National Aeronautics and Space Administration

AOSP Newsletter

Airspace Operations and Safety Program (AOSP)

OCT-DEC 2016 | Quarter 1

AOSP IN THE NEWS

NASA, France Forge Aircraft Noise Reduction Research Partnership; Jaiwon Shin Comments

ExecutiveGov (10/04) reports that NASA and France's aerospace research agency ONERA have entered into an agreement to conduct studies to help mitigate the impacts of civil air transportation noise on communities.

NASA and Chinese Aeronautical Establishment to Jointly Research Air Traffic Management

Airport Technology (10/03) reports that NASA has signed a memorandum of understanding with the Chinese Aeronautical Establishment to conduct research that will help airport operators in the United States and Chine manage traffic. The five-year deal will help both countries improve their respective air transportation automation systems.

NASA & CAE Partner Up for Research on 'Air Traffic Management': Towards A Strong International Academic Bond?

University Herald (10/06) reports that NASA has recently signed a memorandum of understanding with the Chinese Aeronautical Establishment to collaborate for research on "Air Traffic Management." Civil aviation domains consider the results of the collaboration to be essential for building a strong international academic bond between aeronautics industries.

NASA Plans First BVLOS Drone Demonstration

Air Traffic Management (10/13) reports NASA partners will fly five unmanned aircraft systems (UAS) beyond the visual line-of-sight of their operators to test planning, tracking, and alerting capabilities of NASA's UAS traffic management research platform.

Tests Seek to Bring Order to Drone Wild West

Jason Hidalgo of USA Today (10/19) reports that NASA, in partnership with the Nevada Unmanned, Autonomous and NextGen Collaborative Environment Laboratory of the University of Nevada, Reno, recently held the second stage of testing for an air traffic management system designed to coordinate multiple drones flown by different operators.

NASA Conducts 'Out of Sight' Drones Tests at Reno-Stead Airport in United States

Airport Technology (10/24) reports that a team from NASA's Ames Research Center, along with the U.S. Federal Aviation Administration and other industry partners, has successfully conducted 'out-of-sight' drone tests at Reno-Stead Airport in Reno, Nevada.

New NASA Tech to Help Aircraft Land on Time

NDTV (11/01) reports that NASA is working with its partners on a new air traffic control technology that promises to safely increase the number of airplanes that can land on the same runway at busy airports by more precisely managing the time or interval between each aircraft's arrival.

NASA to Equip Alaska Airlines With ADS-B in Tool

John Croft of Aviation Week (11/01) reports that NASA's Langley Research Center plans to purchase Automatic Dependent Surveillance – Broadcast (ADS-B) In avionics for three Alaska Airlines Boeing 737-900ERs to begin operational testing of a NASA-developed fuel-and-time-saving software application in revenue operations in early 2017.

2017 to Witness Test of NASA's Aircraft Arrival Technology

Science World Report (11/03) reports that NASA recently announced that it is working with partners on innovative traffic control technology, called Flight Deck Interval Management.

AOSP IN THE NEWS

NASA Aircraft Arrival Tech Will Get Big Test in 2017

Avionics Magazine (11/08) reports that a coordinated effort involving NASA, the Federal Aviation Administration, and the aviation industry to develop and evaluate new technologies and procedures related to aircraft scheduling and airport arrivals will get a major test in 2017.

NASA: Anomalies Drive UAS Traffic Management

John Croft of Aviation Week (11/18) reports a salvo of increasingly complex tests of unmanned aircraft using newly developed air traffic management aids and conflict-avoidance tools for smaller unmanned air vehicles flying beyond visual-line-of-sight are uncovering the realistic factors that will affect large-scale multi-vehicle operations.

Multiple Drones Flying Beyond Line of Sight Perform in First-Ever Tests by NASA

Nevada Today (11/29) reports the first-ever testing of NASA's air traffic management platform concepts with drones flying beyond visual-line-of-sight. The tests were held at the end of October at the Nevada Unmanned, Autonomous and NextGen Collaborative Environment Laboratory at the University of Nevada, Reno, which is the collaborative workspace for the University and NASA for the research and development of autonomous systems.

FAA to Approve Drone Flights Beyond Visual Line of Sight at Test Site

Robotic Trends (12/27) reports that in October 2016, the FAAand NASA tested beyond visual-line-of-sight drone flights at the Reno-Stead Airport in Reno, Nevada. The test was part of the research that NASA is doing in partnership with the FAA to develop a comprehensive unmanned air traffic control system, which will allow for integration of drones into the National Airspace System.

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UTM TCL2 Test Flights Completed

POC: MARCUS JOHNSON

This quarter successfully marked the demonstration of the first tests of NASA's Unmanned Aircraft Systems (UAS) Traffic Management (UTM) research platform, held at Reno-Stead Airport in Reno, Nevada. From October 3 through 7, 2016, the UTM subproject team completed a second shakedown event in support of Technology Capability Level 2 (TCL2) testing. Seven partner organizations flew vehicles and two partner organizations provided ground equipment and support, accomplishing over 50 sorties during the week. The team tested various scenarios with extended visual line-of-site operations. The UTM system functioned well during the shake-down, and performed as expected during its formal demonstration, which took place from October 17 through 25, 2016. On October 19, during the demonstration period, a media day was held. During the tests, drones flew beyond the line-of-sight of their operators to test the plan-ning, tracking, and alerting capabili-ties of NASA's UTM platform.

Here are links to some national and local coverage of the event:

NASA Plans First Beyond Visual Line-Of-Sight Drone Demonstration in Nevada
ECNmag.com, October 13

NASA Plans First Beyond Visual Line-of-Sight Drone Demo
Aerotech News (blog), October 14

NASA Air Traffic Control System for Drones, Manned Aircraft Gets Test in Reno
Las Vegas Review Journal, Oct. 17

Tests Seek to Bring Order to Drone Wild West
USA Today, October 19

Silent Falcon UAS Tech-nologies Granted Airworthiness Statement by NASA
UASweekly.com, October 19

Drone Traffic Management Tested in Stead
KOLO, October 19

NASA Tests Unmanned Aircraft Management Design at Reno-Stead Airport
CBS 2 KTVN, October 19

For more information about this test, visit:
http://go.nasa.gov/2dV35z9

Explicate Work on System-Level Prognostics for the National Airspace

POC: KAI GOEBEL

Matt Daigle, Indranil Roychoudhury, and Kai Goebel from NASA's Ames Research Center presented recent findings on calculating system-level time-to-safety margin violations at the Prognostics and Health Management (PHM) Society Meeting, in Denver, Colorado, from October 3 through 6, 2016. Safety can be increased by the introduction of tools and methodologies from PHM. PHM will enable the National Airspace System (NAS) to predict unsafe states stochastically, enabling a proactive and preventative response strategy, as opposed to a reactive and mitigative one. However, PHM methods do not currently apply directly to the NAS for several reasons: they typically apply only at the component level; they are implemented in a centralized manner; and they are focused only on predicting remaining useful life. In the paper that Daigle, Roychoudhury, and Goebel presented, the model-based prognostics approach to PHM was extended to provide a framework that can be applied to the NAS. To that end, they provided a system-level approach that supports a distributed implementation, along with algorithms to predict the probability of an unsafe state-either at a specific time or within a time

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interval–and that predicts the time of an unsafe state. Placing the algorithms in this context helped the audience understand the benefits that real-time safety will provide.

Systems Architecture Virtual Integration Semiannual Meeting

POC: KURT WOODHAM

Kurt Woodham from NASA's Langley Research Center hosted a semiannual working group meeting of the Systems Architecture Virtual Integration (SAVI) project in Hampton, Virginia, from October 10 through 14, 2016. The Aerospace Vehicle Systems Institute (AVSI) at the National Institute of Aerospace managed the meeting. SAVI seeks to significantly reduce requirement and design defects introduced during the development of large, complex systems, such as modern transport aircraft. SAVI uses model-based engineering practices, coupled with early integration of models, to expose inconsistencies well before physical system integration occurs. AVSI is a cooperative industry, university, and government research environment supported by the Texas A&M University System. NASA participates in AVSI projects with the Texas A&M Engineering Experiment Station through the Space Act Agreement (SAA-1056A). SAVI members from AVSI, NASA, the Federal Aviation Administration, Department of Defense, Carnegie Mellon Software Engineering Institute, Airbus, Boeing, Embraer, Rockwell Collins, Honeywell, General Electric Aviation, and Lockheed Martin participated in the week-long meeting that addressed closeout of 2016 SAVI activities and plans for 2017. SAVI Tool Partner Eurostep also presented progress on tools and methods for representing, in a common environment using STEP AP239, models expressed in otherwise disparate modeling languages, and subsequent visualization of model relationships for evaluating consistent use of common properties prior to integration. Members of the Langley Research Center Model-Based Systems Engineering community also attended the Eurostep presentation.

ATD-3/DRAW NASA/ NATCA Meeting

POC: KAPIL SHETH

NASA Airspace Technology Demonstration-3 (ATD-3) team members met with National Air Traffic Controller Association (NATCA) representatives on October 12, 2016, at NATCA Headquarters in Washington, DC. NASA provided an overview of the ATD-3 subproject, and the groups identified a need for greater interaction on ATD-3 technologies. The Dynamic Reroutes for Arrivals in Weather (DRAW) concept was presented, along with potential benefit mechanisms for traffic managers and controllers, and implementation details. DRAW addresses a need for the Time-Based Flow Management system to maintain schedule accuracy during convective weather events. DRAW accomplishes this using a trial-planning feature. NATCA provided positive feedback, and the ATD-3 team anticipates further collaboration between the organizations.

Demonstrated Integration of TASAR and Data Communications Explored with FAA

POC: DAVID WING

On October 12, 2016, NASA's Langley Research Center engineer David Wing briefed Jesse Wijntjes, the FAA's Program Manager for Data Communications, and his staff, and demonstrated the Traffic Aware Strategic Aircrew Requests (TASAR) tool. NASA consultant Captain Bob Hilb and Airspace Technology Demonstration (ATD) project personnel–including Mike Madson and Kapil Sheth–attended the meeting, which explored potential operational demonstration opportunities in ATD-3. These opportunities would involve airline partner aircraft equipped with TASAR technology to leverage

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the emerging FAA Data Comm program for sending and receiving reroute requests in digital form. The FAA expressed significant interest in a cooperative demonstration, as attendees discussed possible scenarios involving shadow-mode tests of prototype Data Comm capabilities at the FAA Technical Center. The ATD-3 "Integrated Air Ground" project planning phase, which includes outreach meetings with airline partnership candidates, will explore these opportunities further. The planning phase and meetings will take place during the first half of fiscal year 2017.

AFRL/NASA Executive Research Council Meeting

POC: SHON GRABBE

Members of the Shadow Mode Assessment Using Realistic Technologies for the National Airspace System (SMART-NAS) Test-bed for the Safe Trajectory Based Operations Project collaborated with Air Force Research Laboratory (AFRL) researchers to develop a briefing for the Air Force and NASA Executive Research Council (ERC). The groups met on October 12, 2016, in Dayton, Ohio, just outside of Wright Patterson Air Force Base. The briefing covered several topics, including the fruitful historical collaborations between AFRL and NASA in the area of Verification and Validation (for autonomous systems). The briefing also identified likely areas of valuable collaboration in the future, and proposed a follow-up meeting with the ERC at their next meeting in February 2017, to lay out a roadmap for more collaboration between the two groups in the future.

Dynamic Weather Routes (DWR) Technical Interchange Meeting

POC: KAPIL SHETH

Under the Airspace Technology Demonstration-3 (ATD-3) subproject, NASA is performing research and development of technologies that help airspace users avoid convective weather while gaining flight time and fuel savings via flight plan route corrections in en route airspace. The first of three research transition products defined by the Applied Traffic Flow Management Research Transition Team Plan was transferred to the FAA on September 23. The products include NASA's Dynamic Weather Routes (DWR) concept of operations, twenty-three DWR-focused technical publications, functional and performance requirements, and prototype software and documentation. On October 13, 2016, a NASA-FAA Technical Interchange Meeting took place at the FAA Headquarters in Washington, DC. The FAA and MITRE Corporation representatives who attended observed a DWR concept presentation and examined a description of the technology transfer documents. The groups discussed implementation details of the delivered products.

Presentation to RTCA Combined Surveillance Committee

POC: AARON DUTLE

Aaron Dutle of NASA's Langley Research Center gave a presentation at the fourth meeting of the Combined Surveillance Committee at RTCA headquarters in Washington, DC on October 17 through 21. The committee is composed of members from RTCA Special Committees 209 and 186, and EUROCAE Working Groups 49 and 51. Dutle presented an update on the analysis of the Compact Position Reporting (CPR) algorithm that he, Langley's César Muñoz, the National Institute of Aerospace's Mariano Moscato and Laura Titolo, and the University of Virginia's Greg Anderson have been working on. The CPR algorithm reduces the amount of information transmitted by an automatic dependent surveillance – broadcast (ADS-B) application by use of encoding and decoding techniques for the position of an aircraft. The analysis uncovered gaps in the requirements and identified numerically sensitive points in the algorithm

that can lead to incorrect position reports. As a result, researchers are identifying alterations to the requirements and providing a verifiably reliable reference implementation of the algorithms to mitigate these issues. The committee reacted favorably to NASA Langley's research, and the recommendations for changes to the requirements are under consideration for the next version of the RTCA Minimum Operational Performance Standards for ADS-B.

Eighteenth Workshop/ Meeting of the ICAO SAM Implementation Group

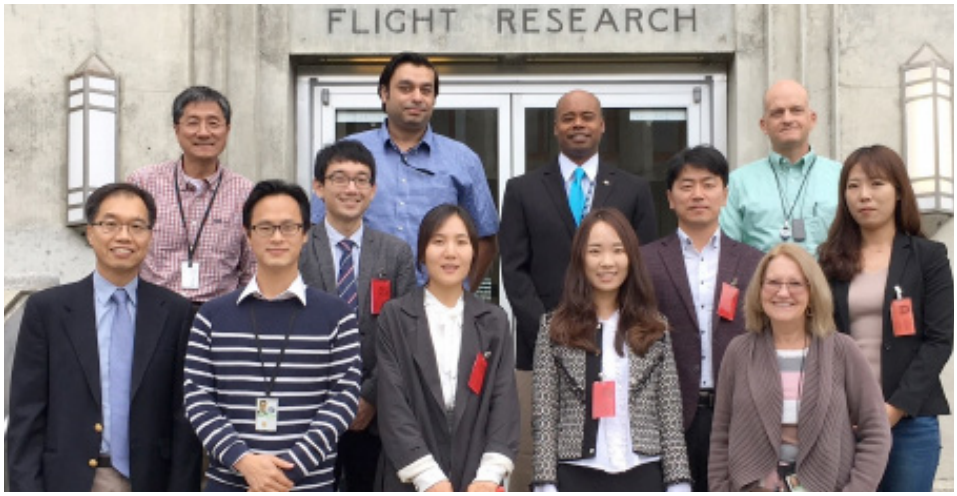
POC: RAFAEL APAZA

On October 17 through 21, 2016, in Lima, Peru, engineers from NASA's Glenn Research Center delivered the Aeronautical Mobil Airport Communications System (AeroMACS) technology development and standardization status presentation at the Eighteenth Workshop/Meeting of the International Civil Aviation Organization (ICAO) South America (SAM) Implementation Group (SAM/IG/18), and participated in the Communications, Navigation, and Surveillance Working Group discussions. Meeting participants included representatives from South American States and industry, and ICAO technical staff. Onofrio Smarrelli of the ICAO chaired the agenda item presentations and working group discussions. Technical discussions included AeroMACS' protected spectrum allocation, critical and non-critical data segregation, and implementation of Internet Protocol Suite for transport over AeroMACS technology. As noted during the presentation, the recent Amendment 90 of the ICAO Aeronautical Telecommunications Volume III, Anex10 publication includes information about the AeroMACS technology.

Korean Aerospace Research Institute (KARI) Workshop

POC: YOON JUNG

The NASA Ames Research Center hosted a joint workshop with representatives from the Korea Agency for Infrastructure Technology Advancement (KAIA) and the Korea Aerospace Research Institute (KARI) from October 24 through 26, 2016. Researchers and managers from the airport surface research area, the Airspace Technology Demonstration-2 (ATD-2) subproject, and NASA headquarters convened to share progress from collaborative research conducted in the past six months. The groups also discussed plans for collaborating on airport surface and terminal area research under a Memorandum of Understanding between NASA and KAIA/ KARI signed in November 2014. The KARI delegation provided briefings on current Air Traffic Management research, which included the Management on Integrated Operations of Departure, Arrival, and Surface (MIDAS) project, which has a similar research focus as that of ATD-2. The NASA team provided briefings and demonstrations of the



NASA Ames Research Center hosted a joint workshop with researchers from KAIA and KARI to discuss the progress in collaborative research on the Integrated Arrival, Departure, Surface (IADS) management (Oct 24-26, 2016).

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ATD-2 system surface optimization algorithms and fast-time simulation and modeling capabilities. The teams discussed specific areas of research collaboration to advance NASA's surface research portfolio, and provided insights into how KAIA and KARI can further develop their high-fidelity surface and terminal air traffic simulation and research tools. The next meeting is tentatively scheduled for May 2017 in Korea.

FAA/NASA Trajectory Based Operations Roadmap Technical Interchange Meeting

POC: BRYAN BARMORE

On October 25 and 26, 2016, the NASA Langley Research Center hosted FAA representatives from the NextGen Portfolio Management & Technology Development Office, including FAA Assistant Administrator for NextGen, Jim Eck. NASA representatives included members of the Trajectory-Based Operations (TBO) project formulation team from Langley and the NASA Ames Research Centers. The meeting included these goals: strategize ways the two agencies can broaden collaborations in the development and implementation of Full 4D TBO in the National Airspace System; initiate collaboration between the two agencies for the development of an organizationally implemented 4D TBO Roadmap; and initiate a quarterly technical interchange between NASA and the FAA related to 4D TBO. The meeting was very successful, and produced an exchange of information that included approximately 15 technical talks and an introduction to FAA and NASA planning activities. Additionally, Eck was given a tour of the Air Traffic Operations Laboratory and Autonomy Incubator. The next meeting is scheduled for February 2017. In the meantime, NASA will continue to work on roadmaps for 4D TBO.

AOSP Annual Project Reviews

POC: KENNY MCCOMBS

From October 26 through 28, 2016, Airspace Operations and Safety Program (AOSP) hosted its Annual Project Reviews for Fiscal Year 2016. The meeting was held at NASA HQ and included an Independent Review Panel, with members from the Federal Aviation Administration, the National Oceanic and Atmospheric Administration, the United States Air Force, and the National Transportation and Safety Board. The panel reviewed AOSP projects, including the Airspace Technology Demonstration Project, Shadow Mode Assessment Using Realistic Technologies for the National Airspace System (SMART-NAS) test-bed for Safe Trajectory Based Operations project, and the Safe Autonomous Systems Operations Project. Project managers presented results for Fiscal Year 2016, and stated their relevance, quality, and technical and managerial performance.

Subject Matter Expert (SME) Evaluation of MFCR

POC: KARL BILIMORIA

The NASA Ames Research Center hosted a Subject Matter Expert (SME) evaluation of the Multi-Flight Common Routes (MFCR) tool on November 1 through 4, 2016, in the Air Traffic Control Laboratory. MFCR is a NASA-developed concept and associated decision support tool designed to assist air traffic flow managers to efficiently update weather avoidance routes in the event of convective weather system. The MFCR groups together multiple flights to reduce the number of advisories evaluated by the traffic flow manager, and merges these grouped flights on a common route segment to provide an orderly flow of rerouted traffic. Five SMEs—all recently retired FAA traffic flow managers—provided feedback on the MFCR tool and its concept of use. Specific topics of evaluation included the operational acceptability of MFCR reroute advisories, the usability of MFCR's graphical user interface, and the overall viability of MFCR's concept of use. Based on a total of 200 evaluation points, the SMEs provided positive feedback, indicating that

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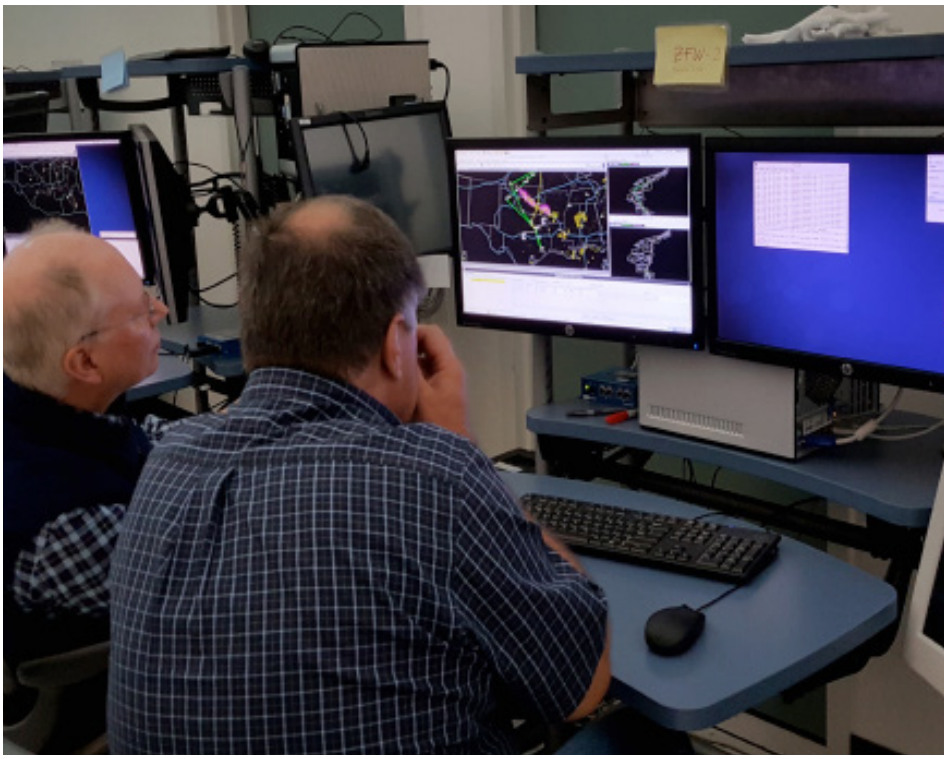

Retired Houston Center Traffic Management Coordinator assessing MFCR tool for its Concept of Use and operational acceptability.

MFCR presented many timesaving rerouting opportunities that would otherwise be difficult to identify manually during air traffic operations in bad weather conditions.

National Airspace System Flow Advisory Manager Undergoes First Evaluation at North Texas Research Station

POC: PAUL BORCHERS

Traffic management coordinators from Fort Worth Air Route Traffic Control Center evaluated the National Airspace System Flow Advisory Manager (NFAM) at the NASA North Texas Research Station (NTX) in Fort Worth, Texas, from November 8 through 11, 2016. Thirteen participants provided feedback during the seven sessions. Under a Small Business Innovative Research contract, Mosaic ATM is developing and evaluating a software tool that provides a predictive capability to allow air traffic managers to visualize the impact of existing and proposed traffic management initiatives several hours in advance. The NFAM concept is based on the Generalized Brownian Motion model algorithms that provide time-varying demand, capacity, and uncertainty in demand and capacity assessments. NFAM is a candidate contributor to the Federal Aviation Administration's overall Advanced Methods project and Collaborative Air Traffic Management (CATM) under Work Package 5. A second evaluation of NFAM will occur at NTX in March 2017.

Airspace Technology Demonstration-3 (ATD-1) Meeting on Air/Ground Integration

POC: KAPIL SHETH

On November 15 and 16, 2016, Airspace Technology Demonstration-3 team members met at the NASA Langley Research Center to discuss the air and ground integration of cockpit-based and ground-based rerouting tools. The team discussed concepts and analyses that included technical objectives, benefit mechanisms, and future technologies. The ATD-3 team also discussed project objectives, budget guidelines, performance metrics, and risks associated with air and ground integration milestones, partnerships, and outreach. The team worked on plans for developing a concept of operations due in March 2017, as well as a plan to achieve a demonstration in 2020. The strengths of cockpit-based technology Traffic Aware Strategic Aircrew Requests

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The ATD-3 team discussing the Concept of Operations for Air/Ground Integration, and the eventual demonstration with a commercial airline in 2020.

and Traffic Aware Planner, and the ground-based technology Multi-Flight Common Route and NAS Constraint Evaluation and Notification Tool, were considered in the development of high-level concepts for integration of these technologies.

ATD-2 Shadow Evaluations Completed in CLTlab

POC: SHIVANJLI SHARMA

This past quarter marked the successful completion of the fourth and fifth Airspace Technology Demonstration-2 (ATD-2) Shadow Mode Evaluations, held at the Charlotte International Airport ATD-2 Lab (CLT).

The fourth Shadow Mode Evaluation took place on October 18 and 19, 2016, and included traffic managers from Washington Air Route Traffic Control Center (ZDC), who met with staff from the CLT Air Traffic Control Tower (CLT ATCT) and FAA headquarters, and NASA personnel at the CLT lab. On the first day, the team presented information to the ZDC personnel on topics such as the CLT lab and the latest ATD-2 tools and the shadow evaluation process. On the second day, the team reviewed the plan to integrate ATD-2 technologies with the operational Time-Based Flow Management (TBFM) system for field demonstration, and the airspace scenarios that the electronic coordination technology would likely use. Strong collaboration and fast progress in this meeting resulted in ample time for system shadow familiarization. On October 20, CLT ATCT, American Airlines CLT ramp, CLT airport operations, and FAA and NASA personnel met in the CLT lab for a follow-up session to clarify ATD-2 requirements for data exchange and integration.

The fifth Shadow Mode Evaluation took place on November 16 and 17, 2016, where CLT ATCT traffic managers, American Airlines ramp controllers, CLT airport operations representatives, and FAA and NASA personnel met again in the CLT lab. Over the two days of evaluations, discussions focused on the following: the development of a capability for real time monitoring of capacity and efficiency of operations; benefits-related measures of performance; a presentation and analysis of CLT operational data and methods used to automatically include National Airspace Systems status information into the system; and proposed adaptation changes to refine the system. The shadow session also included the first successful demonstration of a live-data system at the NASA Ames Research Center, presented remotely to Field Demo Partners in the CLT lab, a capability that permitted discussion on TBFM integration and other development items. The shadow session enabled further collaboration and the exchange of ideas and input to improve model accuracy.

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ATD-2 Integrated Surface and Airspace Simulations (ISAS)

POC: SAVITA VERMA

This past quarter, the ATD-2 Experiment Team performed a series of successful human-in-the-loop (HITL) tests connecting the airspace and surface traffic simulators. On October 12, the team connected the airspace and surface traffic simulators, Multi-Aircraft Control System (MACS), and Air Traffic Generator (ATG) at two NASA Ames Research Center facilities, FutureFlight Central (FFC) and the Airspace Operations Laboratory (AOL). The test series involved the Charlotte Douglas International Airport (CLT) and the surrounding airspace for approximately 100 simulated flights that included both arrivals and departures. Participants included one CLT Ground and two Local Controllers managing flights using the ATG system at FFC, and a total of five feeder and departure sector controllers using MACS at the AOL. The FFC also featured a smaller-scale virtual CLT Air Traffic Control Tower to support the tests. On November 18, the team continued HITL testing, integrating several ATD-2 prototype system components—the Surface Trajectory-Based Operations subsystem, the Time-Based Flow Management/ Integrated Departure Arrival Capability subsystem, and Surface Collaborative Decision Making. The scenario simulated 580 flights at present-day traffic levels with arrivals, departures, overhead traffic, turnaround flights, and manipulations of pushback time compliance and spool-up time in the ramp area. Future work will integrate the 360-degree American Airlines ramp tower simulator to include the evaluation of the ATD-2 ramp management tool. More complex test

NASA ATD-2 researchers and developers testing Air Traffic Control Tower tools at NASA Ames Research Center's FutureFlight Central facility.

Air Traffic Control Tower simulator used for the ISAS HITL tests.

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scenarios will be developed to include different runway configurations and the integration of surface metering and tactical departure scheduling. These tests are major steps towards a HITL demonstration of the full suite of the ATD-2 tools planned for early March 2017 with participants from American Airlines and FAA operational facilities.

ATD-2 Tactical Scheduling and Metering Technical Interchange with American Airlines

POC: YOON JUNG

On November 22, 2016, NASA researchers met at the American Airlines (AA) Integrated Operations Center (IOC) in Fort Worth, Texas, for a technical interchange with personnel from AA's Operations Systems and Decision Support Group. The NASA team presented an update on a tactical scheduling and metering capability that originated out of the Spot and Runway Departure Advisor (SARDA) research activity, currently being developed for application to the ATD-2 subproject. NASA is collaborating with the FAA to demonstrate ATD-2 technologies at CLT beginning in September 2017. The FAA has designated AA as the lead air carrier for ATD-2. This technical exchange provided NASA with valuable air-carrier feedback that will help further refine tactical scheduling and metering capability prior to shadow evaluations and simulation experiments with the full complement of field demonstration partners in early 2017.

Discussion and Demonstration of IDM Concept for FAA's TFMS Deployment Team

POC: NANCY SMITH

On November 29, 2016, Nancy Smith and the Integrated Demand Management (IDM) research team met with Omar Baradi, Acting Traffic Flow Management System (TFMS) Program Manager for the Federal Aviation Administration (FAA), and his TFMS deployment team at the NASA Ames Research Center, to discuss the IDM concept. The meeting included discussions on the results from the August 2016 simulation, and the next steps for IDM concept development. Baradi and his TFMS deployment team decided to meet at Ames to discuss IDM, so that the team can further collaborate with IDM researchers. Pat Somersall, Operations Manager for the FAA, who has been an early supporter and stakeholder for the IDM concept, also attended. During the meeting, Baradi and his team showed great interest in IDM, provided considerable insight into the traffic flow management issues related to current operations and identified key challenges for the IDM concept. Baradi commented that IDM's focus on integrating and coordinating TFMS and TBFM was in accordance with their own efforts, which involve deploying and eventually integrating the "3Ts" (TFMS, Time Based Flow Management, and the Terminal Flight Data Manager). The group is concerned that without proper integration, users could take multiple penalties across the three systems. Therefore, efforts such as IDM offer a way to minimize such negative impacts in future systems.

NASA ATD-2 researchers met with American Airlines' Operations Systems and Decision Support Group to discuss the tactical surface scheduling and metering capability of the ATD-2 IADS system (Nov 22, 2016).

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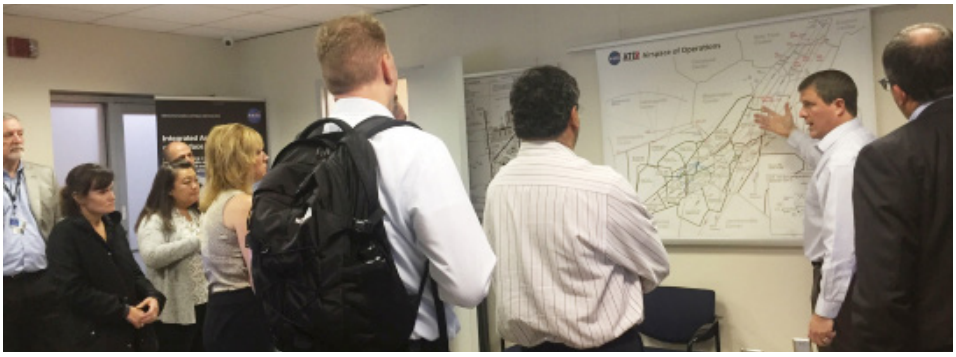

American Airlines hub managers were given an ATD-2 overview at NASA's ATD-2 Laboratory in Charlotte, NC (Nov 30, 2016).

ATD-2 Familiarization for American Airlines (AA) Hub Managers

POC: SHIVANJLI SHARMA

On November 30, 2016 approximately 30 American Airlines (AA) Hub Directors and ramp managers from across the country met in the ATD-2 lab CLT lab for an overview and demonstration of the ATD-2 system and associated technologies. The ATD-2 system overview included a description of the goals, benefits, and tools developed for use across the various user groups, from Air Traffic Control Tower (ATCT) personnel to ramp managers and controllers. The demonstration in the lab allowed the ramp managers to see firsthand the data integration and exchange between ATCT and the ramp that the system will enable, as well as key differences in features between ramp controller and ramp manager tools. In addition, descriptions of a real-time dashboard and monitoring tool were provided as a way for users to gauge benefits and efficiency metrics. This demonstration provided a venue for a unique discussion and thoughtful comments from the ramp managers' perspective.

Meeting with American Airlines (AA)

POC: DAVID WING AND KAPIL SHETH

On November 30, 2016, David Wing and Kelly Burke from NASA's Langley Research Center briefed key personnel at American Airlines (AA) headquarters in Ft. Worth, Texas, on the Traffic Aware Strategic Aircrew Requests (TASAR) concept, and demonstrated the Traffic Aware Planner (TAP), a NASA-developed flight-deck trajectory optimization software application. Among the AA personnel in attendance were Capt. Brian Will (Director, Airspace and Avionics Modernization), Mike Byham (Director, Operations Engineering), First Officer Brian Norris (EFB Program Manager), and Tom O'Neill (Director of Dispatch Operations). The meeting also included additional TASAR team members, NASA consultants Capt. Bill Cotton and Jeff Henderson, and NASA ATD project personnel Mike Madson and Kapil Sheth, among others. In 2013, Capt. Will evaluated TAP in the first TASAR Flight Trial. With the US Airways merger now nearly completed, he requested this meeting to assess the feasibility of implementing TASAR in the AA fleet. The group discussed technical requirements in detail, and AA representatives identified no show-stoppers for proceeding forward. Additional discussions will be held to determine next steps. The meeting also explored potential airline partnership opportunities within the ATD-3 project for conducting an "air/ground integration" operational demonstration in years 2018 through 2020. These opportunities would involve equipping partner airline aircraft with the TASAR technology and installing NASA's National Airspace System Constraint Evaluation and Notification Tool (NASCENT) technology in the partner airline's Operations Center. AA already has NASCENT installed and expressed significant interest in the air and ground integration of these technologies. ATD-3 will demonstrate how the integration of NASA-developed ground and

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flight-deck-based automation tools can improve trajectory efficiency in the en route phase of flight. These NASA technologies enable airspace users to continuously assess weather, wind, traffic, and other information to identify, evaluate, and implement dynamic flight plan route corrections that can significantly reduce flight times and fuel costs in en route airspace. These airline partnership opportunities will continue to be explored in ATD-3's "Air Ground Integration" project planning phase, currently underway.

SBIR Phase 1 Close-Out for Weather Scenario Generator

POC: SHERI BROWN

The final review meeting of the Phase I Small Business Innovation Research (SBIR) awarded to AvMet Applications Inc., was held on December 1, 2016, at NASA's Langley Research Center. The meeting was attended by Colleen Reiche (AvMet), Mark Klopfenstein (AvMet), Jeff Smith (Metron Aviation), and Langley Research Center researchers. Reiche gave the final out-brief presentation on the design and capabilities of a weather-scenario generator. NASA is developing advanced modeling and simulation capabilities for air traffic management (ATM) applications within the Airspace Operations and Safety Program. Weather is a major design constraint in the development of advanced, efficient, and capacity-enhancing ATM concepts. This SBIR effort focused on developing software that would allow ATM researchers to generate realistic weather in a controlled manner for ATM simulations without solely relying on historic records. This will allow researchers to set a range of weather parameters of interest for their study and produce representative and realistic weather conditions. The output of the weather scenario generator would include weather observations and high-resolution deterministic and probabilistic weather forecasts based on grid model data from numerical weather prediction models such as the High Resolution Rapid Refresh (HRRR) model.

SBIR Phase 1 Closeout for Integrated Multi-Mode Automation

POC: SHERI BROWN

On December 2, 2016, Architecture Technology Corporation presented a final briefing at NASA's Langley Research Center for a Phase I Small Business Innovation Research titled "Integrated Multi-Mode Automation (IMMA) for Trajectory Based Operations (TBO)." Attendees included personnel from NASA, the Federal Aviation Administration (FAA), and MITRE Corporation. The lack of support from the Air Traffic Management regarding aircraft with different capabilities is a longstanding and persistent issue that can limit the ability of the National Airspace System (NAS) to take full advantage of advanced aircraft capabilities. To fully utilize the variety of TBO concepts planned for the NAS, some of which use advanced aircraft capabilities for implementing trajectories, an air traffic controller (ATC) must be able to simultaneously support a variety of TBO concepts using different aircraft automation systems to fly the desired trajectory. To accomplish this, the ATC needs automation support to simplify the inherent complexities of using a variety of different TBO concepts and trajectory implementation strategies, and the tools to execute the desired trajectories, maintain situational awareness at all times, and support off-nominal situations. IMMA provides the automation to simplify the inherent complexities of using multiple TBO concepts by focusing the controller interactions on common core functions that all TBO concepts must support. Phase I efforts saw the development of near- and far-term integrated TBO Concepts of Operations (ConOps), the identification of IMMA initial functional requirements, and a demonstration of IMMA through a cognitive walkthrough. Plans were also presented

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

for a proposed Phase II effort in which IMMA prototypes that target near- and far-term ConOps would be created and verified through real-time simulations. Both NASA and the FAA see the potential of IMMA technology to advance the state-of-the-art for NextGen TBO.

Real-Time Safety Monitoring Demo to FAA

POC: MATT DAIGLE

On December 11, 2016, Matt Daigle from NASA's Langley Research Center conducted a Real-Time Safety Monitoring (RTSM) demonstration for several FAA visitors at the Langley facility. Six people from attended, including Aleta Best, Tom Tessitore, George Steinmetz, Tirolu Bati, and Pradip Som. The demonstration was well received and the group identified elements for exchanging information. For example, there are several modules that have been developed at the FAA for wake encounter, loss of control, go-around and opposite landing that may be of interest to RTSM—either for consideration as future-use cases or as plug-ins—as model enhancements to existing models. It was suggested that a face-to-face meeting might make sense to further explore these opportunities.

FAA 4D Trajectory Demonstration at Embry Riddle Florida Test-Bed

POC: BRYAN BARMORE

On December 13 and 14, 2016, Bryan Barmore and Nelson Guerreiro of NASA's Langley Research Center attended the Federal Aviation Administration's (FAA) 4D Trajectory demonstration, hosted by Embry Riddle Aeronautical University, at the Florida NextGen Test-Bed in Daytona, Beach, Florida. The demonstration highlighted possible operational benefits from the data communication standards recently published by RTCA. These standards are for the ATN Baseline 2 (ATN B2) protocol and associated message set that includes support for Dynamic Required Navigation Performance (DRNP) routes and Advanced Interval Management (A-IM). Both direct communications (Controller Pilot Data Link Communications) and automation-to-automation communications (Automatic Dependent Broadcast – Contract) are supported. Industry partners provided two different simulated flight management systems (Honeywell and GE), controller automation platforms (Leidos), and communication network systems (Rockwell Collins/ARINC). Jarrett Larrow from the FAA was the designated DRNP stakeholder and provided a liaison with the DRNP community, including RTCA SC-227. Barmore provided a similar role for NASA, the A-IM community, and RTCA SC-186. The demonstration offered two scenarios to show methods of keeping aircraft on known trajectories using DRNP and maintaining throughput using A-IM. The presentation raised many questions relating to implementation impediments and system flexibility. Most of these questions will be addressed by NASA's TBO Project, currently being formulated.

RECOGNITION

PHM Contributor of the Year Award

POC: KAI GOEBEL

Real-Time Safety Monitoring team members Matt Daigle, Kai Goebel, Edward Balaban, Indranil Roychoudhury, Chris Teubert, John Ossenfort, Scott Poll, Chetan Kulkarni, Shankar Sankararaman, Susan Frost, and George Gorospe received the "Contributor of the Year" award from the Prognostics and Health Management (PHM) Society for their leadership, teamwork, and sustained dedication to the work in the field. The PHM Society is a non-profit professional organization dedicated to the advancement of PHM as an engineering discipline. It is founded on three basic principles: to provide free and unrestricted access to PHM knowledge; to promote interdisciplinary and international collaboration in PHM; and to lead the advancement of PHM as an engineering discipline. Team members have held various volunteer positions as technical chairs at the annual conference, given tutorials, and held positions as associate editors of the organization's International Journal of Prognostics and Health Management. The recipients were recognized at this year's event, held in Denver, Colorado, from October 3 through 6, with this award for their individual sustained support over the last few years.

Best Papers at Digital Avionics Systems Conference (DASC) 2016

POC: KATHARINE LEE

The theme of the recent Digital Avionics System Conference (DASC) 2016, held in Sacramento, California, on October 3 through 6, was "Enabling Avionics for UAS/UTM (UAS Traffic Management)." Ames UTM team members Joseph Rios, Daniel Mulfinger, Jeffrey Homola, and Priya Venkatesan's paper, "NASA UAS Traffic Management National Campaign: Operations across Six UAS Test Sites," was awarded Best of Sessio and Best of Track (out of seven tracks at the conference).

AIAA-HRS Robert A. Mitcheltree Young Engineer of the Year Award

POC: SHERI BROWN

On October 17, 2016, Kurt A. Swieringa of NASA's Langley Research Center was chosen as the 2017 AIAA-HRS Robert A. Mitcheltree Young Engineer of the Year Award. This award recognizes one member of the AIAA Hampton Roads Section (HRS) each year for distinguished service in some facet of aerospace engineering practice as a young professional. With this award, Swieringa automatically becomes the Hampton Road Section's nominee for the peninsula-wide Doug Ensor Award for Young Engineer of the Year.

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