



AOSP Newsletter

Airspace Operations and Safety Program (AOSP)

JUL-SEP 2021 | Quarter 4



ATM-X and AAM Present to RTCA 6
SC-228 WG-2

SWS Kicks-Off Awards with 14
Academic Partners

AOSP IN THE NEWS

[NASA Funds Lidar-Based Urban Weather Sensing](#)

Aviation Week (8/31) reports “unique weather conditions in urban landscapes are a key challenge for the safety and reliability of advanced air mobility (AAM) operations that will require the development of new sensing and forecasting capabilities. Challenges include the complex flow fields at low altitude in built-up areas and...”

[NASA Is Testing Electric Air Taxis with Joby Aviation](#)

The Verge (9/01) reports NASA kicked off test flights of electric vertical take-off and landing (eVTOL) aircraft — colloquially referred to as “flying cars” — with Joby Aviation, the Northern California company that recently went public.

[NASA Joby EVTOL Testing Paves Way for Electric Air Taxis in Cities](#)

SlashGear (9/1) reports “NASA revealed in an announcement today that it recently began testing an electric vertical takeoff and landing (eVTOL) aircraft, a first for the space agency and a move toward bringing ‘air taxis’ to big cities. According to NASA, it will conduct its eVTOL tests through Sept. 10, gathering data on the use of these all-electric aircraft as a potential future transportation option.”

[NASA Flight Tests of Futuristic ‘Air Taxi’ are Finally Underway](#)

Gizmodo (9/1) reports “the first official tests of Joby Aviation’s all-electric vertical takeoff and landing (eVTOL) vehicle have begun. NASA is leading these tests, which it’s doing to foster the development of similarly advanced aircraft. This marks the first inclusion of an eVTOL vehicle in NASA’s Advanced Air Mobility National Campaign. By partaking in the developmental flight tests of a commercial aircraft, NASA hopes to ‘advance airspace mobility’ in the United States, and ‘help integrate air taxis, drones and other inventive new vehicles into the national airspace,’ according to an agency press kit.”

[NASA and Joby Kick Off EVTOL Flight Tests](#)

FlightGlobal (9/2) reports “NASA and US air taxi developer Joby Aviation have started a ten-day flight-test programme using Joby’s in-development air taxi – part of a NASA effort to help advance ‘urban air mobility’ technology. The flights kick off a broader NASA project under which the agency will partner with several companies developing electric vertical take-off and landing (eVTOL) aircraft.”

[NASA is Testing a Straight-From-Science-Fiction Electric Air Taxi](#)

The Hill (9/3) reports “NASA kicked off testing of an all-electric vertical takeoff and landing (eVTOL) aircraft that could eventually fly cargo and passengers around busy cities in the not-too-distant future. The U.S. space agency teamed up with electric aircraft startup Joby Aviation to conduct developmental flight tests of the company’s six-rotor air taxi near Big Sur, Calif.”

[NASA Starts Testing Electric Air Taxi For 1st Time](#)

SPACE (9/3) reports “NASA has started testing a future air taxi that might soon be flying cargo and passengers in busy cities, helping to ease annoying traffic jams. The all-electric vertical takeoff and landing (eVTOL) aircraft, designed by California startup Joby Aviation, is a helicopter powered by six rotors. It was designed to be as quiet as possible in order to fit into busy city life without disturbing residents.”

[NASA Starts Flight Testing with Joby’s Electric Air Taxi](#)

Engadget (9/4) reports “NASA just took an important step toward making flying taxis a practical reality. The agency has started flight testing with Joby Aviation’s electric VTOL aircraft to help model and simulate future airspace with these taxis in

AOSP IN THE NEWS

service. The dry run began quietly, on Aug. 30, and will last through Sept. 10. The effort will include noise check using 50 microphones to gauge the “acoustic profile” of the air taxi throughout the course of a given flight.”

[NASA is Testing Out a New Air Taxi Prototype](#)

Universe Today (9/6) reports “NASA is commonly thought of as America’s space agency, but its name also emphasizes another research area. The National Aeronautics and Space Administration is also America’s civilian aerospace research organization. In that role, it has been instrumental in developing new technologies ranging from rocket engines to aircraft control systems. Part of that role is running the Advanced Air Mobility (AAM) campaign to test autonomous drone technology. The latest milestone in that campaign was testing an electric vertical takeoff and landing (eVTOL) helicopter intended for eventual use as an air taxi.”

[NASA and the FAA Hope this New Software Will Reduce Flight Delays, Carbon Emissions](#)

Washington Post (9/28) reports “the Federal Aviation Administration on Tuesday unveiled a new system designed to make air travel more efficient by reducing the amount of time planes spend sitting on the

taxiway. Software developed by NASA will enable officials to more precisely pinpoint when planes should push away from their gate for takeoff. By reducing the amount of time aircraft spend waiting, airlines can cut the amount of fuel they use.”

[Feds Aim to Reduce Lines of Planes Waiting to Take Off](#)

AP (9/28) reports “Federal officials plan to roll out software at 27 large U.S. airports that they hope will eliminate long lines of planes waiting to take off while also slightly reducing fuel consumption. ... NASA developed the software and has tested it since 2017 at Dallas/Fort Worth International Airport and Charlotte Douglas International Airport in North Carolina.”

[U.S. FAA To Deploy Software to Reduce Airport Delays](#)

Reuters (9/28) reports “the Federal Aviation Administration (FAA) said Tuesday it plans to deploy a new software capability to reduce taxi times and ramp congestion for flights at 27 major U.S. airports. The FAA and NASA said the new software was tested for four years that calculates gate pushbacks at busy hub airports ‘so that each plane can roll directly to the runway and to take off.’ When deployed, the FAA said it anticipates annually saving more than 7 million gallons (26.5 million liters) of fuel and eliminating more than 75,000 tons of CO₂ emissions.”

[FAA And NASA Develop Software to Reduce Taxi Delays and Cut Fuel Burn](#)

FlightGlobal (9/29) reports “the Federal Aviation Administration and NASA have developed software that promises to improve efficiency at major airports across the USA by reducing taxi times, flight delays and, as a result, lower fuel burn and greenhouse gas emissions. The two agencies on 28 Sept. published test results of software that ‘calculates gate push-backs at busy hub airports so that each plane can roll directly to the runway and to take off’.”

[This Software Aims to Make Your Flight Smoother—And Help the Planet](#)

Wired (9/28) reports “Fastening the seat belt buckle and knowing your flight is on its way to its destination: Nice. Getting stuck in a tarmac traffic jam and waiting for your flight to take off: Not so nice. Turns out the wait is also not nice for the planet. ... Taking off and landing is usually just a short part of a flight, but accounts for a quarter of its emissions, according to NASA. Unnecessary plane stops during that process increase fuel use. It would be better for everyone—passengers included—if airplanes smoothly exited and entered airports.”

AOSP IN THE NEWS

[Departure-Optimization Software Ready for Deployment, FAA Says](#)

Aviation Week (9/28) reports “the FAA is set to begin widespread deployment of software that integrates data from several existing systems and calculates optimal pushback times to minimize delays between the gate and departure. Tested for nearly four years under the NASA-led Airspace Technology Demonstration 2 (ATD-2)...”

[FAA Unveils New System to Reduce Planes' Times on Taxiway](#)

The Hill (9/29) reports “the Federal Aviation Administration (FAA) has worked with NASA to develop a new software that calculates specific times when planes should push back from gates in order to limit delays on taxiways and reduce the amount of fuel used by aircraft as they wait to take off. The new system was unveiled by the FAA on Tuesday

following the completion of nearly four years of research and testing at several flight hubs across the country, including airports in Charlotte, Dallas-Fort Worth and Atlanta.”

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

ATM-X Attends European Concept of Higher Airspace Operations Project Workshop

POC: [JAEWOO JUNG](#)

From June 29 to July 1, a team from the Air Traffic Management – eXploration project’s Extensible Traffic Management (xTM) subproject attended the European Concept of Higher Airspace Operations (ECHO) project’s virtual workshop. ECHO will deliver a comprehensive demand analysis and a concept of operations for higher airspace traffic management. The project is setting up a number of large-scale industry information and consultation events. In the workshop, ECHO project partners provided inputs on the initial demand for higher airspace operations including analysis of studies and research, scenario use cases and design, vehicles and operational specificities, and principles and assumptions. This is the first in a series of three thematic workshops that xTM intends to observe.

NASA Awards Grant to Boeing for the V&V 2045 Vision NRA

POC: [GUILLAUME BRAT](#)

On July 8, NASA awarded a grant to Boeing for the Validation and Verification (V&V) 2045 Vision NASA Research Announcement

(NRA) call. This NRA was a collaboration between the System-Wide Safety project and the Transformative Aeronautics Concepts Program’s Transformative Tools and Technologies project. The goal of the proposal is to provide a comprehensive landscape of the future needs in software and system V&V for autonomous aviation cyber-physical-human systems (including both ground and airborne systems), develop a roadmap for the development of V&V needs for the corresponding applications in autonomy and aviation, and to identify where novel V&V techniques are needed to address gaps in the regulatory framework. The Boeing-led team includes industry partners Collins Aerospace and General Electric, academic advisors Ella Atkins of the University of Michigan, Chuchu Fan of the Massachusetts Institute of Technology, Ufuk Topcu of the University of Texas at Austin, and government advisors from the Federal Aviation Administration and the Air Force Research Laboratory. The kickoff meeting is tentatively planned for Aug. 13. The grant will be monitored by Guillaume Brat of NASA’s Ames Research Center in California, with the help of additional researchers from both NASA’s Langley Research Center in Virginia and Ames Research Center in California.

AOSP Participates in SAE G 34/Working Group on AI in Aviation

POC: [KURT SWIERINGA](#) AND [MISTY DAVIES](#)

In early July, two AOSP projects participated in the SAE G-34 Working Group (WG-114) Artificial Intelligence (AI) in Aviation Working Group. On July 1, the Air Traffic Management – eXploration project met with the SAE G-34 Committee Chair and discussed how they might contribute to the SAE G-34/Working Group (WG-114) Artificial Intelligence in Aviation Working Group. SAE G-34/WG-114 focuses on implementation and certification related to artificial intelligence technologies for the safer operation of aerospace systems and aerospace vehicles. This group has been active since 2019 and has approximately 500 contributors around the planet. This group is an industry standards committee that is creating the first standards and guidance for the use of machine learning in aviation. Kurt Swieringa of NASA’s Langley Research Center in Virginia is joining the working group to provide a NASA Air Traffic Management – eXploration airspace perspective. On July 8 and 9, several System-Wide Safety project staff members participated in a virtual SAE G-34 and EUROCAE Working Group plenary meeting. Topics included harmonization with related committees, gaps

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

related to the assignment of Design Assurance Levels, changes to the requirements flow-down process, and the determination of the operating domain.

ATM-X and AAM Present to RTCA SC-228 WG-2

POC: [RAFAEL APAZA](#)

On July 14, the Air Traffic Management – eXploration (ATM-X) and Advanced Air Mobility (AAM) projects presented overviews of their respective work to the Radio Technical Commission for Aeronautics Special Committee-228 (RTCA SC-228). This briefing informed RTCA of NASA's activities in the area of Advanced Air Mobility, with an emphasis on communications. Communication, Navigation, and Surveillance (CNS) technical lead, Casey Bakula, and other representatives from NASA's Glenn Research Center in Cleveland presented the ATM-X CNS work being executed within the Urban Air Mobility (UAM) Airspace Management subproject under ATM-X. Several RTCA members expressed an interest in collaborating with NASA on multiple activities, so the projects are working on future follow-up discussions.

SWS Awards Grant to Flight Safety Foundation

POC: [MISTY DAVIES](#) AND [KYLE ELLIS](#)

The System-Wide Safety project awarded a grant to the Flight Safety

Foundation in July. During the next two years, the Flight Safety Foundation will provide input to NASA on the In-Time Aviation Safety Management System (IASMS) concept of operations and will engage with the broader aviation safety management system communities and stakeholders to develop a mapping between today's safety management system and the future IASMS. The Flight Safety Foundation will also help NASA educate and engage with stakeholders about IASMS development and benefits.

UAM Airspace Management subproject Hosts NC-1 Airspace Partners Kickoff Meeting

POC: [ARWA AWEISS](#)

On July 20, the Air Traffic Management – eXploration's Urban Air Mobility (UAM) Airspace Management subproject successfully conducted a kickoff meeting with seven National Campaign-1 (NC-1) airspace partners that will participate in the UAM X4 simulation activity through June 2022. NASA's Advanced Air Mobility (AAM) project's National Campaign entered into a non-reimbursable Space Act Agreement with the following airspace partners: ANRA Technologies Inc., ARINC Incorporated, Avison Inc., Metron Aviation Inc., OneSky Systems Inc., SkyGrid, and Unmanned

Experts Inc. The kickoff meeting was the first opportunity to discuss the activity's objective, approach, proposed providers of services for UAM capabilities, and schedule, as well as an opportunity for the airspace partners to ask questions and to provide initial feedback. During X4, the Airspace Management subproject will work with industry to continue evolving the UAM airspace architecture, to identify additional information exchanges needed to support initial UAM operation in the National Airspace System, and to prepare airspace partners that plan to participate in the NC-1 flight test.

ATM-X Attends the FAA's BNE Virtual Exhibition Day

POC: [KURT SWIERINGA](#)

On July 21, the Air Traffic Management – eXploration project team attended the FAA's Advanced Air Mobility Beyond Visual Line of Sight (BVLOS) National Airspace System Evaluation (AAM BNE) virtual exhibition day. The exhibition included both presentations on the FAA's AAM BNE activity and live flights. The AAM BNE activity has the objectives of identifying limits of current communications, navigation, and surveillance services, evaluating BVLOS operations, and evaluating Air Traffic Control procedures for large unmanned aircraft system missions in the National Airspace System.

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

ATM-X ETM Team Holds Two-Day Virtual ETM Workshop with FAA

POC: [JAEWOO JUNG](#)

On July 21-22, the Air Traffic Management – eXploration project’s Upper Class E Traffic Management (ETM) team participated in a two-day virtual ETM workshop with members of the FAA’s ETM Research Transition Team (RTT). The workshop was hosted by the NASA Aeronautics Research Institute. On Day 1 of the workshop, an overview of NASA’s and FAA’s ETM work was provided, along with a panel on the ETM concept, including formulation of the RTT and ETM research and development efforts such as operational intent modeling and conflict identification. Four breakout sessions were held on Day 2, including panels on ETM services and architecture, operational intent, ETM operator data needs, and considerations for global operations. Outcomes from the sessions were reported back to the group. More than 140 people from industry, academia, and government agencies registered for the workshop. The NASA and FAA ETM teams plan to continue engagement with the ETM community with another workshop in the future.

Website: <https://nari.arc.nasa.gov/etm2021workshop>

NASA ATM-X DIP Meeting with FAA/ANG

POC: [MIRNA JOHNSON](#)

On July 23, leadership teams from AOSP, the Airspace Technology Demonstration project, and the Air Traffic Management – eXploration project’s Digital Information Platform subproject team met with Steve Bradford and Diana Liang from the FAA’s NextGen organization. This was an informal discussion to initiate NASA/FAA coordination of NASA’s Digital Information Platform and services demonstrations. The early demos beginning in FY22 will support FAA’s analysis and investment decisions for flight object and flow object. The conversation focused on technical goals and approach for these demonstrations. NASA and the FAA agreed that the best mechanism for coordination would be the Digital Mesh Technology and Applications Research Transition Team. Follow-up meetings will be held to further discuss the oceanic flight deck work that the FAA is leading through FY23 and how NASA can contribute for FY24/ FY25 follow-on work.

AEWG CCWG: Transitions of IASMS Across AAM Epochs Using S-Curves

POC: [MISTY DAVIES](#) AND [KYLE ELLIS](#)

On July 27, the Advanced Air Mobility (AAM) Ecosystem

Working Group Cross-Cutting Working Group met to discuss “Transitions of In-Time Aviation Safety Management Systems (IASMS) Across AAM Epochs Using S-Curves.” The event focused on examining requirements for IASMS as the AAM ecosystem evolves over time, which has been portrayed as a series of S-curve epochs. Across each transformative epoch of maturity, the IASMS services, functions, and capabilities (SFCs) may need to evolve with an equal pace of innovation and technological advancement to address the increasingly complex AAM ecosystem envisioned over time. The purpose of the meeting was to identify requisite IASMS SFCs mapped to the different AAM ecosystem S-curve epochs necessary to enable in-time aviation safety. The session was introduced by Misty Davies, project manager of the System-Wide Safety (SWS) project, and kicked off with a presentation entitled “Evolution of IASMS SFCs in Transitions of Increasing Autonomy” presented by Kyle Ellis, deputy project manager of SWS. It was followed by a presentation entitled “Presentation of S-curve Diagram” presented by Parimal Kopardekar, director of the NASA Aeronautics Research Institute. The panel focused on transitions of IASMS across AAM, with panelists Parimal Kopardekar, Jon Hegrans (Founder and CEO, Kittyhawk), Eric Bergesen (Director

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

of Operations, UPS Flight Forward) and moderated by Paul Krois of Crown Consulting, Inc. The presentation and panel session were very well received with more than 100 virtual attendees. The session initiated a robust conversation highlighting the critical need to evolve the concept of IASMS to enable new entrant operations and advance the transformation of the National Airspace System.

NASA ATD-2 Phase 3 Briefing to FAA/Industry Collaborative Decision-Making Teams

POC: [JEREMY COUPE](#) AND [GREG JUR0](#)

On July 29, NASA's Airspace Technology Demonstration-2 (ATD-2) team provided a briefing updating the status and results to date of the ATD-2 Phase 3 field demonstration in the North Texas area. The briefing was provided to the Collaborative Decision Making (CDM) stakeholders. CDM is a joint government/industry initiative aimed at improving air traffic flow management through increased information exchange amongst aviation community stakeholders. Two CDM teams (Surface CDM Team and Flow Evaluation Team) have a joint tasking to work with NASA to facilitate the transfer of ATD-2 knowledge and technology. These two teams include representatives from most US air carriers (passenger and freight), business

aviation, several major airports, and the FAA. The briefing focused on recurring operational uses cases that have provided Trajectory Option Set (TOS) opportunities for the airlines to reroute flights using the ATD-2 system during the Phase 3 field demonstration. Additionally, the briefing provided the opportunity to explain how the ATD-2 system operates in both the air traffic control and airline facilities. Each of the use cases were described in detail from an operational perspective focusing on the ATD-2 system's capabilities to identify flights with potential for delay savings with a departure reroute. These delay savings benefits include off delay savings (earlier takeoff time), in delay savings (earlier arrival time on TOS route vs. filed route at destination) and aggregate delay savings (other flights obtaining delay savings as the result of the reroute). The briefing generated several questions and discussion on how the system could be used in other weather and traffic scenarios. Beneficial fuel and environmental savings metrics through July 26, 2021 were provided to the group for further review. The ATD-2 team received several compliments from CDM stakeholders on how efficiently the multi-partner, collaborative field demonstration has been managed in a live air traffic environment in the North Texas area.

SWS Delivers Invited Briefings to JIMDAT on TASA

POC: [KYLE ELLIS](#), [STEVE YOUNG](#), [CHAD STEPHENS](#), [MICHAEL FEARY](#) AND [LANCE PRINZEL](#)

On July 29, System-Wide Safety (SWS) project researchers provided invited briefings to the industry's Joint Implementation Measurement Data Analysis Team (JIMDAT), a working group within the Commercial Aviation Safety Team (CAST). The briefings provided summaries of research completed under the NASA Technologies for Airplane State Awareness (TASA) subproject (2014-2019) within the SWS project. JIMDAT requested research findings and expertise regarding state-of-the-art and recommendations relevant to "safety enhancements" (SEs). Of particular interest is the CAST-defined SEs calling for Research and Development (SE-207/208, 210, and 211) that focused on developing new technologies and training methods to help mitigate the single largest commercial aviation accident category of loss-of-control inflight. NASA had previously briefed CAST in 2020, summarizing the completed SE research and development. JIMDAT was interested in next steps that should be considered to bring awareness of the research and technology accomplishments and encourage or facilitate transfer to industry. For the new technology aspects, NASA recommended that the research and development

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

findings be the basis for new design SEs. This suggestion and other results of the JIMDAT meeting are to be briefed at an upcoming CAST plenary meeting in September.

FSF Special Report Outlines Public Good Use Cases for SWS Development of IASMS

POC: [MISTY DAVIES](#) AND [KYLE ELLIS](#)

In June 2021, the Flight Safety Foundation (FSF) published a special report entitled “Looking to the Future: Safety System Needs for Humanitarian UAS Operations” based on information gathered from a series of industry workshop engagements. In early August, supporting NASA’s System-Wide Safety (SWS) project, the FSF began organizing industry engagement to outline industry desires and current barriers to inclusion of unmanned aircraft systems vehicles in disaster and emergency response operations. The report outlines three operational use cases that are envisioned for inclusion in SWS’s Safety Demonstrator Series. The Safety Demonstrator Series is a set of spiral development research efforts and flight demonstrations focused on developing and maturing the In-Time Aviation Safety Management System (IASMS) concept to manage risk and assure safety of operations. NASA’s concept of an IASMS is a scalable solution focused on safely integrating

Advanced Air Mobility vehicles and concepts into operational use cases in the National Airspace System.

The report can be viewed at:

<https://flightsafety.org/wp-content/uploads/2021/07/D6-DMFR-FINAL.pdf>.

UAM Airspace Research Roadmap Submitted for Export Control

POC: [IAN LEVITT](#)

On Aug. 5, the Air Traffic Management – eXploration (ATM-X) project’s Urban Air Mobility (UAM) Airspace Research Roadmap (or, simply, Roadmap) was baselined at v1.0 and submitted for export control. The Roadmap is expected to be an important tool for the execution of ATM-X’s UAM airspace research over the next ten years, with the goal of evolving UAM airspace to UAM Maturity Level-4. It provides a basis for prioritizing and coordinating research efforts, and for integrating results that build toward NASA’s research goals. The Roadmap also has the potential to serve as a focal point for ongoing and continuous deliberation, as has been the case during its development. It naturally attracts questions and feedback that are beneficial to overall understanding, which is key to NASA’s leadership in defining the airspace of the future.

SWS NASA Research Announcement Year Two Mid-Year Review Highlights

POC: [NATASHA NEOGI](#)

On Aug. 11, the System-Wide Safety (SWS) project’s NASA Research Announcement topic, “Assuring Increasing Autonomous Systems with Non-Traditional Human-Machine Roles,” held its year two mid-year Review. The team from Pennsylvania State University presented a summary of their progress regarding the Urban Air Mobility (UAM) Concept of Operations and task modelling in the Working Models that Compute framework, with a specific focus on power/battery modelling. The subcontractor, Iowa State University, detailed their progress on integrating the systems theoretic process analysis methodology with traditional model-based systems engineering frameworks in order to enable a safety-forward systems engineering process. On Aug. 17, the team from Collins Aerospace presented their work related to modeling and verifying properties with respect to two specific UAM contingency scenarios by using the Architecture Analysis and Design Language modelling framework with the Assume Guarantee Reasoning Environment model checker. The subcontractors, Florida Institute of Technology and SoarTech, outlined their progress in modeling learning agents in the Soar cognitive architecture framework and verifying

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

these agents in using the NuXMV model checker. Natasha Neogi, the NASA technical point of contact for these awards, arranged for each team to attend the others' brief out leading to a lively red-team oriented question and answer environment. This enabled a vibrant exchange of ideas across both award efforts and has led to a complementary set of research being developed to address a wide range of human-machine teaming challenges in emerging technologies and operations.

ATM-X Team Attends UAS BVLOS Operations Aviation Rulemaking Committee Meeting

POC: [JAEWOO JUNG](#)

On Aug. 11 and 12, NASA's Air Traffic Management – eXploration project was invited to observe the Unmanned Aircraft Systems (UAS) Beyond Visual Line of Sight (BVLOS) Operations Aviation Rulemaking Committee Plenary Sessions meeting. The UAS BVLOS Aviation Rulemaking Committee will provide recommendations to the FAA for performance-based regulatory requirements to normalize safe, scalable, economically viable, and environmentally advantageous UAS BVLOS operations that are not under positive air traffic control. This Aviation Rulemaking Committee will take a holistic approach in recommending a

performance-based, technology-agnostic regulatory framework for BVLOS operations. NASA will continue to observe future meetings at Ames Research Center in California.

ATM-X Holds Meetings with FlyOhio Project at the Ohio UAS Center

POC: [WILLIAM CHAN](#), [KURT SWIERINGA](#), AND [ROB FONG](#)

Between July and August, the Air Traffic Management – eXploration (ATM-X) project held several meetings with representatives from the FlyOhio project, an initiative of the Ohio Unmanned Aircraft Systems (UAS) Center to incorporate multiple use cases for personal travel and delivery of goods across Ohio. On July 14, the ATM-X project team met with the FlyOhio team to discuss potential research collaboration opportunities. The FlyOhio team has a multiyear program which lays out an innovative framework to design, test, and deploy a statewide Advanced Air Mobility (AAM) strategy focused on the movement of people and goods. As an action item, ATM-X project agreed to continue to discuss collaboration opportunities with FlyOhio to further the goals of the project. On July 23, the ATM-X project held a follow-up partnership meeting with the Ohio UAS Center, which is planning

a series of flight demonstrations focused on Advanced Air Mobility and UAS cargo operations. The Ohio UAS Center and ATM-X project further discussed potential collaboration opportunities to advance the state of the art of National Airspace System integration. The technical team planned to work on collaboration details to be presented during a follow-on meeting for August. In an Aug. 13 meeting, the ATM-X project team and Pathfinding for Airspace with Autonomous Vehicles (PAAV) subproject met again with the Ohio Department of Transportation (ODOT) and Ohio UAS Center. Initial discussions with ODOT explored mutually beneficial collaborations between the PAAV effort and their planned demonstrations in the test environment. ATM-X and PAAV will continue follow-on discussions with ODOT to further the goals of the project.

SWS Conduct Flight Tests Beginning in August to Test More than Twenty R&D SFCs

POC: [STEVE YOUNG](#) AND [MISTY DAVIES](#)

Researchers in the System-Wide Safety (SWS) project will conduct a series of flight tests beginning in August and continuing through the autumn. Tests will utilize a small unmanned aircraft systems vehicle (Tarot-18), simulated air traffic, and an experimental air/ground system

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS



SWS-21 Test Vehicle (Tarot T18 Octocopter)

aimed at providing new services, functions, and capabilities (SFCs) that enable timely proactive safety management during operations. SWS-21 is the third of four flight test activities that have been planned over the FY18-24 timeframe and will be conducted on the City Environment Range Testing for Autonomous Integrated Navigation (CERTAIN) test ranges at NASA's Langley Research Center in Virginia. As part of the air/ground system, more than 20 research and development SFCs will be tested, including some that make use of prototypical infrastructure such as those that may be available in urban settings in the future. Objectives of the testing are fourfold: 1) advance and assess the Technology Readiness Level of each SFC and the system architecture as a whole, including collecting data for the verification and validation of underlying models,

software, and assumptions; 2) expose requirements for the design of future in-time safety management systems that may be tailored to specific use-cases; 3) inform decisions regarding future project milestones including considering whether elements or aspects should be reconsidered, dropped, or added; and 4) advance test infrastructure capability in order to support planned future testing with SWS partners. Meeting these objectives will help to achieve more specific project milestones such as demonstrating techniques for automated in-flight risk assessment and mitigation.

DIP Team Briefs RFI Response Summary Brief Out to Stakeholders

POC: [MIRNA JOHNSON](#)

This past quarter the Air Traffic Management – eXploration project's

Digital Information Platform (DIP) team conducted briefings on the results of a request for information (RFI) that was released Mar. 24. The first briefing was on July 29, in which the team met with Airlines for America to share a summary of information received from the RFI responses. The objective of that meeting was to follow up with the respondents' takeaways and inform them of the concept and demonstration plans that were identified by the DIP team. The forum gave participants an opportunity to add on and provide additional feedback to the summary. It was clarified that the summary was an aggregate of responses and not a necessary consensus. Participants were looking forward to workshops to prioritize services and reach consensus to uniformly support the demonstrations. A key takeaway was the lack of input from airports in the responses. The DIP team intends to keep contacts with current and new airports for additional inputs. The presentation also described the roadmap for the collaborative demonstrations and next steps for partner engagement. The airline community was extremely receptive to follow up workshops for more detailed discussions. At a second meeting on Aug. 18, the team again shared with the DIP external community a summary of the information received from the RFI. More than 80 people attended the forum, which gave them an

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

opportunity to ask questions, add-on to, and provide feedback to the summary. The meeting helped describe next steps for partner engagement, including a series of workshops to be held through September and October.

SWS Engagement with DRONERESPONDERS

POC: [KYLE ELLIS](#)

On Aug. 20, System-Wide Safety (SWS) project leadership met with Charles Werner, director of DRONERESPONDERS Public Safety Alliance, to discuss collaboration opportunities in support of NASA's Advanced Air Mobility mission. DRONERESPONDERS membership totals more than 900 emergency and first responder agencies across the globe and has helped hundreds of operators successfully navigate the FAA waiver process to utilize unmanned aircraft systems for special governmental interest missions, including firefighting, search and rescue, law enforcement, utility/critical infrastructure restoration, post-disaster damage assessments, and media coverage for crucial public information. The DRONERESPONDERS community and expertise coupled with NASA's In-Time Aviation Safety Management System research and development efforts pose a significant win-win opportunity to execute on NASA's mission objectives and to expand unmanned aircraft systems

operations for the public good. NASA and DRONERESPONDERS are seeking to establish an umbrella Space Act Agreement with an initial annex to support the SWS project's Safety Demonstrator Series technical challenge.

UAM Presents to the AAM Executive Board Airspace Working Group

POC: [MARIA CONSIGLIO](#) AND [VICTOR CARRENO](#)

On Aug. 20, the Air Traffic Management – eXploration project's Urban Air Mobility (UAM) Airspace Management subproject presented an abstract entitled "Potential of Detect and Avoid in the Flight Deck to Mitigate Collision Risk" to the Advanced Air Mobility Executive Board Airspace Working Group. This presentation described a series of studies conducted to explore the possible mitigation effects of Detect and Avoid in the flight deck through the analysis of a mid-air collision that occurred on August 16, 2015. Results from the study indicated that Detect and Avoid on the flight deck has the potential for virtually eliminating mid-air collisions, making them an extremely improbable event for general aviation. These results suggest that assistive Detect and Avoid technology could also be beneficial to UAM pilots operating in comparable conditions and under similar

regulations. Additional research is needed to evaluate the potential risk mitigation impact of assistive Detect and Avoid technology for UAM traffic patterns as well as their interactions with Rules other Visual Flight traffic. UAM Separation Standards research will also include evaluations of appropriate well-clear configuration parameters for UAM operations throughout the incremental integration stages of the UAM Maturity Level scale.

SWS TC-2 Level 2 Milestone Completion Reporting

POC: [STEVE YOUNG](#) AND [LYNNE MARTIN](#)

On Aug. 30, the System-Wide Safety (SWS) project completed a level 2 milestone, TC2-02-02: "Development of techniques that (a) process state information and predictions about safety evolution in-time to determine best course of action, and then (b) select this action to mitigate selected risks." This milestone has been successfully completed by developing four techniques for part (a) and three techniques for part (b). Furthermore, these have been applied within the overarching framework for In-Time Aviation Safety Management System-based services, functions, and capabilities being investigated within the project. The exit criteria also included defining on-board contingency-selection logic and demonstrating this logic in simulation as part of

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

deterministic decision-making and auto-mitigation functions for selected risks. Advancing the technology readiness level of each technique remains ongoing and includes flight testing across a span of representative use-cases and flight conditions and scenarios. These flight tests are the subject of future project milestones, including the FY22 Annual Performance Indicator.

ATM-X Briefs at NASA/FAA Quarterly Meeting

POC: [MIKE MADSON](#)

On Aug. 31 and Sept. 2, NASA's Air Traffic Management – eXploration (ATM-X) team and the FAA held their latest quarterly review meeting. On Aug. 31, the Digital Information Platform subproject provided an update on their efforts to date. This was followed by the Extensible Traffic Management subproject, who presented the Research Transition Team ATM-X's Upper Class E Traffic Management work and shared results from the two-day workshop held in July. On Sept. 2, the Urban Air Mobility (UAM) Airspace Management subproject provided updates on the X4 simulation, partners, and the UAM Airspace Roadmap. The Pathfinding for Airspace with Automated Vehicles subproject and Sky for All activities also presented updates on their respective ongoing work.

SWS Presents at RTT Convening Authority Meeting

POC: [KYLE ELLIS](#) AND [MISTY DAVIES](#)

On Sept. 2, the System-Wide Safety (SWS) project presented updates to the NASA/FAA Research Transition Team (RTT) Convening Authority regarding technology development and transfer of its In-Time Aviation Safety Management System (IASMS) concept. IASMS was presented as a scalable and tailorable solution to increasingly proactive risk management and safety assurance of both traditional and new entrant operations in the National Airspace System. The SWS RTT has four sub-groups within its RTT focused on addressing the safety challenges of transforming the National Airspace System, including an IASMS concept of operations group tasked with defining the near-term implementation and functionality of an IASMS to augment traditional aviation safety management systems. The IASMS concept represents a critical research and development effort to safely integrate Advanced Air Mobility vehicles and operations into the National Airspace System.

ATM-X Participates in Aura Kickoff Meeting

POC: [RAFAEL APAZA](#)

On Sept. 2, the Air Traffic Management – eXploration (ATM-X) project's Urban Air Mobility (UAM) Communications, Navigation, and

Surveillance (CNS) activity and AURA Network Systems hosted the Announcement of Collaborative Partnership Opportunities (ACO-3) CNS Annex Kickoff Meeting. Other participants included representatives from AURA Network Systems, Advanced Air Mobility (AAM) National Campaign, AAM Aeronautics Mission Integration Office, UAM CNS, and the Aeronautics Research Directorate at NASA's Glenn Research Center in Cleveland. The NASA/AURA partnership has been established to flight test AURA's air-ground communications system performance in a UAM-like operational environment. The kickoff meeting included NASA presentations from the ATM-X project and UAM subproject, CNS UAM architecture development, and NASA Glenn flight test capabilities and experience. AURA Network Systems presented information on their company background, a communications technology overview, previous work and their deployed communications system architecture.

xTM Team Discusses ETM Research with Industry Member

POC: [JAEWOO JUNG](#)

On Sept. 2, the Air Traffic Management – eXploration project team members discussed their Upper Class E Traffic Management (ETM) research with Andy

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

Thurling, a principal of Thurling Aero Consulting LLC who is also associated with the High-Altitude Platform Station Alliance. The team discussed the research captured in two recent NASA ETM papers, “Define Minimum Safe Operational Volume for Aerial Vehicles in Upper Class E Airspace” with Min Xue as the first author and “Cooperative Upper Class E Airspace: Concept of Operations and Simulation Development for Operational Feasibility Assessment” with Hyo-sang Yoo as the first author. The group plans to continue research discussions as the ETM research and development advances.

SWS Presents IASMS Concept to FAA UAM Strategic Working Group

POC: [KYLE ELLIS](#)

On Sept. 2, Kyle Ellis, deputy project manager for NASA's System-Wide Safety (SWS) project, provided an overview of the In-Time Aviation Safety Management System (IASMS) concept to the FAA's Urban Air Mobility Strategic Working Group. The working group consisted of several thought leaders and experts from the FAA Air Traffic Operations (ATO) organization led by James Herrera. This interaction is important as it engages the FAA ATO organization, a key stakeholder whose input is critical to future development concepts for airspace management and safety, especially

in pre-flight and in-flight phases of flight. Increased access to near real-time data and related processes is essential to the IASMS concept and its set of services, functions, and capabilities to be increasingly timely and proactive to monitor, assess, and mitigate risks. The IASMS concept was well received, and further collaboration between NASA and the FAA is currently being pursued across multiple lines of business, including FAA organizations ANG, AVS, and now ATO. This collaboration is essential to future implementation of IASMS concepts focused on enabling safe operations in a transformed national airspace system.

SWS Kicks-Off Awards with Academic Partners

POC: [WENDY OKOLO](#)

This past quarter, the System-Wide Safety (SWS) project kicked off new two research awards with academic partners. On Aug. 10, the SWS project team held a kickoff meeting with representatives from the University of Central Florida (UCF) to summarize and review plans for a new grant research agreement. The one-year research activity encompasses the design and development of a transfer learning approach that will improve battery health management and safety for unmanned air vehicles (UAVs). The goal of the effort is to improve the safety of UAVs through data-driven predictive analytics. The UCF team

will: 1) develop a novel transfer learning approach for predicting the end-of-discharge voltage of lithium-ion batteries of UAVs under varying flight plans and payloads with battery condition monitoring data including current, voltage, and temperature; and 2) validate the proposed transfer learning-based predictive modeling approach using the experimental data. This planned work complements ongoing research in the SWS project. During the kickoff meeting, guidance was provided on potential implementation and infusion points into SWS for the research developed under this research activity.

On Sept. 2, the SWS project held a second kickoff meeting with a team from the University of Texas at Arlington. The purpose of the meeting was to summarize and review plans for a new research agreement grant. The one-year research activity will focus on the assessment and prediction of risks due to uncertainty in UAS flight performance parameters. A framework that combines varying uncertainty types and sources will be developed and utilized to assess which uncertainties pose the most pressing risks to UAS safety, thus providing guidance on safe UAS vehicle design and operations. A methodology for generating safety risk updates based on current knowledge of the National Airspace System as well as at a future instant

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

to predict how the risk changes over time will be developed during the research. The methodologies will be validated using true historical data and simulated data. This planned work complements ongoing research in the SWS project, and during the kickoff meeting guidance was provided on potential implementation and infusion points into SWS for the research being developed under this research activity.

ATM-X PAAV Completes Communication Latency Simulation for Separation Assurance

POC: [MIWA HAYASHI](#)

NASA has just renewed its Space Act Agreement (SAA) with General Electric (GE) to collaborate on software assurance for increasingly autonomous systems. The umbrella agreement is for five years, lasting through May 2026. The first three-year annex focuses on safety assurance research to broaden knowledge of operational risk assessment, evidence curation, and adaptive stress testing. The previous SAA between NASA and GE Global Research expired on May 24. This agreement has increased the collaboration between NASA and GE. Some of the activities and accomplishments under this SAA included: (1) regular monthly meetings to review research needs and possible solutions; (2) successful technology transfer of a NASA-

developed adaptive stress testing tool (AdaStress) to GE Aviation; (3) technology transfer of AdvoCATE, a NASA-developed tool to create and review safety cases; and (4) review of the Formal Requirements Elicitation Tool (FRET), a NASA-developed tool to elicit and formalize requirements for critical systems. The new agreement with GE enables NASA to work with all GE business units and builds on the past collaboration by applying, for example, the AdaStress tool to a flight management system and helping GE incorporate it into their production testing environment.

NC and ATM-X UAM Meet with Wisk Aero

POC: [KEVIN WITZBERGER](#)

On Sept. 3, representatives from the National Campaign (NC) and Urban Air Mobility (UAM) Airspace Management subprojects met with representatives from Wisk Aero. The purpose of the meeting was to discuss NASA's terminal arrival and departure procedure designs, current traffic densities and patterns in the Dallas and Los Angeles metropolitan areas, and the NC-1 simulation (called X4) airspace corridor designs. Wisk Aero requested a meeting with NASA to discuss airspace details based on their conversations with NC staff during their regular NC-1 flight test planning meetings and observations from the weekly X4 airspace partner meetings. The

meeting was interactive, as Wisk Aero showed a continued interest in gaining a deeper understanding of the designs for the terminal arrival and departure procedures as well as the airspace corridor design and rationale for the X4 simulation. A second meeting was requested and tentatively scheduled for Sept. 17. For a number of reasons, Wisk Aero is an important vehicle developer and participant in the NC-1 flight tests due to their desire to lean into partnering with multiple X4 airspace partners that are currently collaborating with NASA to develop their company's Provider of UAM Services that will be tested in the X4 simulation effort. Following the simulation activity, Wisk Aero and multiple airspace providers will conduct a flight demonstration with an electric vertical takeoff and landing vehicle to assess the functional allocation and data exchanges needed for scalable UAM operations.

NFLITE for UAM and AAM Accreditation Milestone 1 Achieved

POC: [NELSON GUERREIRO](#)

On Sept. 7, a key collaborative Inter-Agency Agreement milestone was reached by successfully demonstrating the NASA/FAA Laboratory Integrated Test Environment (NFLITE). The Air Traffic Operations Laboratory at NASA's Langley Research Center in Virginia and the FAA William J. Hughes Technical Center

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

executed a test of integrated laboratory simulation capabilities demonstrating simulated Advanced Air Mobility operations including Urban Air Mobility (UAM) traffic, as well as unmanned aircraft systems traffic, in the presence of conventional traffic operations in the Atlantic City area. The milestone achieved was an accreditation test which validates the functionality of the associated integrated systems and is a formal process developed by the FAA to validate the interoperation of FAA systems with a partner's external systems. The NFLITE activity brings together NASA prototype systems for Advanced Air Mobility and FAA operational systems to support research in the areas of concept validation, systems integration, human/automation interactions, other human factors areas, and autonomous systems, among others. NASA's prototype capabilities used in the initial integration and accreditation included the UAM Vehicle Simulation, a six-degrees-of-freedom electric vertical takeoff and landing piloted/automated aircraft simulation, the UAM Mission Planner for pre-departure trajectory planning of UAM missions, the UAM Vertiport Scheduler to vertiport resource management, and the Advanced Trajectory Services-Toolkit for Integrated Ground and Air Research capability for background traffic generation and scenario visualization.

The FAA's capabilities included the Target Generation Facility for simulated conventional operations, Simlat and ScanEagle products for simulated unmanned aircraft systems operations, a virtual tower view of airspace operations, and the Standard Terminal Automation Replacement System for airport terminal area air traffic controller displays. The accreditation scenario demonstrated potential Advanced Air Mobility operations using airspace suggested routings designed by FAA subject matter experts.

ATM-X UAM Team Holds Meetings with Stakeholders to Develop Use Cases

POC: [SAVVY VERMA](#)

On Aug. 4 and Sept. 8, the Air Traffic Management – eXploration project's Urban Air Mobility (UAM) Airspace Management subproject team conducted the last two of four planned stakeholder meetings with the FAA and industry partner Joby Aviation. The objective of these meetings was to create a set of use cases in the Dallas/Fort Worth area to present and discuss with the FAA. This series of meetings will help to refine airspace and procedure concepts for UAM operations in the near term. FAA participants included personnel from NextGen, the Air Traffic Organization, and the Air Traffic Services organizations. This activity is seeking direct input from airspace experts in the form

of group discussions focused on a series of UAM use cases that range from operations flying in Class E or G airspace that require little or no interaction with air traffic controllers to operations inside controlled airspace. Other topics of discussion were use cases related to repositioning a flight within controlled airspace, as well as handling a flight with an off-nominal situation that led to its leaving controlled airspace and landing at a Class D airport. The last meeting was dedicated to discussing operations that would fly from downtown Dallas to Dallas/Fort Worth International Airport utilizing the spine road. The usage of current day tools like letters of agreement to achieve UAM operations were also explored. The use cases cover a range of operational challenges and potential solutions. The results and lessons learned from these sessions will be used to identify research questions and upcoming simulation studies planned for the UAM Airspace Management subproject.

NASA Participates in DARPA's ARCOS Evaluation

POC: [MALLORY GRAYDON](#) AND [PAUL MINER](#)

During Sept. 7-15, System-Wide Safety (SWS) project researchers Mallory Graydon, Paul Miner, and Natasha Neogi participated as subject matter experts in the government review of achievements in the

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

Defense Advanced Research Projects Agency's (DARPA's) Automated Rapid Certification of Software (ARCOS) project. During the review, ARCOS project participants demonstrated assurance-case-related tooling that they are constructing. Graydon, Miner, and Neogi used their expertise in safety assessment and safety assurance to provide feedback that will help DARPA staff determine whether ARCOS is on track to deliver rapid, low-cost means to assess and assure the safety and security of high-consequence software systems following changes. While ARCOS aims to reduce the cost of certifying software-intensive military systems, the tools and techniques it develops may have applications to software used in aviation and spaceflight applications. The web-site for the ARCOS project is: <https://www.darpa.mil/program/automated-rapid-certification-of-software>

xTM Team Kicks-off ETM Market Study with LMI

POC: [JAEWOO JUNG](#)

On Sept. 15, the Air Traffic Management – eXploration project's Extensible Traffic Management (xTM) subproject team kicked off an Upper Class E Traffic Management (ETM) market study with LMI. This study has two objectives: (1) to elicit knowledge and information to understand current and future

opportunities associated with high-altitude operations at scale and the risks and barriers for realizing those opportunities; and (2) to estimate the difference in high-altitude operations market size with and without the ETM system. The knowledge elicitation results are expected no later than four months after the contract award. A prototype high-altitude market model for the market-size estimation is to be delivered no later than eight months after the award, and the final report is to be delivered no later than 12 months after the award. Monthly status reports will be delivered to monitor the study's progress.

Sky for All Portal Evaluations

POC: [SHAWN ENGELLAND](#)

On Sept. 17, the first round of evaluations for the Sky for All (S4A) portal closed. The S4A activity is part of the Air Traffic Management – eXploration project. Upon closing of the portal, all core team members were invited to provide feedback, and the S4A Core Team is currently testing the first draft of the portal, which includes mechanisms for providing feedback within the content.

NASA Hosts ATD Project TIM

POC: [SHAWN ENGELLAND](#) AND [BARRY SULLIVAN](#)

On Sept. 22 and 23, NASA's Airspace Technology Demonstration

(ATD) project conducted a virtual Technical Interchange Meeting (TIM) as part of the project's closeout process. This online event, hosted by the NASA Aeronautics Research Institute, featured presentations and panel discussions that highlighted how the ATD-1, ATD-2, and ATD-3 demonstration activities have contributed to implementing the Next Generation Air Transportation System. The TIM focused on how the FAA and industry are utilizing the knowledge and technology developed and delivered under ATD. The TIM was kicked off with opening remarks from Robert Pearce, associate administrator of NASA's Aeronautics Research Mission Directorate, and Pamela Whitley, assistant administrator of the FAA's NextGen office. Following opening remarks, a project overview and history was presented. Following the history of the project, plenary sessions for "ATD-1 Trajectory Based Operations (TBO)," "ATD-3 Traffic Aware Strategic Aircrew Requests (TASAR)," and "ATD-3 Dynamic Routes for Arrivals in Weather (DRAW) and Multi-Flight Common Route (MFCR)" were conducted on Sept. 22. The following day included opening comments from Akbar Sultan, director of AOSP, and Steve Bradford, chief scientist of the FAA's Architecture and Nextgen Development. Subsequently, there were the featured panels

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

“ATD-2 Single Airport Integrated Arrival Departure Surface (IADS)” focusing on the research conducted at Charlotte Douglas International Airport, “Multi-Airport Integrated Arrival Departure Surface (IADS)” focusing on the research conducted in the Dallas-Fort Worth metroplex, and the “ATD-2 Digital Services” session. For more information, visit: <https://nari.arc.nasa.gov/atd2021tim>

ATM-X UAM Participates at Horizon UAM Symposium 2021

POC: [IAN LEVITT](#) AND [HANBONG LEE](#)

The Air Traffic Management – eXploration (ATM-X) project’s Pathfinding for Airspace with Autonomous Vehicles (PAAV) subproject held a week-long tabletop walk-through of unmanned aircraft cargo scenarios with subject matter experts, including remote pilots, controllers, and dispatchers, from May 3-7. The goal of the tabletop walkthrough was to highlight shortfalls and gaps that prevent routine unmanned aircraft cargo operations in the National Airspace System within the current Air Traffic Control operating paradigm. A second concept of operations tabletop exercise was held virtually from June 14-18. This exercise was a continuation of the first tabletop held in May 2021, and new topics were discussed such as clearances, surface operations, launch and recovery, and increased

automation considerations. The identified shortfalls from both tabletop exercises will be used to inform trade studies of possible near-term solutions as well as to inform possible automation solutions in the future.

SWS Moderates AEWG Crosscutting WG Panel on ML/AI and Autonomy Standards

POC: [MISTY DAVIES](#)

On Sept. 23, the Advanced Air Mobility (AAM) Ecosystem Working Group’s (AEWG) Crosscutting Working Group hosted a panel on Machine Learning/Artificial Intelligence (ML/AI) and autonomy standards in aviation for the AAM community. Panelists included Kimberly Wasson, the autonomy assurance and certification lead at Joby Aviation; Darren Cofer, a fellow at Collins Aerospace; and Mark Roboff, co-founder and CEO of Sky Thread and the chair for the SAE G-34 Committee that is working new standards which may enable the use of ML/AI in aviation. The panelists reflected on the driving use cases that require ML/AI or autonomy in emerging aviation operations, discussed the likely scope of emerging standards in the near term, and talked about remaining gaps that will need to be researched to enable operations further in the future. Misty Davies, project manager of NASA’s System-

Wide Safety project, moderated the panel. NASA subject-matter experts serve on the associated standards committees, including several key research personnel from System-Wide Safety.

ATM-X Projects Presents X4 Corridors at Joint Executive Board Working Group Meeting

POC: [SAVY VERMA](#)

On Sept. 23, the Air Traffic Management – eXploration (ATM-X) project’s Urban Air Mobility (UAM) Airspace Management subproject made a presentation to the joint NASA/FAA Executive Board Working Group on the corridors designed for the upcoming X4 simulation. This activity is being led by the Airspace Procedures and Design (APD) team within the UAM Airspace Management subproject. The presentation highlighted how tactical separation will be managed by operators rather than air traffic controllers, by using a combination of software on the ground and on-board as well as equipment aboard the vehicles. The corridors designed for the X4 simulation, planned with National Campaign airspace industry partners, identified airspace in the Dallas/Fort Worth area that was de-conflicted from traditional traffic. The design utilized standard approach and departure procedures and historic track data to de-conflict the airspace from the traditional

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

traffic so that Air Traffic Control did not have to intervene and provide services inside corridor airspace. The APD team also presented approach and departures procedures identified for the X4 simulation and a preliminary analysis of routes inside the corridor airspace. Both NASA and FAA participants provided feedback on the corridors that will be incorporated into the next series of simulations. Future work will involve further fine tuning of the airspace construct-corridors based on feedback from X4 simulation and data analysis.

ATM-X Presents PAAV and xTM Technical Challenges's at TC Tollgate Meeting

POC: [WILLIAM CHAN](#)

On Sept. 29, the Air Traffic Management – eXploration (ATM-X) project's Pathfinding for Airspace with Autonomous Vehicles (PAAV) and Extensible Traffic Management (xTM) subprojects presented their revised technical challenges to the Aeronautics Research Mission Directorate's Direct Program Management Council seeking subproject readiness approval. Overall, the projects did a good job in presenting the information and received approval to go forward and execute their plans.

SWS Researchers Present AdvoCATE to Wisk Aero

POC: [GUILLAUME BRAT](#)

On Sept. 29, System-Wide Safety (SWS) researchers Ewen Denney, Ganesh Pai, and Irfan Šljivo of the Robust Software Engineering technical area at NASA's Ames Research Center in California provided a tool demonstration of the Assurance Case Automation Toolset (AdvoCATE) to system safety engineers and safety management system practitioners of Wisk Aero, a joint venture between the Boeing Company and Kitty Hawk Corporation. The tool demonstration covered a variety of AdvoCATE capabilities targeted at aviation safety case development – in particular: 1) the creation of hazard logs recording the results of preliminary and functional hazard analyses; 2) the capture of safety and assurance requirements corresponding to hazard mitigation mechanisms; 3) modeling of safety architectures to capture risk scenarios and architectural risk reduction measures; 4) assurance rationale capture through the development of structured arguments; and 5) evidence and tool modeling to record and manage assurance evidence and evidence generation mechanisms. The tool demonstration also presented several experimental features aimed at assurance case progress tracking and evaluation such as process dashboards, tabular

views, and tool integration views. Afterwards, there was a discussion of safety assurance issues relating to both design and operational considerations for Urban Air Mobility and AdvoCATE support for the same, in which Wisk displayed interest. This may lead to a future follow-on discussion.

IASMS Research Presented to NASA/FAA Associate Administrators

POC: [KYLE ELLIS](#)

On Sept. 30, the System-Wide Safety (SWS) project presented key research activities being conducted in collaboration with American Airlines to associate administrators from NASA and the FAA. The presentation described recent developments toward a predictive and prognostic safety risk dashboard enabled by machine learning algorithms that will be demonstrated at American Airlines' Integrated Operations Center. The presentation was given by Kyle Ellis, deputy project manager of NASA's SWS project. The collaborative research with industry and the In-Time Aviation Safety Management System (IASMS) concept were well received, with statements of support from FAA executive leadership. This engagement with FAA executives is of particular importance as it demonstrates a key technology transfer that addresses key industry needs to assess safety data and improve upon existing

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

safety management system practices. FAA's support of this effort presents an opportunity for establishing a new research safety enhancement with the Commercial Aviation Safety Team – a key step towards accelerating the development and integration of IASMS concepts by the aviation community at large. These collaborative and coordinated research efforts are essential to the transformation of safety management systems to be increasingly proactive and predictive – a necessary capability to enabling safe operations in a transformed national airspace system.

SWS and NIST Formalize Collaboration on the Assurance of Automation

POC: [TERRY MORRIS](#) AND [ALWYN GOODLOE](#)

On Sept. 30, a non-reimbursable Inter-Agency Agreement (IA1-35035) was executed between NASA's Langley Research Center in Virginia and the Information Technology Laboratory of the National Institute of Standards and Technology (NIST). The agreement builds on existing collaboration efforts between the two organizations and relies on System-Wide Safety project expertise in the areas of software testing and formal methods. It streamlines cooperation and coordination in the areas of software verification and assured autonomy. NASA Langley and NIST focus on complementary areas of research in computing. For example, where Langley has a focus

on the assurance of software for autonomous and highly automated aircraft, NIST focuses on the cloud and network infrastructure; visions of Advanced Air Mobility in an urban setting will require seamless operation between the two and requires closer coordination of research in these areas. In addition to regular meetings to coordinate research, regular visits are planned between the two organizations.

NASA/JAXA Sign Research Agreement on Automation for Emergency Response Operations

POC: [JAEWOO JUNG](#)

On Sept. 30, NASA and the Japan Aerospace Exploration Agency (JAXA) jointly signed a collaborative agreement to conduct research on automation for emergency response operations. The goal of the collaboration is to illustrate how disaster relief operations can be conducted in a more efficient manner by the combined use of conventional aircraft (e.g. helicopters), unmanned aircraft systems, and other Advanced Air Mobility aircraft. The first major milestone, due in December 2021, is to develop a plan that defines software requirements and specifications for software development and connectivity testing.

ATM-X DIP Subproject Completes Initial Design Elements for CDDR

POC: [MIRNA JOHNSON](#)

On Sept. 30, the Air Traffic Management – eXploration (ATM-X) project's Digital Information Platform (DIP) subproject completed several technical design elements of the Collaborative Digital Departure Reroute (CDDR) service. The service will be evaluated and validated beginning in FY22 during the first demonstration in DIP's Sustainable Aviation Demonstration series to take place at the NASA/FAA North Texas Research Station. The CDDR service has been designed to utilize a collection of new machine learning based services to provide near real-time predictions for airport surface models. The Airspace Technology Demonstration-2 approach provides these predictions as a single service and are now being redesigned and decoupled in the DIP subproject to work as independent services – a key DIP objective to enable greater use of machine learning-based services and to enable these modular services to serve as building blocks for more complex services in a transformed National Airspace System. This gives DIP a jumpstart in offering high-value reusable services for the community to leverage.

RECOGNITION

Misty Davies Speaks at the NSF Summer Intensive Research Training Program

POC: [MISTY DAVIES](#)

On July 9, Misty Davies, project manager of the System-Wide Safety project, spoke with undergraduate students that are participating in a special National Science Foundation Summer Intensive Research Internship Training Program hosted at the University of New Mexico. The goal of the program is to promote inclusive academic research environments by deliberately encouraging underrepresented students, and to encourage student participation in cyber-physical systems-related graduate programs or employment.

AOSP Projects Participate at AIAA Aviation Conference

POC: [MISTY DAVIES](#), [KYLE ELLIS](#), [WILLIAM CHAN](#), [JAEWOO JUNG](#) AND [KENNETH FREEMAN](#)

From Aug. 2-6, both the System-Wide Safety (SWS) and Air Traffic Management – eXploration (ATM-X) projects participated and engaged in the AIAA Aviation Conference. The SWS project presented six papers on aviation safety topics, participated on panels, and contributed to technical committees. Of particular interest, SWS published a high-level engagement paper in the “In-Time Aviation Safety Management System: Defining Services,

Functions, and Capabilities for an Advanced Air Mobility (AAM) In-Time Aviation Safety Management System (IASMS)” session and also published a paper with the evidence and results for this year’s Thrust 5 Agency Performance Indicator: “Uncertainty Quantification of Expected Time-of-Arrival in UAV Flight Trajectory.”

The ATM-X project was represented by several participants at the Aviation 2021 360 Forum. On Aug. 3, William Chan, project manager of ATM-X, described the innovative research being conducted in ATM-X during the panel session titled “Exploring NASA Aeronautics Innovations for Transforming Aviation.” Along with ATM-X, the panel consisted of representatives from the Advanced Air Mobility, Electrified Powertrain Flight Demonstration, Low Boom Flight Demonstration, Revolutionary Vertical Lift Technology, and Transformational Tools and Technologies projects. Also on Aug. 3, ATM-X subprojects Urban Air Mobility (UAM) and Extensible Traffic Management (xTM) presented their paper “Simulation and Modeling Concepts for Secure Airspace Operations.” Kenneth Freeman and Steve Garcia were invited to be panelists at the “Cyber Security and Information Assurance” session. On Aug. 6, the UAM Airspace Management subproject’s technical lead was a

panelist for “Diversity and Inclusion in Next-Generation Airspace.” The xTM subproject team presented two Upper Class E Traffic Management papers. The first paper presented was “Define Minimum Safe Operational Volume for Aerial Vehicles in Upper Class E Airspace.” Min Xue, first author, presented a mathematical method to define the minimum safe operational boundary needed for operations in Upper Class E airspace with results from the experiments for verification of the proposed methods. The second paper presented was “Cooperative Upper Class E Airspace: Concept of Operations and Simulation Development for Operational Feasibility Assessment.” Lead author Hyo-sang Yoo presented an initial cooperative separation management concept for High Altitude Long Endurance uncrewed aircraft and described a prototype simulation platform for the visualization and assessment of the concept. The website for the conference is: <https://www.aiaa.org/aviation>

SWS Presents at UAS West Symposium

POC: [WENDY OKOLO](#)

On Aug. 12, Wendy Okolo, associate project manager of the System-Wide Safety (SWS) project, presented “Transforming the National Airspace: A UAS Safety Perspective” at the Unmanned Aircraft Systems (UAS) West Symposium. She discussed

RECOGNITION

current progress within the SWS project to address potential operational and design risks to safety in the National Airspace System (NAS) by developing In-Time System-Wide Safety Assurance services, functions, and capabilities. These are the building blocks of an In-Time Aviation Safety Monitoring System that will maintain NAS current safety levels with the inclusion of varying emerging operations with traditional airspace operations. The virtual UAS West symposium was held Aug. 11–13 and included 117 attendees. Among the attendees were industry, Department of Defense, and other government leaders who discussed technology, testing, evaluation, capabilities, and other UAS-related interests.

SWS Researchers Publish Article to Flight Safety Foundations Magazine

POC: [NIKUNJ OZA](#), [CHAD STEPHENS](#)
AND [KAITLYN FOX](#)

NASA's System-Wide Safety (SWS) project published an article in the August edition of the Flight Safety Foundation's digital magazine AeroSafety World. Authored by NASA researchers Nikunj Oza and Chad Stephens, "Enabling Safety from Data: Machine Learning/Artificial Intelligence for In-Time Aviation Safety" is the first in a series of articles that SWS plans to submit to AeroSafety World.

Future topics include assurance of autonomy and the In-Time Aviation Safety Management System. Website: <https://flightsafety.org/asw-article/data-driven-safety/>

SWS Project Researchers Present at the 2021 ISSC

POC: [TERRY MORRIS](#), [MICHAEL HOLLOWAY](#)
AND [GUILLAUME BRAT](#)

From Aug. 17-19, System-Wide Safety (SWS) researchers participated in the virtual 2021 International System Safety Conference (ISSC). Michael Holloway of NASA's Langley Research Center in Virginia delivered a tutorial entitled "Arguing about Safety and Related Concepts" to participants. The tutorial, co-developed with Kimberly Wasson of Joby Aviation, was designed to enable participants to achieve five specific learning objectives including: 1) explain what an argument is and is not by listing the necessary and optional components of an argument, and explaining the difference between atomic and compound arguments; 2) expound on the meaning of this maxim: "you only need argument when you need argument;" 3) recognize common false or misleading statements about arguments regarding their use in safety analysis and assessment; 4) renounce preexisting notions about the uniqueness of "evidence;" and 5) know where to look to explore the subject further based on initial

feedback. Attendees believed these objectives were achieved. Particularly lively and interesting discussion arose in relation to objective 3, centering around the unfortunate ubiquity of the easily-refuted false claim by some critics that argument-based approaches are especially susceptible to confirmation bias. Another SWS researcher, Guillaume Brat, presented a talk that covers research performed in the Robust Software Engineering (RSE) group for developing techniques and tools for the validation and verification for autonomous systems. The talk used the first useful guidance issued by the European Union Aviation Safety Agency (EASA) on the use of machine learning in aviation and showed that the RSE group has been on target and is addressing most of the issues identified by EASA. The work described ranges from dynamic safety cases to formal verification of deep neural networks including tools for formalizing and analyzing requirements, performing adaptive stress testing, using statistical technique to safely bound operations, and analyzing the resilience of complex autonomous systems.

SWS Researcher Featured as NASA STEM Star by Office of STEM Engagement

POC: [GEORGE GOROSPE](#)

On Aug. 18, a streaming YouTube presentation was released featuring

RECOGNITION

Diagnostics and Prognostics Research Group member George Gorospe in the webcast entitled “Failure Is Not an Option with Robotics Expert George Gorospe.” The webcast was hosted by the NASA Office of STEM Engagement. The event provided insight into Gorospe’s Native American background, education, and journey to NASA. Gorospe also discussed his current research supporting NASA’s System-Wide Safety (SWS) project research and NASA’s interest in fostering students of all interests and majors to build a diverse future STEM workforce. The intended audience included students aged 13+. George Gorospe has been a member of the Diagnostics and Prognostics research group since 2013 and serves as the Systems Health, Analytics, Resilience, and Physics-modeling (SHARP) Laboratory Manager. NASA STEM Stars is a monthly web chat series that gives students ages 13+ the opportunity to connect with NASA Subject Matter Experts (SMEs). During the chat, students are encouraged to submit questions to be answered live by NASA SMEs. Each chat introduces a STEM career, addresses a STEM topic, or highlights a NASA mission. Each episode also highlights a STEM activity that students can do at home.

AUVSI XPONENTIAL 2021 Conference Features System-Wide Safety

POC: [WENDY OKOLO](#)

On Aug. 19, Wendy Okolo, associate project manager of the System-Wide Safety (SWS) project, appeared as a panelist at the Association for Unmanned Vehicle Systems International (AUVSI) XPONENTIAL Conference in Atlanta. Entitled “Privacy, Security or Safety: Are They Mutually Exclusive?,” the panel discussed the technical, policy, and social impacts to privacy and security issues surrounding increased automation in the National Airspace System. Joined by other panelists Christopher Hill of The MITRE Corporation and Deven Desai of the Georgia Institute of Technology, Okolo addressed progressively autonomous unmanned vehicles and the associated safety implications for society. The AUVSI XPONENTIAL Conference reported approximately 5500 attendees.

SWS APM interviewed on UAV Digest Podcast

POC: [WENDY OKOLO](#)

Wendy Okolo, associate project manager of the System-Wide Safety (SWS) project, was featured in the Aug. 27 episode of the UAV Digest, a weekly podcast that

covers current news and other developments relating to unmanned aerial vehicles and systems (UAV/UAS). Okolo chatted with the hosts, Max Flight and David Vanderhoff, about the SWS project, its goals, and achievements in developing an In-Time Aviation Safety Management System for the National Airspace System. The episode is available to stream at <http://theuavdigest.com/380-nasa-system-wide-safety-project/>, and was downloaded almost 900 times within the first few days. The UAV Digest podcast has presented commercial and recreational UAV/UAS industry trends and other salient UAV/UAS information to a global audience since 2013. Other recent UAV Digest guests include representatives from Robotic Skies, MissionGO, NV5, and Iris Automation.

SWS Provides Promotional Video to Support NASA’s AAM Safety Poster Contest

POC: [KYLE ELLIS](#)

On Sept. 15, System-Wide Safety (SWS) project researchers contributed to NASA’s Advanced Air Mobility (AAM) mission, which organized a safety poster contest for students in grades 6-12 in conjunction with the National Drone Safety Awareness Week hosted by the FAA. SWS contributed to the AAM safety

RECOGNITION

poster contest formulation by outlining challenges for industry that need to be overcome to see AAM operations become a reality, and generated outreach content to gather student interest. A script was developed by Kaitlyn Fox, SWS communications specialist, and Kyle Ellis, SWS deputy project manager who recorded a requested video to enhance the outreach effort. The poster contest runs through Oct. 15, 2021: <https://www.nasa.gov/aeroresearch/aam/aam-safety-poster-contest>

SWS Presents on a Safety Critical Service at Institute of Navigation GNSS+

POC: [EVAN DILL](#)

On Sept. 22, Evan Dill of the System-Wide Safety (SWS) project presented a paper at the Institute of Navigation Global Navigation Satellite System (GNSS+) conference. His presentation covered the key developments for an In-Time Aviation Safety Management System (IASMS) service that models GPS-quality based on multiple factors including vehicle location, altitude,

and line-of-sight to GPS satellites regarding environment obscuration. This is a key service to determine safe operations of Advanced Air Mobility vehicles, especially in urban environments. This IASMS service is essential for mitigating risks related to position navigation and timing degradations such as a vehicle navigation and contingency management automation. NASA is currently engaged in several Space Act Agreements and an Inter-Agency Agreement with the Department of Justice to further develop and demonstrate this safety critical service.

National Aeronautics and Space Administration

Headquarters

300 E. Street, SW

Washington, DC 20024

www.nasa.gov/aeroresearch

www.nasa.gov