling Software, June 2010

Details: NASA's Precision Departure Release Capability (PDRC) team recently completed an evaluation of the initial PDRC software system. The software includes NASA's Surface Management System (SMS) and the research version of the FAA's Traffic Management Advisor (RTMA) enhancements that implement the initial PDRC functionality. The PDRC research activity will assess the value of using precise, surface trajectory-based OFF (take-off) time predictions for en-route departure scheduling in Call for Release situations. PDRC uses SMS to generate precise OFF time estimates and delivers these to RTMA for en-route departure scheduling. The software integration was completed in May at NASA's North Texas (NTX) Research Station and successfully evaluated in a series of tests using both recorded and live radar data. This integration and checkout activity sets the stage for an engineering shadow evaluation scheduled to begin in July 2010. Objectives for the July PDRC evaluation include further verification of software system performance, refinement of the operational concept and procedures and baseline data collection.

13 Surface Conflict Detection and Resolution with Emphasis on Trajectory-Based Operations Kickoff Meeting, July 2010

Details: The research performed under this ARRA funded NRA will help incorporate conflict detection and resolution (CD&R) principles for surface traffic into existing capabilities. The NRA is expected to develop performance models of surveillance systems, a rule-based framework for short-term conflict detection, a probabilistic trajectory-prediction-based framework for long-term conflict detection, a search-based short-term conflict resolution algorithm, and long-term conflict resolution procedures. The NRA will then implement CD&R into these algorithms, integrate, and test them with surface traffic simulations. The kickoff meeting was attended by NRA researchers from Optimal Synthesis Incorporated and Tufts University, including Dr. Victor Cheng (Principal Investigator) and Dr. Jason Rife (Co-Principal Investigator). Dr. Cheng presented the motivation, objectives, and work plan for his team's NRA effort.

14 Conflict Detection and Resolution Study for Airport Surface Operations Underway, August 2010

Details: On August 25, a kickoff meeting was held between Sensis Corporation and NASA researchers to discuss concepts, requirements, and algorithms for ground-based airport surface conflict detection and resolution (CD&R). This kickoff meeting marked the beginning of a rigorous study to provide a concept of operations for ground-based CD&R, CD&R algorithms and software, and performance metrics to assess CD&R function performance. This work is being funded by the American Recovery and Reinvestment Act (ARRA). The primary objective of the study is to provide air traffic controllers with robust CD&R strategies to mitigate potentially serious conflicts on airport surfaces by fusing new CD&R software modules to the FAA's existing Surface Management System (SMS). These new modules will one day provide air traffic controllers with efficient strategies for dealing with taxiway, ramp area, and runway conflicts. In addition to efficiency gains, the CD&R function will enhance safety for all vehicles on the airport surface by incorporating a hierarchical system for prioritizing strategic, tactical, and critical surface conflicts.

15 Energy Navigation (eNav) Experiments in the Air Traffic Operations Laboratory Validates Low Noise Guidance (LNG) Reduction in Noise and Fuel Burn, March – July 2010

Details: NASA Langley researchers conducted batch experiments in the Air Traffic Operations Laboratory (ATOL) that showed an approximate 1 dB reduction in noise and 3% less fuel burned during descent and arrival using Low Noise Guidance (LNG). This work validated on a large scale (over 13,000 flights) the performance achieved by pilots during the Low Noise

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Guidance (LNG) flight test. In addition, this work demonstrated the feasibility of using advanced FMS guidance in a highly dynamic terminal environment to maximize flight efficiencies. The objectives of the study were to minimize fuel burn, noise and emissions of aircraft during arrival and landing operations through the development and evaluation of a concept and associated technologies that combine dynamic energy-based trajectory generation with real-time flight guidance and energy-based auto throttle commands. An additional goal was to reduce the occurrence of missed approach situations. The approach used was to develop advanced Flight Management System (FMS) concepts and associated cockpit interfaces and then to conduct a sequence of experiments and studies to evaluate the concepts and interfaces, as well as develop crew procedures for optimized guidance.

16 NASA Meets with Southwest Airlines to Discuss NextGen Technologies, May 2010

Details: Researchers from NASA Ames Research Center visited Southwest Airlines to discuss Southwest's recent experience with using NextGen avionics systems. These systems, called Area Navigation (RNAV) and Required Navigational Performance (RNP), allow aircraft to fly any desired flight path within the coverage of specific navigation aids and monitor their navigation performance. This technology is critical in support of concepts for NASA's Super Density Operations (SDO) research. Southwest Airlines is an early adopter of this technology and NASA researchers gained Southwest's feedback on NASA's Super Density Operations concept of operations using RNAV and RNP. NASA researchers Harry Swenson, Paul Borchers and Keenan Roach met with Southwest's RNAV/RNP project leaders including their Chief Technical Pilot and FAA representatives from the Southwest Region. NASA presented information on the North Texas Research Station (NTX) and current research in Terminal Area Precision Scheduling Research. Southwest representatives were very interested in NASA's research since they felt that they would not be able to take full advantage of their RNAV/RNP investment until our research is implemented. SWA expressed interest in a follow-up visit with NASA to review their operations using the RNAV/RNP technologies which would be very beneficial to NASA's SDO research.

17 NASA Meets with FAA to Discuss Improving Terminal Area In-Trail Conflict Detection Technologies, June 2010

Details: On June 22nd, Federal Aviation Administration (FAA) representatives Mike Prichard, Suzanne Newman and six other ex-Terminal Controller/Traffic Managers responsible for the FAA's development of the Automated Terminal Proximity Alert (ATPA) tool met with Aviation Systems Division researchers and managers to discuss progress and plans in an ongoing collaboration towards improving the ATPA tool. ATPA monitors in-trail separation on the final approach course. Early next year, the FAA expects to complete another phase of software improvements to ATPA. NASA has been working with the FAA to understand the effect of aircraft landing speeds on monitoring in-trail separation. The purpose of this meeting was for the FAA to share their current ATPA plans and for NASA to provide results of their relevant research. Aviation Systems Division researchers have been investigating the prediction of aircraft spacing compression during final approach using a variety of methods, and have also been developing a terminal area aircraft conflict detection algorithm and concept of operations. Both NASA and the FAA agreed to continue these meetings and expressed support for continued collaboration. The FAA agreed to provide more operational data to NASA researchers to improve the terminal area aircraft conflict detection algorithm.

18 Terminal Area Precision Scheduling Completes Major Simulation Milestone, July 2010

Details: The Terminal Area Precision Scheduling System (TAPSS) research team completed the third in a complex series of human-in-the-loop simulations of a new precision scheduling system, advanced navigation concepts and controller advisory tools for metering in the terminal radar approach control (TRACON) airspace. This system is a major technological enhancement to the NASA-developed and FAA-deployed Traffic Management Advisor (TMA) technology, providing precision metering schedules at flow merge-points within the terminal airspace. The TMA enhancements align with the FAA Time Based Flow Management long-term concept. A goal of the human-in-the-loop simulation was to evaluate the precision metering concept's capability to conduct environmentally-friendly airspace procedures in high-density airspace. The experiment simulated traffic bound for Los Angeles International Airport, including Southern California TRACON and Los Angeles Air Route Traffic Control Center (Center) operations. Twelve pseudo pilots and eight air traffic controllers (operating three Center metering sectors, three TRACON feeder positions and two TRACON final positions) performed the simulation July 26-30 at the air traffic management simulation laboratory at NASA Ames. This was the first Center-TRACON integrated simulation attempted in TAPSS, after having successfully completed separate TRACON and Center TAPSS simulations. The success of this Center/TRACON integration simulation paves the way for four more weeks of evaluations scheduled in August and September to evaluate delay reduction and increased controllability of traffic along precision navigation routes in the presence of uncertainty.

19 Completion of Terminal Area Paired Procedures Research, August 2010

Details: The Terminal Area Paired Procedures Research (TAPPR) team completed their third and final experiment using the Advanced Concepts Flight Simulator (ACFS) in the Crew-Vehicle Systems Research Facility (CVSRF). This series of experiments investigated pairing aircraft for precision approach and landing to closely-spaced parallel runways 750 feet apart in poor visibility conditions. The third experiment differed from the first two as it evaluated the operational roles and responsibilities between ground controllers and aircrew when using advanced flightdeck and ground automation. The Aviation Safety Program's Intelligent Integrated Flightdeck Design and NextGen's Super Density Operations research areas collaborated to develop this experiment and will share the test results to fulfill independent milestones. The experiment relied on a concept developed by Raytheon and flight deck automation developed by Langley. The experiment offered different levels of automation to the pilots, and provided different types of informational displays that allowed the pilots to monitor the conformance of their

aircraft to inter-pair spacing requirements. Test scenarios began about 100 miles from the airport, where aircraft from different arrival streams were logically paired and brought to a coupling point 15 miles from the runway threshold with one aircraft 5 to 25 seconds in trail of the other. The experiment ran for three weeks with experienced air-traffic controllers and commercial airline crews serving as experimental participants.

20 Visits to Two New York Air Traffic Control Facilities and Meeting with the Port Authority of New York/New Jersey (PANY/NJ) in Support of Runway Management Research, August 2010

Details: During August 26-27, 2010, Gary Lohr (LaRC Crew Systems and Aviation Operations Branch) met with representatives of the Port Authority of New York/New Jersey (PANY/NJ) and two air traffic facilities serving the New York area in support of Airspace Systems Program's runway management research. Several weeks ago, the PANY/NJ invited members of the System Oriented Runway Management Team (SORM) to observe the operation of a departure metering program that is in place at John F. Kennedy International Airport (JFK). The metering program uses a system designed and operated by Passur Aerospace, Inc., under contract to the Port Authority and is designed to reduce queue length at the departure runway by assigning taxi times based on a real-time estimate of when the aircraft will be ready to taxi. The goal is to maintain a queue of 6-8 aircraft per 15-minute period on each departure runway. The system was originally developed in 1993 for use during periods when there were delays due to snow, and eventually for use when the Severe Weather Avoidance Program (SWAP) was activated. Although several other airports have similar systems, only the system at JFK is used on a daily basis regardless of weather conditions for the peak departure periods. Visits were also conducted to both the New York Terminal Radar Approach Control (TRACON) and the JFK Airport Traffic Control Tower (ATCT). JFK is the operational environment selected for the validation of SORM capabilities; as such, operational procedures for both of these facilities are of significant interest. At the TRACON, discussions were held addressing traffic flow management (TFM) for JFK and surrounding airports. TFM is envisioned to be a key factor in future runway management. At the ATCT, discussions with tower staff personnel focused on the issue of surface congestion and the effects of the Port Authority's departure metering system on surface operations. Information obtained through each of these visits will be used to further the research team's understanding of air traffic operations. In the case of the departure metering program, NASA will share information concerning the direction and results of runway management research as this may influence how their program functions. An additional benefit of these visits is the continued development of relationships with experts in the respective domains. The NY area service providers have been very cooperative and are considered an extension of the runway management research team.

21 NASA Administrator Bolden Tours Aviation System Lab, September 2010

Details: NASA Administrator Charles Bolden visited Ames Research Center to attend the Green Aviation Summit. In addition to giving the keynote address at the Summit, Mr. Bolden, accompanied by Aeronautics Associate Administrator Dr. Jaiwon Shin, was given a demonstration and briefing of the NextGen research in trajectory-based operations and terminal area precision scheduling by researchers Dave McNally, Eric Mueller, and Harry Swenson.

22 Longest Convective Weather Forecast Yet Shows Promise for Use in Air Traffic Management, June 2010

Details: Data from the Consolidated Storm Prediction for Aviation (CoSPA) was analyzed to determine its potential use in predicting the impact of convective weather on airspace capacity. CoSPA is the result of a collaborative effort across government agencies, universities, and private organizations to generate a tool capable of predicting the location and intensity of convective weather up to eight hours in advance. Three days of CoSPA data were analyzed to estimate the impact of weather on airspace sectors, primarily measured by the percentage of a sector's volume that was filled by convective weather. To assess accuracy, the predictions were compared against the observed weather. Initial findings show that the correlation of predicted to observed impact on sectors decreases as the look-ahead time is increased up to eight hours. A simple probabilistic model was also developed to show the likelihood of weather affecting a sector based on CoSPA predictions. The results suggest that CoSPA can be an effective tool to aid air traffic managers.

23 Development of Predicted Contrail Frequency Index, July-August 2010

Details: Contrails are visible trails of water vapor produced by the exhaust of aircraft engines. Contrails appear and persist if aircraft are flying in certain atmospheric conditions, and their persistence results in reduced incoming solar radiation and outgoing thermal radiation in a way that accumulates heat on the Earth's surface. In order to measure this effect, the predicted contrail frequency index was developed. The index predicts regions that would form persistent contrails and quantifies the severity. It is computed using weather forecasts and predicted aircraft locations. The results show that predicted indices in the immediate one to three hours are highly correlated with actual indices and have a high success rate in identifying regions with high contrail activities. Air traffic managers can use the predicted index in strategic planning to reduce contrail formations. The results of this study were presented for peer review feedback at the AIAA Guidance, Navigation and Control Conference in Toronto, Canada from August 2-5.

24 Optimization Software Cleared for Open Source Release, September 2010

Details: Dantzig-Wolfe Decomposition is an optimization technique that can be used to solve certain problems in parallel. Software developed within the Systems Modeling and Optimization branch using this technique has been used to perform large-scale Traffic Flow Management optimization and is currently being integrated with the Advanced Concepts Evaluation System (ACES) tool. This software has been approved for open source release and will represent the only implementation of the algorithm available in any form commercial or otherwise.