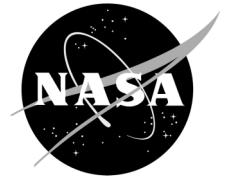


AIRSPACE OPERATIONS AND SAFETY PROGRAM NEWSLETTER



FY 2015 Quarter 3: April — June 2015



NASA's NTX Hosts FAA's NextGen Assistant Administrator

On June 22, the NASA North Texas Research Station (NTX) in Fort Worth hosted a visit from the Federal Aviation Administration (FAA)'s Next Generation Air Transportation System (NextGen) organization, including FAA Assistant Administrator Edward Bolton, Chief Scientist Steve Bradford, and Director for Portfolio Management and Technology Development Paul Fontaine. Mr. Bolton and his colleagues were briefed on Air Traffic Management (ATM) Technology Demonstration-2 (ATD-2) technologies, and tools such as the Spot and Runway Departure Advisor (SARDA) and the Precision Departure Release Capability (PDRC), which were demonstrated with live data from Charlotte Douglas International Airport. The tour also included a presentation on novel surveillance technologies for under-equipped airports, observation of PDRC in operational use at Fort Worth Air Route Traffic Control Center, and an American Airlines (AA) demonstration of the DWR tool at the AA Integrated Operations Center. NTX capabilities and research partnerships were also highlighted. (POC: Paul Borchers)

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An InstantEye unmanned aircraft system is operated in Channel Islands Harbor in Oxnard, California during Coastal Trident 2015 field experimentation and exercise activities
Credits: NASA Ames/Eric James

Emerging Business Opportunities for UAVs

In an article penned on April 2, the Syracuse (NY) Post Standard reported that Parimal Kopardekar, principal investigator for NASA's unmanned aerial systems (UAS) traffic management (UTM) initiative, discussed the financial potential for unmanned aerial vehicles (UAVs) at the CenterState Corporation for Economic Opportunity annual meeting. Kopardekar highlighted those companies participating in the Northeast UAS Airspace Integration Research Alliance's efforts to integrate UAVs into civilian airspace. Kopardekar was quoted as saying that the biggest challenge currently is to develop a system that would allow UAVs to avoid collisions. Kopardekar cautioned that the "safety and security of these operations is missing."

UAV Rules Are the FAA's "Highest Priority"

The Santa Cruz (CA) Sentinel edition of May 1 featured an article on the Drone, Data X conference at the Kaiser Permanente Arena. The Federal Aviation Administration (FAA)'s Jim Williams said that because of the expected growth of the commercial unmanned aerial vehicle (UAV) industry, the FAA's highest priority would be to devise rules. Parimal Kopardekar, principal investigator for NASA's unmanned aerial systems traffic management initiative, observed that "every home is going to have a drone pretty soon ... Right now there is no congestion management problem, but eventually there will be." Phil McNamara, who organized the conference, said that he was happy that 550 people attended the event, and expects next year's conference to be even bigger.

NASA, AUVSI to Host UAV Conference in July

On May 13, David Lumb at Fast Company announced that NASA and the Association for Unmanned Vehicle Systems International (AUVSI) will host a conference in July to discuss unmanned aerial vehicles in the national airspace. Members of the Federal Aviation Administration (FAA) were slated to be in attendance. In a blog post, Jaiwon Shin, associate administrator of NASA's Aeronautics Research Mission Directorate, wrote that "Today, we see the need to establish a safe, low altitude unmanned aerial traffic management system. Bringing together a broad spectrum of people interested in [unmanned aerial systems] technology will help us develop a well coordinated plan that will guide us in the future." Lumb thought it was "admirable" that NASA was "jumping ahead of hard line government drone regulation." In contrast, Lumb criticized the FAA for the way it "clamped down on commercial drones," instead of proposing "solid laws." (The May 13 issue of the publication Engadget also addressed the July conference.)

NASA Will Attempt to Make “Coherent Plan” for UTM

Steve Dent at Engadget wrote on June 12 concerning NASA’s efforts to develop a unmanned aerial system (UAS) traffic management system (UTM) by connecting UAS to a control system that would “geo fence’ them off from trouble.” With multiple companies working on similar system, Dent said that NASA will attempt to form “a coherent plan with that jumble of technology” at the July UTM convention at NASA’s Ames Research Center.

NASA, Verizon Exploring Ways to Use Cell Towers to Monitor UAS

On June 6, The Guardian (UK) newspaper reported that it obtained an agreement between NASA and Verizon to jointly explore whether cell towers could support communications and surveillance of unmanned aerial systems (UAS) at low altitudes: work now underway at the NASA’s Ames Research Center, which plans to test the Verizon system in 2017. The article notes, however, that NASA’s research on unmanned aerial systems traffic management is a “massive undertaking that would stretch NASA’s shrinking budget.” Missy Cummings, professor of aeronautics at Duke University, said that she doesn’t think that NASA can accomplish much unless the government provides more money for the “incredibly underfunded” project. (Related stories appeared on June 3 in Fierce Mobile IT, RT, Next Web, and Engadget.)

FAA Deploys New NASA-Developed Software

On June 24, Aviation Today reported that the Federal Aviation Administration (FAA) is deploying new software

to improve national air traffic control. To that end, NASA developed the Terminal Sequencing and Spacing (TSS) tool, which was tested at NASA’s Ames Research Center before being handed over to the FAA in 2014 for further testing and evaluation.



NASA Future Flight Central, a national Air Traffic Control/Air Traffic Management (ATC/ATM) simulation facility at NASA Ames Research Center

NASA Research Focusing on Two Complementary UTM Systems

In the July 25 edition of Government Computer News, coverage continued on NASA’s efforts, in conjunction with the Federal Aviation System, to develop a unmanned aerial system (UAS) traffic management (UTM) system to track unmanned vehicles flying at low altitudes. Parimal Kopardekar, manager of NASA’s Safe Autonomous Systems Operations Project, was quoted as saying that NASA wants to create a system to keep track of and deliver important information to UAS operators, areas those operators should avoid, other UAS flying in the same airspace, and weather conditions. NASA researchers are testing ways to communicate updated, real time data to UAS, including geo fences and virtual barriers. The article notes NASA will develop two systems: one would be a portable system to monitor operations in various geographic locations, and the second would be a stationary UTM system that would continuously monitor low flying drones over a specific geographic area.



NASA Plans Test of UTM this August at Armstrong Research Center

Inside Unmanned Systems (5/31, Knight) reported May 31 on NASA's efforts to develop unmanned aerial system (UAS) traffic management (UTM) protocols. UTM principal investigator Parimal Kopardekar was quoted as saying that NASA believes there is a need to coordinate UAS traffic so [it] could operate safely at low altitudes. "It's just like with autonomous cars," Kopardekar said. "Even though they're autonomous, you still need roads and traffic lights. We need a way to organize UAS traffic, whether that's by crisscrossing, or with a bike lane, or HOV (high occupancy vehicle) lane kind of construct. The system can make these things happen based on demand. UTM is a virtual system."

The article noted that one of the first tests of the system will take place this August at NASA's Armstrong Research Center, with Kopardekar highlighting how many partners are helping with this effort. "If we do everything by ourselves in our own labs, it will take more time," Kopardekar said. "We need the collaboration of ideas and technologies to allow for faster innovation of the different subsystems and overall integrated operations."



NASA's near term goal is to safely enable initial low altitude UAS as early as possible. While the long term goal is to accommodate increased demand with highest safety, efficiency and capacity

// Technical and Programmatic Highlights

NASA Researchers Host South Korean Collaborators

On April 28-29, NASA researchers and managers representing NASA's airport surface research, the Airspace Technology Demonstration 2 Project and NASA Headquarters held a technical interchange meeting with representatives from the Korean Agency for Infrastructure Technology Advancement (KAIA), the Korea Aerospace Research Institute (KARI), and Incheon International Airport Corporation. The meeting was held at NASA Ames Research Center, where the two parties discussed in detail the plans for collaborating on airport surface and terminal area research, under a memorandum of understanding (MOU) signed between NASA and KAIA in November 2014.

The KAIA delegation provided briefings on Incheon Airport operations, as well as airspace and airport issues encountered in the Republic of Korea. The NASA team provided background and demonstrations of some of NASA's fast time simulation and modeling capabilities. The teams discussed specific areas of research collaboration to advance NASA's surface research portfolio, and ways that KAIA can develop simulation and research tools in order to address its own air traffic management challenges. Another meeting between technical team members is tentatively scheduled for the October/November timeframe. (POC: Yoon Jung)



Technical interchange meeting participants

First Flight Test, 6 May

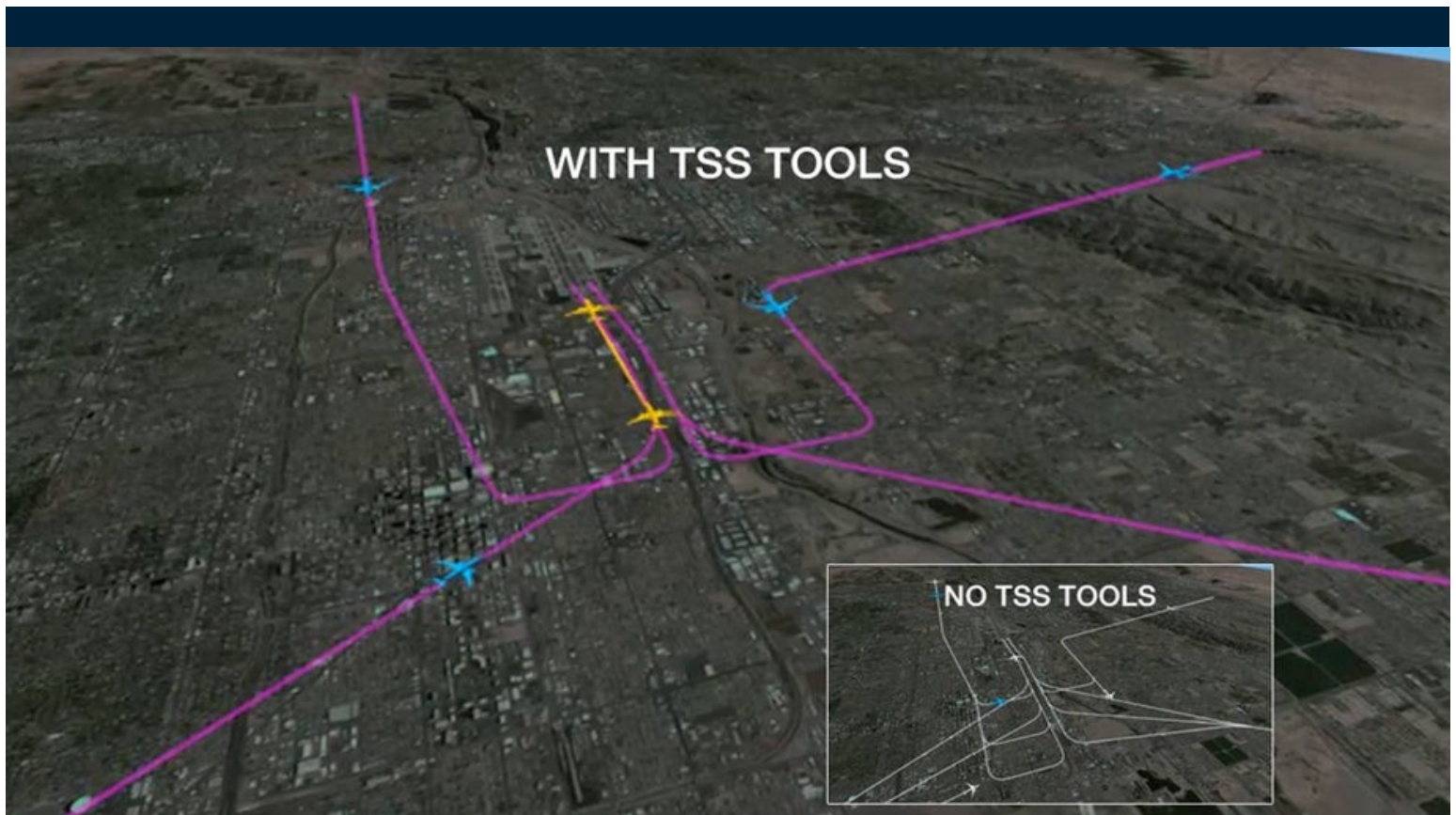


UTM Activity Accelerates

NASA's Safe Autonomous System Operations (SASO) Project staff has completed an initial draft of the Unmanned Aircraft Systems (UAS) Traffic Management (UTM) Concept of Operations. The draft is being reviewed by partners, while planning and implementation of an August 2015 demonstration is ongoing. Included were shake out tests, completed from March through June, to prepare for that Build 1 demonstration. Site selection is complete, and partners have been briefed on their demonstration roles and responsibilities.

SASO staff continue to develop and test an initial UTM system software prototype. Several partners are developing client software for UTM communication. An intermediate test with partners was completed in May utilizing a NASA vehicle. A memorandum of understanding (MOU) was executed with the U.S. Navy to access protected UAS mishap data. The Project is also establishing MOUs with the U.S. Air Force and U.S. Army to access protected mishap data, establishing a hazards analysis team, and initiating work on hazards analysis based on public access Air Force mishap data.

(POC: Dr. Parimal Kopardekar)



Today's air traffic management operations with TSS tools and without (inset)

FAA Approves TSS Deployment

In April, the Federal Aviation Administration (FAA) decided to proceed with full scale implementation of the latest NASA developed air traffic management (ATM) tools that allow air traffic controllers to maximize the benefits of performance based navigation (PBN) procedures on runway approach. These tools, collectively known as the Terminal Sequencing and Spacing System (TSS), combine time based arrival scheduling and display aids for air traffic controllers.

TSS allows use of fuel efficient area navigation and required navigation performance arrival procedures in terminal airspace during the busiest traffic conditions to avoid disruptions. The increased use of PBN procedures will reduce vectoring, require less level offs at intermediate altitudes, and result in fewer verbal communications between controllers and pilots. Starting in 2018, the FAA plans to deploy TSS to five busy airports: Phoenix Sky Harbor, Houston Intercontinental, Atlanta Hartsfield, Seattle Tacoma and Los Angeles.

Leveraging several decades of ATM research, development of TSS began in 2009 under NASA's Air Traffic Management Technology Demonstration 1, or ATD 1 effort. Between 2009 and 2014, NASA conducted 26 large scale, human in the loop simulations to refine TSS algorithms, displays and procedures. Additional simulations were performed in collaboration with the FAA, the MITRE Corporation's Center for Advanced Aviation System Development, and the National Air Traffic Controller Association (NATCA). During development of TSS, two FAA operational systems – the Time Based Flow Management System and the Standard Terminal Automation Replacement System – were modified to include the TSS technologies. NASA transferred these operational prototypes at Technology Readiness Level 6 to the FAA in 2014. The final joint TSS simulation, called the Operational Integration Assessment, involving NASA, the FAA and NATCA, was completed in May 2015. (POC: John Robinson)

NASA Completes OIA of TSS

NASA engineers, in collaboration with the Federal Aviation Administration (FAA), have completed experimental runs in support of the Operational Integration Assessment (OIA). The OIA was a joint operational assessment of the FAA's Ground based Interval Management for Spacing (GIM S) integrated with NASA's Terminal Sequencing and Spacing System (TSS) ground automation technology in an operational like environment at the FAA's William J. Hughes Technical Center (WJHTC). The OIA, with participation from the National Air Traffic Controller Association (NATCA), had the objective to identify TSS operational risks that need to be addressed prior to transitioning TSS from the laboratory to deployment in the national airspace system (NAS). Operational risks are broad and include technical, policy and procedures, training, and TSS computer human interface considerations.

Over the last few months, a series of shakedowns were completed prior to conducting the actual data runs. The first shakedown was completed April 7-9. Twenty two pseudo pilots and 18 controllers participated, including NATCA controllers and traffic management coordinators (TMCs) from Seattle, Houston, Denver, Indianapolis, Memphis and Cleveland terminals and en route air traffic facilities. The objectives of this shakedown were to retire the highest OIA risks, pertaining to the target generation facility automation defects/radar surveillance/pseudo piloting errors and the en route configuration, including extended metering. Other objectives included evaluating scenarios for the OIA, providing familiarization and training for the subject participants, and testing data collection methods and procedures, including the daily schedule. Most of the objectives were met, leaving the team to address some remaining issues.

The second OIA shakedown was completed April 28-30 and included the par-

ticipation of 22 pseudo pilots and 18 controllers, including NATCA TMCs from the Memphis and Cleveland Centers, the Houston Terminal Area Approach Control, and NATCA controllers from Washington, Fort Worth, Indianapolis, Miami, Atlanta, Denver, Philadelphia and Central Florida. Ten simulation runs were conducted, and the OIA risks were addressed satisfactorily, thus leading to the OIA team to conclude that run for record simulations should proceed as scheduled starting May 12. Additional work in preparation for the simulations proceeded, in an effort to finalize the daily run schedule and modifications to improve controller training.

Formal data collection for the OIA – the run for record – was held May 12-21. For these runs, about 40 participants took part, including 22 pseudo pilots, 15 controllers, and three traffic manager coordinators. The first two days were dedicated to training with both classroom and simulation training. The run for record targeted 18 data collection runs, each carefully crafted to tease out certain potential risks. Three contingency runs were reserved on the last day to be used if needed. At the end of the run for record, 20 data collection runs were successfully conducted, each one essentially unique. Over the course of the next few months, the data, including controller feedback, will be consolidated and analyzed. The first planned OIA report is an executive summary, which is expected to be completed in June. (POC: Kevin Witzberger)



The 2015 NASA/FAA OIA Team at the FAA Tech Center

PTM Team Conducts HMI Workshops

On March 30 April 3, the Pair wise Trajectory Management (PTM) team conducted multiple, single day workshops with groups of commercial airline pilots to gather feedback on the PTM Human Machine Interface (HMI). A total of 20 active and recently retired pilots with oceanic routes flying experience received an introduction to the PTM concept, and were then asked to discuss and comment on detailed schematics of a proposed airborne PTM HMI.

The intention of the workshops was to share current design ideas and gather feedback from subject matter experts and potential PTM HMI end users to ensure that flight crews are ultimately provided with an optimized, intuitive PTM tool. PTM team members will use the feedback gathered at the workshop from the pilot participants to refine the PTM HMI. The HMI will be assessed in conjunction with flight crew PTM procedures during upcoming human in the loop (HITL) testing.

Dr. Jennifer Kibler and Mr. Ryan Chartrand from NASA Langley Research Center and Mr. Ken Jones and Mr. Tom Graff from the National Institute of Aerospace conducted the PTM HMI workshops, and are planning a PTM HITL experiment to be conducted at NASA Langley in support of the Airspace Technology Demonstration 3 subproject during fiscal year 2016. (POC: Sheri Brown)

AFDC-1 Experiment Completed

On April 9, the Augmented Flight Deck Countermeasures 1 (AFDC 1) experiment completed data collection with the involvement of 12 regional air transport pilots. Members of the experiment team included Chad Stephens, Alan Pope, Angela Harrivel, Vincent Houston, and Kyle Ellis, all from NASA Langley Research Center.

AFDC 1 was developed to investigate technologies to mitigate spatial disorientation leading to aircraft loss of control, a leading cause of aviation fatalities in current operations. Research focused on improving pilot attitude awareness through the use of advanced flight deck interface avionics, including a photo realistic synthetic vision system and a concept called the "background attitude indicator," capable of presenting an artificial horizon across all four head down display panels.

Separately during this experiment, initial flight scenarios aimed at inducing attention related human performance limitations (AHPL) were evaluated. Benchmark tasks were implemented for AHPL state classification purposes, and psychophysiological instrumentation was integrated toward crew state monitoring technology development.

The team is eager to move into data processing, and results and lessons learned will be applied to future higher fidelity simulation studies as planned. This research is supported under the Airspace Technology Demonstrations (ATD) Project. (POC: Kyle Ellis)



NASA Langley Research Center engineers in Hampton, Va., use the Research Flight Deck flight simulator to continue developing new cockpit technologies, to make airliners safer and more efficient



ATD-1 GIM-S Study Completed

The Airspace Operations Lab at NASA Ames Research Center successfully completed a human in the loop simulation using Ground Based Interval Management Spacing (GIM S) for NASA's Air Traffic Management (ATM) Technology Demonstration 1 (ATD 1) activity. The objective was to evaluate the accuracy and efficiency of time based metering operations using the Federal Aviation Administration (FAA)'s time based flow management (TBFM) system with different delay indications and speed advisories for controllers operating in Center airspace.

Two retired controller teams each staffed seven positions in the Albuquerque, Denver and Kansas City Centers, and Phoenix Terminal Radar Approach Control (TRACON). TBFM version 4.2.3 provided Center controllers with scheduling and time based metering information, and Terminal Spacing and Sequencing System (TSS) information to TRACON personnel. The study varied the delay display accuracy between tens of seconds and rounded minutes, as well as the availability of GIM S speed advisories to Center controllers.

Initial observations and feedback during debriefs indicate controllers were able to deliver aircraft with sufficient accuracy to the TRACON in all conditions. Tens of seconds delay indication appeared more accurate to TRACON controllers. Detailed analysis of delivery accuracy, flight efficiency, safety, controller workload, and acceptability is underway. This activity supports operational integration of TSS ground tools that ATD 1 successfully transi-

tioned from NASA to the FAA, and is supported under the Airspace Technology Demonstrations Project. (POCs: Tom Prevot, Todd Callantine)

Completion of Regulatory Compliance Study

Engineers from NASA Langley Research Center recently completed a study on regulatory compliance with multi tier supplier networks, which compounds safety assurance problems for increasingly complex computer based airborne systems. A solicitation was sent to a range of potential bidders with a wide range of technical and cultural backgrounds and levels of experience. Findings include that existing compliance guidelines are fragmented, obscure, and inadequate to mitigate risks of system and supplier network complexity. Recommendations include new guidelines for multi tier contracting and system model based design; revisions to existing guidelines; development of a product driven structure; and strengthening the guidelines to include a more robust systems engineering perspective.

The impact of this effort was shared with several FAA stakeholders, including Kirk Baker of the FAA's Airborne Systems; Barbara Lingberg, the FAA's *software and airborne electronic hardware team lead*; Natesh Manikoth of the FAA's ground software effort; and Peter Skaves of FAA advanced avionics. Findings were presented at the September 2014 National Systems, Software and Airborne Electronic Hardware Standardization Conference held in Los Angeles. (POC: Sheri Brown)

Researchers Discuss SARDA Field Testing with AA Ramp Managers

NASA researchers visited the American Airlines (AA) Ramp Tower at Charlotte Douglas International Airport North Carolina on April 14-15. Per the terms of a Space Act Agreement between NASA and AA, the NASA team discussed requirements for an operational test of NASA's Spot and Runway Departure Advisor (SARDA) technology. SARDA was developed to reduce taxi times and fuel emissions by monitoring gate delays and providing ramp controllers with departure pushback advisories. The technology has been tested in human in the loop simulations at NASA's Ames Research Center, most recently with participation from American's ramp personnel.

During this trip, the NASA team observed ramp operations, especially the operational changes occurring in three sectors – in bound traffic, out bound traffic, and north sector traffic – as well as the compass cardinal points of north, east, south and west. Discussions were held about field test procedures and logistics, such as how to suspend testing and revert to current day operations, and training requirements. (POC: Savvy Verma)

Benchmarks Achieved as RCO Planning Continues

In April, NASA engineers completed a reduced crew operations (RCO) Build 1 preliminary design review, and developed an RCO concept of operations. The effort was in connection with the award of a NASA Research Announcement to Rockwell Collins. Prototype aircraft monitoring agents are being developed for select scenario events, using the Plan Execution Interchange Language (PLEXIL), and Autonomous Constrained Flight Planner (AFCP) capabilities are being developed as a ground station tool for generating and evaluating routes.

Technologies to enable speech interface capabilities are also progressing. Discussions continue with the Air Force Research Laboratory to establish partnering opportunities, including follow on, deep dive technical discussions in planning upcoming activities. Coordination with the Federal Aviation Administration (FAA) on an RCO baseline simulation is also ongoing. In late March, an Air-space and Operations Safety Program sub project manager, Randy Bailey, traveled to the FAA's *Civil Aerospace Medical Institute* in Oklahoma City to explore mutual research interests. Discussions with the FAA's Flight Operations Simulation Branch were also held, and cooperative research testing plans are being formulated for evaluation of baseline RCO issues. Baseline RCO testing is tentatively planned for September. (POC: Sharon Graves)

NASA Langley Researcher Attends TPC/TIM Meetings in Japan

On May 11, William C. Johnson of NASA Langley Research Center participated in the technical program committee (TPC) meeting for the Japanese government's 2015 Electronic Navigation Research Institute (ENRI) International Workshop on Air Traffic Management/Communications, Navigation, and Surveillance (EIWAC2015) in Tokyo. On the following day, May 12, Mr. Johnson participated in a technical interchange meeting hosted by ENRI and attended by other international aeronautics organizations, where he presented an overview of NASA's Aeronautics Research Mission Directorate portfolio.

Mr. Johnson was the sole United States representative invited to the ENRI TPC gathering for EIWAC2015, where he is working with ENRI to develop EIWAC2015 into Asia's premiere forum for air traffic management technical exchange. Mr. Johnson will return to Tokyo in November for the next TPC meeting and the EIWAC2015 event. (POC: William C. Johnson)

NASA Langley Multi-Disciplinary Student Projects

On May 1, a team of eight NASA Langley Research Center student researchers presented their semester-long projects to managers at NASA Headquarters during a video conference. Disciplines included aerospace, mechanical, energy and software engineering, and computer science. Students came from across the nation to spend 15 weeks at NASA Langley for a hands-on, real-world research experience. Their projects supported the Transformative Aeronautics Concepts Program and the Airspace Operations and Safety Program (AOSP).

The student abstract entitled “Flight Adjustment Logging and Communication Network (FALCN)” was in support of AOSP’s Shadow Mode Assessment Using Realistic Technologies for the National Airspace System Project, as well as networked air traffic management. The group was led by Matthew Underwood with the involvement of Lindsey Carboneau, Daniel Merlino, Drew Wilder and Logan Wilson.

In part, the abstract reads: “There is an overwhelming desire to advance communication mechanisms between entities that operate within the national airspace system. Furthermore, due to the rise of fuel costs, airlines are extremely interested in increasing the efficiency of their flights. FALCN is an innovative system prototype that improves collaborative decision-making without modifying infrastructure or operational procedures within the current air traffic management system. This software enables flight crew and airline dispatchers to share and assess optimized flight routes through an Internet connection. This system prototype will result in an unprecedented use of in-flight Internet to facilitate effective communication with airline operations centers, which may contribute to increased flight efficiency for the airlines.”
(POC: Elizabeth Ward)



Pictured above are the team members, from left to right: Andrew Todd, Alyssa Sylvester, Craig Schmidt, Andrew Olguin, Logan Wilson, Lindsey Carboneau, Drew Wilder, and Daniel Merlino

NASA Works with CAST to Develop New Training Methods

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). This includes the development of realistic simulation scenarios designed to induce AHPLS, and methods to detect and measure these states for induction validation and training purposes.

AHPLS contribute to the loss of flight crew airplane state awareness, and remain a causal factor in commercial aviation accidents and incidents. The challenge is ultimately to create new training methods, which reduce the occurrence of, and enable recovery from, AHPLS in situ. Transitioning effective and useful research and development products to the international commercial aviation training community is key to the success of this work, so the NASA team of Lance Prinzel, Kyle Ellis, Chad Stephens, Angela Harrivel, and the National Institute of Aerospace (NIA)'s Dan Kiggins sought exposure to real airline training sessions early in the task life cycle.

The NIA's Kiggins arranged for observation of training sessions and discussions with Boeing and Pan Am personnel for the NASA Langley Research Center's team in Miami, Fla. at the Boeing Flight Services (BFS) Training Center on May 19-20, and at the Pan Am International Flight Academy on May 21. The visit informed an NIA workshop hosted June 16-17, in Hampton, Va. Approximately, 30 invitees attended the workshop, including representatives from the Federal Aviation Administration, industry, unions, and foreign, domestic and regional airlines.

Workshop outcomes are expected to include a NASA publication describing new scenarios, and docu-

menting relevant analyses and recommendations for the ongoing work. The team is also pursuing relationships with BFS, Pan Am and other partners to access their training facilities for road show demonstrations of new technology and training mitigation concepts. This work is being conducted in response to CAST Safety Enhancement 211 entitled "Training for Attention Management" which supports the ATD Project. (POC: Sheri Brown)

ORC Project Site Visit in Houston, Texas

The Optimized Route Capability (ORC) project is an Federal Aviation Administration (FAA)/MITRE Corporation/NASA collaboration that is developing traffic management unit (TMU) decision support for intelligent arrival meter fix offloading. At many airports, including Houston Intercontinental, the arrival gates or meter fixes are major bottlenecks for arrival traffic, rather than 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 pushback on a large planning horizon: up to two hours from the meter fix. Excessive estimated delay pushback 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 should reduce the flight delay with minimal flight distance increase.

ORC team members from the FAA, MITRE and NASA visited the Houston center, tower, and terminal area air traffic facilities May 12-14 to engage facility supervisors, traffic management coordinators, and controllers (including several National Air Traffic Controller Association representatives) in discussions on ORC. In addition to positive feedback on proposed ORC functionality, facility personnel provided valuable insight into current operations and their greatest challenges, and how ORC could help address those challenges. Periodic follow up visits to the Houston facilities are envisioned as the algorithm is refined, leading up to a prototype ORC demonstration in March 2016. (POC: Shannon Zelinski)

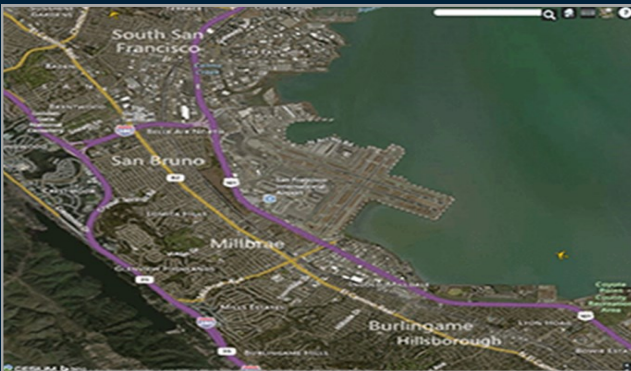
SMART-NAS Distributed Display Evaluation

As one of the first steps in demonstrating progress towards the goal of building a testbed platform, the Shadow Mode Assessment using Realistic Technologies for the National Airspace System (SMART NAS) Test Bed (SNTB) team has developed both an initial distributed aircraft situation display to industry (ASDI) live data feed, as well as the Aircraft Simulation for Traffic Operations Research (ASTOR) software. The display is part of the platform infrastructure, and it takes advantage of a trending technology, running on the NASA/Amazon cloud, enabling the display to be visible nationwide.

Currently, both the ASDI feed and ASTOR run independently on the cloud. As display platforms, the former uses Cesium – a free, open source Web Graphics Library virtual globe and map engine – whereas the latter uses Google Earth. Part of the next research step is to integrate the two into a single display. In both displays, one can examine the flights closely by zooming into an airport.

The upper two figures below show the ASDI live data display on Cesium. The first figure shows an initial state of the live data with the red dots showing the flights. The second figure shows a zoomed in San Francisco airport (SFO) with a yellow flight icon representing an arrival. The bottom figure shows the ASTOR display on Google Earth, with the blue flight icons representing 50 instances of ASTORs in a test scenario.

The team is currently evaluating the Prysm system, wall and 85 inch displays shown below, for their potential use as a collaborative and distributed display platform for the testbed. The first runs in one location, while the second could run in elsewhere in the country. (POC: Kee Palopo)



ASDI live data display on Cesium zoomed in on SFO with a yellow flight icon showing an arrival



ASTOR display on Google Earth with blue flight icons representing 50 instances of ASTORs in a test scenario



Initial state of ASDI live data displayed on Cesium with the red dots representing flights

The Boeing Company Awarded \$10.9 Million Contract for ATD Phase 2 Task

On June 5, the Airspace Technology Demonstrations Project (ATD) awarded The Boeing Company a \$10.9 million, two year contract for its avionics Phase 2 task. ATD is focused on advancing the technology readiness level of innovative NASA technologies through system level demonstrations in relevant environments. One primary ATD Project goal 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 density airport. These technologies are intended to assist flight crews, controllers, and air traffic managers with meeting the Next Generation Air Transportation System (NextGen) objective of increased fuel efficiency during periods of high runway throughput.

Researchers at NASA Langley Research Center have developed 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 2017 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 avionics prototype FIM system. Additionally, United Airlines is providing significant cost sharing which, combined with Honeywell's cost structure, allows NASA to conduct flight testing at significantly less expense. Honeywell will incorporate the latest version of NASA's ASTAR algorithm paired with their latest trajectory generator into a prototype FIM system built on Honeywell's latest Automatic Dependent Surveillance–Broadcast (ADS B) platform

hosting the oceanic in trail procedures (ITP) application created by NASA. Flight testing is planned for the second quarter of fiscal year 2017 with three aircraft, including a Dassault business jet as an ADS B Out target, a Honeywell 757 with FIM, and a United Airlines 737NG with FIM. The tests will be conducted in the Moses Lake and Seattle airspace, where the EcoDemonstrator ASTAR Guided Arrival Research (EAGAR)/ASTAR flight test successfully occurred in December 2014.

Eighty flight hours are allocated to each test aircraft allowing for the development of a flight test plan addressing stakeholder questions. NASA Langley is working to include the Federal Aviation Administration in key planning efforts throughout the contract. Honeywell has also indicated interest in incorporating ASTAR into their future product lines following this work. (POC: Sheri Brown)

ATM Data Warehouse Kickoff Meeting Held

On June 15, a kickoff meeting for the augmentation funded contract with the ATAC Corporation of Santa Clara, Calif. was held at NASA Ames Research Center. The purpose of the effort was to add new capabilities to the air traffic management (ATM) data warehouse – known as Sherlock – to greatly increase the ability of researchers to quickly analyze real track data from the entire national airspace systems (NAS) in a cleanly fused format. The work will include real time streaming of data to clients such as the Shadow Mode Assessment Using Realistic Technologies for the National Airspace System Project's testbed.

The contract task will also include integration of ATAC's SkyView product with Sherlock. SkyView is the commercial version of the FAA's Performance Data Analysis and Reporting System, and has the capacity to examine everything from NAS performance to airspace design. The contract was awarded through SGT, Inc. and has a period of performance of one year. (POC: Michelle Eshow)

TASAR Demonstrated During Industry Forum

David Wing, project lead for NASA's Traffic Aware Strategic Aircrew Requests (TASAR) research and development activity, gave a presentation and demonstration of the TASAR technology at the Electronic Flight Bag (EFB) Users Forum on June 24, in Denver, Colo. The Forum, attended this year by more than 400 participants from around the globe, is a central medium for the exchange of information among airlines, regulatory authorities, installers, suppliers, and designers of avionics systems and components. Mr. Wing briefed TASAR in the "EFB Applications" session, where he described the concept and associated EFB software application, the Traffic Aware Planner (TAP). During the Technology Expo on opening day, he demonstrated the technology running with its newly developed iPad interface.

Substantial interest was indicated from a variety of domestic and international airlines, avionics vendors, and data connectivity suppliers. Several companies expressed interest in the process for commercializing the TAP software. Specific airline interest was received from United, FedEx, NetJets, and British Airways, the first three of which are supplying evaluation pilots to the upcoming TASAR Flight Trial 2. The Federal Aviation Administration (FAA) expressed interest in collaboration, citing a potential linkage of TASAR to the FAA's Aircraft Access to SWIM (System Wide Information Management) Program. The TASAR work is supported under NASA's Airspace Technology Demonstrations Project. (POC: David Wing)

ATD Project Hosts TASAR VIP Demonstration Days

On June 12 and June 19, the NASA Langley Research Center's Traffic Aware Strategic Aircrew Requests (TASAR) team hosted VIP demonstration events at Newport News/Williamsburg International Airport. TASAR is a research task under the Airspace Technology Demonstrations (ATD) Project, within the Airspace Operations and Safety Program (AOSP). The first event was attended by AOSP Direc-

tor John Cavolowsky, ATD Project Manager Leighton Quon, Clayton Turner, NASA LaRC Deputy Center Director, and Captains Scott Sander and Paul Harrison from Alaska Airlines and Virgin America, respectively. The latter are representatives from the two partner airlines involved in the TASAR project who shared their perspectives. TASAR contractors Engility Corporation and Advanced Aerospace Solutions were also recognized for their 2014 Small Business Award nominations by NASA Langley.

NASA has been developing and testing the TASAR concept for aircraft operations featuring a NASA developed cockpit automation tool to improve flight efficiency. Known as TAP – for Traffic Aware Planner – the technology is anticipated to save fuel and flight time, thereby providing immediate and pervasive benefits to the aircraft operator, as well as improving flight schedule compliance and pilot and controller workload. The flight trials were conducted in conjunction with prospective airline partners with the goal of increasing overall readiness for upcoming integration of TAP in partner airline aircraft and operational use testing in revenue service by the airlines. (POC: Sheri Brown)

DWR Demonstration for Sabre Airline Solutions

Representatives from Sabre Airline Solutions visited NASA Ames Research Center on June 18 for a demonstration of the Dynamic Weather Routes (DWR) system. Dave McNally and Kapil Sheth provided a detailed briefing and demonstration of DWR capabilities and testing that occurred at American Airlines. Sabre representatives were interested in whether DWR route advisories could be output to a system like Flight Explorer, a Sabre product used by airline operators and others, to facilitate easy alerting to flight dispatchers. Such an approach would be a potential implementation path for systems like DWR. Sabre visitors included Daria Pulyaeva, Flight Explorer senior product manager; Steve Hansen, solutions manager, Flight Planning and Aircraft Communications Addressing and Reporting System (ACARS); and Michael Hoppin, Global SCOE/AirCentre. (POC: Dave McNally)

Meetings with DLR at AIAA AVIATION 2015

To discuss the ongoing joint research and planned milestones for wake research under an agency level collaboration agreement, Dr. Nashat Ahmad of NASA Langley Research Center held meetings with Dr. Frank Holzapfel and Mr. Stephan Korner of Deutsches Zentrum für Luft und Raumfahrt (DLR) during the American Institute of Aeronautics and Astronautics (AIAA) AVIATION 2015 conference June 23-24 in Dallas. The meetings included productive discussions on the feasibility of different ensemble techniques for wake applications, methodologies for model evaluation, the possibility of data exchange for model evaluation, and potential joint publications. The goal is to develop a validated wake vortex prediction model that can be used in support of the development and use of new procedures in the national airspace system. The progress on the collaboration was also presented at the conference in a paper entitled "Multi Model Ensemble Wake Vortex Prediction." The paper is co-authored by the DLR's Stephan Korner and Frank Holzapfel, and NASA's Nashat Ahmad and Randal Van Valkenburg. (POC: Sheri Brown)

NASA Researchers Present at AIAA AVIATION 2015

Researchers supporting the Airspace Operations and Safety Program (AOSP) participated in the American Institute of Aeronautics and Astronautics (AIAA) AVIATION 2015 Forum held in Dallas, Texas June 22-26. The forum combined several different technical disciplines, including aeroacoustics, aircraft design, modeling and simulation technologies, and aviation technology, integration and operations. This annual conference is attended by approximately 1,500 researchers and professionals throughout government, industry and academia.

During the conference, AOSP researchers presented technical papers covering a number of research areas including integrated arrival, departure, and surface operations; global aircraft trajectory simulation; the Shadow Mode Assessment using Realistic Technologies for the National Airspace System testbed development; dynamic arrival routes; environmental impacts; airport surface and terminal area scheduling; conflict alerting; weather rerouting; and flight simulation motion parameters. The forum also included several sessions with expert panelists speaking on various aspects of air traffic management, including Next Generation Air Transportation System stakeholder engagement, current air traffic operations, unmanned aerial systems integration, and transformation concepts in aviation. Forum keynote speakers included NASA Administrator Charles Bolden and Tom Enders, chief executive officer of the Airbus Group. (POC: Kathy Lee)

NTX Hosts Modeling and Simulation Technical Committee

On June 26, the NASA North Texas Research Station (NTX) in Fort Worth hosted a visit from the American Institute of Aeronautics and Astronautics (AIAA) Modeling and Simulation Technical Committee. The committee was briefed on the NTX's history and current operations, including its working relationships with the Federal Aviation Administration (FAA), Dallas Fort Worth International Airport, and American Airlines. A laboratory tour included demonstrations of NASA's Precision Departure Release Capability (PDRC) and Dynamic Weather Routing (DWR) technologies for novel surveillance at lesser equipped airports, and discussion of time based flow control. This was followed by a visit to the FAA's Fort Worth Air Route Traffic Control Center Traffic Management Unit, where the group observed PDRC in use. The AIAA group also visited American Airlines to get a demonstration of airline dispatch procedures at their Integrated Operations Center. (POC: Paul Borchers)

// Awards, Papers and Appointments

Invention of the Year Awards for 2014

The Office of the General Counsel has announced the 2014 commercial invention of the year: the “Direct To Controller Tool” from NASA Ames Research Center. This invention provides smart direct routes that are up-linked to flight crews within seconds after being identified, enabling commercial airline flights to fly more directly to their destinations. The tool has been licensed to a commercial entity, which has identified annual savings of about one million flight minutes and about \$75 million in airline operating costs. (POC: Mark Dvorscak)

NASA Honored at ATM 2015

The 11th USA/Europe Air Traffic Management Research and Development Seminar (ATM 2015) was held June 23-26 in Lisbon, Portugal, and focused on global ATM research topics, with participation from the United States, Europe, Australia and Asia. Sixty-six papers were presented (nine from NASA), in 13 research themes/tracks, including airport operations, trajectory management, weather, and unmanned air vehicle operations. NASA’s Dr. Parimal Kopardekar served on a panel entitled “Special Session on Remotely Piloted Aircraft Systems (RPAS) Research” as a technical expert in unmanned vehicle operations. NASA’s outstanding technical work was acknowledged with four papers selected as “best in track” at the conference: three papers from NASA Ames Research Center and one from NASA Langley Research Center. (POC: Sandy Lozito)

ATM Seminar Paper Awarded Best in Track

William C. Johnson of NASA Langley Research Center attended the 11th USA/Europe Air Traffic Management Research and Development Seminar on June 23-26 in Lisbon, Portugal. Mr. Johnson coauthored a paper awarded the best paper in the Trajectory and Queue Management Track: “Enabling Performance Based Navigation Arrivals: Development and Simulation Testing of the Terminal Sequencing and Spacing System” that was presented at the event. The paper summarized two key performance improvements found in the testing of the Terminal Sequencing and Spacing System developed within the Air Traffic Management Technology Demonstration 1 subproject.

During the event, Mr. Johnson also had several discussions with U.S. and European leaders regarding air traffic management research and development (ATM R&D). One key topic addressed with transatlantic leaders during the final plenary session was NASA’s participation in the international ATM R&D community. Both Federal Aviation Administration and European leadership at the event recognized NASA’s significant advances in ATM R&D, and expressed a desire to involve NASA in more international ATM R&D initiatives. (POC: William C. Johnson)