



# AOSP Newsletter

Airspace Operations and Safety Program (AOSP)

OCT-DEC 2022 | Quarter 1



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## AOSP IN THE NEWS

### [NASA To Study Urban Weather for Air Taxi and Cargo Drone Operations](#)

Aviation Week (10/7) reports “with cargo drone and air taxi companies aiming to launch operations within the next several years, NASA is pushing to better understand the urban weather in which they will operate. Lightweight, electric aircraft are sensitive to bad weather. Predicting weather will be critical for smooth and...”

### [Xwing Signs 3-Year Contract with NASA To Study Flight Automation](#)

Aviation Week (10/13) reports “Xwing has signed a 3-year contract with NASA to study performance, procedures and risks for flight automation. The San Francisco-based startup initially plans to study hazards, performance and safety benefits of its vision-based auto-landing system, it told Aerospace DAILY on Oct. 6. Data and...”

### [Commercial Aviation, Built on Pollution, Is Getting A Tiny Bit Greener](#)

Seattle Times (11/23) reports “the amount of time between planes landing at Toronto Pearson

International Airport might seem prosaic to the untrained eye, but there’s a lot more going on than a pilot negotiating the gentle return to earth of hundreds of tons of metal. Every millisecond that passes is tied to a new technology touted as a partial solution to two intractable problems (albeit of wildly divergent importance). ... so rather than have planes line up in a physical queue, NASA’s Airspace Technology Demonstration 2 software, or ATD-2, creates a virtual line, such that time normally spent burning fuel on the taxiway is spent at the gate, engines off.”

### [NASA Envisions ‘Highways in The Sky’ with Air Taxis and Drone Deliveries and will Test New Technologies in Northeast Ohio](#)

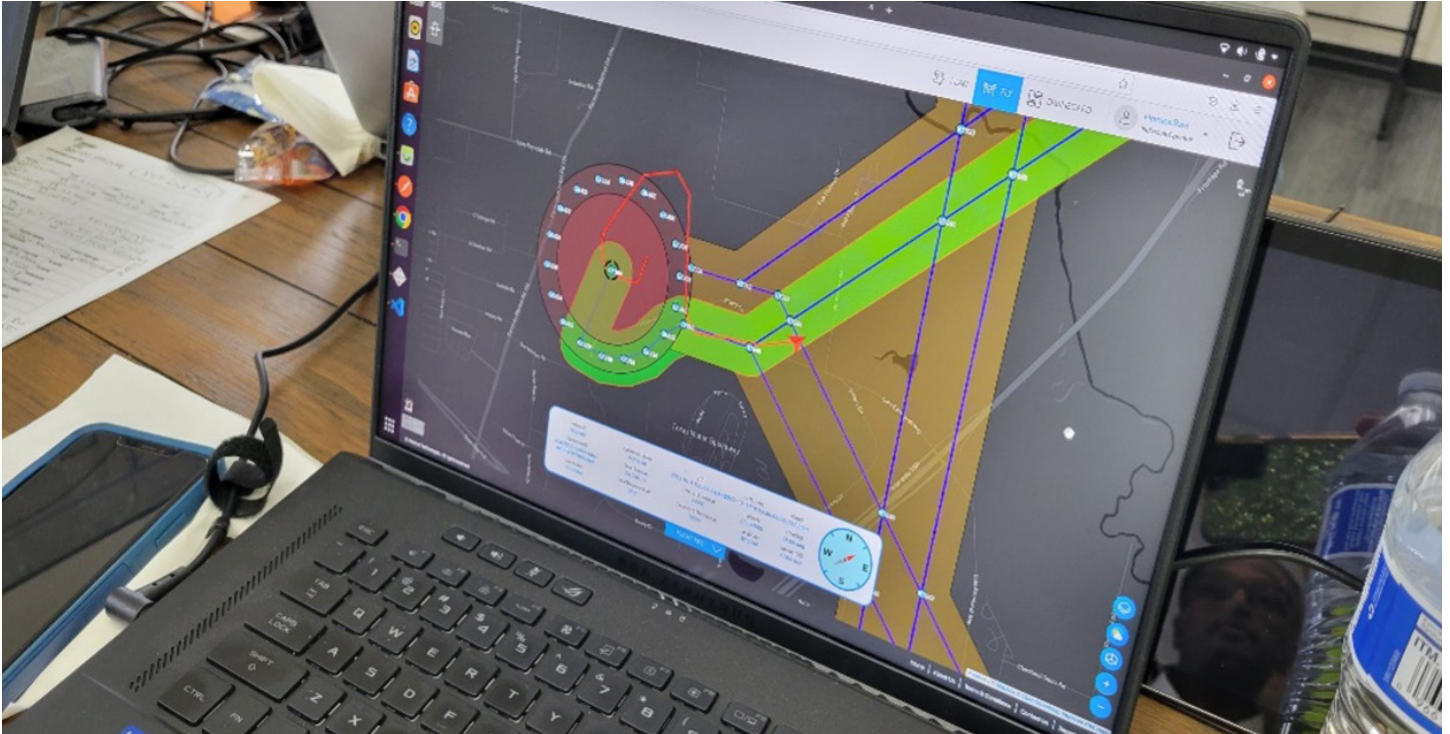
Cleveland Plain Dealer (11/23) reports “in the next several decades, new types of aircraft will fill the skies to transport people and goods in ways previously thought to be impossible. A new era in transportation is emerging, one where automated aircraft drop off packages, taxi people across town and even respond to emergencies. NASA’s vision for the future of aviation will require a very different infrastructure to enable the exchange

of data between aircraft and air traffic control systems.”

### [NASA To Utilize Commercially Available TerraPoiNT Network in SF Bay Area To Further Urban Air Mobility Development](#)

AP (12/6) reports “NextNav (Nasdaq: NN), a leader in next generation GPS, today announced that it has been selected by NASA’s Ames Research Center in Silicon Valley to deliver PNT services for its urban drone program. Utilizing NextNav’s commercially deployed TerraPoiNT network in the San Francisco Bay area, NASA Ames will capture in-flight horizontal and vertical location data to validate drone flight safety at its Mountain View, California, facility.”

## TECHNICAL AND PROGRAMMATIC HIGHLIGHTS



*Tablet Display to receive and send data for overall situational awareness and information exchange*

### AAM National Campaign North Texas Cohort Conducts Flight Test

POC: [GREG JUR0](#)

On Oct. 11, National Campaign researchers within the Advanced Air Mobility (AAM) project took a step towards next generation air travel with a successful live flight test of emerging technologies. This live flight demonstration was done in collaboration with a nationwide partnership of companies and government agencies which included future airspace system automation, i.e., Providers of Services for Urban Air Mobility (PSU), advanced communications infrastructure, a surrogate electric vertical takeoff

and Landing (eVTOL) aircraft and a simulated air route in the North Texas area. This effort is one of several ongoing National Campaign partnerships by a team collectively titled the North Texas Cohort, which includes representatives from 15 companies, universities, and government agencies who have been collaborating on the project for two years. The test built upon the earlier Urban Air Mobility (UAM) simulation work conducted in the Strategic Conflict Management Simulation led by the Air Traffic Management – Exploration project’s UAM Airspace Management subproject team. The vehicle, a Bell 407GX helicopter provided by Bell Textron

flew a simulated high-demand route for unmanned, autonomous cargo and passenger-carrying air transport while providing vital data for industry standards in airspace management, vehicle-to-infrastructure communications, and UAM flight operations. A researcher onboard the vehicle utilized a tablet display which was specifically customized to receive and send pertinent data for overall situational awareness and information exchange. The North Texas Cohort team was able to expand on earlier NASA-led research by validating the integration of live weather data and dynamic capacity balancing into a complex hardware and software solution needed to realize the next generation

## TECHNICAL AND PROGRAMMATIC HIGHLIGHTS



*North Texas Cohort Research Team*

of airborne travel. The helicopter, which was utilized as a surrogate eVTOL for the demonstration, completed the flight along a notional high demand route while providing real-time weather and demand data to a traffic management system monitored on the ground. The route was flown multiple times and led to valuable lessons on the required information exchanged between the ground and air vehicle. Lessons from the North Texas Cohort research will be documented in a forthcoming flight test report.

### **HDV Provides Flight Demo for the Hampton Roads AUVSI**

POC: [LOUIS GLAAB](#)

On Oct. 4, the Advanced Air Mobility project's High Density Vertiplex (HDV) subproject

flight operations team provided a coordinated dual aircraft flight demonstration at the Hampton Roads Association for the Association for Uncrewed Vehicle Systems International (AUVSI) conference. Two aircraft were launched approximately 90 seconds apart to fly a simulated search and rescue mission. Both aircraft departed along a standard instrument departure leg and arrived along the same standard terminal arrival leg simulating low-density vertiport operations.

### **SWS Formalizes Preliminary Partnership and Strategic Engagement Plan**

POC: [NATASHA NEOGI](#)

A preliminary partnership and strategic engagement plan were for-

mulated in early October as a result of findings from the System-Wide Safety (SWS) project's wildland firefighting operations workshop. The workshop, held in March 2022, surveyed stakeholder needs from the wildland firefighting, autonomous systems, and aviation communities. The findings were aggregated into a system engineering framework and used to create a wildfire stakeholder repository. This repository consists of systems modelling requirement elements that can be connected formally to other model elements to ensure traceability from stakeholder needs to Safety Demonstrator-1 realization. A gap analysis was performed to identify which of the stakeholder needs were currently satisfied by, or capable of, being met in the near future by in-house capabilities – identifying gaps in

## TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

stakeholder needs that may need to be met through strategic partnerships. The preliminary partnership and strategic engagement plan then encapsulated SWS's research portfolio approach to addressing identified gaps by outlining plans for establishing collaborative relationships across a broad spectrum of players. Primary partners include those government agencies currently deeply entrenched in the wildland firefighting operational world at the federal (e.g. the U.S. Forest Service, Department of the Interior, etc.), state agencies (e.g. CAL FIRE, etc.), local agencies (e.g. municipal fire departments, etc.), and tribal levels. Engagement with industry, including the wildland firefighting, robotics and autonomy, and aviation sectors, is a key focus in addressing technological capabilities and services that may be required for an in-time aviation safety management system for wildland firefighting operations. Strategic engagement includes coordination within NASA across its Aeronautics Research Mission Directorate, Science Mission Directorate, and Space Technology Mission Directorate; Aeronautics projects themselves such as Advanced Capabilities for Emergency Response Operations, Air Traffic Management – Exploration, Transformational Tools and Technologies; and with external partners.

### **AAM National Campaign Conducts Tabletops with Industry Partners**

POC: [GERRIT EVERSON](#) AND [BRAD SNELLING](#)

The Advanced Air Mobility (AAM) National Campaign's Wisk partner demonstration team completed a series of 10 tabletop exercises with industry partners to explore functional allocations required for airspace automation in the AAM ecosystem. These exercises were conducted between March and October 2022 and included the following partners: 1) Wisk Aero, an original equipment manufacturer (OEM); 2) five airspace service providers: Avison, OneSky, SkyGrid, ANRA, and Collins Aerospace; and 3) two Command and Control Communications Service Providers (C2CSP): AURA and Collins Aerospace. More work is needed to assess concepts and generate data to address technical and regulatory gaps requiring operational solutions to enable an increasingly automated AAM ecosystem. The NASA team worked with Wisk, the primary partner in this activity, to develop Provider of Services for Urban Air Mobility (PSU) user stories based on the public Concepts of Operations of the Federal Aviation Administration and Wisk. The first set of tabletops discussed characteristics of progressive Urban

Air Mobility maturity levels based on the PSU user stories. These discussions are believed to be the first combined meetings between an aircraft OEM, government researchers, and airspace service providers to address airspace automation concepts. The next phase of this activity developed detailed scenarios for flight tabletop exercises. In addition to OEM and airspace partner collaboration, the two C2CSP partners were also included. These exercises have included a realistic set of initial conditions, assumptions, and infrastructure to facilitate detailed discussions on disparate systems that will be required to work together for efficiency and safety in AAM ecosystems. A final report of lessons learned from the tabletop meetings and exercises will be completed by the end of 2022.

### **SWS Participates on Human as Automation Failsafe Panel at HFES**

POC: [SUMMER BRANDT](#)

The System-Wide Safety (SWS) project participated in the Human Factors and Ergonomics Society (HFES) 2022 Meeting held in October. Summer Brandt participated on the "Human as Automation Failsafe (HAF): Concept, Implications, Guidelines

## TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

and Innovations” panel. Members from the Smart Information Flow Technologies (SIFT) team presented their “Humans as Failsafe” report. Humans are frequently left to backstop automated systems, and human factors specialists have argued against this for decades with partial success at best. Taking a different tack and designing to support it has been proposed. The participants were involved in a recent effort to review and document cases across multiple domains where operators acted as a “failsafe” for automation, intervening in unanticipated situations to maximize success and minimize damage. The panel defined an HAF incident and then investigated conditions and practices making HAF success more or less likely. Analyzing these historical incidents, remediation approaches were suggested. Summer Brandt walked through how the SWS project is incorporating the HAF concept into a ground control station and prototype assistant for multi-vehicle control of small Unmanned Aircraft Systems (sUAS) in a wildland fire surveillance mission. There were approximately 40 people in attendance. Christopher Miller and colleagues from SIFT were on the panel, and Julie Adams, an HFES fellow, was also in attendance and actively participated in the discussion. The objective was

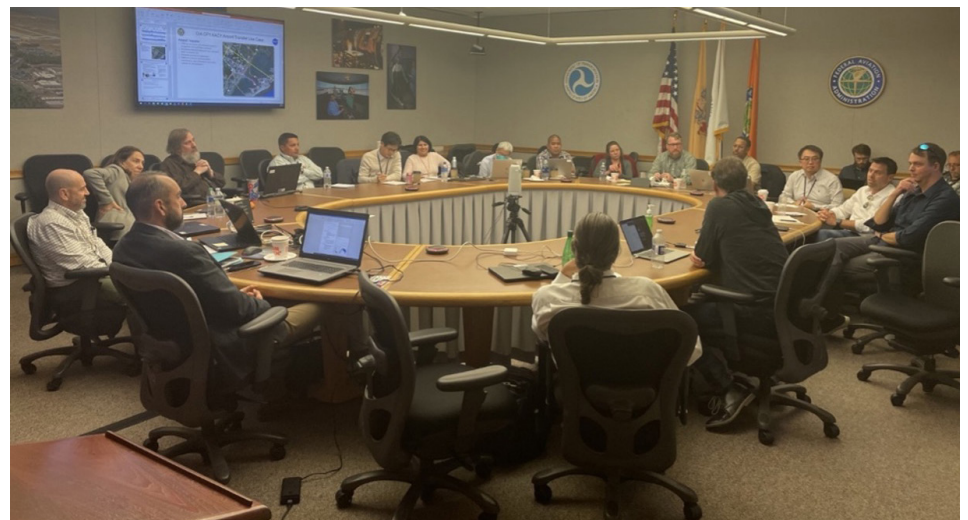
to briefly present these concepts, but more generally to discuss designing for inevitable HAF events. Representatives from Joby, Wisk, MITRE, the Massachusetts Institute of Technology, and many other universities were also in attendance.

### **UAM Team Visits the FAA’s William J. Hughes Technical Center**

POC: [KEVIN WITZBERGER](#)

On Oct. 12, members of NASA’s Air Traffic Management – Exploration project’s Urban Air Mobility (UAM) Airspace Management subproject visited the FAA’s William J. Hughes Technical Center. The UAM team was joined by Adam Yingling, the Advanced Air Mobility National Campaign integration of automated

systems lead, and Gerrit Everso, the National Campaign partner demonstration technology lead. NASA representatives met with FAA personnel including Marty Suech, operational integration and test strategic coordinator; John Bradley, air traffic control subject matter expert; Tom Rubino, verification and validation strategies and practices branch representative; and Chuck Romano, the strategic initiatives coordinator for test and evaluation. The purpose of the meeting was to discuss the joint NASA/FAA UAM Maturity Level (UML)-3 Operational Integration Assessment (OIA) scheduled for 2025. Discussion topics ranged from sharing lessons learned from Dallas/Fort Worth International Airport and Atlantic City International Airport



*NASA and FAA representatives meet at the WJHTC*

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simulated airspace procedures and design efforts to NASA, FAA, and industry-expected UML-3 OIA roles and responsibilities. Two important outcomes of the meeting include: 1) identifying a need to connect a facility at NASA's Ames Research Center in California to the existing NASA/FAA Laboratory Integrated Test Environment to ensure the research objectives can be satisfied, while also establishing a persistent capability that other Advanced Air Mobility efforts can leverage after the UML-3 OIA is completed; and 2) informing opportunities for future National Campaign flight tests with UAM airspace simulation efforts. During lunch, Kevin Witzberger, UAM subproject manager, and Ian Levitt, UAM principal engineer, met with Eric Neiderman, deputy director of the William J. Hughes Technical Center, and informally talked about Advanced Air Mobility ecosystem research needs and potential opportunities to establish shared capabilities across NASA/FAA organizations to help address the research needs.

### UAM Conducts Visits with Stakeholders

POC: [KEVIN WITZBERGER](#)

Members of the Air Traffic Management – Exploration project's UAM Airspace Management



*Airport Transfer Use Case. Taking off from the Hudson River Helipad to Newark.*

subproject conducted visits with key stakeholders in October. The first visit was on Oct. 13 when the team met with staff from Blade Urban Air Mobility. At this meeting they were joined by Adam Yingling, the Advanced Air Mobility National Campaign integration of automated systems lead, and Gerrit Everson, National Campaign partner demonstration technology lead. Blade's founder and chief executive officer, Robert Wiesenthal, opened the meeting with an overview of Blade and described potential future opportunities and challenges associated with electric vertical takeoff and landing (eVTOL) vehicles. Blade's chief technology officer, Brandon Keene, introduced members of Blade's operations

team, which facilitated a lively question-and-answer session with NASA attendees. Since Blade is an indirect air carrier and the only operational UAM service provider, NASA gained valuable insight into current operational challenges and markets and potential future challenges and markets associated with using eVTOLs that could not otherwise be gained. Currently, organ transport operations provide 55% of their operations while air taxi services to and from the Hamptons on Long Island are their most profitable. Blade offers airport transfers to and from the three major international airports of New York. Key takeaways from this visit included: 1) quieter eVTOLs will provide opportunities for growth in

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*Airport transfer use-case. Arrival at Fixed Operating Base at Newark.*



*NASA UAM team members with HHI Heliport CEO, Jeff Hyman.*

areas that cannot be serviced today by noisy helicopters; 2) current and future New York operations will need to make use of current infrastructure and helicopter routes for the foreseeable future; 3) Blade serves as an indirect air carrier, and while unique, this is also intentional

because it extracts Blade from the liability and insurance issues that operators are responsible for; and 4) future New York operations that use eVTOLs will need to integrate safely with current helicopter operations rather than replace current helicopter operations.

On Oct. 15, the team then visited the Helo Holdings, Inc. Heliport (HHI Heliport) in Kearny, New Jersey. During this visit, the team met with Jeff Hyman, the chief executive officer, and received a tour of the facility. HHI Heliport is a private, helicopter-only fixed based operator and conducts an average of 90 operations per day in the busiest helicopter environment on Earth. The HHI Heliport is a two-minute helicopter flight from commonly used heliports in Manhattan. HHI Heliport's location close to Manhattan, Newark Liberty International Airport, and several major distribution warehouses – making it an attractive location for future eVTOL operations. Hyman discussed potential future facility expansion opportunities including notional graphical vertiport depictions. Challenges associated with the limited capacity of the electric grid were also discussed. As an experienced helicopter pilot, Hyman provided his insight into challenges associated with sharing landing and takeoff resources for mixed helicopter and eVTOL operations.

### **SWS Researchers Contribute to 2023 FAA Data Challenge**

POC: [MISTY DAVIES](#)

On Oct. 15, the FAA released an announcement for their 2023 FAA Data Challenge. The goal of



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the Data Challenge is to stimulate universities to apply artificial intelligence and machine learning to address aviation applications. As a regulator and operator, the FAA's diverse mission activities collect and generate a tremendous amount of data. This data and information must be leveraged to its fullest extent possible to enable the mission, which is to provide the safest and most efficient aerospace system in the world, drive efficiency, improve accountability, fuel innovation, exploit the use of data, and embrace modern analytical techniques. The Data Challenge will provide proofs of concept for novel solutions and will also provide a pipeline for talented students at the intersection of computer science and aviation. System-Wide Safety (SWS) project subject matter experts Misty Davies and Nikunj Oza are contributing to this effort. For more information, visit <https://faadatachallenge.nianet.org/2023-competition-overview/>

### **SWS and Other Projects Participate in Autonomy in Aviation Symposium**

POC: [ANDY LACHER](#) AND [NATASHA NEOGI](#)

NASA researchers Natasha Neogi, Andy Lacher, Ian Levitt, and Vincent Shultz attended the American Society for Testing and Material's (ASTM) third annual Autonomy in Aviation Symposium

on Oct. 18. The symposium was conducted as part of ASTM's committee week meetings and helped to bring together key stakeholders in the general aviation and autonomous systems community for a close examination of the impact of these technologies on aviation safety. Additionally, Neogi, Schultz and Nick Borer and Sean Clarke (also of NASA) were in-person attendees for the ASTM Committee F44 on General Aviation. They participated in the F44 Main Committee, F44.10 (General), F44.20 (Flight), F44.40 (Powerplant), F44.50 (Systems and Equipment), and F44.90 (Executive) subcommittees. NASA participants also attended meetings related to ASTM F38 (Unmanned Aircraft Systems), F39 (Aircraft Systems), and Aviation Committee 377 (Autonomy in Design and Operations in Aviation). The symposium and the standards committee meetings allowed for a robust discussion on the use of autonomy in aviation and how it will impact the 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. Work relating to NASA's X-57 distributed electric propulsion flight demonstrator was highlighted in the F44 general meeting, and the

Autonomy in Aviation Symposium emphasized aspects such as the need for novel flight rules, the role of the pilot, and community acceptance.

### **PAAV Meets with Northrop Grumman**

POC: [RICHARD COPPENBARGER](#) AND [ARWA AWEISS](#)

The Air Traffic Management – Exploration project's Pathfinding for Airspace with Autonomous Vehicles (PAAV) subproject held meetings with Northrop Grumman on Sep. 15 and Oct. 19 to discuss potential flight demonstration opportunities. It was discovered that Northrop's optionally piloted Firebird aircraft can be operated autonomously from gate to gate and is well suited for testing PAAV's emerging concept elements for airspace integration. As a result, Northrop has taken preliminary steps towards making Firebird available in the 2023 timeframe. During discussions about possible focus areas for flight demonstration, Northrop expressed interest in computing trajectory solutions in the presence of airspace constraints and leveraging data link. Discussions around a flight demonstration and potential locations was also a topic along with aligning flight test objectives. The value of conducting preparatory shakedown simulations with actual hardware and software in the loop was noted as a means of reducing


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technical risk and validating system interfaces. Next steps include a technical interchange meeting on Nov. 17, which will focus on defining the scope and objectives for the flight demonstration and identifying requirements related to hardware and software components, system integration, data collection, flight readiness reviews, and preflight testing.


## Successful TIM and Cockpit Motion Facility Demonstrations Held at Langley

POC: [JON HOLBROOK](#)

On Oct. 19–21, The System-Wide Safety (SWS) project organized and conducted a technical interchange meeting (TIM) with leading researchers and practitioners in the area of measuring successful performance of flight crews at NASA's Langley Research Center in Virginia. Today's safety policies and design decisions in the aerospace industry are often based on human error and failure data that are not representative of human performance. In the absence of data on routine successful human performance, "data-driven" policies and design decisions are subject to sampling bias and are not optimized to support or leverage human capabilities. The SWS project's



### Measuring Human Contributions to Safe and Successful Performance



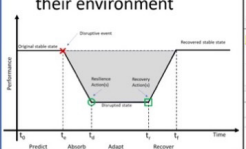

#### Motivation and Objectives

- Address often-unrecognized gap in data collected about operator performance
- The majority of currently collected data focuses on rare safety failures, rather than frequent safety successes
- Can lead to "data driven" policy & design risks due to sampling bias; rare failures are not representative of human performance
- Explored using commercial aviation flight deck due to maturity of simulation capabilities and proliferation of safety data collected in this operational domain

• Principles & metrics for assessment could be generalized to any safety-critical domain, including emerging operations



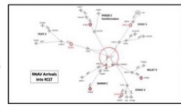
#### Progress and Highlights

- Created a data testbed for identifying approaches for measuring the actions and strategies that operators use to successfully anticipate, monitor for, respond to, and learn from events in their environment

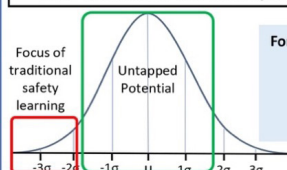
#### Approach

- 13 B737 flight crews took part in a 1.5-day study at Langley's Integration Flight Deck (IFD), using a high-fidelity B737 motion-base simulator
- Participating flight crews flew a series of eight 20-minute scenarios based on arrivals into Charlotte Airport. Each scenario was designed to contain at least 2 manageable "threats" for crews to experience

#### Impact

- Enable assessment of methods for learning from what *happens*, not just from what *fails*
- **Potential to massively expand the pool of safety-relevant data, which will enhance the ability to be "in time" and reduce risk of sampling bias**



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*Summary of the work accomplished; demo in the simulator; and industry, government, and academic stakeholders at the TIM discussing measuring the successful performance of flight crews.*

Human Contributions to Safety research team recently completed a high-fidelity commercial airline operations study designed to create a data testbed for exploring measures of pilots' safety-producing behavior in June 2022. This is an emerging area of interest across a

range of industry, government, and academic stakeholders. The goal of the TIM was to share ideas and identify collaboration opportunities focused on enabling methods for learning from what happens, not just from what fails. This work has the potential to massively

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expand the pool of safety-relevant data, which will: 1) enable better alignment between system designs and operators; 2) enhance the ability for safety-related decision to be “in-time”; and 3) reduce the risks associated with sampling bias.

### **UAM Leadership Briefs NATCA on UML-3 Airspace OIA**

POC: [KEVIN WITZBERGER](#)

On Oct. 20, Kevin Witzberger, the Air Traffic Management – Exploration project’s Urban Air Mobility (UAM) Airspace Management subproject manager, and Ian Levitt, UAM principal engineer, met with representatives from the FAA’s William J. Hughes Technical Center and National Air Traffic Control Association (NATCA) personnel to share information on the UAM Maturity Level-3 (UML-3) Operational Integration Assessment (OIA). Attending the meeting were Will Hutson, the NATCA National UAM and UAM Traffic Management representative, and Adam Rhodes, the NATCA National NextGen representative. The information-sharing session discussed developments on the accredited NASA/FAA Laboratory Integrated Test Environment and the ongoing work by Air Traffic Management – Exploration on

the UML-3 OIA. The NATCA representatives were enthusiastic about the support and expressed their desire to stay involved as the UML-3 OIA progresses. Next steps include inviting NATCA to participate in upcoming tabletop exercises with NASA and the FAA in January 2023.

### **DIP SFNP Ops-2 Virtual Meeting with Google Research**

POC: [MIRNA JOHNSON](#) AND [SWATI SAXENA](#)

The Air Traffic Management – Exploration project’s Digital Information Platform subproject (DIP) Sustainable Flight National Partnership (SFNP) Ops-2 team held a virtual meeting with Google’s Climate Impact Research team on Oct. 26. The Google team is working on the contrail identification, prediction, impact, and avoidance. The Google Climate Impact Group’s project manager and research team attended the meeting and provided a better understanding of Google’s current research work and their plans on sustainability initiatives. The two teams discussed topics of mutual interest, such as predicting persistent contrail formation regions and developing methods for avoiding contrails. The Google team has been working with the Massachusetts Institute of Technology, the German Aerospace

Center, and Imperial College in London on contrail research. Google has shown interest in partnering with NASA on this effort and has agreed to share more information and their publications on this topic. Next steps include establishing technical interchange meetings with Google Research, identifying areas the DIP team would like to further engage with them, and creating an engagement plan aligning with both organizations’ plans.

### **DIP Hosts ARMD Visit for Demonstration of Sustainable Flight Research**

POC: [MIRNA JOHNSON](#)

On Oct. 31, Bob Pearce, NASA’s associate administrator for Aeronautics, and other members of his office at NASA Headquarters in Washington visited North Texas to tour the facilities supporting the Sustainable Flight National Partnership Ops-1 Collaborative Digital Departure Re-Routing (CDDR) demonstration led by the Digital Information Platform (DIP) subproject of Air Traffic Management – Exploration. The group was initially introduced to the tools at the joint NASA/FAA North Texas Research Facility, where they were provided an overview of the subproject and operational challenges the tools are

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addressing. The DIP team walked through a demonstration of the departure rerouting procedures that Air Traffic Control and flight operators coordinate using CDDR to achieve more efficient reroutes departing from Dallas/Fort Worth International Airport and Dallas Love Field Airport, as well as the critical information that needs to be shared to make these operational decisions. Kristen Wilson and John Short, representing FAA Air Traffic Control users, discussed the immediate positive impacts the visualization of information has to their workload and reroute decision making. The demonstration highlighted the need and approach to scale these benefits across the National Airspace System through a service-oriented architecture and digital services applying machine learning to adapt to other airspaces. Following the demonstration at North Texas, attendees proceeded to visit the American Airlines Integrated Operations Center and Southwest Airlines Network Operations Control to tour the facilities where CDDR is operationally implemented. Tim Niznik, American's director of analytics, and Ken Vogt, Envoy Air's manager of flight dispatch technologies, shared the fuel-saving benefits CDDR provides, the advantage the tools provide to fill

gaps in experience, and support of DIP to expand these benefits. Rick Dalton, director of airspace and air traffic management at Southwest's Network Operations Control, revealed that Southwest has saved more than \$3 million using CDDR. Pearce and his staff had the opportunity to celebrate a long-standing partnership with Dallas/Fort Worth airport over lunch, discussing upcoming collaborations between DIP and National Renewable Energy Lab Digital Twin work. The FAA regional director, Rob Lowe, was also in attendance. CDDR has completed Phase 1 of the technology transition to a new architecture and algorithms. In Fiscal Year 2023, CDDR will be available via a cloud-based platform to reduce NASA's hardware footprint before proceeding to a new airspace in a demonstration in Fiscal Year 2024.

### **AFCM Presents HPA Simulation Results to RTCA Special Committees**

POC: [CASEY SMITH](#) AND [CONRAD RORIE](#)

On Nov. 1, the Advanced Air Mobility project's Automated Flight and Contingency Management (AFCM) subproject presented results of their August/September simulation testing to two RTCA subcommittees: SC-147 (Traffic

Alert and Collision Avoidance System) and SC-228 (Minimum Performance Standards for Unmanned Aircraft Systems). The simulation was conducted by the AFCM's Hazard Perception and Avoidance (HPA) in the Vertical Motion Simulator at NASA's Ames Research Center in California. This research evaluated performance and pilot acceptability of an FAA-sponsored prototype version of the Airborne Collision Avoidance System (ACAS) standard currently in design for rotorcraft, ACAS-Xr, in application for electric vertical takeoff and landing vehicles and with assistive automation concept software. Motion-based testing was designed to incite and assess varied avoidance maneuvers recommended by the system in response to a wide variety of encounter geometries and a range of flight phases in preparation for the Spring 2023 flight testing as part of the National Campaign's Integration of Automation Systems first series of research flight tests, IAS-1.

### **SWS Researchers Help to Shape ConOps at Wildland Fires Tabletop Exercise**

POC: [SUMMER BRANDT](#)

On Nov. 1, the NASA Aeronautics Research Institute (NARI) hosted a wildland fires tabletop exercise.

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System-Wide Safety (SWS) project subject matter experts Summer Brandt and Natasha Neogi participated in the meeting. In addition to participation from ARMD and the Science Mission Directorate, there was also multi-agency participation representing the U.S. Forest Service, Army National Guard, Air Force, and FAA. The purpose of the exercise was to: 1) understand the current state of the art in decision and execution cycles specific to prescribed burns; 2) current barriers to effective prescribed burn strategies; 3) identify concepts, models, data, and technologies which could be leveraged for improving current practices and addressing barriers to effective prescribed burns; and 4) develop a demonstration plan of proposed concepts and technologies for burn risk mitigation, monitoring, and containment of burns that may go out of control. This is a multi-agency effort to develop a concept of operations on current state-of-the-art barriers to effectiveness, and areas where technologies and coordination can be improved. A clear multi-year demonstration plan of use of advanced methods and technologies is being developed. The SWS project participants will have opportunities to shape the concept of operations and participate in the planned activities.

### **SWS Formal Methods Work Highlighted at FAA Human Factors Seminar**

POC: [NATASHA NEOGI](#)

On Nov. 1, Natasha Neogi, the System-Wide Safety (SWS) project's technical lead for formal methods, attended the FAA Human Factors New and Emerging Aviation Technologies seminar series. A highlight from the meeting included a presentation by Laura Humphrey, team lead of the verification and validation of complex and autonomous systems at the U.S. Air Force Research Laboratory, titled "Applications of Formal Methods to Aerospace and Autonomous Systems." Her presentation highlighted work that has been done in formal methods by the SWS project team verifying the Compact Position Reporting Algorithm and NASA's Detect and AvOID Alerting Logic for Unmanned System Conflict Detection and Resolution Algorithm in PVS. Humphrey also highlighted the work done on the formal synthesis of designs, which is joint work with the Air Force Research Laboratory, the SWS project, and the University of Texas, Austin. Additionally, Humphrey called out the RTCA DO-333 Certification Case Studies that NASA funded, which provided a benchmark for the industry on how to effectively use

the RTCA DO-333 formal methods supplement in a certification effort. This emphasized NASA's leadership position in the field of using formal methods for assuring safety-critical systems in the aerospace domain. Also presenting at the seminar was Huafeng Yu, senior researcher at Boeing, who discussed certification challenges for artificial-intelligence-enabled autonomous systems. He highlighted several techniques used at Boeing that were developed in collaboration with NASA's SWS team.

### **SWS and ASRS Participate at InfoShare**

POC: [NIKUNJ OZA](#)

System-Wide Safety (SWS) project researcher Nikunj Oza attended last week's InfoShare conference in Seattle on Nov. 1-3. During the workshop, progress was made on finalizing a technical interchange meeting between SWS researchers and American Airlines to be held in Dallas in February 2023. Discussions also occurred between SWS and FedEx regarding future collaboration opportunities in the context of establishing a safety enhancement proposed at a recent Joint Implementation Measurement Data Analysis Team meeting on fatigue risk management in cargo operations. Additionally, NASA Aviation Safety Reporting System

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(ASRS) project manager Mary Keller delivered five presentations on ASRS. The five presentations were titled: “NASA ASRS Reports: Communication Barriers Between Pilots and Mechanics”; “Disconnected: NASA ASRS Reports About Ground/Gate Communication Issues”; “Mixing It Up: NASA ASRS Reports About Rotorcraft Operations at Non-Towered Airports”; “See, Be Seen, Avoid: NASA ASRS Reports on Paragliders Activity Around Aircraft”; and “New Crew Dynamics: NASA ASRS Reports About Crew Resource Management.”

### DIP Team Meets with United Airlines

POC: [MIRNA JOHNSON](#)

On Nov. 2, members of the Air Traffic Management – Exploration project’s Digital Information Project (DIP) subproject team visited the United Airlines Network Operations Center to identify collaboration opportunities with a technical information meeting on their operations and airspace procedures. The DIP team was welcomed by Susan Pfungstler, United’s managing director of network operations air traffic control strategy, and her leads for analytics, system wide information management integration, flight planning, and flight operations. After an initial tour of the facilities, the NASA and United teams

discussed operational challenges in critical airspaces – particularly related to reroute management. Use cases for Collaborative Digital Departure Reroute (CDDR) and other NASA-developed prediction services were identified as potential collaboration efforts to support data-driven analytics and decision making. United has submitted their response to DIP’s announcement for collaboration and expected to formalize partnership in the coming days and is planning to participate in upcoming demonstrations of CDDR in a new airspace for Fiscal Year 2024 sustainability demonstration.

### SWS Presents Safety Challenges and Solutions at UxS Industry Event

POC: [KYLE ELLIS](#)

On Nov. 2, several members of the System-Wide Safety (SWS) project presented at an Unmanned Systems (UxS) Industry event hosted by DRONERESPONDERS and NASA’s Langley Research Center in Virginia. The event was a successful engagement with industry to identify emergency response community needs for Advanced Air Mobility applications and NASA’s ability to advance and integrate potential solutions. Kyle Ellis, deputy project manager for SWS, presented an overview of the In-Time Aviation Safety Management System, and SWS researchers Natasha Neogi, Steve Young, and Evan Dill presented

research studies on advanced safety technologies of interest to the emergency response community. This engagement resulted in identification of target areas of mutual interest that are now being pursued by the SWS project and members of the DRONERESPONDERS community, leveraging an umbrella Space Act Agreement and initial annex recently signed by the two organizations. The DRONERESPONDERS community and expertise coupled with NASA’s research and development efforts pose a significant win-win opportunity to execute on NASA’s mission objectives and to expand Advanced Air Mobility operations for the public good.

### PAAV Attends the RACCA Annual Meeting

POC: [MIWA HAYASHI](#) AND [ARWA AWEISS](#)

On Nov. 1-3, several researchers represented the Air Traffic Management – Exploration project’s Pathfinding for Airspace Autonomous Vehicles (PAAV) subproject at the Regional Air Cargo Carriers Association’s (RACCA) annual meeting in Scottsdale, Arizona. This year’s RACCA event celebrated their twentieth-year anniversary and was attended by over 400 people. PAAV researchers achieved their goal of expanding connections to improve their research capabilities. They established several new regional air cargo industry and government contacts including

## TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

Ameriflight, Reliable Robotics, Sabrewing, and Aura. Contact was also made with the U.S. Department of Homeland Security and the Transportation Security Administration. The researchers attended presentations on issues currently facing the industry, including pilot shortages and aging aircraft, as well as a panel discussion by emerging aircraft technology startup representatives (Sabrewing, Beta Technologies, and Reliable Robotics). The researchers also had an opportunity to see static displays of the new Cessna SkyCourier C-408, Beech 1900D, and SAAV 340 at Scottsdale's airport.

### HDV Submits Safety Case to FAA for BVLOS of Sight Waiver

POC: [LOUIS GLAAB](#)

On Nov. 3, the Advanced Air Mobility project's High Density Vertiplex (HDV) subproject submitted the Beyond Visual Line of Sight (BVLOS) safety case to the FAA, requesting a waiver to perform BVLOS operations at the City Environment Range Testing for Autonomous Integrated Navigation (CERTAIN) range located at NASA's Langley Research Center in Virginia. Matt Coldsnow, the FAA Office of NextGen advisor to director of requirements at air combat command, collaborated with the HDV team, led the development of the safety case, and submitted the request. The waiver will enable limited BVLOS operations to be performed in support of HDV's research

and test objectives, marking a milestone for this effort that has spanned approximately 14 months. HDV has two primary thrusts: 1) to perform rapid prototyping and assessment of an Urban Air Mobility ecosystem to evaluate and assess the integration of onboard autonomous systems, airspace management systems, fleet control/ground control station operator, and vertiport automation systems; and 2) to perform testing and safety risk assessments to achieve operational credit for enabling NASA technologies for unmanned aircraft systems and aircraft to accelerate technology transfer. Within the BVLOS safety case, two NASA technologies are included to enable safe operations including the Integrated Configurable Architecture for Reliable Small Unmanned Aircraft Systems Operations and the Safe2Ditch Autonomous Contingency Management system. The BVLOS safety case provides a comprehensive description of the system to be used, concept of operations, hazards, and mitigations. A team of engineers contributed to this document including Robert McSwain, Jake Revesz, Steve Geuther, Jake Schaefer, and Lou Glaab.

### SWS Participates at the PHM Society Conference

POC: [CHETAN KULKARNI](#)

On Nov. 1-4, System-Wide Safety (SWS) project researchers and management attended the 14th Annual Conference of the Prognostics and

Health Management (PHM) Society held in Nashville. The conference consisted of keynote speakers from defense and industry; technical panel sessions; tutorials; technical presentations; and additional events to present the state of the art and other advances in systems health management in aerospace, transportation, human health and performance, and artificial intelligence. The conference attracted more than 250 participants around the planet. SWS researcher Chetan Kulkarni served as the technical program committee chair. Chris Teubert served as co-chair for the poster sessions. Matteo Corbetta was one of the judges who evaluated participants of the doctoral symposium, where 11 doctoral students presented their work. The recently released ProgPy tool by the group was a topic of interest for several researchers who are interested in using it in their work. Potential partnerships with NASA are in discussion with both industry and academia to visit NASA's Ames Research Center in California or collaborate with researchers within the group.

### AOSP Participates at ATCA Global Conference

POC: [SHIVANJLI SHARMAI](#) AND

[ABIGAIL GLENN-CHASE](#)

On Nov. 7-9, representatives from AOSP and its projects participated in the Air Traffic Control Association (ATCA) Global Conference and Exposition. The conference was

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*NASA Team at ATCA Global Conference*

held at the Walter E. Washington Convention Center in Washington, DC. The AOSP team hosted a booth displaying research activities across its research portfolio and projects, including NASA's Sky for All, Sustainable Flight National Partnership, and recent Advanced Air Mobility project YouTube videos. Nearly 2,000 air traffic management professionals from around the planet attended the event. The event was kicked off by ATCA president Brian Bruckbauer, followed by a keynote speech by NASA's deputy administrator, Pam Melroy. Other NASA speakers included Bhavya Lal, associate administrator for technology, policy, and strategy; Kathy

Lueders, associate administrator for space operations; Akbar Sultan, AOSP program director; Parimal Kopardekar, NASA Aeronautics Research Institute (NARI) director; Raj Pai, chief technologist for aeronautics at NASA's Ames Research Center in California; Kenneth Freeman, cybersecurity aerospace engineer; and Ian Levitt, Urban Air Mobility airspace subproject principal engineer. Other NASA members attending the conference included Paul Krois representing System-Wide Safety, Bryan Barmore and David Wing from NASA's Langley Research Center in Virginia, Steve Weidner from NARI, and Barry Sullivan from AOSP. NASA also

participated in the ATCA Global Women in Aviation breakfast. More than 200 women from across government, industry, and academia gathered to build connections and advance women in the field. NASA Ames's aeronautics director, Huy Tran; Air Traffic Management – Exploration deputy project manager Shivanjli Sharma; Sky for All chief strategist Jeanne Yu; and NARI project administrator Abigail Glenn-Chase facilitated three remarkable table conversations on topics ranging from women in technical and maintenance careers, sustainability, ascending to leadership roles in technical agencies, and building successful partnerships. The event enabled discussions with key members of the FAA, development of potential collaborations across the FAA and the U.S. Department of Transportation, as well as engagement with industry.

### **SWS Presents IFAR Scientific Assessment at ICAO RPAS Symposium**

POC: [KYLE ELLIS](#)

On Nov. 9, Kyle Ellis of the System-Wide Safety (SWS) project participated in an International Civil Aviation Organization (ICAO) Remotely Piloted Aircraft Systems (RPAS) panel. The panel was assembled by the International Forum of Aeronautics Research (IFAR) and hosted in Montreal, Canada. The focus of the panel was to discuss



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a scientific assessment on safety needs to enable Urban Air Mobility (UAM). The panel discussion helped to outline the current challenge space and to establish broader global coordination. The symposium was attended by several global leaders in the aviation industry pursuing the transformation of the aviation industry, including Advanced Air Mobility operations such as UAM. The IFAR scientific assessment teams are focused on gathering international consensus in identifying existing technology and policy gaps that must be addressed to enable UAM and achieve the vision of the future global airspace. The IFAR scientific assessments outline the technical and political challenges that NASA and other similar research organizations across the globe must collaborate on to integrate UAM concepts into the airspace.

### **SWS Researchers Solicited for DARPA Assured Autonomy Program Flight Testing**

POC: [NATASHA NEOGI](#)

On Nov. 9, System-Wide Safety (SWS) researchers Natasha Neogi and Irene Gregory, along with Vanessa Aubuchon of the Transformational Tools and Technologies project, served as subject matter experts in the review of the Defense Advanced Research Projects Agency's (DARPA) Assured Autonomy flight test. DARPA's Assured Autonomy program is working

to provide continual assurance of a learning enabled cyber physical system's safety and functional correctness, both at the time of its design and during its operational life cycle. Parts of the program focus on developing mathematically verifiable approaches and tools that can be applied to different types and applications of data-driven machine learning algorithms in these systems to enhance their autonomy and assure they are achieving an acceptable level of safety. Neogi was solicited to provide expertise to the Assured Autonomy performers.

### **SWS Project Holds TIM with FAA's UAS Integration Office**

POC: [ERSIN ANCEL](#)

Representing the System-Wide Safety (SWS) project, researchers William Cummings, Tricia Revolinsky, Bailey Ethridge, and Ersin Ancel held a technical interchange meeting (TIM) with the FAA's Unmanned Aircraft Systems (UAS) Integration Office in early November. The team presented an overview of the Ground Risk Assessment Service Provider software tool and future enhancements that will expand the public-facing service to perform combined air and ground risk minimization. The software development effort is supported by AOSP's Air Traffic Management – Exploration and SWS projects. Plans to collaborate further with the UAS Integration Office were discussed.

### **AAM National Campaign IAS Team Completes Spiral-1 Flight Testing**

POC: [ADAM YINGLING](#)

The Advanced Air Mobility (AAM) project's National Campaign subproject team successfully performed a number of tests this quarter towards closing out its Integration of Automated Systems (IAS) Spiral-1 flight tests. The first tests included a number of ground tests at Sikorsky Aircraft in Stratford, Connecticut during the week of Oct. 16. The National Campaign subproject's IAS team conducted these ground tests in preparation for the Spiral-1B flight tests scheduled for early November 2022. The ground tests validated that NASA middleware updates resolved deficiencies discovered during Spiral-1A flight tests conducted in late August 2022. The updates addressed deficiencies such as automation induced oscillations in aircraft pitch and roll, improved telemetry performance during datalink dropouts, and enhanced pilot displays for situational awareness. These updates will improve aircrew ride quality while autonomously flying precision routes and aid in efficient execution of flight test points during Spiral-2 flight tests planned for 2023.

The National Campaign's IAS team successfully closed out its IAS Spiral-1 flight tests on Nov. 10. The primary objective of this testing was to validate the physical and

## TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

functional interfaces between the NASA test systems and the Sikorsky Autonomous Research Aircraft. This testing demonstrated that the IAS middleware properly translated automation algorithm commands from the Automated Flight Contingency Management (AFCM) team's interface to the Sikorsky aircraft – a highly modified S-76B. During the two sorties flown, testing validated that aircrew ride quality was significantly improved for the NASA research pilot who was overseeing the execution of the tests. The algorithms flew precise four-directional trajectories, meeting all test objectives. The flight test team included more than 20 personnel from NASA, Sikorsky, the Defense Advanced Research Projects Agency, as well as additional subject matter experts from AFCM's Flight Path Management and Hazard Perception and Avoidance teams, the FAA, and the U.S. Air Force's Agility Prime program. Importantly, IAS Spiral-1 flight tests validated that all previously discovered deficiencies were resolved. Examples include the attenuation of automation induced oscillations in aircraft pitch and roll, improved telemetry performance during datalink dropouts, and enhanced pilot displays for situational awareness. This was an important step towards the primary objective of maturing and evaluating NASA automation technologies in a representative environment while executing their envisioned complex operational scenarios. The next set of flights are

planned for early Spring 2023 as a part of IAS-1 Spiral-2 and will test the NASA automation algorithms in a relevant airspace using other physical aircraft called “intruders.”

### SWS Participates at Various Standards Group Meetings

POC: [MISTY DAVIES](#), [MALLORY GRAYDON](#)  
AND [NATASHA NEOGI](#)

The System-Wide Safety (SWS) project participated in various standards groups meetings this quarter. The first meeting was the American Society for Testing and Materials (ASTM) meeting on Oct. 11. The meeting was organized by the NASA Aeronautics Research Institute at NASA's Ames Research Center in California. Misty Davies and Evan Dill provided presentations on SWS research activities, and how SWS research feeds into standards including current ASTM standards activities.

The second series of meetings was at the Q4 plenary meeting of SAE's S-18 and S-18A committees in Atlanta held Oct. 17–21, in which Mallory Graydon participated. S-18 and S-18A are drafting revisions to two well-known aviation safety standards: ARP4754A “Guidelines for Development of Civil Aircraft and Systems” and ARP4761 “Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment.” Revised versions

of these standards, ARP4754B and ARP4761A, were put to ballot earlier this year, and the committee is revising them to address submitted comments. S-18 is also writing reports on: 1) the subject of “generic errors,” including the meaning of the “no single failure” requirement for critical functions and whether this can be addressed by development assurance or diversity; 2) the use of the Systems Theoretic Process Analysis in a civil aviation context; 3) the applicability of ARP4754B and ARP4761A processes to unmanned aircraft systems; 4) the interaction between human-factors-related assurance activities and the safety assessment process; and 5) the use of tools and modeling in aircraft development.

The third meeting was to the SAE-G34/EUROCASE Working Group-114 standards group on Nov. 17, in which SWS researchers Natasha Neogi and Sarah Lehman were invited to give a talk titled “Towards Assurance for Safety-Critical, Machine Learning-enabled Aviation Systems.” The group acts as a key forum for enabling global adoption and implementation of artificial intelligence technologies that embed or interact with aeronautical systems. A key aim is to enable aerospace manufacturers and regulatory agencies to consider and implement common sense approaches to the certification of artificial intelligence systems. Neogi and Lehman ad-

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dressed the potential use of testing in its various forms in advancing the pursuit of assurance for machine-learning-enabled systems. The talk centered on investigating paths to transition learning enabled systems into risk tolerant aviation applications. Neogi and Lehman then explored the ability of metrics to enhance the understanding of the topological nature of an input with respect to the training set of a learning enabled component. They outlined schemes for augmenting the metrics to give a nuanced interpretation of the use of such metrics to identify potentially problematic inputs for safety-critical systems, and they presented their results of an initial empirical evaluation of these schemes.

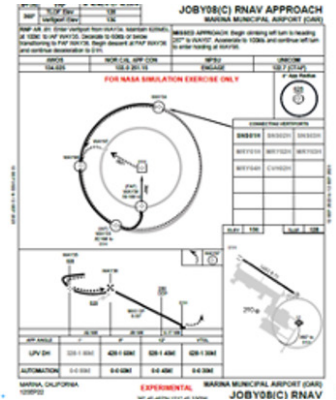
### AAM National Campaign Team Visits Joby

POC: [DAVID ZAHN](#)

On Nov. 15–17, three members of the Advanced Air Mobility (AAM) project's National Campaign partnership team visited Joby at their Marina, California facility. The purpose of the visit was to conduct testing and collect data with Joby's high-fidelity engineering simulator as part of the National Campaign-1 airspace architecture partnership. This test focused on researching candidate AAM procedures tailored to Urban Air Mobility vehicle performance and configuration. Four Joby pilots, including two test



Left: NASA Joby Partnership Team, Andrew Guion and Sarah Eggum—NASA Armstrong, David Zahn—NASA Ames. Right: Experimental Approach Plate



pilots and two commercial pilots, were evaluated while flying the NASA-developed procedures. All four Joby pilots were able to complete the departure and approach test points and provided feedback on the National Campaign developed departure and approach procedure plates. The team was not able to capture all the missed approach test points from two of the Joby pilots. This was caused by an event that occurred late afternoon on Nov. 17 that prevented battery data logging. Despite best efforts from several Joby personnel, they were not able to fully resolve the problem. The team did reach minimum success in that data was collected across the departure and approach test points with all four Joby pilots. The remaining two Joby pilots and simulator support team will execute the missed approach test points needed to complete the test. The Joby tactical team will follow up with the company dur-

ing the next two weeks to get the remaining 22 missed approach test points uploaded to NASA Box. The National Campaign team is working on analyzing the simulation data to report on procedure safety, efficiency, passenger comfort, and acoustic exposure. The report will be ready for NASA internal review by Dec. 23, 2022.

### ETM Team Meets Partners

POC: [JEFF HOMOLA](#)

The Air Traffic Management–Exploration project's Upper Class E Traffic Management (ETM) team met with key stakeholders and partners this past quarter. In the first meeting, held Oct. 13, the team met with representatives from industry, the FAA, U.S. Forest Service, Department of Defense, and other NASA organizations. During this meeting, the ETM team, along with members of industry, provided news and updates on recent and

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ongoing developments. A discussion on altitude referencing and implications for separation in the stratosphere was also held, followed by an overview of a recent, record-breaking flight test by a fixed-wing High Altitude Long Endurance aircraft. A summary of relevant papers in review at the International Civil Aviation Organization for the current assembly was also presented. This was followed by the first public presentation of the Cooperative Area Concept by the FAA to a broader audience. Recent NASA work and resulting publications on negotiation modeling were also presented.

On Nov. 28, the team met with a group from NASA's Airborne Sciences to discuss potential collaborations. The intent of this initial meeting was to begin a dialogue between the two teams to explore opportunities where planned live flights of NASA high-altitude assets (e.g., ER-2, Global Hawk) can be leveraged to ingest data into ETM prototype systems for early insights into service-supported high-altitude operations. A number of flight opportunities were identified in calendar year 2023 that the teams will target and plan towards. The potential collaboration is of mutual benefit to Airborne Sciences as it provides a pathway to integrating NASA flight data into a research environment where new concepts and technologies can be tested. Next

steps include setting up a technical interchange meeting between the teams for a deeper dive on data systems and formats.

### **DIP Team Meet with GE Research and GE Aerospace**

POC: [SWATI SAXENA](#) AND [MIRNA JOHNSON](#)

On Nov. 30, the Air Traffic Management – Exploration project's Digital Information Project (DIP) subproject team conducted a virtual meeting with the General Electric (GE) Research and GE Aerospace teams working on contrails research. Specifically, the DIP team's Sustainable Flight National Partnership Ops-2 team held an introductory technical meeting where they provided an overview of DIP and the team's SOAR service for contrail avoidance. At the meeting the Ops-2 team learned about the ongoing work on contrails at both GE Research and GE Aerospace. GE has been working in this area actively in recent years and shared their approach and plan. Their focus is on climate modeling and characterizing the impact of different types of fuels on contrail formation. They are doing both simulations and experiments, including high-fidelity computational fluid dynamics simulations. Different fuels such as sustainable aviation fuels and hydrogen are being evaluated. GE is also working with NASA's Glenn Research Center in Cleveland conducting experiments in the Glenn

Particulate Aerosol Lab to study the contrail properties for hydrogen fuel. GE is interested in further engaging with NASA on this topic. The next step is to set up a technical interchange meeting in January 2023 where the Ops-2 team will do a deep dive of SOAR tasks and milestones, learn more about GE modeling work, and identify partnership opportunities.

### **SWS Attends JIMDAT Meetings**

POC: [MICHAEL VINCENT](#), [LANCE PRINZEL](#) AND [KYLE ELLIS](#)

Representatives from the System-Wide Safety (SWS) project attended on-going meetings of the Joint Implementation Measurement Data Analysis Team (JIMDAT) this past quarter. The first meeting was held Oct. 4-5 at the National Air Carrier Association (NACA) headquarters in Arlington, Virginia. Representing SWS were Lance Prinzel and Michael Vincent. JIMDAT monitors the implementation and effectiveness of Commercial Aviation Safety Team (CAST) safety enhancements and recommends modifications and changes to the CAST Safety Portfolio (<https://www.cast-safety.org>). JIMDAT, in conjunction with the Aviation Safety Information Analysis and Sharing (ASIAS) program, also identifies emerging risks and additional areas of study. A number of safety enhancements were reviewed at the October meeting including closeout of research

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safety enhancements that NASA had assumed lead roles for. NASA received several new actions in support of JIMDAT for report out at the next meeting. In addition, there was explored establishment of a new working group that, if approved by CAST, directly addresses SWS research and development efforts in safety management systems and new advances in data science. Finally, based on technical discussions at the JIMDAT meeting, Kyle Quakenbush, data science lead for ASIAs, has accepted invitation to meet with the SWS safety intelligence team. He has also agreed to deliver a briefing as part of the SWS project monthly tech talk series.

Following meetings were held on Nov. 15–18, hosted by Embry-Riddle Aeronautical University in Daytona Beach, Florida, and Nov. 28–30, which was held at NACA in Arlington, Virginia. Prinzel provided a briefing on previous NASA research on somatogravic illusions and air transport safety. As a result, the SWS team received actions to include continued exploration of extension to previous NASA-sponsored Technologies for Airplane State Awareness loss-of-control inflight safety technology research and development. Additionally, a new JIMDAT Fatigue Working Group was initiated that NASA successfully lobbied for. Erin Flynn-Evans and Kevin Gregory will serve as NASA subject matter experts.

Kyle Ellis gave a presentation on NASA's In-Time Safety Management System describing how it can help enable JIMDAT/CAST safety metrics and be responsive to envisioned changes expected for the future National Airspace System. SWS continues to work multiple safety enhancement actions in support of JIMDAT, leveraging the project's internationally renowned expertise in aviation safety.

### **AAM and HDV Meet to Plan Scalable Autonomous Operations Work Packages**

POC: [JEFF HOMOLA](#)

On Nov. 30–Dec. 1, the Advanced Air Mobility (AAM) project and its High Density Vertiplex (HDV) sub-project held a team face-to-face meeting at NASA's Ames Research Center in California. During the meeting, the plans and status of preparations for the Scalable Autonomous Operations work package were discussed with respect to simulation, flight testing, and beyond visual line of sight flight operations. An initial simulation experiment review was held, followed by presentations from each of the primary technical research areas and some live demonstrations of current capabilities. Facility tours of the Airspace Operations Laboratory and Autonomous Vehicle Applications Laboratory were also conducted. The event was successful, with plans for additional follow-up discussions on identified topics.

### **ATM-X and DLR Complete Review of Year 2 Collaborative Research**

POC: [WILLIAM CHAN](#)

The Air Traffic Management – Exploration (ATM-X) project met with the German Aerospace Center (DLR) in Braunschweig, Germany, on Nov. 29–Dec. 2. The purpose of the visit was to conduct a review of joint research completed in 2022 with DLR and present findings at the DLR HorizonUAM (Urban Air Mobility) Symposium. The review covered topics such as comparing markets in the United States and Germany for increasingly autonomous cargo and UAM operations, UAM network design, UAM flight performance models, and respective simulation capabilities for conducting research. The review also included a flight demonstration by DLR and Volocopter, an aircraft manufacturer in Germany, at the DLR testing facility at Cochstedt



*NASA and DLR researchers pose for a team picture*

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Airport, where Volocopter demonstrated its cargo drone flying specific use-cases. On Dec. 1–2, the ATM-X team made a presentation at the second DLR HorizonUAM Symposium which highlighted the broad work DLR is conducting to enable UAM operations supported by the HorizonUAM project. The multi-day symposium included two presentations from ATM-X. Shivanjli Sharma and Kurt Swieringa presented an overview of UAM flight activities and demonstrations supported by the Advanced Air Mobility and ATM-X projects. In addition, Kevin Witzberger presented an overview of the work to collaboratively develop a UAM airspace management system and lessons learned in adapting the UAM Traffic Management system to manage UAM operations. The symposium covered a wide range of DLR research that included an evaluation of UAM acceptance by the non-flying public and passenger, cabin and powertrain design, simulation capabilities, UAM network design, wildlife safety, and elderly passenger demand. Both NASA and DLR have made significant progress since the agreement was signed and gained new insights into the UAM market and challenges. In light of NASA's respective progress, next steps involve incorporating the feedback from the review and more recent information about the UAM market to fine tune some current work to improve its relevance and

impact to both NASA and DLR UAM research activities. For background information, visit: <https://dlr.expert/horizonuam2022/front/index.php>.

### Report on Wildland Firefighting Operations Workshop Released by SWS

POC: [SUMMER BRANDT](#)

On Dec. 6, the System-Wide Safety (SWS) project released the summary and findings from the Wildland Firefighting Operations Workshop held in March 2022. This workshop helped inform NASA of the relevant safety-related wildland firefighting concerns and aided the broader ecosystem in understanding the potential safety-oriented role NASA might play in this community. The workshop engaged the broader wild-fire management ecosystem through a series of keynote talks, panels, and breakout sessions. More than 460 participants engaged in the workshop to share information and identify areas of collaboration with the broader wildland firefighting community. Ideas were exchanged in operational firefighting, autonomous systems, policy and planning, and regulatory domains. Steve Clarke, NASA's deputy associate administrator Aeronautics, and Cheryl Quinn, deputy director for AOSP, gave remarks on NASA's portfolio of interests in wildland firefighting. Seventeen breakout sessions and four panels comprised of diverse stakeholders from federal,

state, local, and tribal governments as well as industry and academia occurred during the workshop. Key findings of the workshop report containing the elicitation of safety-oriented stakeholder needs included: 1) enhancing situation awareness is a safety priority, as getting the right information to the right decision makers at the right time is essential to enhancing operational safety and for enabling a common operating picture; 2) timely access to information that can be consolidated, integrated, and displayed would enhance safety-critical decision making is vital – this includes localized data fusion, along with information about data sources and quality issues that allow layered approaches to information display based on context; and 3) tailorable standards and a common operating picture, especially in the field, would enhance interagency cooperation in the wildland firefighting lifecycle. In addition, open standards would enhance safety, flexibility, and data and asset accessibility. The release of the report is intended to share with the community the information discussed and top findings from the sessions as well as to encourage further discussions.

### ACERO Attends Western Governors' Association Winter Meeting

POC: [MARCUS JOHNSON](#)

Joey Mercer, a member of the Advanced Capabilities for Emergency

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Response Operations (ACERO) project's management team, attended the 2022 winter meeting of the Western Governors' Association held in Phoenix on Dec. 6–7. Five United States governors and one governor-elect were in attendance, representing Arizona, Colorado, Oklahoma, Oregon, Utah, and Wyoming. The group discussed wildland fires – specifically their relation to air quality and the states' responsibilities in mitigating air quality. Mercer attended in support of ACERO to learn about the states' current wildfire initiatives and determine possible opportunities for future engagement and partnerships. This was ACERO's first interaction with the Western Governors' Association. The project plans to continue engagement throughout the next year.

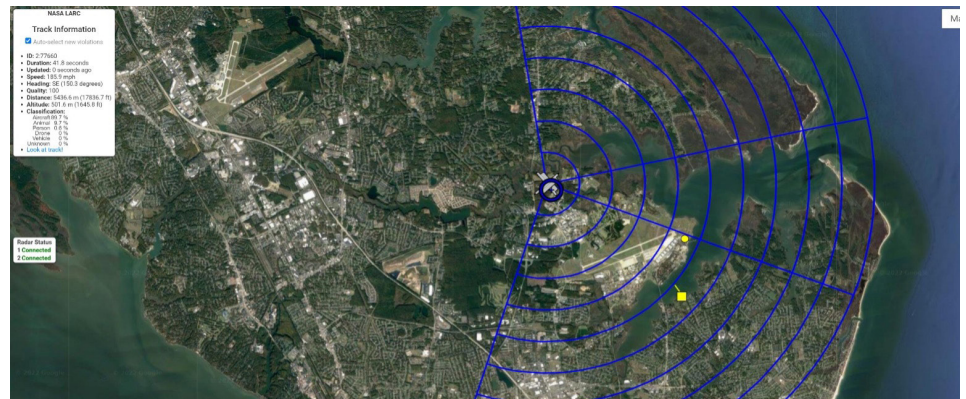
### HDV Radar Flight Tests and Authority to Operate Both Completed this Quarter

POC: [LOUIS GLAAB](#)

The Advanced Air Mobility project's High Density Vertiplex (HDV) subproject team successfully completed a series of radar flight tests this past quarter. The first test, conducted Oct. 12, included NASA's Lancia UC-40 aircraft operated as a target vehicle for checkout and characterization of the surveillance systems being developed to support beyond visual line of sight (BVLOS) operations. For this test, both the lightweight surveillance and target



*NASA Lancia UC-40 aircraft*

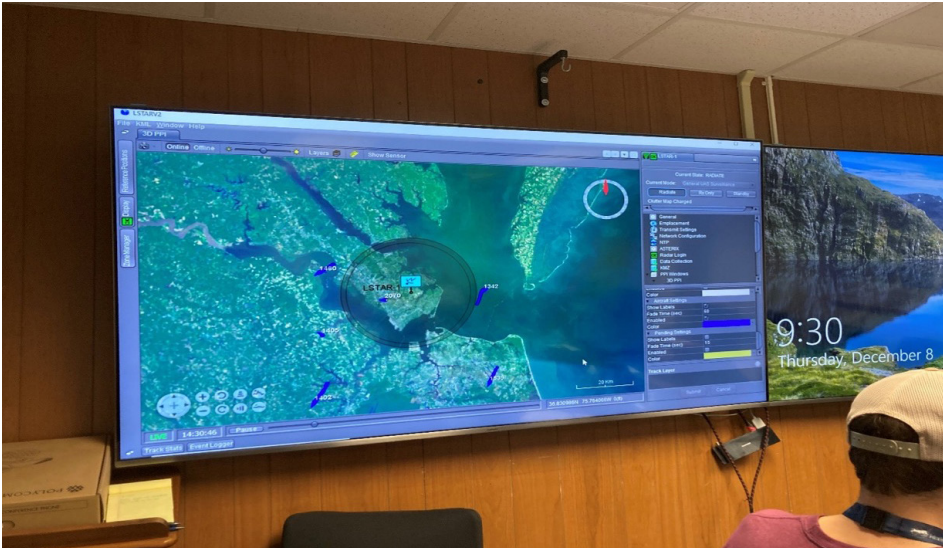


*ANRA Smart Skies Surveillance Display*

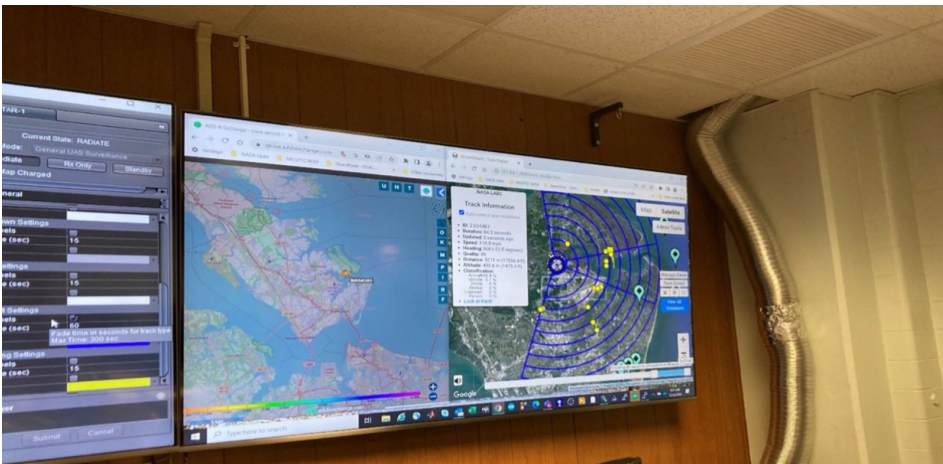
acquisition radar (LSTAR) and dual Dynetics Ground Aware GA-9120 systems were tested. Both radar systems are complementary to each other and will also be augmented by a third radar being accessed through a Space Act Agreement with Longbow, Raytheon, the City of Hampton, and Hampton University. The Radar-2-B flight lasted approximately one hour and will be

followed by several flights to fully install, checkout, and verify radar performance. These general aviation flights are crucial to provide the radar operators practical experience while gathering valuable tracking data. This data will be analyzed to better understand the capabilities of the systems and help make the configuration adjustments necessary for optimum results.

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to provide an airspace surveillance picture for the small Unmanned Aircraft Systems (sUAS) operations team during planned BVLOS operations. HDV also conducted sUAS flight checkout of the Safe2Ditch autonomous contingency management system to acquire performance data to detect and geolocate people moving within a ditch site. Detecting movement in the ditch site is critical to determine if a remote landing site is safe to use. Other elements tested in flight included updated firmware for the FreeFly Alta-8 octocopters and an upgraded radio control link to use during the build-up to BVLOS operations.



*Surveillance displays supporting the Radar 2-3 flight tests*

Shortly following, during the week of Oct. 17, HDV's surveillance team successfully updated the parameters for the Dynetics GA-9120 radars that are mounted on the gantry at NASA's Langley Research Center in Virginia. Each radar panel is capable of covering a 90-degree sector and detecting and tracking aircraft within five nautical miles. The radar systems were updated with parameters from

Dynetics to help remove ground clutter and focus on the aircraft. A target of opportunity was detected and tracked, that was likely a U.S. Air Force F-22 aircraft maneuvering in the landing pattern at Langley Air Force Base. In addition, during the week the output from the GA-9120s were successfully routed to the ANRA Smart Skies Control (ANRA SS CTR) system that will be used

On Dec. 8, the HDV team performed the Radar-2-3 flight test. This flight test was performed in order to acquire data and operational experience for the HDV surveillance system that is being created to enable BVLOS sUAS operations. The HDV surveillance system consists of the 1) LSTAR system installed on Building B1244; 2) Dual Ground Aware GA-9120 panel radars mounted on the gantry; 3) Ground-based uAvionix Ping 2020 ADS-B receiver; 4) Ground-based Flight Alarm receiver; and 5) ANRA Smart Skies Control sensor integration, fusion, and display system. NASA's Lanciar UC-40 aircraft was again used for this effort and was the fourth flight test performed to build up the performance and capability of the HDV surveillance system. Tracking perfor-



## TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

mance of the GA-9120s and LSTAR radar in their latest configurations were the primary test objectives. Preliminary results were encouraging with data analysis currently underway. BVLOS operations are planned for Fiscal Year 2023. Another major accomplishment this week was the completion of an authority to operate request to enable continued usage of the Botlink 4G cell telemetry system for sUAS operations at NASA. The Botlink is essential for plans to perform BVLOS operations at NASA. Part of the challenge recently revealed to HDV was that Botlink leverages some cloud-computing resources while not being FedRAMP certified. This is not surprising as FedRAMP certification incurs significant resources and is usually associated with much larger companies. Through extensive work and support from Sean Kenney from the Research Services Directorate at NASA Langley, a comprehensive description of the Botlink system was created with excellent engagement from Botlink. The result is a clear path forward to acquire an authority to operate and continue to use this essential telemetry link.

### **SWS Participates on AEWG Crosscutting Working Group Meetings**

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

The System-Wide Safety (SWS) project participated on two separate Advanced Air Mobility (AAM) Eco-

system Working Groups (AEWG) Crosscutting Working Group meetings this past quarter. The first one was held Oct. 18 and focused on runtime assurance recommendations. SWS researcher Ganesh Pai presented background information and discussed recommendations for robustness and inclusion of runtime monitoring with failover plans in civil aviation. These recommendations were based on decades of NASA research and are part of a multi-year effort to provide recommendations that will allow for the inclusion of untrusted components in aviation, such as machine-learning systems. This material has been sent to the FAA and the Flight Safety Foundation for feedback and could form a basis for future standards. Misty Davies provided the introductory and closing remarks. Alwyn Goodloe was a substantial contributor to this effort. The audience was also provided with the opportunity to engage with suggestions and comments.

The second meeting was on Dec. 8 and focused on discussing the concept of an In-Time Aviation Safety Management System. A brief overview was provided by Lance Prinzel, followed by the other panelists, including Misty Davies, Kyle Ellis, Jim Ackerson of the NASA Aeronautics Research Institute, Deborah Kirkman of the Flight Safety Foundation, and Paul Krois of Crown Consulting. Questions

were solicited from the audience, prompting a vibrant discussion amongst the panelists, providing insight into key topics of interest within the aviation industry and opinions on near-term wins and long-term visions coming together to transform global airspace. This engagement is helping NASA shape its research to best address industry needs while answering key questions from government regulators. The AEWG Crosscutting Working Group meeting was very well attended by members of industry and government, with more than 50 active participants in the online meeting forum and an additional 50+ participants viewing on YouTube. Each of these meetings were hosted by the NASA Aeronautics Research Institute.

### **Space Act Annex Signed for ATM-X CNS Research for AAM Operations with ODOT**

POC: [RAFAEL APAZA](#)

On Dec. 22, a two-year agreement was established between NASA's Glenn Research Center in Cleveland and the Ohio Department of Transportation (ODOT) to share Advanced Air Mobility (AAM)-related flight test information in Ohio, which will benefit NASA's Air Traffic Management – Exploration (ATM-X) project. ODOT personnel will be given access to NASA's research and flight test planning activities, as well as the results of

## TECHNICAL AND PROGRAMMATIC HIGHLIGHTS

upcoming AAM communications flight test activities, which will benefit ODOT's efforts in this area. The intended result of this annex is to improve information sharing

between both parties and to identify opportunities for future research and flight test activities that may best utilize the assets and abilities of both parties, which will be mutually

beneficial. Work on this agreement will start with a kick-off meeting later this year.

## RECOGNITION

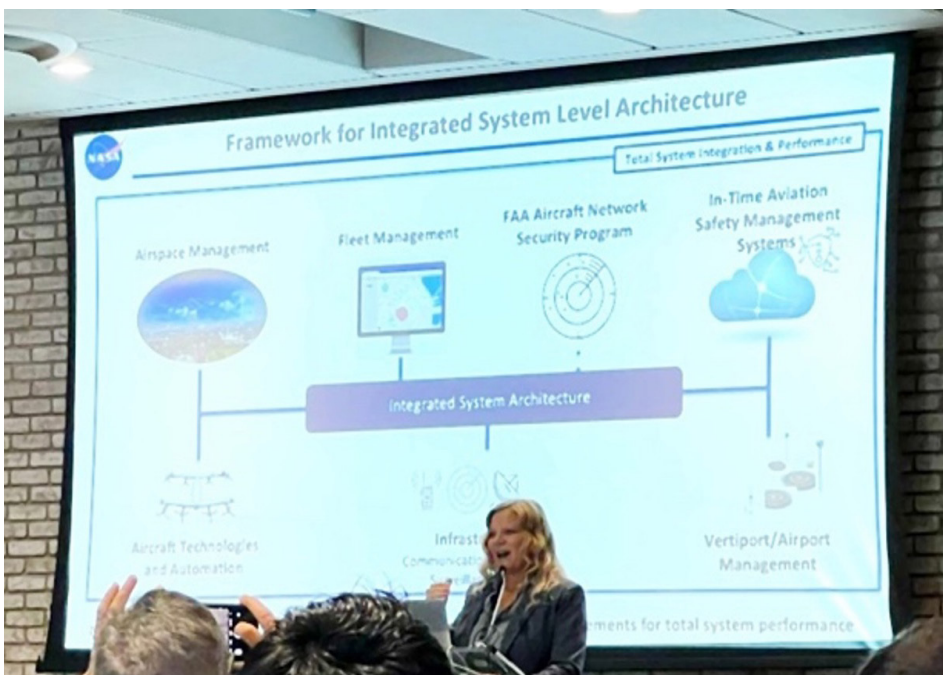
### AAM Participates in the eVTOL Insights Conference

POC: [STARR GINN](#)

Starr Ginn, the Advanced Air Mobility (AAM) project's lead strategist, served as the opening

included speakers such as Nikhil Goel, and Mark Moore and Ian Villa from Whisper Aero – all of whom worked previously for Uber Elevate. There was substantial vehicle representation at the conference including companies

provides the AAM reality index, provided a forecasting cash flow for all public companies. For more information, visit: <https://evtolinsights.com/2022/07/strong-line-up-of-speakers-confirmed-for-evtol-insights-new-york-conference-taking-place-from-october-10-11/>



*Starr Ginn provides opening keynote speech at the eVTOL Insights Conference*

keynote speaker at the electric Vertical Takeoff and Landing (eVTOL) Insights Conference held Oct. 10–11 in New York City. Closing the conference with a talk titled “After Elevate, the evolving Urban Air Mobility landscape,”

such as Elroy Air, Jaunt Mobility, Vertical Aerospace, Piasecki Aircraft Corporation, Eve Holding, Archer and many infrastructure companies. The theme of the day focused on operations and infrastructure. The SMG Consulting Group that

### ATM-X Participates at Edge Computing World Conference

POC: [SHIVANJLI SHARMA](#)

Shivanjli Sharma, Air Traffic Management – Exploration (ATM-X) deputy project manager, served as a guest speaker at the Edge Computing World Conference on Oct. 10–12 in Santa Clara, California. This conference brought together Edge end users and ecosystem service providers for executive insights, case studies, and networking, as well as free Edge developer education. Sharma spoke in a session titled “Intelligent Infrastructure Summit.” The focus of the conversation was on Advanced Air Mobility and how integrated intelligent infrastructure will enable new services for the data age, by underpinning new growth, supporting new job opportunities, and connecting the unconnected ecosystem participants.

## RECOGNITION



*Shivanjli Shrama participating on panel at Doon Insights Auto Mobility Tech 8 Conference*

### ATM-X Participates on Panel at Doon Insights Auto/Mobility Tech 8 Conference

POC: [SHIVANJLI SHARMA](#)

Shivanjli Sharma, Air Traffic Management – Exploration (ATM-X) deputy project manager, participated in the Doon Insights Auto Mobility Tech 8 Conference at Bonny Doon, California on Oct. 26. Sharma was a guest speaker on a panel titled “New Directions in Aviation” during which investors, new Advanced Air Mobility entrants, and existing aviation service providers discussed future trends in aviation and the technology needed across vehicles, airspace, and infrastructure needed to support a system of systems

ecosystem required to enable a diverse Advanced Air Mobility field.

### SWS Researcher Gives Opening Address at the First IEEE International WAAM

POC: [ALWYN GOODLOE](#)

System-Wide Safety (SWS) project researcher Alwyn Goodloe provided the opening talk of the first Institute of Electrical and Electronics Engineers (IEEE) International Workshop on Assured Autonomy, Artificial Intelligence, and Machine Learning (WAAM) in Charlotte on Oct. 31. The presentation titled “Assuring Safety-Critical Machine Learning Enabled Systems: Challenges and Promise” was well received

and generated many questions and offline discussions. As an interesting side note, a talk from a doctoral candidate at the Naval Postgraduate School highlighted interest and use of SWS-developed tools FRET and Copilot Runtime Verification Framework within his group at Naval Postgraduate School. Additionally, Goodloe has been asked to submit the paper as an IEEE Computer magazine article.

### SWS Project Members Attend IASS

POC: [MICHAEL VINCENT](#)

System-Wide Safety (SWS) project members Jon Holbrook and Michael Vincent participated in the annual International Air Safety Summit (IASS) sponsored by the Flight Safety Foundation in Atlanta on Nov. 7-9. Holbrook, the technical lead for human contributions to safety, gave a presentation titled “Learning from All Operations - The Analysis Approach” and was also a panelist during the event. The presentation and panel discussion that followed outlined a framework for safety learning that was developed in collaboration with the Flight Safety Foundation. This safety learning framework will influence future air transport operations by improving training standards to reinforce pilot behaviors that are not normally

## RECOGNITION

captured in safety management systems. The annual IASS conference attracts representatives from the airlines, business, and future Advanced Air Mobility operators, as well as safety service providers from around the planet. The keynote speaker for IASS this year was acting-FAA Administrator Billy Nolen, who highlighted the need for in-time safety systems for future air transport. Executives from Delta, American, and United Airlines also gave presentations to those in attendance.

### **SWS Research Highlighted at the NASA Langley Colloquium and Sigma Series**

POC: [CHAD STEPHENS](#)

System-Wide Safety (SWS) project researchers Chad Stephens and Alan Pope were invited to present their work at the Colloquium Series held by NASA's Langley Research Center in Virginia on Nov. 15. This activity is important to the goals of SWS Human Contributions to Safety research. Specifically, the results of this activity supported extending Human Contributions to Safety analysis methods applicable to the recently completed human-in-the-loop flight simulation Soteria study. A recording can be obtained shortly at the following link: <https://colloqsigma.larc.nasa.gov/recent-past-lectures/>.

### **SWS Researcher Participates in SuperComputing 2022 Panel**

POC: [MATTEO CORBETTA](#)

System-Wide Safety (SWS) project researcher Matteo Corbetta participated in the Birds of a Feather panel session at the SuperComputing 2022 Conference on Nov. 17. The panel was titled “Physics-Informed Machine Learning meets High-Performance Computing: State of the Art and Challenges for Widespread Adoption.” The Birds of a Feather panel are sessions where attendees can openly discuss current topics of interests for the high-performance computing community. Physics-informed machine learning is a promising research field attempting at merging physical and prior knowledge into machine learning models and vice-versa – thus taking advantage of the existing knowledge about a system, and the flexibility of new machine learning algorithms. Almost 12,000 people were in attendance in total for the conference and approximately 50 people were in attendance for the panel. The link for the conference is: <https://www.nas.nasa.gov/SC22/home.html>. The link for the panel session is: <https://sc22.supercomputing.org/presentation/?id=bof169&sess=sess370>

### **SWS Research Presented at Bi-Annual Multi-Agency Range Safety Group**

POC: [EVAN DILL](#)

On Nov. 29, System-Wide Safety (SWS) project researcher Evan Dill was invited to speak to the Range Safety Group consisting of NASA and Department of Defense (DoD) representatives. In attendance were range safety managers from various DoD and NASA installations. The focus of the interchange was the potential use of SWS research to help in the approval and deployment of non-deterministic or highly complex systems on NASA/DoD flight test ranges. Topics included assured vehicle conformance via the Safeguard system, operational hazard mitigation through various services, functions, and capabilities, as well as runtime assurance methods.

### **ODIN-Fire Presented at TFRSAC Fall Meeting**

POC: [PETER MEHLITZ](#)

On Nov. 30, Peter Mehlitz of the robust software engineering group at NASA's Ames Research Center in California demonstrated the “Open Data Integration for Wildland Fire Management” (ODIN-fire) system at the Tactical Fire Remote Sensing Advisory Committee (TFRSAC) autumn meeting. The ODIN-fire

## RECOGNITION

system is a software architecture to create field deployable servers that can import, process, and display an open number of wildland fire related data sources such as weather, fire location, and near-real-time location of vehicles and personnel. TFRSAC is the primary biannual event for the wildland fire stakeholder community, bringing together federal and state agencies, research organizations, and commercial vendors. This was a joint presentation with Delphire, Inc., an early adopter of ODIN-fire who became a collaborator as a result of the SWS project's Wildland Firefighting Operations Workshop held in March 2022.

### **ACERO Supports NASA's Climate Summit**

POC: [MARCUS JOHNSON](#)

Marcus Johnson, project manager of the Advanced Capabilities for Emergency Response Operations (ACERO) project, co-led a

breakout session at NASA's Climate Summit held Dec. 9. The breakout session was conducted along with Daniel Lockney, the agency's Technology Transfer Program executive. The session was titled "Rethinking NASA Technologies to Address Climate Challenges." The virtual event was intended to invite everyone at NASA together to begin a broader open dialogue about the agency's role in researching and addressing climate change issues for the agency's mission and for humanity.

### **Autumn 2022 American Geophysical Union Meeting**

POC: [JOSEPH COUGHLAN](#)

Joseph Coughlan, System-Wide Safety's senior technical advisor for Autonomy, presented a paper at the American Geophysical Union meeting on Dec. 12–16. Coughlan's paper described Open Data Integration for Wildland Fire Management (ODIN-fire)

low-latency features, and near-real-time/low-data-latency data and tools for Earth science applications. The ODIN-fire system is a software architecture to create field deployable servers that can import, process, and display an open number of wildland fire related data sources such as weather, fire location, and near-real-time location of vehicles and personnel. This session was co-chaired by NASA's David Green.

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