



AOSP Newsletter

Airspace Operations and Safety Program (AOSP)

APR-JUN 2024 | Quarter 3



NASA Integrated ATD-2 Tools 3
Within FAA's TFDm Achieve Initial
Operating Capability

SWS Fatigue Expert Contributes 13
to FAA Air Traffic Controllers
Fatigue Panel Report

AOSP IN THE NEWS

[NASA Tests Architecture to Integrate End-To-End Autonomy](#)

Aviation Week (4/8) reports “as part of a program to develop technologies for automated air transportation, NASA has flight tested software to enable autonomous flight in busy airspace using a pair of Sikorsky experimental helicopters.”

[Bipartisan Bill Seeks To Grow NASA Program Using Drones To Fight Wildfires](#)

NextGov (4/25) reports “House lawmakers introduced bipartisan legislation this week that would expand a NASA initiative designed to use drones and other advanced aviation technologies to assist with wildfire prevention and mitigation

efforts. The bill — introduced on Tuesday by Reps. Mike Garcia, R-Calif., and Jennifer McClellan, D-Va. — would bolster NASA’s Advanced Capabilities for Emergency Response to Operations program, or ACERO, ‘to improve aerial responses to wildfires.’”

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

NASA Integrated ATD-2 Tools Within FAA's TFDM Achieve Initial Operating Capability

POC: [CHERYL QUINN](#)

On May 14, the FAA's Terminal Flight Data Manager (TFDM) achieved Initial Operating Capability at Charlotte International Airport (CLT) as reported at the FAA Surface & Data Sharing NextGen Integrated Working Group on Jun. 7, and the NextGen Advisory Committee subcommittee meeting on Jun. 13. CLT controllers began using the TFDM system on May 14. A key element of TFDM includes the Integrated Arrival/Departure/Surface (IADS) operations tools developed within NASA's Airspace Technology Demonstration-2 (ATD-2) project. The project was executed in three distinct phases and demonstrations.

During Phase 1, the following capabilities were developed and deployed to the CLT Air Traffic Control (ATC) facilities, including the tower and ramp, as well as Washington Air Route Traffic Control Center (ARTCC) for field evaluation (end of Sep. 2017 – Sep. 2018):

1. data exchange and integration, which provides foundational data sharing among the FAA and the operator community;
2. overhead stream scheduling that leverages operator-provided earliest off block times

- (EOBTs) along with highly accurate trajectory-based taxi time estimates to schedule into the overhead stream, and communicate the corresponding release times to all users; and
3. tactical surface metering, which leverages concepts consistent with Surface Collaborative Decision Making and TFDM metering while allowing the latest inputs (like pilot call in, or lack of EOBT) to be factored into the surface metering plan.

The Phase 2 Fused IADS system provided substantial updates to the Phase 1 Baseline IADS demonstration capability. Improvements were made to the IADS modeler and tactical surface scheduling, collaborative surface metering, tactical departure scheduling for overhead stream insertion, electronic flight data via integration with the FAA Advanced Electronic Flight System, Ramp Traffic Console/Ramp Manager Traffic Control, and departure trajectories.

New capabilities included:

1. a TFDM System Wide Information Management (SWIM) prototype feed that enabled delivery of IADS data via the TFDM Terminal Publication (TTP) service of the FAA's SWIM system;
2. fusion of strategic and tactical surface scheduling and metering;
3. integration and ingestion of data from TTP-connected

- mobile application for general aviation flights;
4. expansion of airspace deployments to include adjacent center automation, in particular interface with the Atlanta Center arrival metering Time Based Flow Management system to evaluate prescheduling of flights; and
5. improvements in data analysis and system health monitoring and updates. Field evaluation of Phase 2 IADS capabilities commenced in Sep. 2018 and continued through the end of Sep. 2019.

The Phase 3 Metroplex IADS system provided additional capabilities for a multi-airport demonstration in the North Texas terminal environment including Dallas/Fort Worth International Airport (DFW) and Dallas Love Field Airport. "Stormy 20" was originally scheduled for Apr. to Aug. 2020, but the COVID-19 pandemic significantly impacted data collection due to the dramatic reduction in traffic volume as well as the reduction in flight operator and operational ATC resources. Given the significant in-kind investments made by field demo partners and the strong interest expressed by the broader airline community in collecting operational data associated with this body of work, NASA leadership directed the ATD project to extend ATD-2 through FY21. The "Stormy 21" operational evaluation commenced

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Apr. 2021 and concluded in Sep. 2021. “Stormy 21” achieved the goal of the extension to enable data collection, analysis, and stakeholder engagement to deliver meaningful ATD-2 Phase 3 results to NASA stakeholders. New Phase 3 functionality included:

1. Trajectory Option Set service – flight operator submitting requests to reroute flights on pre-coded departure routes;
2. scheduling to the terminal boundary – multi-airport scheduling via the DFW Terminal Radar Approach Control; and
3. Traffic Management Initiative propagation – Fort Worth ARTCC entered restrictions propagated via the National Traffic Management Log.

By all accounts, the TFDM system is performing well at CLT. Controllers are adjusting to the differences between TFDM and ATD-2 plus FAA prototype electronic flight strip system. The TTP data feed from CLT is now available via SWIM. The next step is for TFDM to exercise surface metering at the CLT key site to obtain the official in-service decision that will allow them to proceed with implementation. NASA’s ATD-2 system at CLT was decommissioned on May 7 and FAA requested NASA keep equipment on the shelf for 30 days in case TFDM encountered problems. NASA is

continuing to help the FAA’s TFDM Program Office answer questions about TFDM/ATD-2 benefits and assist the FAA’s Investment Planning and Analysis organization, which is working a post-COVID re-baselining of the TFDM program.

ATM-X NExCT Hosts the University of Oklahoma and Oklahoma State University

POC: [KEN FREEMAN](#)

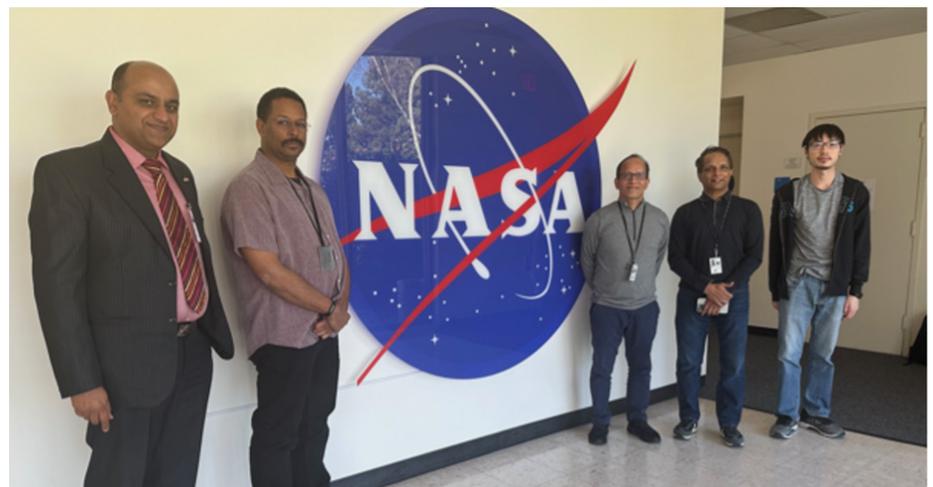
On Apr. 2, the Air Traffic Management-eXploration (ATM-X) project’s National Airspace System Exploratory Concepts and Technologies (NExCT) subproject conducted a hybrid meeting with the University of Oklahoma (OU) and Oklahoma State University (OSU) at NASA’s Ames Research Center in California. OU and OSU are candidates for the NASA Oklahoma Experimental

Program to Stimulate Competitive Research (EPSCoR). Both OU and OSU are working on research to enable efficient and safe intelligence for uncrewed aircraft system traffic management systems. University of Oklahoma associate professor Dr. Mike Banad attended the meeting in person, in addition to NExCT representatives Ken Freeman, Dr. Sandeep Shetye, Dr. Krishna Kalmanje, and NASA intern Chaz Chang. The NExCT subproject will work with OU and OSU to identify potential collaboration areas as they proceed through the EPSCoR process.

ATM-X DIP Participates in the NREL Sustainability Aviation Energy Conference

POC: [JEREMY COUPE](#)

On Apr. 1–4, the Air Traffic Management-eXploration



From Left: Dr. Banad, (University of Oklahoma), Ken Freeman, Dr. Shetye, Dr. Kalmanje, and Chaz Chang.

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(ATM-X) project's Digital Information Platform (DIP) team attended the National Renewable Energy Lab (NREL) Sustainable Aviation Energy Conference. The conference was co-hosted by Dallas Fort Worth International Airport (DFW). The event brought together stakeholders and leaders from the Department of Energy, Department of Transportation including the FAA, Department of Defense, Department of Agriculture, and the Environmental Protection Agency. Also invited were several large airport sustainability departments to talk about decarbonization and aviation's transition to a cleaner energy future. During the event, members from the DIP team had the chance to meet with the NREL Strategic Partnership manager/Sustainable Aviation Platform lead to discuss several promising and mutually beneficial collaboration opportunities. The DIP team also had discussions with DFW Airport Vice President of Environmental Affairs and Sustainability regarding using DIP aviation services to contribute to its ongoing sustainability initiatives.

ATM-X DIP Participates in FAA TIM for CATI

POC: [SWATI SAXENA](#)

On Apr. 2–4, representatives from the Air Traffic Management-eXploration (ATM-X) project's Digital Information Platform (DIP) team attended the FAA's

third technical interchange meeting (TIM) for the Connected Aircraft Trajectory Information (CATI) project in Daytona Beach, FL. Embry-Riddle Aeronautical University's (ERAU) Florida NextGen Test Bed hosted the TIM. Representing the DIP team were Dr. Swati Saxena and Dr. Miwa Hayashi, who attended in person, as well as Shawn Engelland, Doug Christensen, Ryan Chartrand, and Orval Sword (DIP pilot subject matter expert), who attended remotely. Other attendees included representatives from Boeing, Honeywell, MITRE, LS Technologies, Mosaic ATM, and ERAU. Participants at the meeting discussed fast-time and real-time simulation studies to evaluate the benefits of air-to-ground exchange of aircraft operational intent (AOI) data. Both Boeing and Honeywell's high-fidelity flight management system simulators will be used in the studies. The participants also discussed system architectures, benefit metrics, and use cases. The Flight and Flow Information for a Collaborative Environment Release 2, Flight Information Exchange Model data flows will be simulated and assumed in the benefit estimations. The final evaluations are scheduled to be completed by July 2024. The CATI AOI discussions have many overlaps with the DIP's upcoming Sustainable Flight National Partnership Operations 2 flight demonstrations

in FY25 and FY27. The DIP team held insightful discussions with the CATI developers and analysts. The next CATI TIM in mid-June will be the readiness review.

ATM-X DIP Hosts TIM for Wisk and SkyGrid at NTX

POC: [JEREMY COUPE](#)

On Apr. 3, the Air Traffic Management-eXploration (ATM-X) project's Digital Information Platform (DIP) team hosted representatives from Wisk and SkyGrid (both Boeing-affiliated companies) for a technical interchange meeting (TIM) at NASA's North Texas Research Station (NTX). The DIP team provided an overview of the series of field demonstrations the team is conducting in support of NASA's Sustainable Flight National Partnership (SFNP) mission. These demonstrations are designed to highlight how decision support services for aviation can help improve the efficiency of operations for both traditional and non-traditional flight operators. The DIP overview was followed by a demonstration of the Collaborative Digital Departure Reroute tool currently undergoing operational evaluations with air traffic control and airline partners in North Texas, with plans to expand to the Houston area next year. Subsequently, the Wisk and SkyGrid representatives shared

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information regarding their concept for Urban Air Mobility operations and their plans for moving from concept to reality in the Houston area. Following those discussions, the groups discussed potential areas of collaboration given that each of the organizations have Houston-area activities planned in the near future.

ATM-X DIP Team Hosts FAA/AJM-2 Leadership Team at NTX

POC: [JEREMY COUPE](#)

On Apr. 4, the Air Traffic Management-eXploration (ATM-X) project's Digital Information Platform (DIP) team hosted members of the FAA's leadership team for the Air Traffic Systems Directorate (AJM-2) in the FAA's Program Management Organization at NASA's North Texas Research Station (NTX). The AJM-2 leadership team requested this visit as part of their multiday visit to the North Texas Air Traffic Control facilities. The DIP team provided an overview of the series

of field demonstrations the DIP team is conducting in support of NASA's Sustainable Flight National Partnership mission. The first of these demos features the Collaborative Digital Departure Reroute (CDDR) service, which is currently being evaluated by air traffic control and airline partners in North Texas. The CDDR briefing included an in-depth discussion on the DIP team's experience in transforming CDDR from a traditional on-premises and monolithic ATM decision support tool to a cloud-based and service-oriented architecture. Additionally, the DIP team described how artificial intelligence (AI) and machine learning (ML) models were employed to replace traditional physics-based algorithms for key portions of CDDR's predictive engine. The AJM-2 leadership team is intimately familiar with the challenges of developing and maintaining the site adaptation required by traditional physics-based decision support algorithms, and they

expressed interest in learning more about the maintainability, portability, and scalability benefits associated with the AI/ML approach the DIP team is using. The briefing, demonstration, and discussion in the NTX lab were followed by a visit to American Airlines' Integrated Operations Center, where the group was familiarized with airline operations and observed air traffic control coordinators using the CDDR tool.

Dual Propeller Test Completed in NASA Langley 12-Foot Low Speed Tunnel

POC: [STEVE YOUNG](#)

On Apr. 5, members of the System Wide Safety (SWS) project completed development of a dual propeller test rig to study complex aerodynamic interactions between propellers in the NASA Langley Research Center 12-Foot Low Speed Tunnel. A large database of individual propeller forces and moments was acquired to support high-fidelity modeling activities for the SWS project's services, functions, and capabilities framework. The purpose of this test was to characterize aerodynamic interactions between propellers as a function of separation distance, advance ratio, incidence angle, and motor rotation direction. Static forces and moment measurements of each propeller were obtained



Meeting participants at American Airlines' Integrated Operations Center.

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

Propeller-Propeller Aerodynamic Interaction Study



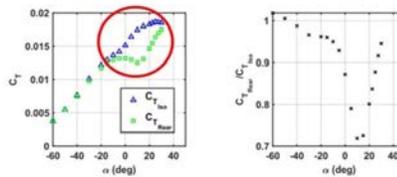
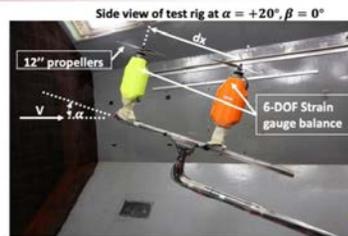
PROBLEM: Multirotor sUAS and eVTOL configurations often feature designs with multiple propellers operating in proximity. This results in complex aerodynamic interactions that can significantly impact propeller performance and may result in abrupt changes in vehicle stability and control characteristics. There is a need for high quality experimental datasets to better understand the flow physics between adjacent propellers and provide a baseline to calibrate aerodynamic prediction tools.

OBJECTIVE: Characterize propeller-propeller aerodynamic interactions as a function of separation distance, airspeed, motor rotational speed, and angle of attack. Identify operating conditions where these effects are significant and measure performance degradations.

APPROACH: Develop a dual propeller test rig to study the impact of propeller-propeller interactions in the LaRC 12-Foot Low Speed Tunnel. Measure individual propeller forces and moments using 6-DOF strain gauge force balances. Implement static and dynamic test techniques including one-factor-at-a-time (OFAT) and forced oscillation methods. Utilize flow visualization techniques to obtain qualitative assessments of propeller wake interaction and correlate to time-averaged thrust measurements.

Accomplishments/Significance: The results from this test showed that there are significant aerodynamic interactions between adjacent propellers that result in up to a 30% thrust reduction and increased power requirements. It is important for control system designers to utilize models that capture these interaction effects so that they can adequately tune the feedback control gains and develop guidance logic to avoid saturation and maintain stability. This is especially important if these sma multirotor vehicles will be operating in beyond visual line of site conditions over densely populated areas. In addition, this data will be used to update high-fidelity multirotor simulations for in-time risk assessment and pre-flight trajectory planning for multirotor vehicles operating in the national airspace system.

POC: George Altamirano and Justin Matt, LaRC



Propeller-propeller aerodynamic interaction study.

to characterize thrust and torque variations due to wake interaction. A forced oscillation technique was used to investigate dynamic derivatives and unique data reduction techniques for the propellers. In addition, flow visualization was used to obtain a qualitative assessment of the wake interactions in regions where significant thrust degradation was observed. A second phase is being planned to expand on forced oscillation testing.

SWS Project Produces Video for American Airlines Human Factors Training Course

POC: [CHAD STEPHENS](#)

American Airlines' (AAL) Director of Training approached the System-Wide Safety (SWS) project to help address an identified issue AAL pilots were experiencing.

As part of the NASA and AAL collaboration, the teams worked together to produce a 10-minute human factors video completed in April 2024. The video will be shown to more than 14,000 pilots during recurrent, required AAL training. SWS subproject manager

and research scientist Chad Stephens and SWS communication liaison Kaitlyn Fox coordinated with NASA subject matter expert consultant Captain Dan Kiggins to develop a script and shoot the footage remotely. Filming was conducted in both NASA's Glenn Research Center in Cleveland and Armstrong Flight Research Center in California studios, as well as locally in NASA's Langley Research Center in Virginia studio. Experts who were interviewed in the video included Nils Larson and James Less, NASA Armstrong test pilots, and Dr. Michael Tong (Cleveland Clinic). This project was a collaborative effort involving the NASA Langley Media Solutions Branch and Public Affairs, and NASA Headquarters Public Affairs. The video title is "Collaborative Decision Making." The feedback



Human Factors Video.

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from AAL has been overwhelmingly positive. The AAL Manager for Safety Learning & Development underscores the value NASA provided, “we truly appreciate the partnership with NASA and your willingness to continue to support our Flight Human Factors program.”

AMP Team Presents AIS Results to AOSP and FAA

POC: [SAVVY VERMA](#)

Researchers from the Air Mobility Pathfinders (AMP) project presented their preliminary results from the Air Traffic Management Interoperability Simulation (AIS) to AOSP on Apr. 2 and the FAA on Apr. 9 at the NASA-FAA quarterly meeting. The Airspace Procedures team under the Airspace Operations subproject conducted the presentations. The AOSP team was represented by Cheryl Quinn,

Kevin Witzberger, and Barry Sullivan. The FAA team included representatives from their NextGen organization, who attended the last NASA-FAA quarterly meeting. The presentations provided an overview of the simulation and discussed the procedures and information requirements developed to evaluate the feasibility of Urban Air Mobility (UAM) operations with air traffic controllers and pilots during initial and midterm environments. Dallas Fort Worth and Dallas Love Field were presented as the test airspace for this research and the routes, corridors, and displays designed were also discussed. The results obtained from air traffic controllers managing UAM operations under nominal conditions were shown as well as controller feedback obtained during the simulation. The presentations were well received by the respective audiences, who

asked questions and provided great feedback on the experiment and potential follow-up studies.



Photos from AIS.



Photos from AIS.

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AOSP Projects Participate in NASA/FAA Quarterly Review

POC: [KEN FREEMAN](#), [KAREN CATE](#),
[SHIVANJLI SHARMA](#), [JOSEPH RIOS](#),
[PARIMAL KOPARDEKAR](#) AND [JOEY MERCER](#)

On Apr. 8–11, AOSP held a quarterly review of its respective projects with the FAA. The NASA Aeronautics Research Institute hosted the review at NASA's Ames Research Center in California. The first day focused on the Air Traffic Management-eXploration (ATM-X) project. Updates on research status and project schedules from the Advance Air Mobility Autonomy Roadmap, the Digital Information Platform, Pathfinding for Airspace with Autonomous Vehicles, and National Airspace System (NAS) Exploratory Concepts and Technologies subprojects were presented. In addition to the ATM-X presentations, the FAA presented the FAA Safety Landscape Briefing and Info-Centric NAS update.

Discussions on day two (April 9) focused on Urban Air Mobility Research Transition Team (RTT) discussions as well as Upper Class E progress to date. Day three switched focus to Unmanned Aircraft Systems (UAS) Traffic Management (UTM), including updates to the UTM Key Site Operational Evaluation, Near-term Approval Process, UAS Service Supplier

criteria, and RTT discussions. In addition, a review of the Low-Density UAS-Ops Communication Evaluation Simulation Analysis was also conducted.

Day four included discussions on Advanced Methods, Adaptive Learning for Flow Management and Routing Decision, Aviation Large Language Modeling, Flight Data-Collaborative Decision Making, and Digital Letter of Agreement. Day four also included a meeting between the Advanced Capabilities for Emergency Response Operations project and the FAA, with whom they recently established a Wildland Fire Airspace Operations RTT to guide the development of future wildfire technology, particularly in airspace access, traffic management, and engineering and testing. The group discussed airspace access and traffic management, particularly the questions of what type of information needs to be exchanged across a wildfire-related incident and what information needs to be exchanged with the national airspace.

These discussions will help inform a concept of operations for the future of wildland fire management under development by NASA and other government agencies. The next quarterly meeting is tentatively planned for the week of July 22.

SWS Participates at ASTM Committee Week for F44 General Aviation Aircraft

POC: [NATASHA NEOGI](#)

On Apr. 9–12, System-Wide Safety (SWS) project researcher Dr. Natasha Neogi participated at the American Society for Testing & Materials (ASTM) International General Committee Week held at the European Union Aviation Safety Agency Headquarters in Cologne, Germany. Neogi's participation helps influence the consensus standards for airworthiness for normal category General Aviation Aircraft (F44) through her work with the F44.50, Equipment and Subsystems Subcommittee. These standards committee meetings allowed for a robust discussion on the use of autonomy in aviation and how it will impact safety of aviation operations under a host of emerging market conditions, including the incorporation of regional air mobility, Urban Air Mobility, unmanned aerial systems, and other novel operations and technologies.

Neogi participated in the F44.50 Equipment and Subsystems meeting, where the subcommittee voted on outstanding negatives pertaining to the revision of F3230, "Standard Practice for Safety Assessment of Systems and Equipment in Small

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Aircraft.” The dispositioning of the negatives resulted in the standardization of language to best align with the FAA’s Advisory Circular, AC 23.1309-1E “System Safety Analysis and Assessment for Part 23 Airplanes.”

AMP Project Provides PSU Demonstration for Air Force Fellows

POC: [DIVYA BHADORIA](#) AND [HANBONG LEE](#)

On Apr. 15–16, the Air Mobility Pathfinders (AMP) project’s Airspace Operations (AO) subproject team provided a demonstration on the Provider of Services for Urban Air Mobility (PSU) to the Air Force Fellows during a visit to NASA’s Ames Research Center in California. The AO subproject presented the current development status of NASA’s PSU, including the Urban Air Mobility airspace system architecture, results from simulation activities, and the future work plan for Technology Capability Level 1 under the AMP project. The team also demonstrated the actual software involved in the PSU prototype simulation, such as the Surrogate Fleet Operator for operational intent submission, Demand-Capacity Monitoring Tool for strategic conflict management, and Grafana Server for visualizing Urban Air Mobility traffic in a 3-D map.

ATM-X DIP Introduces SFNP-Ops 1 Demo to FAA NATCA Representative

POC: [ERIC CHEVALLEY](#)

On Apr. 16, the Air Traffic Management-eXploration (ATM-X) project’s Digital Information Platform (DIP) subproject team met with FAA NextGen representatives and FAA National Air Traffic Controllers Association (NATCA) representatives virtually. The FAA’s NextGen Office organized the meeting. The DIP team is leading the Sustainable Flight National Partnership Demonstration 1 (SFNP-Ops-1). The purpose of the meeting was to introduce the SFNP-Ops-1 work to the newly appointed FAA NATCA representative.

ATM-X DIP Participates in A4A ATM Council Meeting

POC: [SWATI SAXENA](#)

On Apr. 16, the Air Traffic Management-eXploration (ATM-X) project’s Digital Information Platform (DIP) team participated in the ATM Council’s Meeting of Airlines for America (A4A). The A4A ATM Council is composed of airline representatives from both passenger and cargo carriers. Dr. Swati Saxena gave an overview of the ATM-X DIP subproject. This included the project vision, alignment with

NASA’s Sustainable Flight National Partnership (SFNP) initiative, and the plan for SFNP operational demonstrations throughout FY 2030 and technology transfer strategy. Dr. Jeremy Coupe, technical lead for the DIP SFNP Operations Demonstrations, gave an overview and shared details of use cases from the second operational demonstration in the SFNP operations demonstration series (SFNP-Ops-2) planned for FY25-27. The goal of SFNP-Ops-2 is to demonstrate the capability of integrated air/ground trajectory services, including validation of the International Civil Aviation Organization’s Flight and Flow Information for a Collaborative Environment services and concept, in a live transatlantic flight demonstration. The SFNP-Ops-2 presentation was very informative to council members, as it provided them with the latest updates on current plans. Airline members who are not currently partners with DIP were encouraged to consider partnering with the DIP team and other airline partners. Future exchanges between the DIP team and ATM Council were also discussed. The new National Air Traffic Controllers Association (NATCA) representative expressed a strong interest in the capability and indicated interest in proceeding forward with supporting the field demonstrations in Houston.

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NATCA will be invited to a live demonstration in North Texas in the coming weeks to learn more about the current capabilities and demonstrations in the North Texas area and to discuss next steps with the demonstration preparations in Houston. NATCA's participation will be instrumental in the success of the next phase of the SFNP-Ops-1 field demonstration. NATCA will help the DIP team to facilitate the implementation of the research capability in the field, as well as to identify procedures and training needs, as well as agreeing on operational testing milestones.

ATM-X DIP and PAAV Meet for Site Visit and Conduct Digital Taxi Test at Moffett Field

POC: [DOUG CHRISTENSEN](#)

Digital taxi clearance is a part of the NASA Ames Research Center capability development exploration

activity to support the Air Traffic Management-eXploration project's Digital Information Platform (DIP) and Pathfinding for Airspace with Autonomous Vehicles (PAAV) subprojects. The concept is especially relevant as it enables a digital workflow end-to-end for a variety of aviation use cases for DIP, and safe remote pilot operations where digital data for Instrument Flight Rules flight operations will be essential for PAAV. On Apr. 17, a combined team of Boeing, DIP, and PAAV representatives met at NASA Ames and toured Moffett Field airport and the FutureFlight Central facility. They drew out the requirements to accomplish the digital taxi clearance testing at Moffett Field. The primary risk identified was the Boeing requirement to use an Aircraft Communication Addressing and Reporting System (ACARS) Very High Frequency radio to transmit

the digital taxi clearance message to the aircraft. Right now, that is not available at Moffett Field. The team has identified one option to get ACARS at the field and one alternate method using Satellite Communication to transmit the message. Those options are currently being confirmed.

SWS and ATM-X Participates at the ERAU-NASA-NSF Aviation Cyber Security Workshop

POC: [VINCENT VAROUH](#)

On Apr. 17–18, the Air Traffic Management-eXploration (ATM-X) and System-Wide Safety (SWS) projects participated at the Embry-Riddle Aeronautics University (ERAU)/NASA/National Science Foundation (NSF) Aviation Cyber Security Workshop at ERAU in Prescott, AZ. SWS Aviation Security Liaison Paul Hoyt Nelson and SWS Aviation Cybersecurity Advisor Vincent Varouh participated on the panel, "NASA Research Trends," where NASA research panelists shared ongoing developments in aviation cyber security. The moderator was Ron Madler (ERAU) and other NASA panelists included Kenneth Freeman, ATM-X deputy project manager, Lori Coombs from NASA's Goddard Space Flight Center, and Mark Muha from NASA's Glenn Research Center in Cleveland. Representatives



NASA Ames site visit participants at Moffett Field.

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SWS project's Paul Hoyt Nelson and Vincent Varouh participated on the panel.

from academia, industry, U.S. Government, and national research labs also attended the event. The intended impacts of the panel were the enablement of safe and secure operations in the future National Airspace System. Additionally, the SWS project's In-Time Aviation Safety Management System was highlighted, with specifics around research toward the security of the system, vehicles, and information; establishing partnerships and building coalitions in aviation cybersecurity with academia, as well as industry partners; and raising awareness of NASA research areas to the next generation of engineers. Navigating the intricacies of aviation cyber security poses a considerable challenge, given the diverse stakeholders with competing interests in an ever evolving and complex ecosystem. This workshop strived to foster knowledge

dissemination, collaborative exploration of future avenues, and a dynamic learning experience, especially for scholars involved in the NSF CyberCorps® Scholarship for Service program and others interested in aviation cyber security.

SWS Attends NASA RF Spectrum Managers Annual Meeting at Wallops

POC: [JAY ELY](#)

System-Wide Safety (SWS) project researchers attended this year's Radio Frequency (RF) Spectrum Managers Annual Meeting at NASA's Wallops Flight Facility last week. Representatives included NASA Langley Research Center researchers Jay Ely, C. Lee Joyce, and Franck Charmaine. Each NASA center is required to designate an RF spectrum manager and alternate to present and participate,

per NPR 2570.1C. The Spectrum Management Group (SMG) meeting rotates across centers each year. Kicking off the event, Wallops Flight Facility Director David L. Pierce provided an overview of the facility. All 13 NASA field installations provided overviews of their center organizations, succession plan, supported missions, RF authorizations, and RF interference events/evaluations/resolutions. Several agency-level briefings provided valuable insight about the National Telecommunications and Information Administration's Spectrum Strategy Implementation Plan, international activities, training, lunar spectrum management, and other timely topics. The annual RF SMG meeting provides a resource for center spectrum managers to interact with the larger NASA spectrum community to gain awareness of both NASA-wide spectrum issues as well as spectrum issues at other centers. The goal is to help overcome challenges and navigate the regulatory processes more efficiently.

SWS Invites FAA CSTA to Give Tech Talk on ICAO PTLP Automation Study Report

POC: [KYLE ELLIS](#)

The System-Wide Safety (SWS) project invited Dr. Kathy Abbott, the Chief Scientific and Technical

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Advisor (CSTA) for Flight Deck Human Factors to the FAA, to give a Tech Talk on Apr. 18. The topics included the International Civil Aviation Organization (ICAO) Personnel Training and Licensing Panel (PTLP) Automation Study Report. Abbott focused on human performance and human error, systems design and analysis, flight crew training/qualification, and flight crew operations and procedures. She has led the integration of human engineering into FAA/international regulatory material and policies. She also serves as the FAA liaison to industry and other government and international agencies dealing with human factors. The ICAO PTLP was tasked with looking at the scope of automation dependency in transport aircraft worldwide, with identifying other automation-related issues, and topics related to manual flight and pilot monitoring. Her presentation described the results of this study, which reviewed data including 77 worldwide accidents, 309 major incidents, and over 200 references. In addition, she discussed some preliminary results of a simulator study focused on manual flight operations in the Boeing 737 and Airbus A320. Approximately 40 attendees participated on Teams and presentation slides and the ICAO report was shared with participants.

SWS Fatigue Expert Contributes to FAA Air Traffic Controllers Fatigue Panel Report

POC: [ERIN FLYNN-EVANS](#)

Internationally recognized as a fatigue subject matter expert, the System-Wide Safety (SWS) project's Dr. Erin Flynn-Evans recently participated in an FAA panel investigating fatigue in air traffic controller operations. The three-member panel also included Chairperson Dr. Mark Rosekind (Chief Executive Officer, California Mobility Center and formerly with the National Transportation Safety Board, National Highway Traffic Safety Administration, and NASA to name a few) and Dr. Charles Czeisler (Harvard Medical School, Division of Sleep Medicine). The panel reviewed fatigue risks in the context of air traffic controller workforce, work requirements, and scheduling; and identified 58 opportunities [in a report](#) for the FAA to pursue to reduce air traffic controller fatigue. In response to the panel's report, on Apr. 19, [FAA Administrator Michael Whitaker requested several short and long-term changes to air traffic controller schedules](#). As an initial step, he will require 10 hours off between shifts, and 12 hours off before a midnight shift, effective in 90 days, consistent with the expert panel's recommendations. He is also directing the Air Traffic Safety

Oversight Service to ensure the agency has a robust methodology to ensure compliance with this direction. The recommendations of this panel will have far reaching effects.

SWS Participates at Seminar on Engineering and Assurance of Safe Autonomous Systems

POC: [MALLORY GRAYDON](#)

On Apr. 15–19, System-Wide Safety (SWS) project researcher Dr. Mallory S. Graydon participated in Seminar 24151, “Methods and Tools for the Engineering and Assurance of Safe Autonomous Systems” at Leibniz Center for Informatics-affiliated Schloß Dagstuhl in Wadern, Germany. Invited participants from government, industry, and academia gathered to share perspectives and define the challenges to the design and safety assurance of autonomous air, road, and rail vehicles. Intensive discussions over the week revealed key challenges such as:

1. the lack of a well-validated development assurance theory for machine learning components to match the mature theories for aviation electronic hardware and software (e.g., as codified in RTCA DO-178C and other standards);
2. the lack of well-founded definitions of what it means to be “adequately safe” (with metrics such as “as safe as

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- a human driver” failing to address some accidents); and
3. the problem of unknown unknowns in a context where automation must take over from humans the inadequately understood roles of proactive safety planning and reaction to novel situations. The discussions will be summarized in a forthcoming report and are expected to lead to new collaborations and research efforts among the participants and others.

AMP Provides PSU Demonstration for ARMD Office of the Associate Administrator

POC: [DIVYA BHADORIA](#) AND [HANBONG LEE](#)

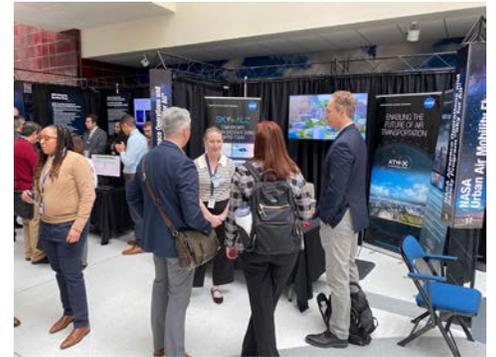
On Apr. 22–23, the Air Mobility Pathfinders (AMP) project’s Airspace Operations (AO) subproject provided a presentation on the Provider of Services for Urban Air Mobility (PSU) development updates to the NASA Office of the Associate Administrator within the Aeronautics Research Mission Directorate (ARMD) during a visit to NASA’s Ames Research Center in California. The leadership team included ARMD Associate Administrator Robert Pearce and ARMD Deputy Associate Administrator Carol Carroll. The AO subproject presented the current development status on AMP’s PSU, including key PSU functions, Urban Air Mobility airspace system

architecture, the achievements from simulation activities, and the future work plan for Technical Capability Level-1 in the AMP project. The AO subproject also demonstrated the actual software involved in the PSU prototype simulation, such as Surrogate Fleet Operator for operational intent submission, Demand-Capacity Balancing Monitor Tool for strategic conflict management, and Grafana Server for visualizing Urban Air Mobility traffic in a 3-D map.

AOSP Participates at ATCA Technical Symposium

POC: [JEREMY COUPE](#), [KEN FREEMAN](#)
AND [BARRY SULLIVAN](#)

On Apr. 23–24, AOSP participated at the Air Traffic Control Association (ATCA) Technical Symposium in Atlantic City, NJ. As part of the events, an aviation science, technology, engineering, and mathematics day was hosted at the William J. Hughes FAA Technical Center on Apr. 22. In support of this effort, AOSP had a booth highlighting its “Sky for All” Vision for 2050, and two Urban Air Mobility (UAM) flyers from NASA’s Langley Research Center in Virginia. Abigail Glenn-Chase and Barry Sullivan manned the “Sky for All” booth while Neil O’Connor, Terence McClain, and David West oversaw activities with the UAM flyers. Numerous groups of students attended the events throughout the morning



Abigail Glenn-Chase interacting with visitors at NASA’s “Sky for All” booth at the FAA Tech Center.



Neil O’Connor and Terence McClain demonstrating the capabilities of the UAM Flyers.

and afternoon. The following day kicked off the Technical Symposium with the “Tech Center Tuesday” event. ATCA participants were able to visit the Tech Center to see various booths highlighting the FAA’s research and development activities, along with the NASA booths and UAM Flyers. AOSP Deputy Program Director Cheryl Quinn joined ATCA President and CEO Carey Fagan along with FAA Technical Center Director Shelley Yak in welcoming visitors to the Tech Center. In addition to seeing the various booths, visitors were

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Operationalizing AI panel at ATCA 2024. Dr. Jeremy Coupe is second from the left.

able to go on tours of the various facilities at the FAA Technical Center. On Apr. 24, the events switched over to the Resorts Hotel. Once again, Quinn participated in the welcoming ceremonies. From the Air Traffic Management-eXploration (ATM-X) project's Digital Information Platform (DIP) team, Dr. Jeremy Coupe participated in the "Operationalizing Artificial Intelligence (AI)" panel discussion. This is currently a popular topic within the aviation community and the panel discussions were a good opportunity for the DIP team to showcase their expertise in the domain, as their Collaborative Digital Departure Reroute services,

which use AI and machine learning (ML) technologies, have been already evaluated in the operational environment in Dallas airspace for years. Comparisons between the traditional physics-based models versus the AI/ML-based models, including challenges in gaining users' trust, as well as potential advantages for hybrid approach of these traditional and AI-based models were among the topics discussed. Also representing the ATM-X project's National Airspace System Exploratory Concepts and Technologies (NExCT) subproject team was Aidan Jones, who presented with Dr. Adam Monsalve from the Center for

Naval Analyses. The two of them presented in the cybersecurity track and spoke to the benefits of using blockchain in UAM. Jones focused on recent research the ATM-X NExCT subproject has been doing on leveraging blockchain as a mechanism for secure data exchange and storage in a UAM environment, specifically focusing on flight plans and vehicle telemetry. Also representing NASA at the event was Dr. Richard Wahls, who participated on the "Climate Change resiliency in Aviation" panel. Wahls is the Sustainable Flight National Partnership mission integration manager in the Aeronautics Research Mission Directorate. Closing out the Symposium, Quinn provided a presentation on AOSP's "Sky for All" Vision.

ATM-X DIP Team Deploys the Platform Software Release v.1.8

POC: [PALLAVI HEGDE](#)

On Apr. 24, the Air Traffic Management-eXploration (ATM-X) project's Digital Information Platform (DIP) subproject team deployed the Platform Release v.1.8 for DIP partners. This is a major release for the team to meet the Sustainable Flight National Partnership Demonstration 1b-related requirements.

The following features were implemented as part of this release:

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1. Collaborative Digital Departure Reroute (CDDR) capability for the I90 Terminal Radar Approach Control, including traffic management initiatives parsing and standardization;
2. scratchpad function on CDDR extended for international flights;
3. Trajectory Option Set filtering options based on the airport configuration, such as deciphered runway directions;
4. improved Section 508 universal accessibility compliance;
5. upgraded DIP Portal catalog to the latest React version 1.8; and
6. Loki logging and Grafana monitoring enabled to help debugging and issue tracing.

AOSP Projects Participate at AUVSI Xponential

POC: [MICHAEL VINCENT](#), [HILLARY SMITH](#),
[ANDREW GUION](#), [MATT GREGORY](#)
AND [ARWA AWEISS](#)

On Apr. 22–25, AOSP project representatives participated at the Association for Uncrewed Vehicle Systems International (AUVSI) Xponential Conference and Trade Show in San Diego, CA. Representing the System-Wide Safety (SWS) project and manning a NASA booth were Dr. Paul Krois and Akash Patel from NASA’s Ames Research Center in California, and Darisha Vidrine and Michael Vincent from NASA’s Langley Research Center

in Virginia. Attendees were able to learn about the In-Time Aviation Safety Management System, the NASA Aviation Safety Reporting System for drone pilots, and the opportunity to experience a virtual reality visualization of how SWS safety technology will enable future Advanced Air Mobility (AAM) missions. SWS Associate Project Manager Michael Vincent also appeared on the live morning show broadcast for FOX 5 KSWB San Diego on April 22, and a recorded segment on NBC 7 KNSD San Diego to talk about NASA’s role in emergency response and aviation safety. In addition, Vincent participated in the panel

discussion, “Exploring Airspace Modernization Across Multiple Visions,” with representatives of Zipline, the Civil Air Navigation Services Organization, and the Flight Safety Foundation on April 24, and will appear on the “Xeo Cast” video podcast hosted by Bronwyn Morgan, CEO of Xeo Air.

Representing the Advanced Capabilities for Emergency Response Operations (ACERO) project were Joey Mercer, Lauren Roberts, Yasmin Arbab, Jonas Jonsson, and Hillary Smith. The theme for the conference was uncrewed systems and autonomy. ACERO Chief Engineer Joey Mercer spoke on a panel



Paul Krois, Darisha Vidrine, and Akash Patel staffing the SWS booth. Michael Vincent in the TV studio for the live interview, and a pup that stopped by the AUVSI booth for a photo.

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Left: ACERO mobile pilot traffic exhibit demo kit. Right: Joey Mercer, NBC 7 interview.

titled “Innovating Autonomous Wildfire Detection & Response,” and held a TV interview with NBC 7 San Diego (click for video stream: TV interview with NBC 7 San Diego). Mercer discussed the overall goals of the ACERO project. ACERO communications lead Hillary Smith supported the NASA exhibit booth and engaged attendees in the ACERO mobile traffic exhibit demonstration kit. Members of the Air Traffic Management-eXploration project’s Pathfinding for Airspace with Autonomous Vehicles (PAAV) team engaged in a panel discussion titled “Accommodate the Third Revolution of Aerospace,” which focused on the National Airspace System modernization required to safely integrate AAM. PAAV team member Andrew Guion supported the panel, as well as members of the Department of the Air Force’s

innovation arm (AFWERX), the FAA’s Air Traffic Organization, and the Northeast Unmanned Aircraft Systems Airspace Integration Research Alliance. PAAV also co-introduced a ResilienX technical product demonstration. This technical demo was related to ongoing ResilienX work under a Civilian Commercialization Readiness Pilot Program small business funding opportunity NASA and AFWERX co-sponsored. NASA seeks opportunities for small business innovation and collaborative engagement with industry. ResilienX gave an overview of their OptiX operations center and common operating picture project and consortium involving multiple other companies, including OneSky, Sunhillo, and TruWeather. In addition, PAAV took advantage of the event to conduct additional market research similar

to the Request for Information it released earlier in April. PAAV representatives had informative exchanges with multiple companies including Aurora, Collins, and ResilienX. Additionally, the PAAV team staffed a NASA exhibition booth to portray PAAV’s research activities related to AAM.

AUVSI Xponential is held annually and is attended by over 7,000 members of the drone, robotics, and autonomy industry as well as members of government and academia.

ATM-X NExCT Conducts Research Concept and Systems Requirements Review

POC: [KEN FREEMAN](#)

On Apr. 25, the Air Traffic Management-eXploration (ATM-X) project’s National Airspace

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System Exploratory Concepts and Technologies (NExCT) subproject conducted a Research Concept and Systems Requirements Review for the Discovery and Synchronization Service (DSS) at NASA's Ames Research Center in California. The DSS is an entity that provides an integrated operating picture related to operational intent for vehicles operating in a collaborative area. Members from the Air Mobility Pathfinders project, the Advanced Capabilities for Emergency Response Operations project, and the ATM-X project's Unmanned Aircraft System Traffic Management Beyond-Visual-Line-of-Sight subproject had the opportunity to review the NExCT plans for researching and developing a reference service for an integrated operating picture that supports the management of operational intent for diverse operations. The review was also available virtually for folks unable to attend in person.

SWS Project Research Presented to NASA/DoD Range Safety Group

POC: [EVAN DILL](#)

On Apr. 29, System-Wide Safety (SWS) project researcher Dr. Evan Dill presented an overview of selected SWS project research to NASA and Department of Defense (DoD) representatives at the 134th Range Safety Group (RSG) meeting held at Stennis Space Center. Dill

was invited to brief the group on various safety technologies that could contribute to the RSG's goals. Specific topics included the concept and architecture of the In-Time Aviation Safety Management System, as well as SWS-developed technologies for assured geospatial containment, a predictive micro-weather service, and a prognostic navigation quality assessment service.

AOSP Projects Attend Spring 2024 ASTM F38 Committee Meeting

POC: [HANBONG LEE](#)

On Apr. 29–May 2, representatives from the Advanced Capabilities for Emergency Response Operations, Air Mobility Pathfinders (AMP), and Air Traffic Management-eXploration projects attended the American Society for Testing and Materials (ASTM) F38 Unmanned Aircraft Systems Committee Meeting in Morgan Hill, CA. The

meeting was held at the Komodo Fire Systems building. In addition to the NASA team, representatives from industry and the FAA also attended the committee meeting and exchanged achievements and issues on the uncrewed aircraft systems (UAS) standards development and revision. The meeting covered the regulatory updates related to UAS industry, shared the current status and plans on standards and specifications for UAS and Urban Air Mobility (UAM), and held breakout sessions for technical functions and UAS Traffic Management Application Programming Interface updates.

SWS Assists DARPA with Assurance Tools at General Atomics

POC: [RORY LIPKIS](#)

On May 1–2, System-Wide Safety (SWS) project researchers Dr. Pavlo Vlastos and Rory Lipkis held a 2-day working group meeting



ASTM committee meeting attendees listening to the status updates from each working group.

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with General Atomics (GA) in Poway, CA. The purpose of the meeting was to discuss integration activities and scope within the GA team. Vijay Ramasubramanian of the Defense Advanced Research Projects Agency (DARPA) organized the meeting. Also in attendance were Steven Drager and William McKeever of the Air Force Research Laboratory Information Directorate. The Robust Software Engineering Group (RSE) in the Intelligent Systems Division at NASA's Ames Research Center in California introduced two tools developed under the SWS project, namely AdaStress and IKOS. RSE is assisting the Tactical Technology Office of DARPA in the LongShot project. The role of RSE is to help supervise the GA-developed flight software for DARPA. RSE is also expected to contribute software assurance technology and apply it to the GA software. For that task, AdaStress is an Adaptive Stress Testing tool, which aims at finding subtle, corner-case failures in a system. AdaStress is using artificial intelligence on a system and its simulated environment to exercise and find unlikely failures. IKOS is a static code analysis tool based on the theory of abstract interpretation. Compared to commercial tools, IKOS has a low rate of false positives. These two software Verification and Validation tools (IKOS and AdaStress) are being integrated into the

LongShot project at GA on a trial basis. There is interest at the vice president level at GA to expand the use of these tools within GA, if the project finds them useful.

SWS Team Attends TIM at ERAU

POC: [CHAD STEPHENS](#)

On May 2, System-Wide Safety (SWS) project researchers, subproject managers, and an associate project manager met with representatives from Embry-Riddle Aeronautical University (ERAU) at their Daytona Beach campus. The purpose of this technical interchange meeting (TIM) was to discuss collaborative work opportunities to examine various

data sources to find evidence of resilient performance and continuous learning opportunities within the National Airspace System. The SWS team presented updates on the progress made since the cooperative agreement kick off. The ERAU team presented a mid-year status report of their research. ERAU and SWS are performing the work as part of a cooperative agreement that is currently established for 1 year. The data ERAU will examine includes existing mishap data, data already collected as part of the SWS project's Human Contributions to Safety effort, National Transportation Safety Board accident docket, and other relevant data ERAU has



SWS team participating at ERAU TIM.

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collected independently. The goal is to identify the data streams that reveal strategies and practices that promote resilience. All research activities are on-track to be completed and will support completion of Technical Challenge 6 (TC-6), IASMS for Commercial Air Operations, FY24 milestones. One example of the ERAU team exceeding expectations is their determining that capabilities developed within their Department of Electrical and Computer Engineering could be applied to processing NASA data further, which fits within the scope of an ERAU internally funded research project. The results of this analysis will contribute to the TC-6 goals of developing new safety data for aviation risk identification to benefit commercial airline safety management system processes.

Toyota North America R&D Interested in SWS-Developed Software Tool

POC: [GUILLAUME BRAT](#)

On May 2, the System-Wide Safety (SWS) project met with senior principal scientists and engineers from Toyota Research Institute of North America (TRINA). The purpose of the meeting was to discuss the use of the SWS-developed Formal Requirements Elicitation Tool (FRET). Representing the SWS team were Dr. Anastasia Mavridou, Tom Pressburger, Dr.

Andreas Katis, and Dr. Trinh Khanh. Toyota is interested in the areas of temporal logics, formal verification and requirements, testing, machine learning, and motion planning and control for autonomous systems. As part of their work at TRINA, they are building foundations for Toyota's product development through in-house research and collaborative efforts with internal and external partners across North America. During the meeting, Mavridou gave a demo of NASA's open-source FRET tool and in particular the structured natural language of FRET that allows writing of intuitive and unambiguous requirements, the realizability checking feature for identifying conflicting requirements, the newly added test case generation mechanism as well as the connection of FRET with existing formal analysis tools such as state-of-the-art model checkers and runtime monitoring tools. The FRET team also presented an overview of projects that have used FRET (e.g., authoring and analyzing requirements for NASA's Lift Plus Cruise aircraft). Toyota is interested in sharing FRET within Toyota and asked for links to related publications and demos. They are also interested in collaborating, such as extending FRET to support perception logics that use both spatial and temporal modalities and thus enable reasoning over data streams of perception systems. Such logics can be used to specify correctness requirements on perception systems, as well as to

compare machine learning stacks on their performance. This is particularly useful in the analysis of autonomous systems, which typically depend on robust perception systems.

ATM-X PAAV Participates at the RTCA SC-228 Spring Meeting

POC: [JORDAN SAKAKEENY](#), [CONRAD RORIE](#), AND [ARWA AWEISS](#)

On Apr. 30–May 3, the Air Traffic Management-eXploration (ATM-X) project's Pathfinding for Airspace with Autonomous Vehicles (PAAV) subproject members attended the spring meeting of the RTCA Special Committee 228 (SC-228) in Washington, DC. Representing the ATM-X team were Conrad Rorie, Jordan Sakakeeny, Andrew Guion, and Tod Lewis. RTCA SC-228 is developing the Minimum Operational Performance Standards for uncrewed aircraft systems (UAS). The four representatives, along with David Wing and Casey Bakula who joined virtually, presented an overview of the PAAV subproject to SC-228. The overview discussed the PAAV subproject's scope, assumptions, and objectives, and they presented ongoing and future planned research and the approach for the Airspace Ecosystem flights. Key discussion points centered on PAAV's involvement in existing work of the subcommittee (e.g., detect and avoid, lost command and control link procedures, surface management)

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as well as additional research areas relevant to the subcommittee (e.g., traffic pattern integration, dynamic path planning, air-to-anything communication). There was a strong desire from the subcommittee to be involved in numerous aspects of planned PAAV research, including: evaluating the Airborne Collision Avoidance System-X, Version 4, when released; in human-in-the-loop simulation settings, evaluating the interaction between en route and terminal area detect and avoid capabilities; and quantifying the impact on the airspace and air traffic control of lost link procedures. The subcommittee also indicated the need for additional discussions regarding the development of a traffic pattern integration prototype and how it would be designed to interact with detect and avoid systems and other aircraft in the area.

ACERO Travels to the NIFC to Conduct Interagency Logistics and Suppression Tabletop

POC: [HILLARY SMITH](#)

On May 2–3, the Advanced Capabilities for Emergency Response Operations (ACERO) project's Wildland Fire Management Concept of Operations (ConOps) team, led by researcher Dr. Brandon Cook, hosted a 2-day interagency tabletop exercise on Logistics and Suppression at the National Interagency Fire Center (NIFC) in Boise, ID. The



NASA ConOps team participants at NIFC.

goal of the tabletop was to assess the current state of logistics and suppression operations in wildland firefighting and to identify areas of improvement by leveraging NASA's expertise in technology, aeronautics, and innovation. Logistics and Suppression are the final two use cases informing an interagency wildland fire management ConOps. Previous use cases completed by the interagency working group include Prescribed Burns, Remote Sensing, Airspace Management, and Communications. Close to 60 wildland firefighting community members attended the tabletop, including representatives from the FAA, CAL FIRE, Colorado Fire, the Department of Interior, U.S. Forest Service, and more. These sessions ensure the wildfire ConOps that ACERO is developing accurately addresses the wildland firefighting community's needs by openly communicating and soliciting feedback throughout all stages of development. In addition to the tabletop exercises, the NASA

ConOps team toured several NIFC facilities, including the National Interagency Coordination Center, Remote Automatic Weather Station, National Incident Radio Support Cache, Avionics Shop, Infrared Remote Sensing Operations and Maintenance Station, and the Great Basin Cache Warehouse.

SWS Attends Simulation Demonstrations of ILASMS Concepts

POC: [STEVE YOUNG](#)

On May 7, System-Wide Safety (SWS) project researchers participated in simulation demonstrations and related findings for In-time Learning-based Aviation Safety Management System (ILASMS) concepts at George Washington University (GWU). This marks the completion of one of the final milestones of 3 years of collaborative research between GWU and the SWS project. Simulations covered two use cases associated with scalable

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Research was performed by a team including GWU (principal investigator Dr. Peng Wei), Vanderbilt University, University of Texas (Austin), and MIT Lincoln Labs. Dr. Steve Young (NASA Langley) is the NASA technical POC.

heterogeneous Advanced Air Mobility operations. These included developed ILASMS capabilities applying machine learning techniques and, in some cases, novel design assurance methods. Additionally, demonstrated innovations included: an integrated safety management system architecture spanning onboard systems, ground control stations, and cloud-based services; techniques for data-driven learning-based detection, assessment and prediction of vehicle anomalies and mission risks; and verifiable automated operational mitigation solutions to achieve resilience and scalability.

SWS Holds Presentation on AAM Wake Vortex Research with FAA CSTA for Wake Turbulence

POC: [WENDY OKOLO](#)

On May 8, the System-Wide Safety (SWS) project team presented an

introductory overview of SWS-funded efforts to characterize wake vortex interactions for Urban Air Mobility vehicles to FAA Chief Scientific Technical Advisor (CSTA) for Wake Turbulence Dr. Edward Johnson. Representing the SWS team were Associate Project Manager Dr. Wendy Okolo and Advanced Air Mobility (AAM) Wake Vortex Principal Investigator Dr. Nhan Nguyen. The presentation covered the SWS In-Time Aviation Safety Management System (IASMS) and how the wake vortex work ties into the predictive and mitigative facets of the IASMS. Future plans include a briefing by Johnson and a quarterly exchange between the FAA and NASA on AAM wake vortex interactions between vehicles, buildings, and traditional aircraft operating at airports.

AMP Demonstrates AIS to FAA Tech Center Colleagues

POC: [SAVVY VERMA](#) AND [ROBERT WOOD](#)

On May 13, the Air Mobility Pathfinders (AMP) project's Airspace Operations subproject Airspace Procedures team demonstrated the Air Traffic Management Interoperability Simulation (AIS) to colleagues from the William J. Hughes FAA Technical Center. The demonstration was held at the FutureFlight Center (FFC) facility at NASA's Ames Research Center in California. The demonstration discussed the evaluation of the proposed air traffic control and pilot communications and procedures to support simultaneous traditional and Urban Air Mobility operations within Dallas Fort Worth International Airport and Dallas Love Field Airport under nominal conditions. Participants were shown routes and corridors designed for this research and displays the controllers used to evaluate feasibility and scalability of procedures for initial and midterm operations. FAA Tech Center colleagues were presented with details on location of vertiports, design of procedures, controller feedback and other results related to the test that focused on nominal operations for both initial and midterm conditions. The demonstration resulted in interest in the FFC facility and its capabilities, and generated questions pertinent to the experiment and procedures designed.

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FutureFlight Central AIS Demonstration to the FAA Tech Center.

AMP Supports G3AM Launch Ceremony and Global Conference

POC: [HANBONG LEE](#)

On May 14, Air Mobility Pathfinders (AMP) project researcher Dr. Hanbong Lee participated in the Global Association for Advanced Air Mobility (G3AM) Conference, following its launching ceremony held in Seoul, Korea. G3AM is a new standardization organization and was launched to develop and maintain new standards in various fields related to the advanced air mobility (AAM) ecosystem. Approximately

100 people from AAM-related industries, academia, research institutes, and government agencies attended the event. In the global conference following the launching ceremony, a series of presentations discussed technical achievements and development plans, such as a piloted test of Korea's Urban Air Mobility Grand Challenge, electric vertical take-off and landing vehicle development trend, and vertiport and communications infrastructure. Lee, AMP Airspace Services team lead, virtually attended this conference and presented an overview of NASA's AMP project, including project goals, approach, expected outcomes,

standards involvement, and international collaboration efforts.

Air Mobility Pathfinders Members Attend Wisk Tour and Flight Demo

POC: [QUANG DAO](#) AND [DOUG ISAACSON](#)

On May 15–16, Air Mobility Pathfinders project members along with FAA staff involved in Urban Air Mobility development efforts attended a tour and flight demonstration hosted by industry partner Wisk in Mountain View and Hollister, CA. NASA and FAA staff visited the Wisk aircraft assembly and passenger experience

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development facilities. In addition, attendees saw demonstration operations in Wisk's simulation facility, illustrating operations from a passenger trip request to landing of the aircraft. The use case demonstration was couched within near-term operations in airspace controlled by air traffic control. On the following day, Wisk conducted a flight demonstration of their Gen 4.5 aircraft and showcased their research and development facility in Hollister, CA.

ATM-X UTM BVLOS Team Meets with North Texas Public Safety Community

POC: [FAISAL OMAR](#)

On May 16, the Air Traffic Management-eXploration (ATM-X) project's Unmanned Aircraft System Traffic Management (UTM) Beyond-Visual-Line-of-

Sight (BVLOS) subproject team in coordination with the Arlington Police Department engaged in valuable discussions and briefings with the North Texas Public Safety Community. The meeting was held in City Hall in Arlington, TX, with representatives from 17 different cities, 2 counties, 4 regional representatives, 3 federal agencies, and 5 universities. The purpose of the meeting was to ensure the needs and priorities of public safety are represented within the North Texas Key Site Operational Evaluation (KSOE). The NASA team briefed out on the concept of UTM, KSOE status, and the importance of the public safety use case within the Key Site. In addition, the NASA team discussed and received feedback on mechanisms to share lessons learned and information from the KSOE with the broader public safety community. The FAA

team briefed the uncrewed aircraft system (UAS) operation leading to regulatory updates and the Law Enforcement Assistance Program. The meeting was well received by attendees, and they were encouraged and appreciative of NASA's support and commitment to the public safety UAS community. Future engagements might be necessary to continue the effort of a successful participation of public safety organizations within the KSOE.

SWS Meets with FAA to Discuss SWS RTT Revamp of Joint Management Plan

POC: [KYLE ELLIS](#)

On May 16, System-Wide Safety (SWS) project representatives met with FAA executive leadership and management leads from Aviation Safety, NextGen Organization and Office of Senior Technical Experts at FAA Headquarters in Washington, DC. Representatives from the SWS team included project leadership and Research Transition Team (RTT) co-leads. FAA attendees included Executive Director for Office of Accident Investigation and Prevention Kim Pyle and Office of Senior Technical Experts Director Bruce DeCleene, among several other senior managers leading FAA activities related to aviation safety. The meeting served as a kickoff



ATM-X UTM-BVLOS team meets with North Texas Public Safety Community.

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SWS team and FAA executive leadership and management at FAA Headquarters.

to discuss strategic alignment of research and transformation initiatives between NASA and the FAA, with intention to identify and scope key research threads across several working groups within the SWS RTT, including Assurance of Autonomy, Human Factors, Data Analytics, and In-Time Aviation Safety Management System Concept of Operations. The meeting resulted in the establishment of several task teams to outline specific research goals with a timeline to establish a revised RTT joint management plan that is well coordinated across other RTTs and that address the greatest national needs for aviation safety. The FAA and NASA plan to finalize the plan at a technical

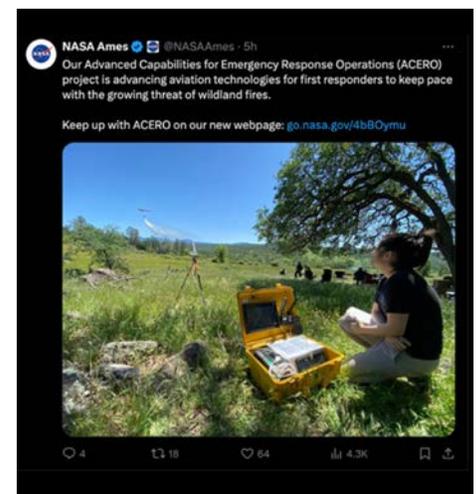
interchange meeting to be held at NASA's Langley Research Center in Virginia on Aug. 14-15, for the RTT Convening Authority's final consideration before the end of the fiscal year. This activity helps to ensure NASA and the FAA are well coordinated to address the nation's greatest needs to advance aviation safety and enable new and expanded operations in the future airspace.

ACERO Official Website Posted Live

POC: [HILLARY SMITH](#)

The Advanced Capabilities for Emergency Response Operations (ACERO) project website was officially posted live on May 17.

The website is located under the agency's Airspace Operations and Safety Program. NASA's Ames Research Center social media leads shared the ACERO



NASA Ames social media post highlighting new ACERO website.

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website link on X/Twitter on May 20. The posting has already received more than 4,000 views. The NASA Aeronautics Research Mission Directorate also retweeted the post to amplify its coverage. The ACERO project will continue to update the site with the latest ACERO news as it becomes available.

ATM-X DIP Team Conducts Tabletop Exercise with United Airlines' NOC Team

POC: [ERIC CHEVALLEY](#)

On May 20, the Air Traffic Management-eXploration (ATM-X) project's Digital Information Platform (DIP) subproject field demo team conducted a tabletop exercise with United Airlines at their Network Operation Center (NOC) in Arlington Heights, IL. The tabletop exercise was part of the preparation for the field demonstration of the Sustainable Flight National Partnership Operations 1b (SFNP-Ops-1b) Collaborative Digital Departure Reroute (CDDR) capability in the Houston airspace in 2025. The field demo team walked through how the envisioned CDDR capability could be used in various operational scenarios with United Airlines leaders and members of the network operation, flight planning, data analysis and software departments. The group had a fruitful discussion about desired requirements and use cases that

would benefit United Airlines and the Houston operation. Metrics and potential reroute benefits were also discussed. The agreed-on capability will further integrate data from FAA to support departure reroutes with existing FAA equipment. The field test of NASA and FAA's capability will help to inform how flight operators and FAA can further make data-driven decisions to support reroutes in the future, as well as help to inform future requirements for the next generation of the FAA's flow management system.

AMP Project Team Joins FAA and NASA UAM Staff on a Tour Hosted by Archer

POC: [KAREN CATE](#)

On May 21, the Air Mobility Pathfinders (AMP) project accompanied FAA representatives and other NASA staff involved in Urban Air Mobility (UAM) development efforts on a visit to electric vertical take-off and landing (eVTOL)

aircraft manufacturer Archer. The visit included an overview by Archer's management followed by a tour of the company, as well as their assembly laboratory. Afterwards, the group traveled to the Salinas Municipal Airport where Archer's prototype eVTOL is currently located.

ATM-X Project Management Office Convenes Meetings at NASA Langley

POC: [KURT SWIERINGA](#) AND [ANDREW GING](#)

On May 21–23, representatives from the Air Traffic Management-eXploration (ATM-X) project's management office visited NASA's Langley Research Center in Virginia for a Project Metrics Workshop. Also attending the workshop was the lead systems engineer and integration team. In addition to project metrics, the team also discussed and decided on strategies and plans regarding a variety of near-term topics, including integration team tasks, communications strategy,



Archer's eVTOL at Salinas Municipal Airport in California.

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revisions to project goals, success criteria, milestones, configuration management planning, and systems engineering coordination with project management. In addition, the team held an all-hands meeting with the NASA Langley workforce to talk about the ATM-X research portfolio, research priorities, answer questions, and listen to any concerns. The participants also took the opportunity to meet with counterparts from NASA Langley, such as the System-Wide Safety project manager, and made a preliminary agenda and plans for the next ATM-X project leadership face-to-face workshop tentatively scheduled for mid-July.

SWS Participates at U.S. DOT AI Assurance Workshop

POC: [GUILLAUME BRAT](#)

Subject matter experts from the System-Wide Safety (SWS) project were invited to attend a U.S. Department of Transportation (DOT) Artificial Intelligence (AI) Assurance Workshop on May 29-30. Representing the SWS team were Dr. Guillaume Brat, subproject manager, who participated on a panel titled “Government AI Safety Programs” along with Dr. Trung Pham (FAA) and Dr. Alvaro Velasquez (Department of Defense). Other NASA Ames Research Center researchers also gave talks on Verification and Validation of the machine learning component and runtime monitoring. Members of



Folks participating at U.S. DOT AI Assurance Workshop.

the Hazard Analysis DESigner and Formal Requirements Elicitation Tool software development teams participated at the workshop. The event provided team members with perspectives across industry, academia, and other government agencies on the current state-of-the-art and challenges as well as future directions on the topic of assurance of AI, including AI safety and risks, research needs, data assurance, and design and operational time assurance. These discussions will be important for ongoing design and operational assurance research, and in particular as the SWS team formulates recommendations for In-time Aviation Safety Management System requirements and

demonstrate services, functions, and capabilities and design assurance tools in the Safety Demonstrator Series.

ATM-X DIP Team Participates at IAH Quarterly Meeting in Houston

POC: [GREG JURO](#)

United Airlines invited members from the Air Traffic Management-eXploration (ATM-X) project’s Digital Information Platform (DIP) team to attend the George Bush Intercontinental/Houston Airport (IAH) quarterly meeting on May 30. The purpose of the meeting was to meet with Houston FAA air traffic control facility personnel and other participating flight operators.

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Topics covered at the meeting were weather forecasts for the summer and fall, including hurricane forecasts for the Gulf of Mexico, springtime convective weather events in the Houston area, discussions about surface congestion and arrival rates, and recent Trajectory Option Set (TOS) testing between Houston center and United Airlines. The TOS testing was of particular interest to the DIP team as TOS-related reroutes will be a significant part of the Sustainable Flight National Partnership Operations 1b (SFNP-Ops-1b) demonstration plan in Houston airspace. The team had several opportunities to engage in instrumental side conversations with FAA and airline representatives on Collaborative Digital Departure Reroute-related matters. The team is invited to attend the next quarterly meeting in August 2024.

Air Mobility Pathfinders Project Holds Face to Face Meeting at NASA Ames

POC: [KAREN CATE](#)

On Jun. 4–6, the Air Mobility Pathfinders project's leadership team held a face-to-face meeting at NASA's Ames Research Center in California as part of the project's center tour series. The leadership team met to discuss use case scenarios toward Technical Capability Level-1 as well as systems engineering processes and review schedules. The team also had the opportunity to tour several NASA

Ames facilities supporting project activities including FutureFlight Central and the Vertical Motion Simulator (VMS). The Flight Operations subproject is conducting the current experiment in the VMS, Automation Enabled Pilots-2.

SWS Conducts Role of Assurance in the Safety Demonstrator Series Workshop

POC: [HANNAH WALSH](#)

On Jun. 7, the System-Wide Safety (SWS) project conducted a workshop on the Role of Assurance in the Safety Demonstrator Series (SDS) at NASA's Ames Research Center in California. Attendance at the meeting included both live and virtual participation. The workshop provided an opportunity to discuss topics related to assurance and how the assurance work in the SWS project could be best highlighted in the SDS. Researchers have four lightning talks: Irfan Sljivo on AdvoCATE for assurance cases, Michael Holloway on overarching properties, Chetan Kulkarni on in-time assurance, and Seydou Mbaye on computational functional hazard assessment. The lightning talks were used to spark discussion on four topics: assurance needs for the SDS, assurance and the In-time Aviation Safety Management System, in-time assurance, and demonstrating assurance tools in the SDS. The workshop provided 3 hours of productive discussion

and group brainstorming online and in-person, providing important input from SWS researchers that will be used to coordinate and plan assurance work in the SDS. Nineteen researchers attended in-person and over forty participants joined online.

SWS Initiates IASMS Shakedown Flight Campaign with ODOT

POC: [EVAN DILL](#) AND [STEVE YOUNG](#)

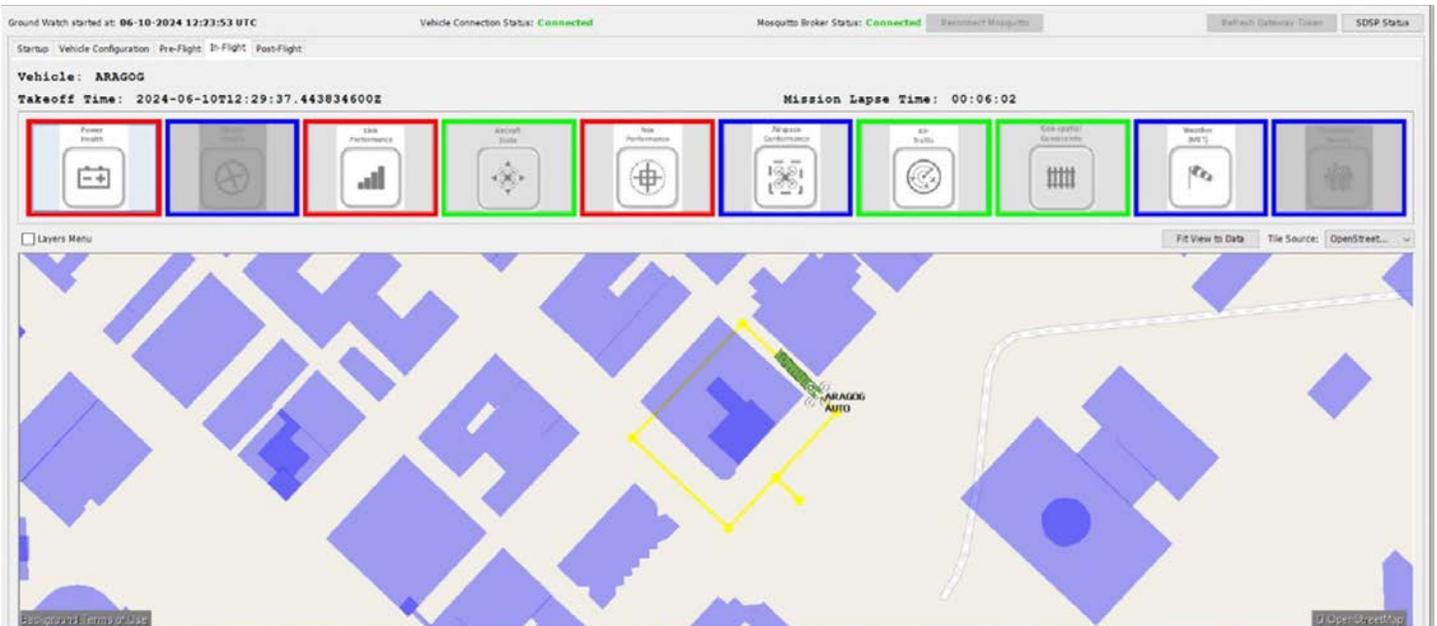
As part of a formal collaboration between the System-Wide Safety (SWS) project and the Ohio Department of Transportation's (ODOT) National Advanced Air Mobility Center of Excellence, inaugural flight testing of onboard elements of an In-Time Aviation Safety Management System (IASMS) tailored to uncrewed aircraft system (UAS) operations were successfully completed on Jun. 10. The SWS project and ODOT are conducting a joint flight campaign aimed at advancing the concept of an IASMS for future highly autonomous operations. These inaugural flight tests mark the start of several planned research flights to test and evaluate SWS-developed safety technologies during ODOT operations of UAS. The first ODOT flights of onboard elements of an IASMS were successfully conducted in Columbus. It is anticipated that periodic flights will continue in Columbus throughout the summer. These flights will play

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an important role in providing a portion of the data necessary to inform recommendations for IASMS

requirements and guidelines, as well as establishing an efficient path to future joint testing with

additional external partners as planned for the SWS project's Safety Demonstrator Series.



Pictures of ODOT test facilities and vehicles.

SWS Hosts JAXA Engineer at NASA Ames

POC: [GUILLAUME BRAT](#)

On Jun. 10, Yuta Nakajima, a Senior Project Flight Systems

Engineer at the Japan Aerospace Exploration Agency (JAXA), visited System-Wide Safety (SWS) project researchers at NASA's Ames Research Center in California. Nakajima is working on

Engineering Test Satellite-9, which is an all-electric satellite that uses an electric propulsion system to transfer to geostationary orbit and to control attitude and station-keeping maneuvers. During his

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visit, Nakajima met with members of the Formal Requirements Elicitation Tool (FRET) team and a member of the AdvoCATE tool team. During the meeting, Anastasia Mavridou presented FRET and Irfan Sljivo presented AdvoCATE. Ongoing discussions with Nakajima involve using FRET to specify and validate requirements for an orbiting spacecraft. The goal of this effort is to provide a prototype for integrating the Ontological Modeling Language, descriptive language with FRET-ish requirements, through an orbiting spacecraft case study. Nakajima is currently a visiting researcher at System Modeling Methodology Group at the Jet Propulsion Laboratory. FRET allows users to write, understand, formalize, and analyze requirements. AdvoCATE is an Assurance Case Automation Toolset that allows users to create and edit assurance case documentation, link associated assurance artifacts, and perform risk analysis.

AMP Project's Airspace Operations Team Holds Meeting with SkyGrid and Wisk

POC: [DIVYA BHADORIA](#)

On Jun. 11, members of the Air Mobility Pathfinders (AMP) project's Airspace Operations (AO) subproject team hosted SkyGrid (a Boeing SparkCognition Company)

and Wisk Aero at NASA's Ames Research Center in California. The purpose of the meeting was to discuss potential opportunities of collaboration for midterm Urban Air Mobility (UAM) airspace research. The meeting covered a range of topics including a recap of NASA's previous UAM research with industry partners, a roadmap for the next set of UAM airspace services needed for the AMP project, and a Provider of Services for UAM (PSU) development status and standards. A follow up meeting will be scheduled in July in which SkyGrid will present their detailed PSU development roadmap to NASA. Attendees included AMP project management, AO subproject management, the AO Airspace Services lead, researchers and developers, SkyGrid Program Management, technical leads, and developers, as well as Wisk Airspace Integration Management teams.

ATM-X DIP Team Holds Meetings with FAA AES R&D Operating Environment

POC: [SWATI SAXENA](#)

The Air Traffic Management-eXploration (ATM-X) project held meetings with the FAA's Automation Evolution Strategy (AES) team this past quarter. On Apr. 10, the first meeting was held at NASA's Ames Research Center in California with the Research and Development Operating



NASA and FAA folks participating at the TIM.

Environment (RD-OE) project manager. Representing the Digital Information Platform (DIP) team were DIP subproject manager Dr. Swati Saxena and Dr. Jeremy Coupe, together with Shawn Engelland and Al Capps. The team discussed the collaboration plan between DIP and RD-OE and the next steps of engagement. DIP-developed digital aviation services can potentially be deployed on the RD-OE cloud environment and contribute to DIP technical transfer artifacts. The DIP team is working to identify an RD-OE tenant service that can use one or more of the current DIP services and work on the connection requirements. There is also a potential to demonstrate platform interoperability between DIP and RD-OE.

For the second meeting, the ATM-X project's DIP team conducted a two-day technical interchange meeting (TIM) with the FAA team managed by Rob Hunt on Jun. 12–13. The TIM was held at FAA Headquarters in Washington, DC, and included representatives from

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the FAA's Program Management Group, NextGen Organization, Information and Technologies Group, and Tech Operations. The purpose of the meeting was to share information about the DIP technologies such as its cloud-based platform architecture, Collaborative Digital Departure Reroute, and NASA-developed machine learning services, Fuser Integrated Data Feed, MLOps pipeline, and learn about FAA's AES and Flow Management Data Services plans. The TIM went very well, and the FAA team was very engaged throughout. The teams had a successful two-way discussion about several topics of interest such as platform interoperability, cloud migration, data trust, and quality to name a few. The DIP team proposed a plan to continue further engagement with AES. The next step is to reconvene with the smaller group to go over and consolidate action items from DIP and FAA, and then execute on the engagement plan.

System-Wide Safety Participates at AI, Autonomy, and Aviation Safety Workshop

POC: [JON HOLBROOK](#)

On Jun. 18, 14 representatives from government and industry with diverse interests in the application of artificial intelligence (AI) technologies to aviation safety participated in the AI, Autonomy, and Aviation Safety Workshop at



(L to R): Trung Pham (FAA), Jon Holbrook (NASA), and Andrew Dunbeck (Delta Air Lines).

EUROCONTROL Headquarters in Brussels, Belgium. The represented groups included NASA, FAA, Delta Air Lines, Amazon Prime Air, Avtrain, Beams Safety AI, Usher AI, AirBaltic Corporation, Flight Safety Foundation, Assaia, Netherlands Airport Consultants, Lufthansa, and the International Business Aviation Council. System-Wide Safety project researcher Dr. Jon Holbrook, gave a presentation on "Adding AI to Human-Machine Teaming." The workshop provided an opportunity for participants with diverse perspectives on AI and aviation safety to share ideas and concerns in a small group setting that encouraged discussion. Participants discussed what they were most excited about and most worried about in terms of

the future of AI in aviation. The workshop was an opportunity to raise awareness of NASA research, as well as to share and discuss ideas with an international audience of AI developers, practitioners, consultants, and regulators within the aviation community.

AMP Researchers Demonstrate NFLITE Capabilities to FAA Managers

POC: [NELSON GUERREIRO](#)

On Jun. 18, Air Mobility Pathfinders (AMP) project researchers provided demonstrations to the FAA's lines-of-business of the impact the NASA/FAA Laboratory Integrated Test Environment (NFLITE) has had in achieving key FAA

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milestones related to their Innovate 28 initiative, as well as NASA's own farther term research on Advanced Air Mobility (AAM). NFLITE was developed under an Inter-Agency Agreement to support FAA and NASA research related to AAM. The FAA Innovate 28 initiative seeks to demonstrate the feasibility of, and helps address the technical challenges related to, initial AAM operations, specifically related to Urban Air Mobility.

The AMP project is conducting research focused on AAM in the midterm and beyond. NFLITE brings together NASA prototype functionality with FAA's operational systems to demonstrate and identify barriers and challenges that must be researched and solved in support of both agencies' AAM missions and milestones. Attendees at the demonstration included FAA's William J. Hughes Technical Center Director Shelley Yak, Assistant Administrator for NextGen Paul Fontaine, Portfolio Management & Technology Development for NextGen Director John Maffei, Program Manager for NextGen's Technology Development and Prototyping Mitchel Bernstein, Wendy O'Connor (Air Traffic Services), Will Hutson (National Air Traffic Controllers Association AAM Representative), and many others. The meeting also served as preparation for an upcoming similar demonstration

to AAM industry partners that NASA will also support.

SWS Participates at FSF Safety Forum 2024 and "Learning from All Operations" Working Group Meeting

POC: [JON HOLBROOK](#)

On Jun. 19–21, System-Wide Safety (SWS) project researchers participated at the Flight Safety Foundation's (FSF) Safety Forum and subsequent "Learning from All Operations" Working Group meeting at EUROCONTROL Headquarters, in Brussels, Belgium. Representing the SWS project were Dr. Immanuel Barshi and Dr. Jon Holbrook. The meetings provided internationally attended forums for discussing current practices, thinking, and research on the knowledge, skills, and

experience needed to enable safer aviation operations. The meetings represented opportunities to raise awareness of NASA research, as well as to share and discuss ideas with an international audience of aviation safety practitioners. Barshi and Holbrook each presented at the Safety Forum in support of the SWS project's Technical Challenge 6, *In-Time Aviation Safety Management System (IASMS) for Commercial Aviation Operations*. The theme of this year's Safety Forum was "Aviation Weather Resilience." Barshi presented "Extracting Lessons of Human Performance and Resilience Management from a Study of Weather-Related Safety Risks and Incidents reported to NASA's Aviation Safety Reporting System." Holbrook presented on "Understanding Pilot Resilient



(L to R): Dr. Immanuel Barshi (NASA Ames), Dr. Hassan Shahidi (President and CEO, FSF), Dr. Jon Holbrook (NASA Langley), and Mr. Tzvetomir Blajev (Director Europe and Global Operational Safety, FSF).

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Performance in Weather Risk Management: Methods and Insights from a Simulation Study.” Over 200 front-line aviation safety professionals, trainers, and managers representing industry and government from across the globe attended the Safety Forum.

SWS Hosts MITRE and FAA for TIM at NASA Langley

POC: [LANCE PRINZEL](#)

On Jun. 21, a technical interchange meeting (TIM) was held with MITRE at NASA’s Langley Research Center in Virginia. The purpose of the TIM was to continue technical discussions and explore collaboration opportunities identified from a previous TIM held this past Feb at MITRE

Headquarters in McLean, VA. The focus of the meeting was to discuss the new MITRE/FAA potential reimbursable funding opportunity to be given to the System-Wide Safety (SWS) project to enable the next generation of the Aviation Safety Information Analysis and Sharing (ASIAS) system. Visitors included Matt Cabak (FAA Senior Technical Advisor, Office of Accident Investigation and Prevention; Government Chair Joint Implementation Measurement Data Analysis Team (JIMDAT)) and Kyle Quakenbush (MITRE Technical Leader/Senior System Engineer for ASIAS; MITRE Machine Learning/Artificial Intelligence R&D Lead; Tri-Chair Issues Analysis Team). NASA Langley Air Traffic Operations

Lab and Cockpit Motion Facility tours were conducted, and a TIM followed. MITRE is currently responsible for ASIAS (under funding from the FAA). ASIAS was developed to promote the open sharing of safety-critical data to continuously improve aviation safety, which is collected from airlines and other sources as part of safety management system (SMS) data programs (e.g., Flight Operations Quality Assurance). ASIAS leverages internal FAA datasets, airline proprietary safety data, publicly available data, manufacturers, and other data types. The MITRE Corporation safeguards the airline safety data and analyses in a de-identified manner to foster broad participation and engagement. ASIAS fuses various



MITRE / FAA Visitors Touring the 737-800 Simulator in the Cockpit Motion Facility (CMF).

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MITRE / FAA Visitors Flying eVTOL Simulation Demo in CMF

aviation data sources to proactively identify safety trends and assess the impact of changes in the aviation operating environment through information analysis and information sharing in support of proactive safety management systems. ASIAS serves as a central conduit for exchanging data and analytical capabilities among its participants under the direction of the ASIAS executive board, of which NASA is a member. MITRE, through ASIAS, supports the Commercial Aviation Safety Team through data studies and analyses through actions requested by data analysis arms of the JIMDAT and Issues Analysis Teams and other Aviation Safety Team needs and

requests. The FAA has initiated funding to enhance current ASIAS capabilities in response to envisioned changes expected for the future airspace system. A critical need is to augment existing machine learning-based data analytical methods, tools, and techniques for “in-time” proactive and predictive safety intelligence, which is a crucial feature of SWS project research and development for In-Time Aviation Safety Management System (IASMS) concepts of operations and requisite services, functions, and capabilities. MITRE has approved the SWS project to collaborate on the next evolution of ASIAS in terms of system architectures, data sharing

platforms, security and data protection, and advanced NASA-developed machine learning (ML) and other artificial intelligence (AI) (e.g., natural language processing) approaches that are central to the SWS IASMS Concept of Operations (ConOps). Dr. Lance Prinzel provided a detailed briefing on international efforts toward predictive safety intelligence and how the SWS project is at the forefront leading through the IASMS ConOps, research and development (e.g., new advances in ML and other AI data analytical approaches), and many domestic and international collaborations and participation in multiple committees and initiatives to

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help advance the future of SMS and safety intelligence toward a more enhanced proactive and novel predictive safety intelligence capability. Kurt Swieringa's overview presentation on the Air Traffic Management-eXploration (ATM-X) project complemented the SWS briefing, of which the MITRE and FAA visitors saw opportunities, including that potentially offered by ATM-X project's Digital Information Platform, which has commonalities of objectives for ASIAs safety data sharing and repositories. The overarching goal of the TIM was to discuss how SWS can collaborate to help evolve ASIAs through project ML/AI research and development, system architectures, and modeling, including the use of model based systems engineering, simulations (e.g., digital twins), trade-offs and requirements analyses, system-wide data sharing and protections, and novel collaborative environments (e.g., Collaborative Research Environments, Joint Learning Platforms). The next step is for MITRE and FAA to determine the specific tasking to provide to the SWS project for collaborative support of advancement in the state-of-the-art in ML/AI-based data analytics of commercial aviation safety-critical data and help evolve ASIAs' services, functions, and capabilities within the IASMS framework and ConOps, as advocated by the National

Academies and endorsed by national and international entities (e.g., Flight Safety Foundation, ICAO). The TIM is part of a more significant partnership plan effort of the FAA and MITRE to make faster (i.e., "in-time") the process of deriving analytics results on the data airlines voluntarily upload supplement with large volume, big data of publicly available safety data and other sources.

SWS Researchers Present to ICAO Safety Management Panel

POC: [KYLE ELLIS](#)

System-Wide Safety (SWS) project researchers were invited to give a presentation on the concepts of "Learning from All Operations" and "Human Contributions to Safety," also known as "Safety-II" or "Productive Safety," to the ICAO Safety Management Panel (SMP) on Jun. 24. Representing the SWS project were Dr. Immanuel Barshi and Dr. Jon Holbrook, along with Tzvetomir Blajev of the Flight Safety Foundation. ICAO SMP leadership requested the presentation, as they continue to develop the 1st edition of the Safety Intelligence Manual and 5th edition of the Safety Management Manual, which are to be published in the next year. The concept of "Learning from All Operations" and "Safety-II" have garnered significant attention in the aviation

community as a key enabler to advance safety management system implementations, a key advancement for aviation transformation to safely introduce increasingly complex operations, such as envisioned with Advanced Air Mobility. SWS researchers have contributed significantly to the development of new approaches and techniques, working closely with the Flight Safety Foundation and industry to advance the concepts. SWS Project Manager and co-rapporteur for the ICAO SMP Safety Intelligence Working Group Dr. Kyle Ellis coordinated the invited presentation.

ATM-X DIP Team Showcases Research to NAC Aeronautics Committee

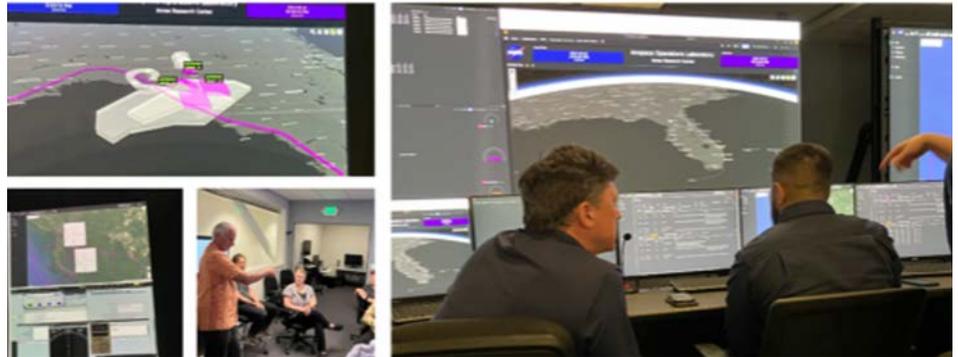
POC: [JEREMY COUPE](#)

On Jun. 25–26, the Air Traffic Management-eXploration (ATM-X) project's Digital Information Platform (DIP) team presented their Collaborative Digital Departure Reroute (CDDR) research to the NASA Advisory Council (NAC) Aeronautics Committee in Dallas. The committee and Aeronautics Research Mission Directorate (ARMD) leaders convened at NASA's North Texas Research Station on the premises of the FAA's Fort Worth Air Route Traffic Control Center to observe AOSP research in the field. ATM-X

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Dr. Jeremy Coupe briefed the NAC Aeronautics Committee about the SFNP-Ops demonstration.



Researchers running the ETM CE-1 experiment.

project researcher Dr. Jeremy Coupe introduced the group to the CDDR service on behalf of the DIP team and is supporting NASA's Sustainable Flight National Partnership (SFNP) Operations effort. The group then traveled to the nearby American Airlines Integrated Operations Center where they observed CDDR in-use and discussed sustainable aviation benefits of the technology with American Airlines partners. On Jun. 26, AOSP leadership presented additional details on CDDR and the SFNP Operations demonstration series during their briefing at the NAC Aeronautics Committee public meeting.

ATM-X NExCT Completes an Experiment for the First ETM Collaborative Evaluation

POC: [KEN FREEMAN](#)

The Air Traffic Management-eXploration (ATM-X) project team successfully completed an experiment for the first Upper

Class E Traffic Management (ETM) Collaborative Evaluation (CE-1) this past quarter. In preparation for the experiment, the ATM-X project's National Airspace System Exploratory Concepts and Technologies (NExCT) subproject held an Experiment Review on May 30. As part of the ETM CE-1 Experiment Review, the NExCT ETM team, along with an external review board, evaluated experiment material that shows the ability to:

1. test connectivity to an initial ETM system with partners;
2. develop and refine ETM Cooperative Operating Practices with feedback from partners; and
3. collect prototype ETM evaluation data. The team successfully completed the experiment on Jun. 25–27.

As part of the ETM CE-1, NExCT invited two ETM community partners (AeroStar International and AeroVironment) to connect to and collaboratively evaluate a

prototype NASA research ETM system, which allows for increased airspace access in Upper Class E airspace. During the ETM CE-1 test, the NExCT ETM team along with external partners were able to successfully complete the objectives listed above.

SWS Project GRASP Software Release Completed

POC: [WILLIAM CUMMINGS](#)

The Ground Risk Assessment Service Provider (GRASP) software, created by members of the System-Wide Safety (SWS) project's Technical Challenge-2, *In-Time Aviation Safety Management System (IASMS) Capabilities for Emerging Operations* team, has completed the software release process and is now available to support key partners in U.S. industry. GRASP is a software tool that analyzes the flight plan of a small uncrewed aircraft system (sUAS) and estimates the probability of casualty associated with a loss of control at every point

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along the trajectory. This tool is important for enabling beyond visual line of sight operations for sUAS and will now be available for industry partners in the United States. The completion of the NASA Langley Research Center software release process marks a significant milestone for this tool, which has been in development since 2016. The software release allows the dissemination of the capability beyond existing NASA partners with minimal burden, accommodating requests from sUAS operators, service providers, and researchers.

ATM-X DIP Team Conducts Training with UAL in Preparation for the SFNP-Ops-1b Field Test

POC: [ERIC CHEVALLEY](#)

The Air Traffic Management-eXploration (ATM-X) project's Digital Information Platform (DIP) field test team conducted a training session with approximately 15 United Airlines (UAL) employees on the Collaborative Digital Departure Reroute (CDDR) tool suite that will be used to conduct the Sustainable Flight National Partnership Operational Demonstration 1b (SFNP-Ops-1b) in Houston airspace on June 27, 2024. Attendees included data analysts, operational users, as well as operational managers and directors. The training included

instructions, exercises, and discussions about the current CDDR capability. The group was well engaged and able to exercise what their decision-making process would be in an operational capacity. The feedback and discussions also greatly helped the DIP team to assess the suitability of the capability. The UAL team is now equipped with knowledge and the CDDR tool suite to start assessing operational benefits. A refresher training session will take place in fall and will cover enhancements of the CDDR capability that will integrate some Airlines Trajectory Option Set data. At that point, the DIP team and UAL will be ready to start targeted tests with FAA facilities. The DIP team is progressing with the SFNP-Ops demo preparation as planned.

RECOGNITION

ACERO Project Featured at White House Easter Egg Roll

POC: [HILLARY SMITH](#)

An Advanced Capabilities for Emergency Response Operations (ACERO) project's science, technology, engineering, and mathematics (STEM) table was featured at the White House Easter Egg Roll on Apr. 1. There were roughly 30,000 attendees at the event. Aeronautics Research Mission Directorate (ARMD) STEM leads engaged students and adults on ACERO's mission with a hands-on robot navigation activity through a fire zone. An ACERO tabletop poster was also displayed. During the day, ARMD STEM integration lead April Lanotte shared ACERO's project goals with a Scripps News TV anchor, which resulted in an interview request.



NASA Ames social media post highlighting new ACERO website.

IASMS Capabilities Test and Evaluation Team Receives NASA Group Achievement Award

POC: [STEVE YOUNG](#)

The System-Wide Safety (SWS) project's In-Time Aviation Safety Management System (IASMS) Capabilities Test and Evaluation team is the recipient of a NASA Group Achievement Award. The award is for completing significant test and evaluation activities over the period 2021–2023 to advance the IASMS concept for future highly autonomous aircraft and operations. The team completed numerous simulations, wind tunnel tests, and flight tests using small uncrewed aircraft and a connected air-ground system to validate and demonstrate the efficacy of novel IASMS services, functions, and capabilities aimed at mitigating safety risk. The team consists of 48 individuals within the SWS project's Technical Challenge 2, IASMS Capabilities for Emerging Operations, spanning both NASA's Langley Research Center in Virginia and Ames Research Center in California. The award will be presented this summer during NASA Langley's award ceremony.

Air Mobility Pathfinders-UAM Fast-Time Simulation Tool Released

POC: [HANBONG LEE](#) AND [KUSHAL MOOLCHANDANI](#)

On Apr. 15, the Air Mobility Pathfinders project's Airspace

Services (AS) team released the Urban Air Mobility (UAM) Simulation Tool for Airspace services Research (USTAR) v1.0 to internal researchers at NASA. USTAR is a fast-time simulation tool coded in Python that supports the development of UAM airspace services and estimates the expected outcomes in advance before implementing expensive collaborative simulations involved in by its many stakeholders. The AS team plans to submit two conference papers at the 2024 Digital Avionics Systems Conference with the simulation results using USTAR, including demand-capacity balancing algorithms for UAM, and an uncertainty impact study of departure times. The AS team is also working on the documentation and a Tech Talk for this tool. For more information: <https://atmjira.arc.nasa.gov:7443/stash/projects/UAM/repos/ustar-uam-sim-tool/browse>.

Smithsonian Science Education Kit with ACERO Content Posted Live

POC: [HILLARY SMITH](#)

The Advanced Capabilities for Emergency Response Operations (ACERO) project and the Smithsonian Science Education Center have worked together over the past 6 months to develop content for a science, technology, engineering, and mathematics

Marcus says ...

Wildland fires are a natural part of a healthy ecosystem and wildland fire smoke is a rich and complex mixture of greenhouse gases and **aerosols**. The NASA ACERO work uses drone technology to help enable more of the "good fire" through the use of **aerial ignition for prescribed burns** (a controlled application of fire to restore health to the ecosystems), which reduces the risk of fires growing to a large scale.

Dr. Marcus Johnson as quoted in the STEM guide.

(STEM) education kit. The climate-centered STEM guide, which went live in April 2024, is widely and freely available, and is an online tool for educators to engage students on ways to mitigate human impacts on the atmosphere. ACERO is featured in the kit's section on climate change and wildfire, beginning on page 95.

AMP Project Presents at Boeing Open-Industry Symposium

POC: [NIPA PHOJANAMONGKOLKIJ](#)

On Apr. 25, representatives from the Air Mobility Pathfinders (AMP) project's Operational Concepts, Architectures, and Requirements Integration team presented at the 3rd Open-Industry Knowledge Systems and Graph Technology Symposium. Boeing Digital & Systems Engineering and Boeing Information Technology in Seattle, WA, hosted the symposium. The event also allowed virtual participation. The Knowledge Systems & Graph Technology Symposium is an industry forum and inclusive platform for professionals, subject matter experts, and enthusiasts across all

disciplines to share related needs, usages, approaches, and impacts with real business case examples aligned to knowledge system and graph technology practice. The symposium included presentations and demonstrations emphasizing in-practice activities that address real business problems, leverage state-of-the-current solutions, share lessons learned, and exercise the knowledge system value stream, all within the overarching theme of Graph Analysis, Generative & Conversational AI, and Semantic Reasoning. AMP project researchers Dr. Nipa Phojanamongkolkij and Mr. Braxton VanGundy presented and provided a live demo on an infusion of knowledge graph analysis and large language models for the UAM requirement discovery use case.

Air Mobility Pathfinders Project Researcher Awarded for Integration of ChatGPT

POC: [IAN LEVITT](#), [NIPA PHOJANAMONGKOLKIJ](#), AND [BRAXTON VAN GUNDY](#)

Air Mobility Pathfinders project researcher Dr. Nipa Phojanamongkolkij from NASA's Langley Research Center in Virginia was awarded NASA's 2024 Systems Engineering Technical Excellence Award for Advancement of Systems Engineering. Phojanamongkolkij led a team researching requirement discovery using embedded



Acting Deputy Chief Engineer, HQ Office of the Chief Engineer Katherine Van Hooser presents award to Dr. Phojanamongkolkij.

knowledge graph with ChatGPT. The team integrated ChatGPT with a graph database and graph data science capabilities readily available in a tool. The ChatGPT acts as an intermediary between user and database, translating user questions into database queries and database responses into human-readable answers for the user. The systems engineering team reported this system has increased their speed of requirement creation seven times faster than general processes, and the requirements this system generates are, in some cases, more creative than those created by human users. The ChatBot has been actively used in the Air Traffic Management-eXploration project for the last 6 months. The award was presented to Phojanamongkolkij during the NASA Systems Engineering (SE) Workshop, an annual event that brings together systems engineers and stakeholders from across the agency to discuss, develop, and

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improve the state of the discipline as a community. Other members of the research team include Braxton Van Gundy, Ramana Polavarapu, Dr. Ian Levitt, and Joshua Bonner, with support from Barclay Brown of Collins Aerospace. The fundamental goals of the Systems Engineering Workshop are to better engage and develop systems engineers to improve NASA's mission success and improve the systems engineering community and knowledge sharing within the discipline through focused and pertinent interactive learning.

SWS Researchers Participate at Vertical Flight Society's Forum 80

POC: [NATASHA NEOGI](#)

On May 8, Dr. Mallory Graydon and Dr. Natasha Neogi presented their paper entitled "Scoping, Tailoring, and Abstraction Refinement in Hazard Assessment Processes" at the Vertical Flight Society's Forum 80 in Montreal, Canada. Their presentation was one of seven in the Safety track, which was very well attended. The Vertical Flight Society's 80th Annual Forum & Technology Display is the world's leading international technical event on vertical flight technology. The conference spanned three days and included over 250 technical papers on every discipline from Acoustics to

Test & Evaluation, as well as invited presentations and discussions by leaders in the military, government agencies and industry.

SWS Research Presented at the HCSS Conference and SCC Workshop

POC: [NATASHA NEOGI](#)

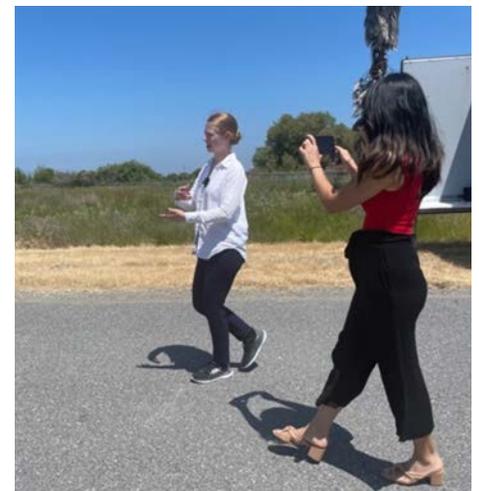
System-Wide Safety (SWS) project researchers attended the High Confidence Software and Systems (HCSS) Conference, from May 6-8, as well as the Software Certification Consortium (SCC) Workshop, from May 9-10. Both events were held in Annapolis, MD. Representing the SWS project were Dr. Alwyn Goodloe, Dr. Sarah Lehman, and Mr. C. Michael Holloway. On May 7, Goodloe gave a presentation at HCSS titled "An Assured Open Source Framework for Runtime Verification." The talk described how he and co-authors Ryan Scott and Ivan Perez have taken the copilot runtime verification from a pure research project to a NASA software engineering tool (Class D) that can generate mission-critical and safety-critical monitor code while remaining an open-source project. Several talks at HCSS focused on the "Rust" programming language that has gained a lot of attention recently due to a presidential directive to use memory-safe languages. On May 10, Goodloe also presented a talk

titled "Challenges in Safe Remote Operations: Lessons from Aerospace," which he co-authored with Dr. Laura Humphrey and Dr. Natasha Neogi at the SCC Workshop. Industries ranging from robo-taxis to the nuclear power industry are exploring ways to employ remote operations to reduce cost while introducing new technologies.

ACERO Subject Matter Experts Interviewed by CBS News

POC: [HILLARY SMITH](#)

Researchers Kathryn Chapman and Jonas Jonsson from the Advanced Capabilities for Emergency Response Operations (ACERO) project participated in video interviews on site at Ames Research Center with CBS News reporter Mary Lee



Left: Kathryn Chapman explains ACERO's project goals to CBS reporter Mary Lee at the Outdoor Aerospace Research Facility.

RECOGNITION

on May 15. The interview, which was held at the Ames Outdoor Airspace Research Facility, was an opportunity to highlight ACERO's story to the media. The story will be shared on CBS Bay Area TV news coverage and on their website in the coming weeks. CBS Bay Area has a viewership of roughly 300,000.

SWS Presents on Human-Autonomy Teaming at IEEE ICHMS in Toronto

POC: [VICTORIA DULCHINOS](#)

On May 17, System-Wide Safety (SWS) project researcher Victoria Dulchinos presented a paper at the 4th Institute of Electrical and Electronics Engineers (IEEE) International Conference on Human

Machine Systems (ICHMS) in Toronto, Canada. On behalf of the Human-Autonomy Teaming (HAT) Laboratory at NASA's Ames Research Center in California, Dulchinos presented the following paper, "Human-Autonomy Teaming Assistant to Support Small Uncrewed Aircraft Systems for Wildland Firefighting Operations." The theme of the conference was Trustworthy HAT. A range of research topics were covered at IEEE ICHMS, including design for safe and trusted HAT; technological aids for verifiable artificial intelligence (AI) decisions; trust modeling, measures, and management; and fundamental issues of trust and barriers to adoption of AI-enabled autonomy in complex socio-technical systems.

ATM-X DIP Team and Team Members Receive 2023 NASA Honor Awards

POC: [SWATI SAXENA](#)

The Air Traffic Management-eXploration (ATM-X) project's Digital Information Platform (DIP) Planning and Field Test Team were recipients of the prestigious NASA Group Achievement Award on May 22. The ceremony was held at NASA's Ames Research Center in California. The award was in recognition for their outstanding accomplishments in planning, developing, and field-testing air traffic management technologies. The DIP team's Collaborative Digital Departure Reroute (CDDR) service helps address aviation's impact on climate change by improving fuel efficiency in airline operations. CDDR relies on enhanced aircraft trajectory predictions using machine learning. Additionally, machine learning automates the creation of airport surface operation adaptation, expediting the field-deployment of the CDDR services. Former DIP subproject manager Dr. Gilbert Wu accepted the award on behalf of the team from NASA Ames Director Dr. Eugene Tu and NASA Ames Deputy Director Dr. David Korsmeyer. In addition to the Group Achievement Award, two of the DIP team members



Meghan Saephan (Transformational Tools and Technologies) and Victoria Dulchinos (SWS) at IEEE ICHMS Conference.

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS



From left: Liang Chen, Dr. Miwa Hayashi, Dr. Jeremy Coupe, Dr. Gilbert Wu, Dr. Swati Saxena, Shawn Engelland, and Pallavi Hegde.

received the prestigious Exceptional Achievement Medal. Dr. Jeremy Coupe received the medal for outstanding contributions to pioneering real-time application of machine learning to air traffic management used in real-time decision making, while Pallavi Hegde was awarded the medal for her outstanding contributions toward enabling a digital information ecosystem to support the transformation and scaling of the National Airspace System. Furthermore, Shawn Engelland was also honored with the Exceptional Service Medal for his sustained leadership, significant

achievements with innovative technologies, and mentoring to enable NASA to deliver world class air traffic management research.

ATM-X DIP Presents at AI DevSummit

POC: [JEREMY COUPE](#)

On May 29, Dr. Jeremy Coupe from the Air Traffic Management-eXploration (ATM-X) project's Digital Information Platform (DIP) subproject presented at the 2024 Artificial Intelligence (AI) DevSummit Conference hosted at the San Francisco Convention Center. The AI DevSummit is an industry-focused event dedicated to AI, featuring tracks on chatbots, machine learning (ML), open-source AI libraries, AI for enterprises, and deep AI/neural networks. During the summit, Coupe presented NASA's approach to integrating AI and ML within a human-centered design framework to enhance air traffic management decision-making with decision support tools. This human-in-the-loop approach influenced many aspects of NASA's Machine Learning Airport Surface Model, from user interfaces to the selection of appropriate prediction models. As a result, the DIP team's Airport Surface Model

successfully combines human input with machine learning to generate predictions that align with air traffic control's expectations for traffic flow.

Sustainability Benefits Paper of ATM-X DIP SFNP-Ops Demos Submitted to ICAS 2024

POC: [SWATI SAXENA](#)

The final manuscript of a paper summarizing the Air Traffic Management-eXploration (ATM-X) project's Digital Information Platform (DIP) subproject's Sustainable Flight National Partnership-Operations-1 (SFNP-Ops-1) field demonstration of Collaborative Digital Departure Reroute (CDDR) was submitted to the 34th Congress of the International Council of the Aeronautical Sciences (ICAS 2024) in early June. The conference is to be held in Florence, Italy on Sep. 9-13, 2024. The U.S. Aviation Climate Action Plan, published by the FAA in 2021, aims for net-zero carbon emissions by 2050. The present paper outlines NASA's response to the plan through the SFNP project initiatives to enhance sustainability in the National Airspace System. The paper outlines the SFNP-Ops demo series, detailing the cloud-based infrastructure used to deploy CDDR decision support tools for flight

TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

operators and air traffic controllers. Key results include jet fuel savings, carbon-dioxide emission reductions, and improvements in operational efficiency metrics like delay savings.

SWS Researchers Present at the Waterloo Institute for Sustainable Aviation Seminar

POC: [CHAD STEPHENS](#)

On Jun. 27, System-Wide Safety (SWS) subproject manager Chad Stephens gave an invited presenta-

tion to the [Waterloo Institute for Sustainable Aviation](#) Seminar at the University of Waterloo. The title of Mr. Stephens talk was “Optimizing Attention and Performance for Aviation Safety: Insights from Multimodal Psychophysiology.” SWS project researcher and distinguished research associate Dr. Alan Pope also presented “Psychophysiology and Biofeedback Mechanisms for Pilot Training and Performance Quantification.” Over 40 attendees joined the seminar in-person and

virtually including University of Waterloo faculty and undergraduate and graduate students.

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