National Aeronautics and Space Administration

AOSP Newsletter

Airspace Operations and Safety Program (AOSP)

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AOSP IN THE NEWS

NASA Tech Transfer Helps the FAA Improve Air Traffic Efficiency

In the June 30 issue of NextGov Hallie Golden reports that when NASA handed over Terminal Sequencing and Spacing (TSAS) software to the Federal Aviation Administration (FAA), it was the fourth time NASA helped the agency improve its air traffic efficiency. By better controlling spaces between planes, the software should allow aircraft to follow fuel-efficient, continuous-descent arrival procedures while passing through airspace surrounding an airport. Ms. Golden notes that the FAA "plans to deploy TSAS between 2018 and 2022 in nine key airports, including those in Atlanta, Seattle, San Francisco and Las Vegas."

NASA to Test UAV Air Traffic Control System

On August 10, the Associated Press reported that a project managed by NASA Ames Research Center will have 12 groups test unmanned aerial vehicle (UAV) software at the agency's Crows Landing Airport as part of testing "an air traffic control system for drones." Richard Kelley, chief engineer at the University of Nevada-Reno's (UNR) Nevada Advanced Autonomous Systems Innovation Center, said the goals would be "to create a system the Federal Aviation Administration (FAA) can use to monitor fast-flying manned and unmanned aircraft that operate at altitudes of 500 feet and below."

The Las Vegas Sun reported that UNR researchers, who wrote software that allows its test drone to communicate with NASA's system, will run their test with Flirtey, a company that conducted the first FAA-approved delivery via drone in July, and Drone America, a Reno-based firm that operates and manufactures unmanned aircraft hardware.

NASA Sleep Research Shows Benefits of Naps

Eric Barker wrote at TIME on July 1 about sleep, citing NASA research finding that "pilots who take a 25 minute nap in the cockpit – hopefully with a co-pilot taking over the controls – are subsequently 35% more alert, and twice as focused, than their non-napping colleagues." He sums up the findings: "NASA found that naps made you smarter — even in the absence of a good night's sleep."

AOSP IN THE NEWS

Alaska Airlines, Virgin America Benefit From NASA Software

In an article published by Aviation Week, writer John Croft reported that Alaska Airlines and Virgin America will be the first two commercial carriers that will use "a new generation of empowered airline employees flying increasingly connected aircraft." These airlines will utilize "a NASA-built software engine that constantly searches for a more fuel-efficient or quicker route anytime the aircraft is above 10,000 feet."

NASA, UK Discuss UAV Traffic Management System

An article written on September 16 by Madhumita Murgia in the Telegraph newspaper noted that that the United Kingdom (UK) and NASA are now in talks for developing an unmanned aerial vehicle (UAV) traffic management system. Lord Ahmad Tariq, the UK's Under Secretary of State for Transport, said that he hopes the discussion "will lead to a UK involvement in the development of that system and the participation of UK industry in future trials to test the robustness of the technology." Murgia wrote that the move is being spurred on by "widespread anxiety about the possibility of a mid-air collision between small drones and commercial aircraft.

North Dakota Helps NASA Develop UTM

The Bismarck (N.D.) Tribune reported on September 18 in an article written by Jessica Holdman that NASA has given the North Dakota Department of Commerce a contract to help develop its unmanned aerial systems (UAS) traffic management system (UTM). Gov. Jack Dalrymple said in a statement that the NASA contract "is more confirmation that our ongoing work to establish North Dakota as a national hub for UAS research, development and commercialization is gaining more traction every day." Other local partners for the project test include Sensurion Aerospace, Altavian and Botlink, all of which will provide corporate feedback.

The Associated Press also covered the story.

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

NASA Participates in UTM Convention

POCs: JOEY RIOS AND MARCUS JOHNSON

On July 28-30, NASA and the Silicon Valley Chapter of the Association of Unmanned Vehicle Systems International (AUVSI) partnered in cosponsoring the 2015 UTM Convention: A New Era in Aviation, at NASA Ames Research Center. About 1,000 people registered and participated in the event, including representatives from the unmanned aerial system (UAS) community, agriculture, film and other industries, conventional aviation, government and academia.

Topics at the convention included discussions of the latest developments in UAS technology, solutions for privacy concerns and issues, safety and security, and the future impact of low-altitude flight on the emerging business sector, as well as indoor and outdoor flight demos of UAS applications.

Keynote speakers included NASA Associate Administrator for Aeronautics Dr. Jaiwon Shin; the Federal Aviation Administration's Assistant Administrator for the Next Generation Air Transportation System Ed Bolton; Gur Kimchi of Amazon Prime; and Dave Vos from Google's Project Wing initiative.

The three-day gathering brought together a broad international and U.S. audience of government and civilian representatives, including leaders from industry and academia, to discuss, understand and define UAS impacts and the challenges ahead. Highlights from the UTM Convention are listed in the following NASA social media links listed below.

#UTM2015
Twitter: @NASAAmes and @NASAAero
Facebook: NASA Ames Research Center
Instagram: @nasaames

In this image, an unmanned aircraft system is operated in Channel Islands Harbor in Oxnard, California during Coastal Trident 2015 field experimentation and exercise activities. The exercises included a demonstration of UTM concepts. Image credit: NASA

NASA LANGLEY HOSTS ATD-1 AVIONICS PHASE 2 KICKOFF ACTIVITIES

POC: SHERI BROWN

In a meeting held July 16-17, NASA Langley Research Center kicked off activities related to the $10.9 million, two-year Boeing Company contract award entitled "Air Traffic Management Technology Demonstration-1 (ATD-1) Avionics Phase 2."

ATD-1 is a major applied research and development activity of NASA's Airspace Operations and Safety Program (AOSP), and the first of a series of subprojects advancing the technology readiness level of innovative NASA technologies through system-level demonstrations in relevant environments. A primary goal of ATD-1 is to operationally demonstrate an integrated set of NASA arrival management technologies for planning and executing efficient arrival operations in the terminal environment of a high-

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density airport. These technologies are intended to assist flight crews, controllers, and air traffic managers with meeting the Next Generation Air Transportation System objective of increased fuel efficiency during periods of high runway throughput.

NASA Langley researchers developed the Airborne Spacing for Terminal Arrival Routes (ASTAR) algorithms for trajectory-based control law for time-based spacing of Flight Deck Interval Management (FIM) operations. The Avionics Phase 2 task leverages Phase 1-identified solutions for equipping existing in-service aircraft with FIM equipment, an airborne spacing tool leveraging technology under development at NASA, for a fiscal year 2017 second quarter flight test demonstration. The Avionics Phase 2 team is comprised of organizations and individuals from each organization that are recognized leaders in the community.

The Boeing Company, in partnership with Honeywell and United Airlines will build, test, and fly the ATD-1 avionics prototype FIM system, which NASA plans for technology transfer to the Federal Aviation Administration (FAA).

Day 1 of the meeting was attended by 37 individuals (including seven remote participants) including project leadership, engineers, researchers, and key stakeholders from the ATD project, the ATD-1 subproject, NASA Langley's Aeronautics Research Directorate, the FAA, Boeing, Honeywell and United Airlines. The Boeing team provided a presentation facilitating the review and discussion of the project objectives, approach (i.e., project schedule, milestones, deliverables), and the desired outcomes and tangible products. All agreed the discussion was fruitful and informative.

Day 2 of the meeting included a half day of briefings provided by the ATD-1 project team presenting a historical overview of the project, the current state of ASTAR technology, and an introduction to an ongoing experiment followed by a demonstration in the Air Traffic Operations Laboratory (ATOL). The demonstration included an experiment scenario used for training pilots on FIM operations. Permitting Boeing team members to fly simulated aircraft and to manipulate displays. Questions were addressed in real-time by onsite research pilots.

As seating was limited, one of the aircraft displays was enlarged in the ATOL briefing room for another onsite research pilot to talk through and answer questions. A playback of a previously recorded experiment scenario was displayed in the briefing room for the team to observe a fully staffed scenario with trained controllers and pilots for a better sense of the density and complexity of FIM operations, as well as an opportunity to observe the controller stations.

On Sept. 24, NASA Langley hosted a preliminary design review. At the meeting, the Boeing team provided a presentation that reviewed and discussed aircraft selection, proposed modifications, system architecture, including hardware and software approaches, and installation requirements. Presentation topics include assumptions, requirements, trades, interfaces, a detailed design plan, hardware locations, preliminary verification and validation plans, schedule and margins, and risks and mitigation plans.

The meeting was attended by a total of 37 individuals (11 remotely representing leadership, engineers, researchers, and key stakeholders from the ATD project, the ATD-1 subproject, Langley's Aeronautics Research Directorate, and the FAA. All review board members agreed the technical discussion was fruitful and informative. The ATD-1 Sub-project manager noted that the presentation exceeded the statement of work requirements. Denise Scearce is the ATD-1 Avionics Lead and Technical Point of Contact for the Phase 2 task.

NASA-FAA ATD-2 COLLABORATION COMMENCES

POCs: SHAWN ENGELLAND, PAUL BORCHERS AND RICHARD COPPENBARGER

On July 16, researchers from NASA Ames Research Center and several stakeholder organizations joined the Federal Aviation Administration's

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(FAA) Assistant Administrator for the Next Generation Air Transportation System (NextGen) Ed Bolton to kick off collaboration on the Airspace Technology Demonstration-2 (ATD-2) departure metering initiative in North Carolina at Charlotte Douglas International Airport (CLT). Improving airport surface operations is a high priority for the FAA, and NASA's ATD-2 project is seen as a critical activity for addressing the NextGen Integration Working Group (NIWG) stakeholder recommendations for surface improvements.

The ATD-2 efforts will increase aircraft arrival, departure and surface movement predictability and efficiency in metroplex traffic environments by integrating evolving collaborative decision making (CDM) capabilities with state-of-the-art air traffic management scheduling technologies. These include NASA's Spot and Runway Departure Advisor (SARDA) and Precision Departure Release Capability (PDRC), as well as leveraging FAA and industry technologies. ATD-2 will also enable more effective CDM through enhanced two-way sharing of prediction and scheduling information.

CLT will serve as the test site for the initial ATD-2 demonstration of a NextGen departure metering capability consistent with the FAA's surface CDM concept of operations. NASA participants at the kickoff meeting included Ms. Huy Tran, the NASA Ames acting director of aeronautics, and Leighton Quon and Shawn Engelland, key project leads from NASA's Airspace Operations and Safety Program (AOSP) and ATD-2 subproject. Stakeholder representatives included leadership from American Airlines, Charlotte Airport, the FAA's NextGen Office, the National Air Traffic Controllers Association (NATCA), and local, regional, and national FAA offices, who expressed enthusiasm and support of the proposed activities iterated at the kickoff meeting.

NASA researchers discuss the Ramp Traffic Console (RTC) component of the ATD-2 integrated system with field demonstration partners in the NTX laboratory. Image credit: NASA

A follow-on meeting occurred at CLT on Aug. 18 –19. Its objectives were threefold:

- To familiarize FAA and airline stakeholders with the ATD-2 concept and technology;
- To connect the NASA research team with subject-matter experts in preparation for smaller but more frequent technical interchanges; and
- To allow the NASA team to directly observe ramp, tower, and Terminal Radar Approach Control (TRACON) operations to prepare for the planned ATD-2 demonstration in 2017.

Attendees again included representatives included American Airlines, local and regional FAA personnel, NATCA, CLT, FAA and NASA. Subject-matter experts presented briefings on airport and airspace operations and the FAA led tours of the CLT Tower and TRACON.

The NASA team observed simulations of FAA procedures training for managing converging runway

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operations and upcoming changes to departure routes and also visited the American Airlines ramp tower. The visit provided the team with a deeper understanding of the techniques used to manage traffic volume and stage aircraft movement, and specifically the interaction of arrivals and departures due to gate and ramp constraints, the management of runway crossing operations, and the dependency of departures on arrivals during converging runway operations.

During and after the summit, FAA and airline representatives expressed their appreciation for the overall technical interchange, the strong team that NASA has assembled to support ATD-2, and the efforts by the NASA team in preparing briefings and conducting working sessions.

A subsequent meeting was held Sept. 16-17, 2015, at the NASA North Texas Research Station (NTX) in Fort Worth, Texas. At this meeting NASA Ames personnel again met with key stakeholders from American Airlines, NATCA and CLT. The purpose of this meeting was to review ATD-2 objectives and discuss software harmonization efforts and operational considerations for the upcoming tests.

The group also observed PDRC displays in operational use in Fort Worth En Route Center to gain a greater appreciation of NASA's existing NTX efforts.

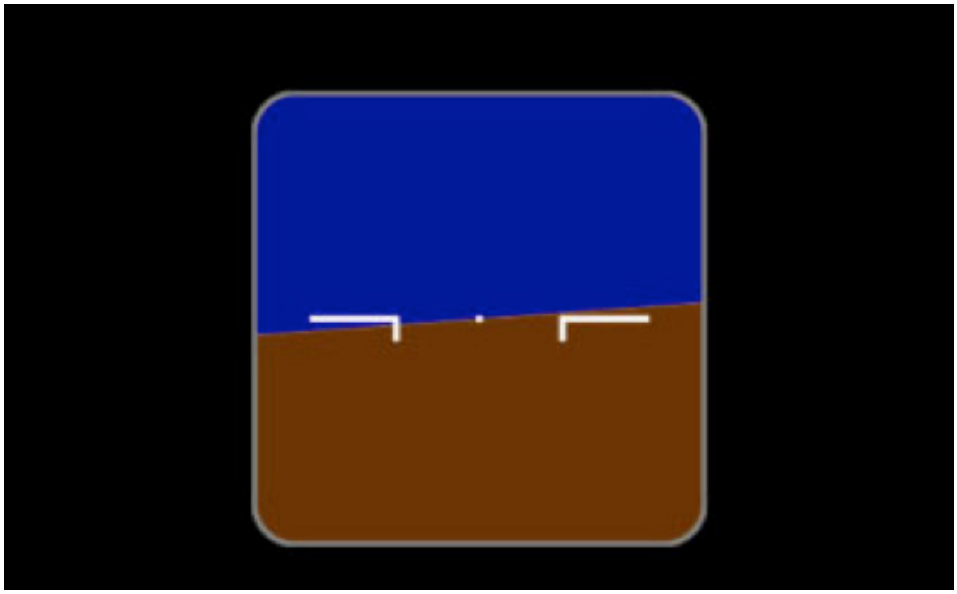
VVAP II VMS EXPERIMENT COMPLETED

POC: SCOTT REARDON

Because pilot loss of control is the leading cause of jet casualties worldwide, the U.S. Congress has mandated that aircrews be trained in stall and upset recovery, which airlines use motion-based simulators to accomplish. However, simulator motion-cueing systems must be configured to provide the best stall and recovery training.

Conducted at NASA Ames Research Center's Vertical Motion Simulator (VMS) July 20 through September 11, and sponsored by the Technologies for Airplane State Awareness element of NASA's Technologies for Airspace Technology Demonstration Project, the Visual-Vestibular Active Psychophysics II (VVAP II) experiment was the second in a series of studies aimed at developing cueing requirements for full stall-recognition and recovery training.

The experiment's goal was to develop a model of the pilot's combined motion and visual perception dynamics in the pitch/longitudinal and heave axes. The model could then be used to configure simulator motion cueing systems for stall and recovery training. VVAP II consisted of a simple pitch-tracking task using an aircraft math model near stall. The pilot was asked to try to keep the aircraft level while a sum-of-sines disturbance was introduced in the pitch axis. The pilot would then



Simplified primary flight display.

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track the disturbance in a simple primary flight display.

Approximately 15 general aviation pilots participated in the experiment and were asked to first train for the task with limited or no motion, and then perform the task with full motion in the pitch, longitudinal and heave axes. Measurements of simulator visual and motion stimuli and pilot control inputs will be used to estimate the parameters of the pilot model. Data analysis is currently underway.

DLR COLLABORATION WORKSHOP

POC: YOON JUNG

Researchers from NASA Ames Research Center and the German Aerospace Center (DLR) in Braunschweig, Germany participated in a two-day workshop held at NASA Langley Research Center in Hampton, Va. on July 21-22 to discuss research progress related to surface management and future collaborations as defined in the collaborative research agreement between the two organizations.

Research progress made through the collaboration for the past year included development of a harmonized concept of 4D surface taxi, and modeling and simulation of airport surface traffic management using surface optimization techniques developed by each organization.

Discussions on future collaboration in the surface management subtopic centered on:

- Development of common performance metrics;
- Joint development of a gate turn-around model to be integrated into existing simulations;
- Integration of DLR's taxi optimization modules into NASA's fast-time simulation environment; and
- Integration of DLR's surface management tool with NASA's Next Generation Air Transportation System flight-deck taxi simulation.

IMAC PILOT DATA COLLECTION COMPLETED

POC: SHERI BROWN

From July 27-Aug. 14, NASA Langley Research Center personnel supported piloted data collection for the Interval Management Alternative Clearances (IMAC) project. Three two-member crews flew a Boeing 757-200 model in the NASA Langley Development and Test Simulator (DTS), and three two-member crews flew the new Boeing 737-800 model in the Integration Flight Deck (IFD). The IFD includes all new flight deck hardware, and was used with full motion operations in the Langley Cockpit Motion Facility.

A new digital oculometer system known as SmartEye, as well as a new tool for Multimodal Analysis of Psychophysiological and Performance Signals software were integrated and used during data collection. Both the IFD and DTS included a custom interface for electronic flight bags to provide operational functionality with the Airborne Spacing for Terminal Arrival Routes 13 algorithm for interval management. The cockpits were used in conjunction with the Air Traffic Operations Laboratory in a distributed simulation that included both pilots and air traffic controllers as research subjects.

FAA SMART-NAS TECHNICAL INTERCHANGE MEETING

POC: KEE PALOPO

The NASA Shadow Mode Assessment Using Realistic Technologies for the National Airspace System (SMART-NAS) Test Bed (SNTB) team met in July with the Next Generation Air Transportation System (NextGen) Integration and Evaluation Capability (NIEC)/Verification And Validation (V&V) Facility Team led by Mr. John Frederick of the Federal Aviation Administration's (FAA) William J. Hughes Technical Center to discuss a potential collaboration.

NASA presented the SNTB five-year plan to build a test bed infrastructure and to operate as a distributed environment in a virtual location, and the FAA presented their test capability needs and vision. The meetings also included tours and demonstrations of the FAA's NIEC facility and

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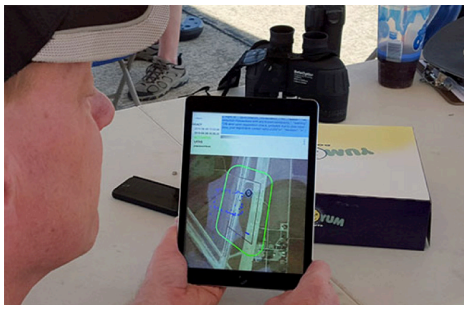
capabilities, as well as an opportunity to discuss lessons learned in the FAA's experience with their System of Systems Assessment Platform Project, and to discuss SMART-NAS integration connectivity needs. A number of action items resulted, including plans to jointly collaborate on a V&V event using the SNTB to validate an FAA NextGen objective.

UTM BUILD 1 DEMONSTRATION COMPLETED

POCs: JOEY RIOS AND MARCUS JOHNSON

The NASA Unmanned Aerial System (UAS) Traffic Management (UTM) project successfully kicked off its Build 1 Demonstration this past quarter. In preparation for the build, a flight test shakeout was completed at Crows Landing, Calif. Aug. 10-12. Crews from the NASA Ames Research Facility UTM flight demonstration team and a team from NASA Langley Research Center each flew several UAS flights while interacting with the prototype UTM System. The shakeout enabled the NASA team to finalize the test procedures, data collection, and software development in preparation for a larger-scale demonstration.

Following the successful shakedown, the team completed its Build 1 Demonstration Aug. 24- Sept. 2. Among the industry, academic and government partners involved in the effort were Exelis, Gryphon Sensors, San Jose State University, the



UTM field test site viewer.

The UTM field site at Crows Landing.

100-foot-tall meteorological tower with real-time weather sensors

University of Nevada-Reno, Airware, SkySpecs, Unmanned Experts, Precision Hawk, Ne3rd, Harris, Verizon, and the Lone Star UAS Center.

There were several objectives to the flight test, including the demonstration of UTM capabilities and procedures, navigation performance, and aircraft tracking. Data were collected on noise signatures and observations for weather models. Analysis of the results is underway to help design future UTM flight tests.

JAXA Official Visits NASA Ames

POC: DR. BANAVAR SRIDHAR

Helicopter Section Leader Dr. Hirokazu Ishii of the Japan Aerospace Exploration Agency's (JAXA) Aeronautical Technology Directorate visited NASA Ames Research Center on Aug. 13. NASA and JAXA have a five-year agreement extending to 2019 to explore areas of mutual interest in air traffic management. As part of the pact, NASA will assess JAXA's noise-modeling capability and its possible use in development of efficient terminal area arrival and departure trajectories with minimal noise impact.
Dr. Ishii met with NASA personnel Dr. Banavar Sridhar, Dr. Shon Grabbe and Ms. Sandy Lozito to discuss the differences between Federal Aviation Administration and JAXA noise models. NASA presented simplified noise models for use in the development of efficient aircraft arrival trajectories with minimal noise impact. Preliminary discussions were also held on the collection and distribution of common scenarios at the Baltimore-Washington International Airport in Maryland for comparative evaluation of different noise models.

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TASAR Briefing to CNS Task Force

POC: DAVID WING

On Aug. 18, David Wing, project lead for NASA's Traffic Aware Strategic Aircrew Requests (TASAR) research and development activity briefed the Communication Navigation Surveillance/Air Traffic Management (CNS/ATM) Task Force on the TASAR project. The CNS/ATM Task Force is an aviation industry forum of airlines, aerospace system manufacturers, and government representatives that meets quarterly to review and promote advancements in the state of aviation technologies, procedures, and operations in the national airspace system.

Sponsored by the Airspace Technology Demonstration (ATD) Project within NASA's Airspace Operations and Safety Program, TASAR brings advanced flight optimization capability to the cockpit via a NASA-developed software application installed on an electronic flight bag, with connectivity to onboard avionics and external data sources such as winds, weather, airspace restrictions and nearby aircraft traffic.

More than 150 attendees participated in the August 2015 meeting held at a Boeing facility in Seattle, Wash. Mr. Wing's briefing detailed TASAR's status, highlighting recent accomplishments, including the completion of a second flight trial in June; emerging partnerships with Virgin America and Alaska Airlines for upcoming operational testing; and the interest in commercialization by connectivity providers Rockwell Collins and Gogo Inc.

Virgin America Flight Technical Manager Capt. Paul Harrison joined Mr. Wing in the briefing, providing the airline's perspective of TASAR as the next step in enhancing Boeing's existing Direct Routes service. The briefing sparked interest by two organizations – Boeing and GE Aviation – and concluded with additional discussions and a technology demonstration of TASAR on a mobile platform.

Boeing requested a follow-up meeting at NASA Langley Research Center in Hampton, Va. to further discuss TASAR and Boeing's Direct Routes service.

ATD-1 Presentations to A4A/ FAA CNS TF

POC: WILL JOHNSON

On Aug. 19, William Johnson, deputy lead for the Air Traffic Management Technology Demonstration-1 (ATD-1) delivered a presentation to the Airlines for America (A4A) Communications, Navigation and Surveillance Task Force (CNSTF) held at a Boeing Company facility in Renton, Wash. The CNS TF is comprised of members from airlines, manufacturers, systems integrators, the Federal Aviation Administration (FAA) and NASA.

Mr. Johnson, a CNSTF member, presented the history and status of prototyping new automation systems for the ATD-1 subproject. The systems included in the presentation were the flight deck interval management (FIM) airborne spacing system developed at NASA Langley Research Center, and the Traffic Management Advisor – Terminal Metering (TMA-TM) ground automation scheduler system and the Controller Managed Spacing (CMS) ground automation tools, both developed at NASA Ames Research Center. Together, these prototypes are being developed by ATD-1 and industry partners to accelerate the adoption of new arrival management capabilities for NextGen, the Next Generation Air Transportation System.

The ATD-1 Avionics Prototype and Flight Test team, comprised of the Boeing Company, Honeywell, and United Airlines, was unveiled during the presentation. The United Airlines project manager was also in attendance at the event. Comments received were very positive, and plans are being made for follow-on reports to future gatherings of the commercial aviation stakeholder community.

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NASA Attends BADA Meeting

POC: ALAN LEE

The 41-member European Organization for the Safety of Air Navigation's (Eurocontrol) Base of Aircraft Data (BADA) is a collection of aircraft performance models (APMs) used to generate aircraft trajectories. BADA is the standard for APMs used in air traffic management research. The BADA User Group Meeting has traditionally been hosted by Eurocontrol, in France, but was held for the first time in the United States on Sept. 9-10 in Washington, D.C., hosted by the Federal Aviation Administration and the Boeing Company.

The meeting was attended by 60-plus government and corporate participants, with more than 50% from non-U.S. organizations. NASA Airspace Operations and Safety Program personnel were also present at the meeting, which included presentations on research and applications of BADA, as well as future additions to BADA with unmanned aerial vehicle models for the Global Hawk and Predator, a standalone trajectory calculator, and a dedicated helicopter model.

FAA P3 Meeting on Departure Metering

POC: RICH COPPENBARGER

Researchers from NASA's Air Traffic Management (ATM) Technology Demonstration-2 (ATD-2) subproject met with representatives from the Federal Aviation Administration's (FAA) Surface Efficiency Office (SEO) on Sept. 16-17 at NASA Ames Research Center to gain insight into processes, procedures and policy (P3) relevant to the project. The FAA launched the P3 initiative to collaborate with airlines and airport authorities on issues pertaining to departure metering automation. Such issues include the provision of pushback intent data by airlines and potential conflicts of interest between metering holds at the gate and existing on-time performance metrics reported to the Department of Transportation.

FAA representatives expressed their view that neither NASA nor the FAA should attempt to directly influence reportable on-time metrics to accommodate new concepts such as ATD-2. The FAA also stressed the importance of monitoring the accuracy of airline pushback intent data to prevent gaming of the system for competitive advantage. There was general agreement by all participants on the importance of data collection and benefits analysis from simulations and field activities to allow a data-driven approach to decisions affecting technology deployment, stakeholder participation, and the future regulatory environment.

Ms. Pat Bynum, SEO senior advisor, led the FAA's participation at the meeting.

FedEx Team Visits NASA Ames

POCs: JOHN ROBINSON, DAVE McNALLY, KAPIL SHEITH

Members of the Federal Express (FedEx) Air Traffic Operations, Flight Technical, and Global Operations Control organizations visited NASA Ames Research Center on Sept. 17. FedEx personnel Mr. Dan Allen, Mr. Josh Kendrick and Mr. Paul Tronsor were briefed on NASA's Airspace Technology Demonstration (ATD) projects. The three attended presentations on the Terminal Sequencing and Spacing (TSAS), Dynamic Weather Routes (DWR) and the National Airspace System (NAS) Constraint Evaluation and Notification (NASCENT) tools, the last of which is a NAS-based implementation of the DWR concept.

The FedEx team expressed their enthusiasm and appreciation for the briefings, noting potential benefits for TSAS operations at the FedEx Memphis Center, and also expressed interest in operational testing of DWR enhancements at the FedEx Global Operations Control Center. The trio saw value in exploring NASCENT's capabilities to evaluate reroute opportunities across the NAS.

NASA Ames researchers gained insight into potential for collaboration with FedEx, especially given FedEx's leadership in adopting and implementing airborne data communications across their airfleet.

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University Collaborations Support UTM

POC: BASSAM MUSAFFAR

On Sept. 22, Dr. Claire Tomlin from UC Berkeley and Professor Dr. Mykel Kochenderfer from Stanford University updated Airspace Operations and Safety Program researchers and members of the University Affiliated Research Center staff on their separation-assurance work supporting the Unmanned Aerial Systems (UAS) Traffic Management (UTM) subproject.

For real-time application in a distributed system for conflict avoidance, the Stanford team implemented three variants of a coordination-based conflict resolution algorithm with solution times in the milliseconds. The UC Berkeley team devised an algorithm for the safe platooning of unmanned aerial vehicles via reachability sets.

Both professors were slated to visit NASA Ames Research Center ARC on Oct. 1 to conduct discussions with researchers from the Human Systems Integration Division Airspace Operations Laboratory about integrating these algorithms into UTM tools being developed and used at NASA Ames.

AOSP Researchers Host FAA Visitors

POC: SANDY LOZITO

On Sept. 22, Airspace Operations and Safety Program (AOSP) researchers hosted Mr. Stephen Merlin and Mr. Chris Dorbian from the Federal Aviation Administration's (FAA) Environmental Policy and Operations Division and the Office of Environment and Energy, respectively. The FAA visitors were given overviews and tours of several of AOSP's technologies and facilities, including a demonstration of its airport surface research at FutureFlight Central. Also presented were briefings concerning Terminal Sequencing and Spacing research, Dynamic Weather Routing research, Unmanned Aerial Systems in the National Airspace System activities, and air traffic management environmental research led by the NASA Ames Senior Scientist for Air Transportation Research Dr. Banavar Sridhar.

The FAA visitors, who also presented their work in the FAA Environment Office, were appreciative of the discussions and demonstrations, and hopeful for future collaboration opportunities.

NRA First-Year Review of Cloud-Based ATM

POC: WILLIAM N. CHAN

On Sept. 22 a Mosaic ATM/Harris Corporation team presented a review of their NASA Research Announcement (NRA) first year's work, as well as second-year plans to accelerate development of cloud computing-based air traffic management. Research staff from both NASA Ames and NASA Langley Research Centers attended the review.

During the first year, the teams focused on three main activities:

- Identification of the general challenges that confront national airspace system modernization;
- A survey of case studies of how cloud computing has been successfully adopted in other industries; and
- Identification and evaluation of five candidate ATM cloud-enhanced business model concepts, including their potential costs and benefits.

For the second-year effort, the team will select, in consultation with NASA, one or more of the following concepts for eventual prototype development: data warehouses, electronic flight bags, simulation tools, and traffic flow management services.

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Airline Will Use NASA Cockpit Software

POC: DAVID WING

NASA Langley Research Center has signed Space Act Agreements with Virgin America and Alaska Airlines to test NASA's cockpit technology for the Traffic Aware Strategic Aircrew Requests (TASAR) software on commercial flights. TASAR constituents include the Traffic Aware Planner (TAP) software application that runs on an electronic flight bag and connects to aircraft avionics for aircraft state and flight plan information; the Automatic Dependent Surveillance Broadcast (ADS-B) application for traffic data; and broadband Internet for external sources of winds, weather and airspace data. Using this information, TAP monitors for flight-optimization opportunities in the form of lateral route changes and/or altitude changes that the aircrew can request of air traffic control, modifications that would save flight time and/or fuel burn while avoiding known conflicts.

In addition to developing the TAP software, the TASAR team has conducted two simulation experiments and two flight trials with airline pilots to prepare for upcoming operational deployments. The TASAR team has also estimated potential benefits and evaluated the safety, certification, and operational approval requirements. Planning for the operational trials with Alaska Airlines is getting underway with a technical kickoff meeting at their Flight Operations Training Center in Seattle, Wash. on Sept. 22-23, with the first TASAR flights on Boeing 737-900ER aircraft expected in spring 2016. Virgin America trials on their Airbus A320 aircraft will follow, likely starting in the summer 2016. David Wing is the technical lead for the TASAR activity.

TASAR Partnership with Alaska Airlines Launches Kickoff Meeting

POC: DAVID WING

The Space Act Agreement between NASA and Alaska Airlines on the Traffic Aware Strategic Aircrew Requests (TASAR) project was formally initiated with a technical kickoff meeting held at the Alaska Airlines Flight Operations Training Center in Seattle, Wash. on Sept. 22-23. TASAR features Traffic Aware Planner (TAP) cockpit software that monitors flight-optimization opportunities in the form of lateral route changes and/or altitude changes – de-conflicted from known traffic, weather, and restricted airspace – that the aircrew can request of air traffic control to save flight time and/or fuel burn.

David Wing, TASAR technology lead, was accompanied at the meeting by NASA personnel Dr. Kelly Burke and Jim Fay, and Engility Corporation representatives Bob Vivona, Sharon Woods, and Dr. Jeff Henderson. Approximately 15 Alaska Airlines attendees represented departments of flight operations, performance, engineering, training, dispatch and compliance. Several Federal Aviation Administration (FAA) compliance inspectors attended, as did representatives from vendors United Technologies Aeronautical Systems (UTAS) and Gogo Inflight. UTAS and Gogo supply the hardware and connectivity envisioned for the TAP software's installation on Alaska Airlines aircraft.

Over the course of the two-day meeting, attendees converged on a breadth of detailed technical topics critical for charting the implementation of TAP on an initial fleet of three Alaska Airlines B737-900ER aircraft in early/mid 2016:

- Hardware/software architecture alternatives were identified and prioritized;
- A sample computer-based trainer module was successfully test-deployed on Alaska's Learning Management System;
- TAP software installation and data retrieval procedures were defined;
- Weather data source alternatives were reviewed;
- Dispatch coordination needs and approaches were discussed; and
- Hardware/software testing objectives were identified and initial plans established for a phased deployment.

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

A high-level target schedule was proposed and will be adjusted as information is gathered on pacing items such as wiring-installation certification, FAA compliance requirements, aircraft installation availability, and software readiness. The successful meeting generated interest and momentum that will be leveraged to move forward on simultaneous fronts toward achieving operational testing of TASAR on Alaska Airlines flights over the next two years.

ORC Workshop Held at NASA Ames

POC: SHANNON ZELINSKI

On Sept. 23-24, at NASA Ames Research Center, Airspace Operations and Safety Program (AOSP) researchers hosted visitors from the Federal Aviation Administration's (FAA) William J. Hughes Technical Center (WJHTC) to coordinate efforts leading up to the completion of the first phase of optimized route capability (ORC) development. ORC is an FAA/NASA collaboration developing traffic management unit decision support for intelligent arrival meter fix offloading.

At many airports, including Houston Intercontinental, the arrival gates or meter fixes serve as the major bottlenecks for arrival traffic, rather than the runways.

NASA is developing an algorithm to identify projected periods of meter fix overload and suggest individual flight reroutes to alternate meter fixes. The algorithm monitors estimated time-based flow management arrival scheduling delay at meter fixes on a large planning horizon: up to two hours from the meter fix. Excessive estimated delay triggers the algorithm to search for suitable flights (both airborne and pre-departure) to reroute to an alternate meter fix at minimal cost. In most cases the reroute is expected to reduce the meter fix delay with minimal increase to flight distance.

NASA is evaluating ORC's potential inclusion in AOSP's Air Traffic Management Technology Demonstration-3 subproject. During the workshop, the FAA and NASA discussed how they might jointly collaborate moving forward, and specifically the baseline evaluation scheduled for completion in March 2016.

NASA Ames Hosts Second S-CDM TIM

POC: MICHELLE ESHOW

On Sept. 22-23, as part of the Airspace Operations and Safety Program's Air Traffic Management Technology Demonstration-2 (ATD-2) subproject, NASA Ames Research Center hosted the second Technical Interchange Meeting on the Federal Aviation Administration's (FAA) Surface Collaborative Decision Making (S-CDM) prototype software system. A team of six engineers from Metron Aviation provided in-depth briefings on the prototype departure metering system they developed to support the FAA's S-CDM concept engineering effort.

The FAA and NASA are collaborating to demonstrate departure metering consistent with the S-CDM concept of operations as part of the larger ATD-2 demonstration at Charlotte-Douglas International Airport in North Carolina. Managers from Volpe and the FAA joined more than 25 NASA and contractor personnel working on ATD-2, and were briefed on the S-CDM concept, software design, and current software status.

By the end of the second day, the ARC team successfully built and ran the S-CDM software in the NASA Ames Air Traffic Management Verification and Validation Laboratory, natively in the NASA Ames environment. This capability will now enable the ATD-2 team to execute simulation scenarios, interact with the software, and modify the source code for ATD-2 needs. Further collaboration with Metron is expected.

NRA First-Year Review

POC: TODD LAUDERDALE

On September 25, researchers from Optimal Synthesis Inc. and Purdue University presented their progress in the first year of a three-year NASA Research Announcement (NRA)

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

designed to identify and classify controller intervention in historical aircraft track data. Starting with simulated track data, the team was able to identify when aircraft were maneuvered by a conflict resolution system and to identify the type of resolution executed. The research will now turn to identifying maneuver in real aircraft track data, and these identified maneuvers will provide a dataset to iterate situation-based behaviors of controllers.

The goal of the research is to inform development of advanced controller tools for conflict resolution such that, wherever possible, the tools suggest resolutions that conform to a controller's general preferences.

NASA/CAST AHPLS Training

POC: SHERI BROWN

NASA is leading research chartered by the Commercial Aviation Safety Team (CAST) to develop and assess commercial flight training methods focused on mitigating the effects of attentional human performance limiting states (AHPLS). AHPLS are cognitive states that contribute to the loss of flight crew airplane state awareness, and remain a casual factor in commercial aviation accidents and incidents. A significant challenge is to detect AHPLS using a convergence of behavioral performance, psychophysiometric and self-reported data. These techniques, along with flight scenarios designed to induce AHPLS, will be incorporated in training to reduce the occurrence of, and enabling recovery from, AHPLS in situ. These detection techniques will also be used to validate AHPLS induction. Current detection approaches use only one or two psychophysiological measures, or do not perform such measures in high fidelity flight simulation studies. Therefore, the crew state monitoring team has demonstrated the integration of multi-modal psychophysiological measurement instrumentation in a visual simulator in preparation for future motion-based simulation studies.

Time-series data were collected for 24 airline pilots and multi-class, ensemble machine learning classification methods have been implemented for state detection. Findings indicate preliminary state classification models are reliable for across-task prediction of cognitive state for channelized attention and low workload (precision = 0.891, 0.906 respectively), meeting the Airspace Operations and Safety Program's (AOSP) Technologies for Airplane State Awareness (TASA) Subproject milestone SE211-1. Ongoing are model improvements for diverted attention, the analysis of startle/surprise, and plans for detecting confirmation bias.

Lessons learned support the Scenarios for Human Attention Restoration using Psychophysiology Study to be conducted during fiscal year 2016 in NASA Langley Research Center's Cockpit Motion Facility. This work is being conducted in response to CAST Safety Enhancement 211 entitled "Training for Attention Management" that supports AOSP's Airspace Technology Demonstration Project within the TASA subproject.

Team members include SE211 Technical Lead Angela Harrivel, Lance Prinzel, Chad Stephens, Alan Pope, Kyle Ellis and Charles Liles.

AWARDS, PAPERS AND APPOINTMENTS

Dr. Karl Bilimoria Chosen as ISU Visiting Lecturer

In July 2015 Airspace Operations and Safety Program researcher Dr. Karl Bilimoria served as a visiting lecturer at the International Space University (ISU) Space Studies Program (SSP) in Athens, Ohio. The SSP is a graduate-level professional development program conducted by ISU at various locations around the world since 1988. The intensive nine-week curriculum covers the full range of space-related fields including policy and law, business and management, humanities, physical and life sciences, engineering, and space applications.

Summer 2015's SSP was hosted by Ohio University, NASA was the prime sponsor, and 98 students from 30 countries participated. Dr. Bilimoria, an ISU alumnus of SSP 2007, supported the Space Engineering Department during the week of July 13 by leading a half-day workshop on spacecraft cockpit design, attended by about 20 students who have selected the engineering department for specialized studies.

The workshop began with a presentation on the cockpits of various piloted spacecraft over the past five decades, and was followed by a participatory activity where small teams of students designed cockpit displays and hand controllers for the rendezvous and proximity operations phase of an asteroid exploration mission. The workshop was well-received, and informal feedback indicated that the students found it to be both interesting and useful.

Manuscript Published, Selected for Invited Conference Session

NASA Langley Research Center personnel Dr. Sara Wilson, Kurt Swieringa and Dr. Jennifer Murdoch-Kibler, along with Robert Leonard and Dr. David Edwards of Virginia Commonwealth University, have published in the journal Quality Engineering their manuscript entitled "Model Specification and Confidence Intervals for Voice Communication." The article, citing research performed in support of the Air Traffic Management Technology Demonstration-1 project, presents a case study using data from a human-in-the-loop experiment with a simulated flight environment conducted to investigate airborne spacing procedures.

The interval management procedures during approach to an airport required a complex voice clearance issued by air traffic control to a flight crew using radio communications. The time required for voice communication transfers is modeled, as is the time required for flight crews to complete data entry tasks. Initial results will lead to design guidance for the phraseology used in air/ground communications.

The article was presented by Dr. Wilson at the Institute for Operations Research and Management Sciences annual conference, during an invited session designed to feature papers that address practical quality and reliability problems.

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