National Aeronautics and Space Administration

AOSP Newsletter

Airspace Operations and Safety Program (AOSP)

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AOSP IN THE NEWS

UNT-Led Team Collaborates with NASA on Advanced Air Mobility Project

Phys (UK) (4/14) reports "In the next 10 years, low-flying traffic over cities in the United States is expected to increase significantly and a University of North Texas-led team of academic and industry experts is working together to ensure safe skies through proper communication and coordination. ... The UNT-led team is one of eleven teams selected to work with NASA on their Advanced Air Mobility National Campaign."

Why Flying Taxi Makers are Hitting Turbulence

Fortune (4/21, Alsever) reports "Imagine, in a few years, climbing into a small four-seat air taxi to get to the airport. The craft resembles an airplane but takes off and lands vertically like a helicopter. Its electric motors make for an eerily quiet ride. And as for the cockpit, well, there isn't one because there's no pilot. ... Parimal Kopardekar, Director of NASA's Aeronautics Research Institute, says: ''getting off the ground and making sure safety is assured will be the biggest challenge ahead. But how do you prove that you're safe through operation and design? And then how do you scale it in airspace and manufacturing?' At the NASA Ames Research Center in Mountain View, Kopardekar's team is working to sort those questions out with the Federal Aviation Administration."

OSU Receives NASA Award to Study Weather for Drones

Oklahoman (4/22, Denwalt) reports "NASA awarded a team of Oklahoma State University researchers $5.2 million over the next four years to study low-level wind and turbulence forecasting. The research aims to improve the safe operation of drones in both urban and rural environments, particularly in the field of advanced air mobility that could one day include autonomous transport of people and cargo."

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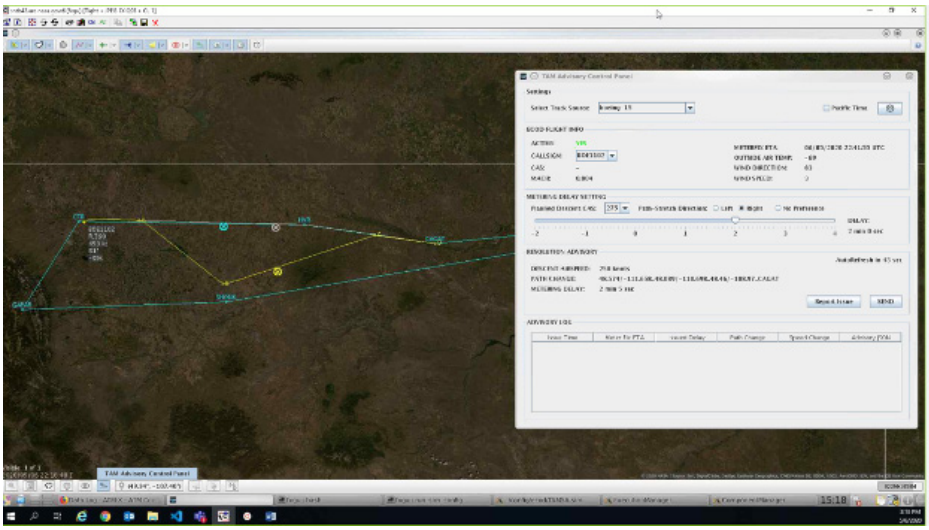

TAM advisory solution for simulated ecoD aircraft arriving at Glasgow, Montana

ATM-X Completes TAM 5A and 5B Simulation Tests with the FAA and Boeing

POC: RICH COPPENBARGER, KEE PALOPO AND ARWA AWEISS

Despite the impact of COVID-19 these past few months, the Air Traffic Management-eXploration (ATM-X) project was able to complete multiple simulation tests with the FAA and Boeing this past quarter. On May 6, a simulation test, referred to as Tailored Arrival Manager (TAM) 5A, was carried out in collaboration with FAA and Boeing to further prepare for the ecoDemonstrator (ecoD) flight demonstration involving NASA's TAM prototype. The simulation test was successfully completed with all partners working remotely, due to COVID-19 restrictions. The NASA team was able to operate systems in the testbed laboratory to generate TAM solutions using periodic input data from Boeing's virtual B737 simulator and Flight Management System (FMS). With the FAA unable to access their data communications laboratory in New Jersey, a manual method was devised for delivering TAM trajectory solutions to the Boeing flight deck. The method relied on text messaging to first send the TAM solution from NASA to FAA for translation into a Controller Pilot Data Link Communications (CPDLC) uplink message. The translated uplink message was then routed via text messaging from FAA to Boeing for loading into the FMS. The test provided valuable insight into how best to conduct remote simulation test activities where connectivity and automated processes are limited. Furthermore, all technical objectives were met. These included testing the integration of new flight plan messages from Boeing, testing a new potential ecoD 2020 arrival route in Montana airspace, further validating the FAA's CPDLC translation process, and testing fallback procedures in response to advisory-generation contingencies.

On May 27, a second simulation test was conducted, known as TAM 5B. The simulation was a follow-on test in preparation for the upcoming ecoD flight demonstration involving NASA's TAM prototype for August and September 2020. TAM-5B also was completed successfully despite only Boeing having physical access to their laboratory facilities. The NASA team once again operated systems in the testbed lab remotely to generate TAM solutions using periodic input data from a B787 simulator and FMS in Boeing's Integrated Aircraft Systems Laboratory.

TAM trajectory solutions were relayed manually to the Boeing flight deck. TAM-5B marked the first opportunity to integrate with real-world avionics representing

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View of B787 navigation display after loading TAM path-stretch solution

a B787, which was confirmed recently by Boeing as the aircraft type for the upcoming ecoD 2020 flight. Key accomplishments of the test included the acquisition of 1 hertz track data representing Automatic Dependent Surveillance-Broadcast (ADS-B) and the verification of coordinate transformations performed by the FAA in translating TAM solutions into CPDLC messages. ADS-B-like data from the B787 relied on Boeing sending data to the FAA using a simulation data exchange standard known as Test and Training and Enabling Architecture (TENA). After receiving TENA data from Boeing, the FAA's Target Generation Facility formatted the data into track messages and sent them to TAM via testbed. This data interface with testbed can conceivably be used to acquire ADS-B data from any live flight in National Airspace System. The availability of ADS-B data for the ecoD flights will provide an additional source of aircraft position and velocity in the event of data contingencies.

NASA ATM-X UAM Research Virtual Workshop

POC: HEATHER ARNESON

The Air Traffic Management-eXploration (ATM-X) Urban Air Mobility (UAM) subproject research team hosted a virtual workshop from March 31–April 2. Participants included UAM research principal investigators, their teams and collaborators, UAM subproject management, as well as ATM-X project management and line management. Attendees' affiliations included NASA's Ames Research Center in California, NASA's Langley Research Center in Virginia, and NASA's Glenn Research Center in Cleveland. The objective of the workshop was to discuss UAM research in the context of ongoing work related to the development of a UAM concept of operations, the National Campaign, and ATM-X Phase 2 planning efforts. Technical discussions developed consensus on cross-cutting assumptions and additional input required to complete fiscal year 2020 research and to coordinate results of the research being conducted across 12 research threads.

ATM-X Participates in Acoustic Technical Working Group

POC: HOK NG

The Air Traffic Management-eXploration (ATM-X) Urban Air Mobility (UAM) subproject team participated virtually in both the Acoustic Technical Working Group and the UAM Noise Working Group meetings from April 7–9. During these meetings, there was substantial technical exchange on ongoing cross-project collaborations between ATM-X and the Revolutionary Vertical Lift

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Technology (RVLT) projects related to development of a Noise Power Distance database and preliminary noise abatement recommendations for UAM operations. There were also technical discussions on how to incorporate acoustic measurements collected during National Campaign Development Testing flight activities into research planned by ATM-X and RVLT for fiscal year 2021 and beyond.

NASA/FAA UTM Quarterly Meeting

POC: RON JOHNSON

The latest NASA/FAA quarterly meeting was held on April 9 to discuss recent developments in the FAA-led Unmanned Aircraft System Traffic Management (UTM) Pilot Program (UPP) and the UTM project. UPP awards have been made to the two FAA designated UAS test sites at New York and Virginia to conduct a series of flight tests later this year. The tests will have multiple UAS fly scenarios that will demonstrate critical UTM system functions such as remote identification of the vehicle, priority operations by first responders, and implementation of airspace restrictions called UAS volume reservations. Previously, the UTM project transferred to the FAA the UTM software that UPP will be using as the backbone of the system to be tested. In addition, the project has supported UPP by providing guidance on scenario development, field testing with the test sites, selection of industry partners, and the data collection process. The UTM project will continue to assist during preparations and flight tests. Other topics covered at the meeting included the latest developments on defining performance authorizations and the categorizing UAS Service Supplier functionality and operations.

System-Wide Safety Participation in DARPA ARCOS Kickoff

POC: MALLORY GRAYDON, NATASHA NEOGI AND PAUL MINER

From April 22–23, researchers Mallory Graydon, Paul Miner, and Natasha Neogi from NASA's Langley Research Center in Virginia participated virtually in the kickoff of the Defense Advanced Research Projects Agency's (DARPA's) Automated Rapid Certification of Software (ARCOS) project. Graydon gave a keynote presentation outlining her research on the efficacy of proposed techniques for creating and assessing the assurance arguments in safety cases and other assurance cases. ARCOS project participants also gave briefings on their proposals for research into generating, curating, and presenting evidence of software fitness for use in military applications where there is risk of death, injury, or cyberattack. Subject matter experts representing NASA's System-Wide Safety project and other agencies will participate on the ARCOS review board, helping to assess and guide this research toward a goal of reducing critical military systems' certification costs. Techniques that reduce military certification costs may have application to software used in aviation and spaceflight applications. The website for the event is as follows: https://www.darpa.mil/program/automated-rapid-certification-of-software.

Virtual Workshop with National Campaign Airspace Partners

POC: SPENCER MONHEIM AND SAVVY VERMA

In April, the Air Traffic Management-eXploration (ATM-X) Urban Air Mobility (UAM) subproject hosted two virtual workshops with National Campaign partners. The first workshop, held on April 21, included about 50 participants who have signed an annex for National Campaign simulations, as well as the FAA. The purpose of the workshop was to update industry partners with information on the X-3 simulation scheduled for summer 2020. The discussion included updates to the annex and simulation schedule due to COVID-19 and other changes required to update the NASA UAM airspace management system to the latest industry standards. National Campaign scenarios or use cases focusing on nominal operations

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as well as off-nominal operations were also discussed, along with the requirements associated with those scenarios. The last workshop topic discussed was emulated airspace that will be provided to industry partners for exercising the scenarios. The second workshop, held April 29, included about 60 participants. The meeting's purpose was to update industry partners with X-3 simulation software-related information and included an update to the simulation requirements based on the latest industry standards that impact UAM airspace management system core services; a discussion on data collection and example metrics followed. The session also provided information to industry partners on connectivity tests with NASA's system. Plans for providing validation tests, functional tests, and scenario tests were also discussed. Partners provided feedback on data collection and shared some of the validation tests that they are collectively working on for the new Discovery system. The feedback will be used to inform the software systems and their development. The ATM-X National Campaign team will continue to have virtual weekly tag-ups with industry partners to ensure project continuity.

Unmanned Aircraft Safety Team Meeting

POC: STEVE YOUNG AND BECKY HOOEY

On May 7, Steve Young from NASA's Langley Research Center in Virginia and Becky Hooey from NASA's Ames Research Center in California participated virtually in the Unmanned Aircraft Safety Team (UAST) meeting. The UAST is a government/industry group chartered in 2016 to develop consensus-based and data-driven safety enhancements for unmanned aircraft systems (UAS) and operations. The team consists of more than 75 leaders representing organizations that span the UAS community. At this meeting, agenda topics included status reports from the four active working groups. As part of the data working group status report, Hooey described her team's work with the FAA to enhance NASA's Aviation Safety Reporting System to enable better reporting of UAS incidents, as well as better analysis of reports to identify safety-relevant trends and precursors. Hooey reported the project is on schedule and estimated to go live by the end of the year. In parallel, the FAA is taking steps to confirm that those who submit reports are protected from retribution or enforcement actions regarding violations (unless a crime was committed). Young serves as co-chair of the safety mitigation working group and contributes to multiple initiatives based in part on research within NASA's System-Wide Safety project. At the meeting, updates on safety enhancement initiatives were provided. For example, safety enhancement-1 recommends improvements in airspace awareness; and an initial action recommendation has been published describing how to protect commercial airports from inadvertent incursions by small UAS. Impact is expected soon as UAST member organizations begin to implement this recommendation. Additional safety enhancements are in development to cover automated vehicle responses to failures and procedure/checklist best-practices. The safety assurance working group discussed the development status of a set of safety performance indicators that the UAST and others can use to monitor and track trends. Also presented at the meeting was a status of policy/regulatory activities as reported by the FAA. For example, community response to the "RemoteID" notice of proposed rulemaking, and processing of exception requests for new carriage-for-hire operations (e.g., for the transport of COVID-19 test kits and samples) was discussed.

UAST website: http://unmannedaircraftsafetyteam.org

A recent UAST white paper describing a safety enhancement recommendation for manufacturers to provide out-of-the-box protections of commercial airport airspaces: http://unmannedaircraftsafetyteam.org/cdn/UAST_SE-1_AA-Geofencing_05-01-2020.pdf

Aviation Safety Reporting System website: https://asrs.arc.nasa.gov/

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ATM-X Insight Assessment Workshops

POC: BRYAN BARMORE

Several Air Traffic Management-eXploration (ATM-X) insight assessment workshops were held this past quarter. The first was hosted by NASA and Booz Allen Hamilton on May 7, and was the second of three insight assessment workshops for the ATM-X project. About a dozen industry and government representatives participated in reviewing ATM-X findings on safety and human factors of future air traffic management systems. Results will help inform the ATM-X Phase 2 priorities.

The insight assessment was recommended during ATM-X formulation as an additional way to engage with the growing aviation community beyond typical academic conferences. In calendar years 2018 and 2019, Booz Allen Hamilton reviewed ATM-X publications and interviewed researchers from ATM-X (and what is now the Advanced Air Mobility project) to collect and synthesize findings and insights. That process is culminating with three industry workshops where the outcomes are presented, and industry representatives can give feedback and identify areas of need to them. The workshop was to be held at the National Institutes of Aerospace in early April; however, COVID-19 canceled that workshop, so a series of three virtual workshops was planned in its place instead. This workshop was focused on safety, human factors and workload, and emergency procedures for future aviation concepts. Hyo-Sang Yoo from NASA's Ames Research Center in California and Matt Daus from Windels Marx Law Firm facilitated the conversations during the two-hour workshop. There was good, lively discussion on several topics. This followed the previous workshop on noise and weather held on May 1. The final workshop on concepts of operation and air traffic management was held on May 13. About 20 industry and government representatives participated by reviewing ATM-X findings on air traffic management and concept of operation topics, which was the focus of this workshop. Rosa Oseguera-Lohr from NASA's Langley Research Center in Virginia and Husni Idris from Ames facilitated conversations during the two-hour workshop. Once again, there was good, lively discussion on the various research topics. A final report will be delivered by Booz Allen Hamilton in July and will be shared with the participants and be made publicly available following their delivery.

12th NASA Formal Methods Symposium

POC: DIMITRA GIANNAKOPOULOU, RITCHIE LEE, AND ANASTASIA MAVRIDOU

The 12th NASA Formal Methods (NFM) Symposium (NFM 2020) was successfully held as a virtual event with a record number of registrations and very high participation, from May 12–14, with two affiliated workshops on AI safety and cryptographic proofs on May 11 and May 15, respectively. The NFM Symposium is a forum to foster collaboration between theoreticians and practitioners from NASA, academia, and industry, with the goal of identifying challenges and providing solutions toward achieving assurance for safety-critical systems. The NFM Symposium is an annual event organized by the NFM Steering Committee, comprised of researchers spanning several NASA centers. NFM 2020 was organized by researchers from NASA's Ames Research Center in California, including Anastasia Mavridou and Dimitra Giannakopoulou as general chairs, Ritchie Lee and Susmit Jha as program co-chairs, and Hamza Bourbouh and Maxime Arthaud as local chairs. Guy Power handled registrations, and the NASA Aeronautics Research Institute team, in particular Christine Clark, Alina Eskridge, and Michael Tsairides, handled the platforms that hosted the event. The NFM 2020 featured six keynote talks covering all aspects of safety-critical systems, including: the cloud, presented by Byron Cook from Amazon Web Services and University College London; blockchain, presented by David Dill from Facebook and Stanford University; transportation, presented by Dana Schulze from the National Transportation Safety Board; and

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autonomy on the ground, in the air, and in other planets, presented by Sanjit Seshia from UC Berkeley, Leonard Bouygues from Google Loon, and Vandi Verma from NASA's Jet Propulsion Laboratory. Twenty-five research papers, carefully selected from 62 full paper submissions, were presented over nine technical sessions. Each paper received at least three reviews from the NFM program committee. Keynote speakers gave live talks; authors of the research papers recorded their talks and were available live for questions and answers. Finally, a special session was presented by the joint SAE G-34/EUROCAE WG-114 committee, committed to producing a means of compliance for the certification of safety-critical artificial intelligent systems for both airborne and ground air traffic control platforms. Overall, there was overwhelming community interest in the virtual event. There was a total of 858 registrations from 48 different countries. During NFM 2020's three days, the number of active participants ranged between 148 and 288. COVID-19 placed a real challenge for the organizing and steering committees. Making the event virtual not only turned out to be the correct decision, but it also gave NFM the opportunity to discover a global interest in formal methods. Even though a physical conference has a lot of benefits, the community appreciated being able to attend talks of interest without having to commit to the travel, resulting in a much higher participation than previous NFM events. There is hope that future NFMs will consider supporting virtual participation in addition to physical attendance.

ATD-2 Phase 3 Briefing at the FAA National Customer Forum

POC: GREG JURO

From February 10–11, NASA's Air Traffic Demonstration-2 (ATD-2) team visited field demonstration partners at Charlotte Douglas International Airport (CLT). The purpose of the visit was to observe and assess how the system has been performing since metering has been turned on for all banks of flights at CLT since February 1, 2020. Initial feedback from the FAA and airline participants at CLT describe a positive effect on managing traffic on the surface at CLT, as well as the surrounding Terminal Radar Approach Control (TRACON) airspace. During periods of highly irregular operations, such as during recent severe weather events that affected flights along the eastern half of the country, ATD-2 users retained the option to temporarily suspend metering. The ATD-2 team also met with the new American Airlines manager for air traffic operations for the southeast, who was given a tour of the Traffic Management Units at CLT tower and TRACON to gain a more comprehensive understanding of how the ATD-2 system affects and improves traffic flow at CLT. The group also toured the new CLT tower to observe the progress being made toward the expected commissioning of the new tower on June 21.

ATM-X Testbed Demo for FAA NextGen Office

POC: KEE PALOPO

On May 19, the Air Traffic Management-eXploration (ATM-X) project conducted an ATM-X testbed online demonstration for representatives from the FAA and its support organization, Concepts Beyond, as requested by Matt Modderno from FAA's NextGen office. The demonstration included a discussion on an example use-case from a recent ecoDemonstrator test to show how the testbed is used along with its simulation tools. The demonstration included the software development kit's adapter template code, generation Wizard. An adapter is an interface code between the testbed and a user's application. NASA also provided the testbed's documentation, including its interface control document, to the FAA.

Unmanned Aircraft System Traffic Management Kicks Off Lessons Learned Activities

POC: RON JOHNSON AND JAEWOO JUNG

The Unmanned Aircraft System Traffic Management project is in

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its closeout year and it is important to capture positive and negative lessons learned, as well as best practices employed, to help other projects achieve success in execution and formulation phases. To this end, a contract was awarded to Crown Consulting in early May to conduct an extensive lessons learned data collection and analysis activity that will engage project personnel, the office of the associate administrator, and stakeholders, to document their experiences with the project. The data collection process will entail virtual face-to-face interviews, surveys, initial analysis, and supplemental interviews that will last three months. A final report and brief out is planned for August. The results will be shared with other projects within the Aeronautics Research Mission Directorate, as well as broader lessons entered into NASA's Lessons Learned Information System.

UAS Casualty Risk Assessment Technology Transfer Meetings with FAA and North Carolina IPP

POC: ERSIN ANCEL AND KYLE ELLIS

System-Wide Safety project leadership and researchers held several virtual meetings with the FAA's aircraft evaluations division (AED) and North Carolina UAS Integration Pilot Program (IPP) regarding the use of NASA's Non-Participant Risk Casualty Estimation Tool to support the safety case development as part of Part 107 waivers that allow commercial UAS flights over people and moving vehicles. Initiated within the Unmanned Aircraft System Traffic Management project, NASA's System-Wide Safety (SWS) project continues the development of a casualty metric and subsequent Non-Participant Casualty Risk Assessment Technology that uses a combination of cell phone generated population density data and several models to assess the number of potential individuals along a proposed flight route that could be impacted by a UAS catastrophic failure. The tool was presented to the FAA's AED, which is responsible for evaluating and granting UAS operator waiver/exception requests. The AED representatives showed interest in the use of the tool by commercial applicants as part of their safety case development. Additionally, the SWS project has connected with the North Carolina UAS IPP about the use of the Non-Participant Casualty Risk Assessment Technology to assist IPP participants obtain approval for UAS operations including drone COVID-19 response/personal protective equipment delivery. Ongoing communication is pursued with the FAA, North Carolina UAS IPP, and commercial companies to help NASA identify critical needs for the industry and initiate collaborative partnerships to develop innovative new tools and concepts designed to assure the safety of Advanced Air Mobility operations. Advancements in safety assurance capabilities and services such as the Non-Participant Risk Casualty Estimation Tool will accelerate industry efforts toward approval from the regulatory bodies to enable commercial solutions/operations.

Delivery of Aircraft Flight Performance model to National Campaign

POC: JOHN FOSTER, DAVID HARTMAN AND CHRIS HARTMAN

A flight performance model for a six-passenger Urban Air Mobility (UAM) quadrotor aircraft was delivered to the National Campaign subproject on May 26. Due to the lack of existing models for UAM vehicles, this model was designed using the Base of Aircraft Data format and was the first developed by NASA for air traffic management research using this approach. This model was based on conceptual designs and performance prediction software provided by the Revolutionary Vertical Lift Technology project. Documentation describing the database development process was also provided to the National Campaign to enable partners to further develop and implement future models. Feedback from the partners indicated a desire for models of other configurations and efforts are continuing to provide models to UAM research principal investigators to support project research objectives.

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Advanced Air Mobility Ecosystem Working Groups Kickoff

POC: PARIMAL KOPARDEKAR

On May 18 and 28, the Aeronautics Research Mission Directorate kicked off the second and third of four Advanced Air Mobility (AAM) ecosystem working groups. The community integration working group virtual meeting was held on May 18 and was attended by just under 250 people. Seven panel participants represented community acceptance stakeholders including North Carolina Department of Transportation, Airports Council International, the non-profit Community Air Mobility Initiative thought leaders in the areas of vertiports (Alpha 5), local decision makers (Duetto Group), and local development companies (Deloitte supporting Hillwood). The group discussed community needs related to UAM, barriers to community integration, the need for education initiatives, and current initiatives to address the community acceptance barriers to enabling UAM. The aircraft working group virtual meeting was held on May 28 and was attended by approximately 200 people. Six panel participants represented the aircraft community including Aerospace Industries Association, Boeing NeXT, Bell, Joby, Uber Elevate, and Wisk. The group discussed barriers related to new vehicle certification, design trade space, challenges with the public acceptance of automation, electric propulsion, and European Union Aviation Safety Agency development of certification rules. The Conference.io system enabled online participants to actively engage during the meetings. Recordings and slides from both meetings will be posted at https://nari.arc.nasa.gov/aamecosystem along with the two National Campaign virtual breakout sessions.

X-3 Simulation Design Review

POC: ANNIE CHENG

The Air Traffic Management-eXploration (ATM-X) project's initial Urban Air Mobility (UAM) subproject conducted the X-3 simulation design review (SDR) for airspace simulations with industry partners scheduled to begin at the end of June 2020. The X-3 effort is intended to support NASA's National Campaign-1 testing and review, conducted on June 3, assess the extent that the X-3 system design meets the X-3 requirements, and that the verification and validation plan is well defined and acceptable. The review was a collaborative effort, which included presentations of the X-3 design by the ATM-X UAM subproject, as well as data collection efforts by the Advanced Air Mobility (AAM) project's National Campaign subproject's airspace test infrastructure team. An independent NASA review panel and internal stakeholders took part in the SDR. They conveyed appreciation for the quality of work in the X-3 simulation planning and design, with suggested actions and feedback along with ratings for each individual exit criteria. They provided valuable feedback and recommendations to the UAM team to ensure that the X-3 simulation system design and verification and validation plan will support the goals and objectives of UAM and ATM-X, as well as those for the AAM project and the National Campaign subproject.

X-3 Connectivity Testing with Partners Begins

POC: SPENCER MONHEIM

Connectivity tests were conducted with partners for the upcoming X-3 Urban Air Mobility (UAM) airspace simulation between June 12–24. These connectivity tests are an important foundational step for the upcoming X-3 simulation, in which the airspace partners connect to the NASA Flight Information Management System-Authorization (FIMS-AZ) service and exchange data utilizing an FAA or self-signed authorization token. These tests are beneficial to both partners and the Air Traffic Management-eXploration (ATM-X) project because they provide feedback on the efficacy of the FIMS-AZ service, and are an important predecessor to more integrated testing. To

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date, the ATM-X UAM subproject has completed connectivity tests with six airspace partners: ANRA Technologies, University of North Texas (UNT/Frequentis USA), Avision, Metron/Airbus, Uber, and AirMap. More tests with partners are expected to be completed in July.

UTM and Smart Mobility at Ames Team Returns to Center for Flight Operations

POC: JAEWOO JUNG AND BIMAL APONSO

From June 29–30, the Unmanned Aircraft System Traffic Management (UTM) project and Smart Mobility at Ames team conducted a small UAS flight test at the Moffett Field airport ramp area. The flight test's purpose was to research the feasibility of the Time-Based Conformance Monitoring (TBCM) concept using several carefully designed flight profiles. The TBCM concept may be included in a future UTM environment as an advanced UAS Service Supplier feature designed to enable the continuation of a planned UAS mission in a communications-challenged area. Due to COVID-19 impacts, the flight tests were governed by a center-approved return-to-work plan that contained strict safety guidelines, such as social distancing and personal protective equipment use, which was developed by the Smart Mobility at Ames team along with input from center operations and safety organizations. Five specifically designed flight profiles were successfully tested over 26 flights. The test data will be analyzed and used to assess the feasibility of the TBCM concept. The team is planning on conducting another flight test soon to strengthen the data and address any gaps in understanding.

UTM project and Smart Mobility at Ames Team Safely Operating Unmanned Aircraft at Moffett Field

UTM Project Delivers Research Transition Team Products to the FAA

POC: MARCUS JOHNSON AND RONALD JOHNSON

NASA's Unmanned Aircraft System Traffic Management (UTM) project made multiple deliveries of research transition team (RTT) products to the FAA this past quarter. On May 21, NASA delivered one of its last remaining research transition products (RTP) to the FAA as part of its UTM activity within AOSP. The RTP was completed by the RTT Sense and Avoid (SAA) subgroup for Technical Work Package #3 on Large-scale Contingencies Mitigation. Included in the RTP package was an updated UTM conflict management model that is a concept overview paper describing the conflict mitigation methodology that supports the use-cases described in Technical Capability Level 4 (TCL 4) operating environments (urban beyond visual line of sight operations) and capturing the minimal level of separation provisions that are necessary for safe airspace operations. The RTP package also included a set of eight conference publications on SAA system-level performance metrics and analyses that were conducted during TCL 4, and the relevant UTM technologies which are designed to enable UAS operations safely in low-altitude airspace.

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NASA Delivers Next Installment of Technology Transition

POC: MARCUS JOHNSON AND RONALD JOHNSON

On June 30, NASA delivered the eleventh installment of technology transition products to the FAA as part of the joint FAA-NASA RTT collaboration as detailed in the RTT plan, that is known to Congress. This installment featured a UTM project TCL 4 flight demonstration report that provided an executive summary of the demonstration and a collection of the TCL 4 flight demonstration final reports from Nevada and Texas FAA UAS designated test site organizations that participated in the demonstrations. The installment also contains a report "Flight Demonstration of UAS Traffic Management (UTM) at Technical Capability Level 4," which was presented at the 2020 American Institute of Aeronautics and Astronautics aviation forum and exposition virtual event, and an appendix of references from this report that captures further TCL 4 results and analysis. This delivery marked the final technology transition from NASA to the FAA under the UTM RTT joint management plan.

Safety Enhancement Research Presented to Industry Group

POC: ERSIN ANCEL AND KYLE ELLIS

On June 30, Steve Young from NASA's Langley Research Center in Virginia provided a summary of research completed over the period 2014–2020 to industry's joint implementation measurement and data analysis team (JIMDAT). The JIMDAT is a government/industry group chartered in the late 1990s to track the implementation and effectiveness of safety enhancements (SEs) that have been defined by JIMDAT's parent organization, the Commercial Aviation Safety Team (CAST). Young's presentation marked the completion of SE-207 and SE-208, which were defined by CAST in 2014 with the goal of developing and demonstrating technology-based interventions to mitigate loss of airplane state awareness by flight crews. This includes loss of awareness regarding energy, automation, attitude, and system states, particularly in off-nominal situations. Over the course of six years of research, 13 technology concepts were developed, evaluated, and advanced as part of 11 high-fidelity flight simulation studies that spanned six test platforms. These platforms included advanced flight deck simulators at Langley and NASA's Ames Research Center in California, Honeywell, the University of Iowa, and the FAA Aeronautical Center in Oklahoma City. During these studies, more than 200 airline flight crews and test pilots participated. They completed more than 1,700 complex scenarios such as had occurred in prior accidents, incidents, or similar events. Overall, 49 reports in total were published either as conference/journal articles or as NASA technical reports. In recognition of its efforts, the team of more than 100 individuals that completed the 2019 flight simulation studies was recently awarded a NASA Group Achievement Award. This team was led by Lynda Kramer from Langley. Following Young's presentation, JIMDAT complimented the team's extensive work and discussed plans for follow-on activities regarding the findings.

RECOGNITION

AUVSI Cascade Chapter, Webinar on UAM/AAM

POC: SPENCER MONHEIM

On May 22, researcher Spencer Monheim from NASA's Ames Research Center in California participated virtually as a panel member at an Association for Unmanned Vehicle Systems International (AUVSI) cascade chapter webinar on Urban Air Mobility (UAM) and Advanced Air Mobility (AAM). Almost 100 people attended the webinar comprised of mostly people outside of the UAM industry. Monheim answered multiple questions involving what approach NASA is taking with UAM, including the five pillars for UAM as outlined by the AAM project; what is the expectation in terms of how UAM will fit into the current airspace system; will UAM be naturally phased in, or will we see changes to the airspace as a whole as a result of UAM; what are the concerns with cybersecurity; and how integral is safety to UAM, compared to cars or traditional commercial air traffic. The panel participants gave insight on how external stakeholders see UAM, as well as their thoughts and concerns. It allowed the Air Traffic Management-eXploration project to share their plans and vision for UAM, including the National Campaign and other research threads. A recording of the meeting was posted online.

Parimal Kopardekar Elected Chair of ICAO's UAS Advisory Group

POC: PARIMAL KOPARDEKAR

On May 27, Parimal Kopardekar, director of the NASA Aeronautics Research Institute, was elected by members as the new chair for the International Civil Aviation Organization's (ICAO) Unmanned Aircraft Systems-Advisory Group (UAS-AG). In this capacity, Parimal Kopardekar will represent the United States at ICAO, and the FAA supported his nomination. The group's charter is to harmonize Unmanned Aircraft System Traffic Management (UTM) across the globe. UAS-AG Phase II will support and guide ICAO member states to establish a common global framework for UTM to allow further developments and to focus on better defined issues, whether technical, operational, or legal.

Flight Demonstration of UTM TCL 4 - Presentation at 2020 AIAA Aviation Forum

POC: JOSEPH RIOS

On June 17, Unmanned Aircraft System Traffic Management (UTM) project Chief Engineer Joseph Rios virtually presented "Flight Demonstration of Unmanned Aircraft System (UAS) Traffic Management (UTM) at Technical Capability Level 4" at the 2020 American Institute of Aeronautics and Astronautics Aviation Forum, using a video recording. In the presentation, the flight demonstration scenarios that contained research objectives, test characteristics that defined the flight environment in each scenario, and test events that were designed to induce changes to the environments or operations for testing different technologies and procedures were discussed. The summer 2019 demonstration took place in Reno, Nevada, and Corpus Christi, Texas, and unmanned aircraft tracks and associated operation volumes from some operations were shown. The presentation concluded with a discussion on how the viability of the UTM concept to manage large scale operations and contingencies in an urban environment was shown with the demonstration, and the potential use of the demonstration results for the FAA and other regulators to inform future rule making and identification of additional gaps that require further analysis.

NASA's Formal Requirements Elicitation Tool Received Honors and Awards

POC: DIMITRA GIANNAKOPOULOU AND MISTY DAVIES

NASA's Formal Requirements Elicitation Tool (FRET) received honors and awards at a significant international conference, the 26th International Requirements Engineering: Foundation for

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Software Quality (REFSQ 2020), held from June 23–26. FRET allows requirements to be precisely stated; this enables automated analysis and testing for complex systems, including increasingly autonomous systems. FRET is now available through an open-source license and is being used together with U.S. aviation partners as part of an effort to understand the safety cases that can enable innovative, highly automated aviation systems. FRET is part of the System-Wide Safety Assurance of Autonomy Technical Challenge.

Twitter acknowledgment of NASA's FRET receiving honors and awards at REFSQ 2020

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