National Aeronautics and Space Administration

Airspace Systems Program

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

SEPTEMBER—DECEMBER 2010

Technical/Programmatic Highlights

www.nasa.gov

See inside for details

Technical/Programmatic Highlights

1 Dynamic Airspace Configuration Final NASA Research Announcement Briefings, September 2010, Ames Research Center

The Dynamic Airspace Configuration (DAC) research team hosted a final meeting with the three DAC NASA Research Announcement (NRA) contractors—Mosaic ATM, CSSI, and Metron Aviation. The three NRA contractors developed methods for dynamically designing and modifying airspace boundaries to manage airspace capacity to demand. Using a technical interchange meeting format, each of the three contractors presented a summary of their work for the past three years with emphasis on the more recent accomplishments. The contractors also demonstrated their airspace partition-ing software.

2 Airspace Sector Combining Algorithm Presented at FAA's High Altitude Airspace Technical Interchange Meeting, November 2010, MITRE

Dr. Robert Windhorst and Mr. Michael Bloem, researchers in the Systems Modeling and Optimization branch, participated in this meeting organized by the FAA Operations Planning group. Researchers from the FAA, NASA Ames, industry, and academia gathered to discuss high altitude airspace concepts, analyses, simulation results and to discuss future research opportunities. Mr. Bloem described an algorithm that can help air traffic control supervisors determine when and where to combine airspace sectors, a task they do today without sector combining decision-support. He presented simulation results that show that this algorithm can identify sector combinations that reduce congested airspace with only a small increase in sector reconfigurations. Researchers from the FAA and other institutions expressed interest in further collaboration in this area.

3 Efficient Descent Advisor Flight Trials, October 2010, Denver, CO

Flight trials were conducted to evaluate the trajectory predictor supporting NASA's Efficient Descent Advisor (EDA)—an automation tool designed to enable fuel-efficient descents into congested terminal areas. The flight trials measured the accuracy of the EDA trajectory predictor and determined the sources and magnitudes of the errors in its predictions. Whereas a similar activity last year focused on commercial transport aircraft, the current flight trials focused on regional jet aircraft types. These aircraft constitute approximately one-third of arrival demand at major airports and tend to have different performance and vertical navigation capabilities than their mainline counterparts, posing different challenges for trajectory prediction. While initial flights involved a single FAA flight test aircraft, follow-on flights involved SkyWest Airlines arrivals to Denver over several weeks.

4 Interagency Technical Interchange Meeting on Precision Departure Scheduling, September 2010, Ames Research Center

The Aviation Systems Division hosted an interagency technical interchange meeting to discuss the Precision Departure Release Capability (PDRC) research activity. PDRC aims to improve scheduling of departures into constrained overhead streams of aircraft. NASA and FAA stakeholders were briefed on PDRC progress over the last year and provided feedback on plans for the coming year. During the past year, the PDRC research team implemented the concept in prototype software that couples an en route departure scheduling system with a trajectory-based surface automation system. The PDRC prototype software is currently undergoing live-data, engineering shadow evaluations at NASA's North Texas Research Station to verify system performance and refine the operational concept and test procedures. Plans for the coming year include shadow and operational evaluations with FAA subject matter experts. FAA representatives from the System Operations, Terminal Services and NextGen and Operations Planning organizations participated in the meeting, which included a live-data demonstration of the prototype software and a special session devoted to PDRC benefits mechanisms and assessment methodologies. Participants expressed support for the PDRC research activity and provided valuable feedback that is being incorporated in the PDRC Concept of Operations, Research Management Plan and NASA/FAA Integrated Arrival/Departure/Surface research transition product definition.

5 Controller-in-the-Loop Evaluation of Efficient Descent Advisor Underway, November-December 2010, Ames Research Center

A controller-in-the-loop simulation of the Efficient Descent Advisor (EDA) was recently completed in the air traffic control lab of the Crew-Vehicle Simulation Research Facility. The objective of the simulation was to evaluate the performance of EDA in the presence of trajectory-prediction uncertainty introduced through error models of aircraft weight, forecast winds, and path-stretch-turnout delay. These error models were tuned to approximate the top-of-descent and arrival-time errors observed in recent EDA field tests at Denver Center. In simulation dry runs with former Denver Center controllers, EDA software performed well and was robust to a wide range of arrival management techniques. Testing with active-duty controllers occurred during the first half of December. This activity was the fourth in a series of human-in-the-loop simulations aimed at developing EDA for transfer to the FAA under the Efficient Flows into Congested Airspace Research Transition Team. This was also the first EDA simulation involving National Air Traffic Controllers Association representatives.

6 Next Generation Air Transportation System Human Computer Function Allocation Panel Participation at HCI-Aero, November 2010, Cape Canaveral, FL

Leighton Quon moderated and Savita Verma participated as an invited panelist in the Human Computer Function Allocation session. Akbar Sultan represented the Airspace Systems Program and other panelists participated on behalf of the FAA and Eurocontrol. Functional allocation is key to an effective transformation to the U.S. Next Generation Air Transportation System (NextGen) and Eurocontrol's Single European

Research Events and Activities

- **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 Congress 2010

- **Sep. 22–23:** Integrated Arrival and Departure Surface Research Transition Team Meeting, NASA Ames

- **Sep:** Terminal Area Precision Scheduling Simulation, NASA Ames

- **Sep:** Collision Avoidance for Airport Traffic Fast-Time Simulation Study, NASA Langley

- **Oct. 3–7:** 29th Digital Avionics Systems Conference

- **Oct. 6–7:** ASP Users Forum, NASA Ames

- **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 Annual Conference, Washington, DC

- **Oct. 26–28:** JPDO/AFRL UAS Workshop, Dayton, OH

- **Oct. 27–28:** NASA/ONERA Workshop, NASA Ames

- **Nov.–Dec.:** Separation Assurance Dynamic Weather Batch Study, NASA Langley

- **Nov. 3–5:** International Conference on Human Computer Interactions, Orlando, FL

- **Nov. 15–17:** Flight Deck Interval Management Working Group Visit, NASA Langley

- **Nov: 17–18:** ADS-B IN ARC visit, NASA Langley

- **Nov. 30–Dec 1:** Strategy, Architecture and Analysis Office Systems Analysis Summit, Washington, DC

- **Dec. 1–2:** Global Wake Next Conference II, San Diego, CA

- **Dec.:** En Route Descent Advisor/3D Path Arrival Management Experiment, NASA Ames

Sky ATM Research (SESAR). The introduction of new airborne and ground-based technologies will place emphasis on the changing roles and interactions between pilots, controllers and automated systems, and on the transition to new technologies considering the alteration in roles. The session explored different aspects of requirements and interactions for the transition to NextGen and SESAR, and discussion ranged from the general context of NextGen and SESAR needs to some specific investigations of future concept and technology function allocation studies. Ms. Verma presented her work on levels of automation for a pairing tool used for simultaneous approaches, as well as flight deck tools and displays to assist flight crews in this environment.

7 Participation at the International Council of the Aeronautical Sciences, September 2010, France

Ten air traffic management researchers from the Aviation Systems Division presented technical papers and served as session chairs at the 2010 International Council of the Aeronautical Sciences (ICAS) conference in Nice, France. ICAS was sponsored by numerous international aeronautics and aviation societies including the American Institute of Aeronautics and Astronautics and the Royal Aeronautical Society. The sponsors encouraged international, coordinated research collaboration and sustainable aviation in the design of future aviation systems. Papers were presented highlighting the Airspace Systems Program's work in efficient arrivals in constrained airspace, collaborative air traffic management, dynamic route structures and methods for airspace configuration, a near-term concept for trajectory-based operations, automated conflict resolution, and the environmental impact of aviation operations. Presentations were well-received by an international audience of air transportation and aeronautics/aerospace scientists and researchers. To receive a particular paper electronically, please email Donna Whitaker [donna.whitaker(at)nasa(dot)gov]; otherwise, all papers will be available when Airspace Systems' Concepts and Technology Development Project makes available its annual CD.

8 Boeing/NASA Air Traffic Management Meeting, October 2010, Langley Research Center

Four researchers from Boeing Advanced ATM and Boeing Commercial Aircraft divisions attended meetings at Langley to discuss current work and future collaboration opportunities with the Crew Systems and Aviation Operations Branch and the Concepts and Technology Development Project. NASA presented current research in Energy Navigation (new control laws for the aircraft's flight management computer to minimize fuel consumption during descent), and synthetic vision technology and displays to enable the flight crew to conduct more efficient operations. Topics briefed by Boeing included their new guidance and control algorithms for aircraft during descent based on constant ground-speed, development of data analysis tools, and Boeing's vision of the future of aviation operations. Representatives from the Crew Systems and Aviation Operations Branch, Concept and Technology Development Project, and senior researchers were present for discussions on future collaboration to update aircraft performance models, exchange algorithms that allow for on-board aircraft to self-space behind another aircraft, and participate in future joint experiments. Follow-on discussions are planned.

9 Partnership for Air Transportation Noise and Emission Reduction Advisory Board Meeting and Presentation, October 2010, MIT

Dr. Banavar Sridhar, Senior Scientist for Air Traffic Management, attended the Partnership for Air Transportation Noise and Emission Reduction (PARTNER) Advisory Board Meeting. PARTNER is a cooperative effort in environmental research sponsored by NASA and FAA as well as other domestic agencies and Transport Canada. The organization funds research at several universities including MIT, Stanford University, and Georgia Tech, who are investigating noise, emissions, alternative fuels and emission reducing operations. At this meeting, the organization invited presentations on noise and emission research not funded by the PARTNER effort. Dr. Sridhar presented results on the trade-offs between fuel burn and

contrail reduction using wind-optimal aircraft trajectories. His presentation generated interest from the climate scientists and FAA Office of Energy and Environment.

10 Navy Broad Area Maritime Surveillance System Simulation, October 2010, Ames Research Center

The SimLabs at NASA Ames recently completed the second in a series of distributed controller-in-the-loop simulations at the Crew-Vehicle Systems Research Facility. The simulations investigated the integration and safe operation of the U.S. Navy's Broad Area Maritime Surveillance (BAMS) unmanned aircraft system (UAS) in the National Airspace System (NAS), and allowed researchers to examine BAMS collision avoidance displays and processes in a highly realistic instrument flight rules (IFR) and oceanic air traffic environment. The experiment leveraged the Live-Virtual-Constructive Distributed Environment infrastructure of five networked facilities across the United States that was developed during last year's BAMS experiment. The BAMS mission control station, located at the Northrop Grumman facility in Bethpage, NY, "flew" the BAMS UAS in an offshore IFR and oceanic air traffic environment off the U.S. East Coast as modeled and simulated at SimLabs. Navy command and control aircraft, as well as "encounter" traffic were simulated at NAS Pax River, MD, while real-time data analysis took place at the SIMAF facilities at Wright-Patterson AFB, OH. A cross-domain solution located at Redstone Arsenal, AL enabled the distributed simulation to occur simultaneously at two different levels of security classification. SimLabs provided airspace and air traffic models, tailored oceanic air traffic control displays and ARINC operator interfaces, as well as air traffic controllers and pseudo-pilots. Following three integration activities to test the simulation and scenarios, a formal four-day simulation with humans-in-the-loop was conducted. Future BAMS experiments will continue to leverage SimLabs facilities, including the B747-400 simulator, to answer questions related to equipping UAS with Automatic Dependent Surveillance-Broadcast and Traffic Collision Avoidance Systems.

11 NASA Aeronautics Research Presented at Ames Public Lecture, October 2010, Ames Research Center

Dr. Banavar Sridhar, Dr. Kapil Sheth, and Mr. Richard Coppenbarger presented in the last of a series of four public lecture/panel discussions describing NASA's research and how such research impacts the daily life of the general public. The Aviation Systems Division researchers described their aeronautics work on environmental impact of aviation operations, traffic flow management, and procedures and technologies for efficient descents into terminal airspace. The presentations were tailored to an audience of interested members of the public, rather than technical or academic experts. The hour-long presentations were followed by a question and answer session that lasted another hour. Seventy-five members of the community attended and asked questions. The lecture is available online at *http://connect. arc.nasa.gov/p92951185/*

12 Airline Users Forum, October 2010, Ames Research Center

Representatives from several major airlines including Alaska, FedEx, Continental, American, UPS, the Air Transport Association, and the FAA attended the Airspace Systems Program's (ASP) Users Forum. Participants convened to discuss some of ASP's air traffic management research and gain the users' perspective on operational issues and support for air traffic management research efforts. Division researchers presented research on the environmental impact of aviation operations, surface scheduling algorithms, terminal area precision scheduling, and trajectory based operations with air/ground datalink communications. The users expressed interest in the concepts presented, and agreed to continue a dialog with NASA to further understand potential benefits and help provide a broader exposure to the user community.

Research Events and Activities Continued

2011

- **Jan. 4–7:** AIAA Aerospace Sciences Meeting, Orlando, FL

- **Feb. 8–10:** Dynamic Airspace Configuration Research Transition Team Meeting

- **Feb. 17:** NAS Network Evolution Workshop, Washington, DC

- **Feb 22–25:** RTCA Special Committee-186 (ADS-B) Working Group Meeting

- **Mar.:** Collision Avoidance for Airport Traffic Fast-Time Simulation Study, NASA Langley

- **Mar. 16–17:** WakeNet USA, Miami, FL

- **Mar. 20–Apr. 1:** Terminal TSAFE Experiment, NASA Ames

- **Mar. 29–31:** ASP Technical Interchange Meeting, San Diego, CA

- **Mar. 31:** Industry Day, San Diego, CA

- **April:** Human-in-the-Loop Efficient Descent Advisor Simulation, NASA Ames

- **May:** Interval Management to Dependent Parallel Runways Human-in-the-Loop Simulation, NASA Langley

- **May 16–19:** Society for Industrial and Applied Mathematics Conference on Optimization, Darmstadt, Germany

- **Jun. 14–17:** ATM 2011 Ninth USA/ EUROPE Air Traffic Management Research & Development Seminar, Berlin, Germany

- **Jun. 27–30:** AIAA Atmospheric and Space Environments; HI

- **Aug. 8–11:** AIAA Guidance, Navigation, and Control and Modeling and Simulation Technologies Conferences, OR

13 Federal Aviation Administration's ADS-B IN Aviation Rulemaking Committee, November 2010, Langley Research Center

Brent Weathered and Lisa Rippy hosted the regular November meeting of the FAA's ADS-B IN Aviation Rulemaking Committee (ARC). Automatic Dependent Surveillance-Broadcast (ADS-B) is a prime technology upon which NASA and FAA efforts to modernize the airspace system are currently based. 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 on the flight deck). This implementation is crucial to realizing the vision of a future airspace structure. The ADS-B IN ARC is tasked with providing a roadmap and technical recommendations for implementation of ADS-B IN in the National Airspace System. The ARC is comprised of approximately 40 domestic and international members from airframe manufacturers, avionics manufacturers, Department of Defense, pilots associations and airline/corporate operators in all segments of aviation, and FAA personnel from a wide cross-section of disciplines and regulatory offices. In between regular ARC business discussions, numerous personnel from Langley Research Center provided state of the art technology briefings, demos and hands-on tours of the Air Traffic Operations Lab and the Integration Flight Deck and Research Flight Deck simulator cabs. Feedback from the committee leadership and membership was positive, both about the technology and the knowledge of the presenters. Neil O'Connor briefed the ARC on use of ADS-B IN capabilities as part of aircraft wake vortex encounter avoidance.

14 Technical Interchange Meeting Between NASA and MIT-Lincoln Laboratory, December 2010, Ames Research Center

Forty researchers and managers participated in this meeting and discussion of topics for collaboration. A total of eight technical presentations were provided from both NASA and MIT-Lincoln Laboratory. The topics included Lincoln Laboratory's work in surface traffic management, improved airport winds forecasting, convective weather translation modeling, automated methods to optimize decision making for conflict avoidance, and Unmanned Aircraft System airspace access. NASA presented their surface management research, the development and deployment of a method to improve en route departure scheduling, and concepts and results of a trajectory-based operations simulation. More detailed follow-on discussions are planned to further clarify topics for potential collaboration.

15 Visit from Director of the German Aerospace Laboratories (Deutschen Zentrums für Luft und Raumfahrt—DLR), Prof. Johann-Dietrich Wörner, December 2010, Ames Research Center

The Aviation Systems Division's Future Flight Central facility hosted a small delegation from DLR. Dr. Banavar Sridhar and Dr. Yoon Jung provided presentations on their current work on environmental impact of contrails and surface traffic management. Some initial exploration of potential collaboration with DLR has begun with the environmental research, and the surface research area has been the focus of some ongoing collaborations between the Aviation Systems Division and DLR. The delegation also toured the tower cab simulator of Future Flight Central.

16 Trajectory-Based Automation System for Enroute and Transition Airspace Completes Evaluation of Near-Term Trajectory-Based Operations Concept, October 2010, Ames Research Center

A simulation evaluation of a near-term concept for Trajectory-Based Operations (TBO) with air/ground datalink communication was completed in the Crew Vehicle Systems Research Facility. The simulation investigated whether a trajectory-based automation system that solves traffic conflicts, time-based metering problems, and weather-avoidance problems in an integrated fashion, with air/ground datalink communication, can produce substantial benefits for the National Airspace System. Thirty-one hours of simulation runs were conducted over twelve days, and utilized the SimLabs' distributed simulation environment, integrating both the Advanced Concepts Flight Simulator (ACFS) and Boeing 747-400 flight simulators, as well as the air traffic control simulation laboratories. A number of enhancements were made to the existing simulation environment to enable simultaneous display of weather information to the cockpit systems and en route sector displays. Eleven recently-retired controllers from Fort Worth Center, and twelve pilots familiar with today's integrated Flight Management System (FMS)/datalink operations, participated in the simulation. The simulation provided rapid-feedback trajectory automation at the Center radar controller position and currently operational capabilities for two-way air/ground datalink communication integrated with the FMS. Preliminary data analysis shows that higher proportions of datalink-equipped aircraft reduce controller workload, which allows the controllers to provide more efficient flight plan reroutes and respond to aircraft requests more quickly using the new trajectory automation features. Results of this simulation will be used to enhance the system's functionality in preparation for a follow-on simulation planned for Spring 2011. NASA is collaborating with the FAA to determine the feasibility of an operational evaluation of the near-term TBO concept in the next two to three years.

17 Unmanned Aircraft Systems Integration in the National Airspace System Project Approved, October 2010, Headquarters

The acting project office team members and representatives from the Airspace Systems Program briefed the Aeronautics Research Mission Directorate and a panel of other government agency experts on a plan to support the Unmanned Aircraft Systems Integration in the National Airspace System Project. The project will be part of the Integrated Systems Research Program Office and will have four primary technical focus areas that investigate aspects of Separation Assurance, Human Systems Integration, Communication,

and Certification as they relate to unmanned controlled flight. A fifth area, Integrated Test and Evaluation, will focus on the integration of the four technical elements in a relevant environment via a series of simulations and flight tests. After a successful review, this 5-year/$150 million project was accepted to begin upon NASA budget approval.

18 Terminal Area Precision Scheduling System Team Completes Four Weeks of Human-in-the-Loop Simulations, September 2010, Ames Research Center

Simulations evaluating terminal area scheduling decision support tools were completed. These simulations helped in the evaluation of the concept of precision metering with staged delay distribution to account for uncertainty within the system and also investigated environmentally-friendly procedures in high-density airspace. The simulation focused on traffic arriving at Los Angeles International Airport (LAX), a single high-flow airport, in a complex Metroplex airspace within the Southern California terminal radar approach control (TRACON). Controllers staffed three Air Route Traffic Control Center arrival-metering sectors, three TRACON Feeder Positions and two Final Positions. Initial results using the Terminal Area Precision Scheduling System (TAPSS) decision support tools showed close to a 20 percent increase in airport throughput when using more fuel-efficient aircraft maneuvers, and lower controller workload when compared to current-day airport operations. In the first two-week period, specific features of the decision support tools were evaluated, and results compared well with previous Monte-Carlo analytical simulations that were used for the scheduling and controller tool design. In the second two-week period, today's LAX arrival operations were compared to the TAPSS tool-enhanced environment. The demand on the airport was varied from current day levels to anticipated traffic levels in 2020. The simulation was demonstrated to senior FAA managers, the NASA Advisory Committee, and the NASA Administrator.

19 Terminal Area Research Team Visits Southern California Terminal Radar Control, October 2010, San Diego, CA

A terminal area research team focusing on the terminal tactical separation-assisted flight environment (Terminal TSAFE, or T-TSAFE) visited the Southern California (SoCal) Terminal Radar Control (TRACON) in preparation for a human-in-the-loop experiment planned for August 2011 that will test a conflict detection and resolution tool. The visit was facilitated by the FAA's Strategic Planning Advisory Review Cadre (SPARC) team. The planned experiment will evaluate an algorithm that provides controllers with conflict detection alerts. In cooperation with the FAA, the tool will also be integrated with FAA's prototype Automatic Terminal Proximity Alert (ATPA) tool that detects compression errors in the final approach phase. The team met with SoCal TRACON experts and observed airspace over Los Angeles International Airport (LAX) and the Southern California terminal area and identified areas where controllers have to exercise control to keep aircraft separated. Discussions were held on how conflict detection tools such as Conflict Alert and Terminal Proximity Alert are currently used in the airspace. The team also had the opportunity to view a scenario development tool developed at SoCal TRACON, which the FAA uses for training purposes. The tool effectively creates conflicts in the airspace for training scenarios, and the T-TSAFE team plans to use this tool for generating traffic scenarios for the upcoming experiment.

20 Interval Management Research Briefings, October 2010, Langley Research Center

The FAA's Air Traffic Planning Manager for en-route operations (AJE) and two of his colleagues were given technical briefings on the Interval Management research conducted in the Air Traffic Operations Laboratory (ATOL) and Cockpit Motion Facility. The research to develop the concept, procedure, and algorithm for an aircraft to self-space behind another aircraft using Automatic Dependent Surveillance-Broadcast technology is being conducted jointly, and under the leadership of the FAA Surveillance

and Broadcast Services (SBS) Office. Due to Langley's participation and desire to facilitate collaboration across FAA organizations, FAA AJE is now increasing its participation in the FAA SBS work to implement the Interval Management concept, and directly participating in designing and conducting Langley's March 2011 experiment using commercial airline pilots to evaluate the concept and procedure. This additional support from the FAA AJE organization will directly benefit NASA's research in interval management and provide benefit to NASA's efforts and deliverables to the FAA under reimbursable agreements.

21 Wake Presentations at National Institute of Aerospace, October 2010, Hampton, VA

Carsten Schwarz of the German Aerospace Center DLR presented a research seminar titled "DLR Wake Vortex Research Overview." The seminar provided an overview on the latest DLR wake vortex activities and achievements including European Commission and DLR internal projects, industry contract work, simulator and flight tests and field campaigns as well as the current National Institute of Aerospace (NIA), DLR and FAA collaboration on severity assessment of near-field wake turbulence encounters. The German Aerospace Center DLR, Germany's national research center for aeronautics and space, is continuously conducting research in the field of aircraft wake vortices, which is increasingly relevant with the onset of Europe's Single European Sky ATM Research and the United States' Next Generation Air Transportation System programs and their goals of increased throughput at current facilities. Through December 2010, Carsten W. Schwarz was a visiting researcher at NIA in cooperation with the FAA working on severity assessment of near-field wake turbulence encounters. NASA aircraft wake researchers attended the briefing and interacted with Mr. Schwarz during his tenure at NIA.

22 Demonstration of FAA's Tower Flight Data Manager and Staffed NextGen Tower Prototype Systems, November 2010, Dallas Fort Worth International Airport

At the invitation of the FAA, Sherilyn Brown and Gary Lohr attended a demonstration of the FAA's Tower Flight Data Manager (TFDM) and the Staffed NextGen Tower (SNT) Prototype System. The demonstration followed an evaluation of the TFDM by air traffic controllers conducted in August 2010, using live traffic. The TFDM, being developed by MIT Lincoln Labs under contract to the FAA, is a suite of tools and supporting displays for the airport traffic control tower intended to integrate systems in the tower. Control towers have a myriad of systems that have been added over the years; however, integration and information sharing for these systems has not been fully accomplished. TFDM is intended to integrate these systems while upgrading core capabilities. NASA's invitation to this demonstration was based on the FAA's interest in algorithms being developed under the Airspace Systems Program's System Oriented Runway Management research effort. The demonstrated capabilities under development for the TFDM will be part of the SNTs (previously referred to as Staffed Virtual Towers). Fully developed SNTs will incorporate the requisite surveillance and other information available through sensors that would permit controllers to provide air traffic control services without the need of a physical tower structure, i.e., a "tower" control facility could be located in a regular building and perhaps even off the airport proper. The demonstration was conducted by the Terminal Planning System Engineering Group (AJT-34). The next demonstration is planned for 2011, also at Dallas Fort Worth.

23 2nd Global Wake Vortex Conference, December 2010, San Diego, CA

The second of three planned conferences was held to provide information exchange, and to coordinate objectives and concepts for ensuring avoidance of hazardous wake vortex encounters while reducing terminal aircraft separation to increase airport capacity. Approximately 50 participants from Europe, Russia, Australia, and the United States attended the conference. Both the U.S. Next Generation Air Transportation System and the European Single European Sky Air Traffic Management Research activities envision dynamic pair-wise aircraft separation achieved through a three-phased evolution of aircraft wake separation standards: (1) 2010, six static aircraft categories; (2) 2015, static pair-wise separation; and (3) 2020, dynamic pair-wise separation. Safety of operations must be maintained; therefore, changes in aircraft separation standards and the associated safety assessments must be supported by science and data. Areas identified as needing further work and global harmonization included wake encounter reporting and analysis, onboard wake vortex warning systems, reconciliation of wake models that give different results, provision of better wind and atmospheric data, and collection and sharing of aircraft wake data. Langley participants were Neil O'Connor, Paul Stough, and Gary Lohr. The third in the series of Global Wake Vortex Conferences is scheduled for September 2011 in St. Petersburg, Russia.

24 User Preferences Research Presented at the Airline Dispatcher's Federation Annual Symposium, October 2010, Washington, DC

Dr. Kapil Sheth was an invited speaker at the Airline Dispatcher's Federation (ADF) 2010 Annual Symposium. The symposium participants included representatives from the airlines, general aviation, and the air traffic management research community as well as FAA management. Dr. Sheth presented a concept he is researching that prioritizes flights based on credit points that would be administered by the FAA. Results were presented from the human-in-the-loop experiments conducted at NASA Ames in January 2010. The ADF members' initial feedback was that the credit points concept provided a viable option for users to provide their flight preferences, in conjunction with the FAA's Collaborative Trajectory Options Program. Several ADF members have requested participation in future experiments for this research.

25 American Recovery and Reinvestment Act Phase 3 Small Business Innovation Research Final Review Briefing, November 2011, Langley Research Center

Members of Intelligent Automation Inc. (IAI) presented a Final Review Briefing and Demonstration for the Phase 3 Small Business Innovation and Research (SBIR) to develop enhanced systems analysis and simulation capabilities to support exploration of Next Generation Air Transportation System operations concepts. This meeting was hosted by the Aeronautics Systems Analysis Branch with Patricia Glaab as technical monitor. The software developed under this SBIR adds the capability to model terminal airspace Merging and Spacing working cooperatively with Conflict Detection and Resolution in the Airspace Concept Evaluation System simulation. IAI began this SBIR in November of 2009 and final software has been delivered. As part of the briefing, demonstrations were provided showing the systems operating for Atlanta's Hartsfield-Jackson International Airport configured with routes to match current day operations. This effort was funded with American Recovery and Reinvestment Act funds.

26 Aeronautics Research Mission Directorate Holds Initial Systems Analysis Summit, December 2010, JPDO

The purpose of the summit was to develop a roadmap to integrate and leverage ongoing systems analyses among the Joint Planning and Development Office (JPDO), Aeronautics Research Mission Directorate programs, and NASA's four aeronautics research centers. Representatives from Ames, Langley, Glenn and Dryden Flight Research Centers, the JPDO, and industry attended the meeting. Ongoing systems analyses efforts were briefed. The summit also began the process to identify gaps and overlaps, and to develop options for improved collaboration and leverage. The attendees agreed that the next steps are to establish, document, and conduct configuration control on a set of metrics, scenarios, and demand cases.

27 "Analysis of NextGen Gaming" NASA Research Announcement Final Review, January 2011, Langley Research Center

Principal Investigator Prof. Lance Sherry of George Mason University (GMU) presented the results of the three-and-a-half year effort that included work at GMU and Sensis Corporation. The effort was aimed at identifying the potential of unintended consequences and "gaming" in the National Airspace System (NAS) that could occur following the implementation of

Next Generation Air Transportation System (NextGen) Concepts and Operations (ConOps). An examination of flight-by-flight gaming led to the conclusion that, for the purposes of evaluating NextGen ConOps (e.g. trajectory-based operations) and technologies (e.g. System-Wide Information Management, or SWIM),it would be more advantageous to consider macro-level decision-making mechanisms at the NAS-wide level, where all actions are determined based on decision making with a large number of input states and participants. In the task that evolved, two questions arose: (1) What types of decision making yield advantageous outcomes for airlines?; and (2) How can this type of decision making be evaluated? The Sensis effort focused on static decision making for airborne route selection, flight delays and cancellations. The GMU effort designed and implemented a first of its kind adaptive decision-making algorithm for pre-departure route selection for each day in the NAS. The decision space included 300,000 states, such as sector loading for time of day, distance-flown and fuel-burn options, scheduled departures, scheduled arrivals, and other variables. The impact of the implementation of NextGen SWIM was evaluated in the presence of adaptive flight plan route selection. The somewhat unexpected result was that, under the assumptions of the model, adaptive decision making in route selection, informed by SWIM, led to a stable equilibrium, which, in turn, resulted in better NAS performance. The significance of the conducted research is twofold. Its practical usefulness is evident when applied to NextGen technologies planned for NextGen in the near term. From a broader perspective, the GMU research resonates well with current findings on adaptivity in complex systems. Numerous reports and presentations can be obtained from Natalia Alexandrov at NASA Langley. A Contractor Report will be available on the NASA Technical Reports Server in the near future.