2023 FORUM PROGRAM

June 21-22, 2023

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2023 FAA DATA CHALLENGE

DRIVING INNOVATION THROUGH DATA

TABLE OF CONTENTS

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FORUM AGENDA

Wednesday, June 21, 2023

[Day 1 Livestream]

8:00 – 9:00 am	*Check-in and poster setup*
9:00 – 9:15 am	**FAA Data Challenge Forum Opening Remarks & Introductions** Marseta Dill, Deputy Chief Data Officer, Federal Aviation Administration Shelley Spears, National Institute of Aerospace
9:15 – 9:30 am	**Welcome & Security Briefing** Dr. Craig Wanke, The MITRE Corporation
9:30 – 9:35 am	**Kick-off Team Presentations**

TEAM PRESENTATIONS

Improve Aviation Safety

9:35 – 10:15 am	**George Mason University** "Proposal for a Modernized Flight Risk Assessment Tool for General Aviation Pre-Flight Planning"
10:15 – 10:30 am	*Morning Break*
10:30 – 11:10 am	**The Cooper Union and Manhattan College** "Safety with Numbers: A Data-Driven Approach to Mitigate Aviation Accidents"
11:15 – 11:55 am	**University of North Dakota** "LAGOM: A Balanced Approach to Real-Time Flight Safety Analysis"
11:55 – 1:15 pm	*Lunch Break*
1:15 – 1:55 pm	**University of Southern California** "Artificial Intelligence to Expediate Data Analysis on Runway Incursions and Excursions"
2:00 – 2:40 pm	**University of Southern California** "Probabilistic Learning and Optimization for Real-Time Flight Management with Safety and Environmental Constraints"
2:40 – 3:05 pm	*Afternoon Break*

Improve Operational Efficiency of the NAS

3:05 – 3:45 pm	**Duke University** "An Optimization of Airport Surface Congestion to Minimize Taxi Times"
3:45 – 4:55 pm	**Poster Session**
4:55 – 5:00 pm	Adjourn

All times are in Eastern Daylight Time (EDT).

2023 FAA DATA CHALLENGE

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FORUM AGENDA

Thursday, June 22, 2023

[Day 2 Livestream]

8:15 – 8:25 am	*Teams arrive for tours*
8:30 – 10:00 am	**MITRE Lab Tours for University Teams** IDEA, SEAL, and MASE Labs
10:00 – 10:10 am	*Check-in and Morning Break*
10:10 – 10:15 am	**Welcome**

TEAM PRESENTATIONS

Assist with the Rapidly Evolving New and Novel Uses of the NAS

10:20 – 11:00 am	**Embry-Riddle Aeronautical University** "Expanding the Capabilities of the NAS through AI: A White Box for the Airspace Ecosystem"
11:05 – 11:45 am	**Georgia Institute of Technology** "A Deep Learning Approach Using Social Media Data to Estimate Ground Risk of UAS in Urban Areas"
11:50 – 12:30 pm	**University of Miami** "Machine Learning for Dynamic Scheduling of Air Taxis"
12:30 – 1:30 pm	*Lunch Break*
1:45 – 3:00 pm	Networking Opportunity & Poster Session
3:05 – 3:20 pm	Group Photo
3:25 – 3:45 pm	**Remarks from Steering Committee**
3:45 – 4:45 pm	**Awards Ceremony and Reception** Natesh Manikoth, Chief Data Officer, Federal Aviation Administration
4:45 – 4:55 pm	Closing Remarks
4:55 – 5:00 pm	Adjourn

For more information about the 2023 FAA Data Challenge Forum, please visit https://faadatachallenge.nianet.org/forum-information/

#FAADataChallenge2023

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FAA CHALLENGE LEADERSHIP TEAM

NATESH MANIKOTH is the Federal Aviation Administration's (FAA) Chief Data Officer in the Finance and Management organization. He is responsible for providing executive direction and high-level leadership to the FAA, as well as oversight of the work related to strategically managing and exploiting the data assets of the agency. Mr. Manikoth is responsible for Enterprise Information Management initiatives for FAA including enterprise services to drive adoption of machine learning and AI to drive safety and efficiency improvements.

Previously in the FAA, Mr. Manikoth was the Chief Scientist and Technical Advisor for the National Airspace System (NAS) Software in the Next Generation Air Transportation System (NextGen) organization. As the NAS systems become ever more software-centric, it was his responsibility to provide expert technical guidance, advice, and leadership in all software related areas of the FAA system acquisition and development process. As such, Mr. Manikoth's primary focus areas were the sustainable acquisition practices for software intensive systems with an emphasis on improving the time and effort related to software validation and verification.

Prior to joining FAA in 2012, Mr. Manikoth was the Chief Technology Officer for the Transportation, Central and Local Government Sector for Xerox Services. He has over 30 years of experience with the development and deployment of large-scale systems. Mr. Manikoth holds a B.S. in Electrical Engineering, a M.S. in Industrial Engineering, as well as a Master of Business Administration from the Robert H. Smith School of Business at the University of Maryland.

MARSETA DILL is currently the Deputy Chief Data Officer at the Federal Aviation Administration. This entails providing leadership for FAA's Data Strategy and enterprise capabilities needed to execute on the vision. Prior to this role, Ms. Dill spent most of her FAA career in the NextGen organization serving in various roles including Chief of Staff, Technical Advisor, and Portfolio Manager. She has a B.S. in Electrical Engineering, M.S. in Computer and Systems Engineering, and Certificate in Data Analytics.

CHALLENGE STEERING COMMITTEE

GIAN BURDHIMO is the Data Program Manager in the FAA's Air Traffic Organization. He works with the executives of the Data Evolution Leadership Team (DELT) to champion the ATO's data activities and initiatives. He also supports the ATO's Safety and Technical Training Policy and Performance Director, and serves on the Operations Review Board as the Safety, Training, and Systems Engineering subject matter expert to administer the congressional allocation of operational funds across ATO service units.

JEFF CARTER is the Manager of the Safety Analysis Branch in the Office of Accident Investigation and Prevention (AVP). He supports FAA initiatives related to data integration, predictive analytics, and data visualization. His office also leads the Safety Data and Analysis Team (SDAT) and Aviation Safety Information Analysis and Sharing System (ASIAS). He has worked in various capacities supporting aviation safety analysis for the past 20 years and has been a manager in AVP since 2017.

DR. MISTY DAVIES is the Project Manager for the System-Wide Safety Project in the NASA Airspace Operations and Safety Program. The System-Wide Safety Project has a goal to explore, to discover and to understand how safety could be affected by the growing complexity of advanced aviation systems. In particular, the System-Wide Safety project is leading the development of the In-Time Aviation Safety Management System (IASMS) and is working on tools and techniques to enable the assurance of increasingly autonomous systems. Prior to SWS, Dr. Davies was the Ground System Development manager for the TESS mission. Dr. Davies previously was a researcher focused on predicting the behavior of complex, engineered systems early in design as a way to improve these systems' safety, reliability, performance, and cost. She has a Ph.D. in Mechanical Engineering and an M.S. in Aerospace and Astrospace Engineering from Stanford University. She is an Associate Fellow of the American Institute of Aeronautics and Astronautics.

GABRIEL ELKIN is the Assistant Leader of the Air Traffic Control Systems Group at MIT Lincoln Laboratory. In this role, he oversees research in the areas of aviation cyber security, information architectures and weather sensing technologies. Gabe joined the Laboratory in 1988 as a software engineering subcontractor developing aircraft tracking algorithms and became a Technical Staff member in the ATC Systems Group in 1996 and later the Weather Sensing Group, where he led the successful development, field testing, and technology transfer of a major processing augmentation to the aircraft surveillance radar (ASR-9PAC) and the Terminal Doppler Weather Radar (TDWR) receiver and data acquisition system. He also served two field assignments spanning seven years at the Reagan Test Site (RTS) on the Kwajalein Atoll in the Marshall Islands as a command-and-control systems engineer and field site manager. In between Kwaj tours, he spent two years overseeing research in the area of homeland security and disaster preparedness. Prior to joining the Laboratory, Gabe worked at the MITRE Corporation in Bedford, MA, where he developed software systems for surveillance and communication applications. He received a MS from Boston University in Computer Science, and a B.S. in Applied Math & Computer Science from Union College in Schenectady, NY.

BRIAN O'DONNELL is a senior project manager and AI subject matter expert at the Volpe National Transportation Systems Center, an agency of the U.S. Department of Transportation. Before joining Volpe, Brian worked on machine learning, computer vision, and signal processing technologies in industry and the private sector. He served as the Vice President of Technology for G4S, the world's largest security company, and was their subject matter expert for biometrics and intelligent surveillance. Brian invented AI-based stock trading algorithms for a start-up company working as a 'Wall Street Quant.' Brian has a B.S. in Applied Physics and an M.S. in Electrical Engineering and is a doctoral student in computer science with a specialization in AI. In addition, Brian is a senior member of the I.E.E.E. and holds several U.S. patents for machine learning and image processing applications in the defense and surveillance industries. Brian is a retired Navy officer and spent the last part of his career as an Engineering Duty Officer in the Reserves working on Los Angeles Class nuclear submarines.

MIKE PAGLIONE is the Branch Manager of the FAA's Software and Systems Branch. This Branch conducts research in support of aircraft safety technology development and continued enhancement of aircraft certification procedures, airworthiness standards, operation requirements, inspection and maintenance processes, and safety oversight to achieve the next level of safety. It also includes application of data science technologies and advances in artificial intelligence/machine learning to support aircraft safety and aviation cyber security resiliency. Before taking the Software and Systems Branch Manager position in February 2017, he managed the FAA's Modeling and Simulation Branch for five years and served as a FAA engineer and project lead for 13 years before that. He has extensive experience in air traffic control automation algorithms, simulation problems, analysis of decision support software, applied statistics, and general systems engineering. Mr. Paglione holds B.S. and M.S. degrees in Industrial and Systems Engineering from Rutgers University.

DR. CRAIG WANKE is the Chief Engineer for the MITRE Corporation's Center for Advanced Aviation System Development. He earned a Ph.D. in aeronautical engineering from the Massachusetts Institute of Technology in 1993, and then joined MITRE, where he has focused on decision support systems for pilots, air traffic controllers, and air traffic managers. Several tools developed under this work have been successfully deployed as part of the U.S. Traffic Flow Management System. He is also responsible for selecting and directing MITRE's internal research and development program in aviation and transportation, aimed at developing innovative solutions to critical U.S. national problems in those areas. Dr. Wanke is an Associate Fellow of AIAA, an associate editor of the Journal of Air Transportation, and currently serves on the organizing committee for the U.S./Europe ATM Research and Development Seminar series. He has authored more than 100 conference and journal papers on aviation and air traffic management topics.

NIA PROGRAM TEAM

The FAA Data Challenge is managed by the National Institute of Aerospace (NIA) on behalf of the Federal Aviation Administration.

SHELLEY SPEARS
Program Director

SHANNON VERSTYNEN
Program Manager

LAZARO BOSCH
Project Coordinator

FINALIST TEAMS AND PROJECT INFORMATION

DUKE UNIVERSITY

"An Optimization of Airport Surface Congestion to Minimize Taxi Times"

Faculty Advisor: Dr. Mark Borsuk

Team Member: Matthew Brune

The large variance in airport taxi times provides an opportunity to create a more efficient method to both predict—and optimally control—the surface flow of aircraft. By maximizing operational efficiency on the airfield, this in turn contributes to a greater efficiency of the national airspace system (NAS), a vital necessity in the face of unprecedented growth in the aviation sector. The aim of this research is two-fold: to train a machine learning model to predict taxi times and use these prediction outputs to identify optimal pushback intervals. The priority is on lower-fidelity models which can have more tractability across airport geometries than existing airfield-specified optimization algorithms.

EMBRY-RIDDLE AERONAUTICAL UNIVERSITY

"Expanding the Capabilities of the NAS through AI: A White Box for the Airspace Ecosystem"

Faculty Advisor: Prof. Omar Ochoa

Team Members: Alexandra Davidoff, Timothy Elvira, Tyler Thomas Procko, Sarah Reynolds, and Lynn Vonder Haar

The National Airspace System (NAS) is, at any given moment, populated with the data of thousands of instances of aircraft, radio communications, aircrews, airports, and various other entities. Managing such a complex, dynamic system is an issue of prime importance when the lives of those in flight, and those under flight paths, are at stake, along with millions of dollars of airspace equipment. It is of utmost importance to leverage newer Artificial Intelligence technologies to increase the capabilities of the NAS to improve the airspace ecosystem. This proposal details the Ontology-Enabled Machine Learning Flight Analysis System (OEML-FAS), an extensible Machine Learning (ML) framework for safety, risk, and incident analysis of aircraft flights in the NAS that leverages the agnostic languages of the Semantic Web domain to capture flight data and semantics in real-time, establishing a white box for flights. The proposed OEML-FAS uses well-formed, extensible OWL ontologies as the basis for representing flight data from takeoff to landing, flight data is recorded into a flight-specific Knowledge Graphs (KG), i.e., a graphical representation of the relationships between real-world entities, using the ontology suite as a formal data contract, to ensure data validity. These real-time KG of flight data allow NAS flights to be used as white boxes, in that they contain all the information about flights, structured as conforming to well-formed ontologies, facilitating the examination of flight data for the purposes of risk and safety analysis.

GEORGE MASON UNIVERSITY

"Proposal for a Modernized Flight Risk Assessment Tool for General Aviation Pre-Flight Planning"

Faculty Advisor: Dr. Isaac Gang

Team Members: Kathleen Hill, Chi Quinn, Erick Torres, and Hunter Walden

This project sought to research machine learning methods that could be used to create a modernized Flight Risk Assessment Tool (FRAT). The tool could be made available to General Aviation (GA) pilots, which could increase pre-flight hazard identification and subsequently decrease accident risk and improve safety for the GA community. This would be an improvement on existing FRATs through the incorporation of predictive modeling, developed through research on historical accident data, utilizing algorithms that predict a pre-defined risk category for a given flight profile. The models evaluated during this project were specifically designed for pre-flight risk assessment and, as such, utilized only information available during pre-flight analysis and did not consider pilot errors, lapse of judgment, air traffic controller errors, other in-flight human errors, or mechanical component failure anomalies as those data points are not known prior to takeoff. This modern application of risk analysis could be superior to legacy tools as it is capable of: 1) continuously updating risk profiles based on additional data provided by each flight record, 2) identifying a risk that the pilot may otherwise not identify, and 3) providing a customized a risk score based on a specific flight profile.

GEORGIA INSTITUTE OF TECHNOLOGY

"A Deep Learning Approach Using Social Media Data to Estimate Ground Risk of UAS in Urban Areas"

Faculty Advisors: Drs. Dimitri Mavris and Michael Balchanos

Team Member: Jeffrey Pattison

The use of Unmanned Aerial Systems (UAS) is growing in a variety of industries, including law enforcement and logistics. However, governmental agencies like the FAA impose strict regulations around UAS to ensure safe operations, and these regulations are not likely to change without the proper ground risk assessment ensuring safety to people on the ground. Current methods for UAS ground risk assessment rely on physics-based methods that are time intensive and use population density estimates that might be stale and inaccurate. In urban areas that have a constantly changing distribution of people, there is a need for quick and accurate ground risk assessment. This work attempts to remedy these issues by employing a Machine Learning model to estimate UAS ground risk in a more time efficient manner using social media activity to supplement historical data for better population density estimates. Using this Machine Learning method to generate a ground risk map, UAS users can create safe routes that do not surpass an acceptable level of risk.

THE COOPER UNION AND MANHATTAN COLLEGE

"Safety with Numbers: A Data-Driven Approach to Mitigate Aviation Accidents"

Faculty Advisors: Profs. Masoud Masoumi and Bahareh Estejab

Team Members: Benjamin Aziel, Sohaib Bhatti, Fayad Sarker, Jacob Sigman, and Ryan Truhn

This project details the development of LARRAS (Landing Approach Risk Reduction and Assessment System), an innovative auditory alert system designed to enhance pilot situational awareness and improve aviation safety. LARRAS is driven by a machine learning model trained on historical aviation data and utilizes real-time sensor information from pilots and air traffic control. This system relays discreet and distinguishable auditory alerts at appropriate times, assisting pilots in making informed decisions by preemptively alerting them to potential go-around situations. A primary factor underlying poor go-around compliance is rooted in psychosocial factors where situational awareness is negatively potent in a pilot's decision making. LARRAS aims to offset these psychosocial factors contributing to landing accidents and address the widespread issue of poor go-around compliance.

UNIVERSITY OF MIAMI

"Machine Learning for Dynamic Scheduling of Air Taxis"

Faculty Advisors: Drs. Nurchin Celik and Nina Miville

Team Members: William Hoy and Kelin Monahan

The objective of this project is to conduct a comprehensive analysis and evaluation of the efficacy of introducing an advanced air mobility taxi service at Miami International Airport (MIA), through the collection and analysis of relevant data to develop an accurate model. This service will transport travelers from MIA in a safe, low-cost, and sustainable way. Travel will be to some of the most populous areas surrounding the airport with set destinations to each location. The air taxis will go to these vertiports in intervals determined by a machine learning algorithm that maximizes the number of travelers. The impact of this service could be tremendous, including lowering travel time, costs, and emissions for travelers. This new service will serve as a model of new, innovative technology for other major cities to adopt.

UNIVERSITY OF NORTH DAKOTA

"LAGOM: A Balanced Approach to Real-Time Flight Safety Analysis"

Faculty Advisors: Profs. Ryan Guthridge and Brandon Wild

Team Members: John Dulski, Zachary Hoff, Jocelyn Ledin-Bruening, and Ryan Peene

This project, titled "LAGOM," proposes a balanced approach to real-time flight safety analysis. Lagom (pronounced "law-gom") is a Scandinavian term, meaning to have balance in the present moment. The term also applies to this project, which focuses on Leveraging ADS-B for GA and Operations Management of the National Airspace System (NAS). This project seeks to utilize the Automatic Dependent Surveillance Broadcast (ADS-B) dataset along with the use of Artificial Intelligence (AI) and Machine Learning (ML) to provide GA operators with a robust solution for real-time flight data monitoring and analysis; all without the cost and technological hurdles of an on-board flight data recording solution.

UNIVERSITY OF SOUTHERN CALIFORNIA

"Artificial Intelligence to Expedite Data Analysis on Runway Incursions and Excursions"

Faculty Advisors: Profs. Najmedin Meshkati, Daniel Scalese, Yolanda Gil, Thomas Anthony, and Bahadir Inozu

Team Members: Andrew Bruneel, Vivian Lin, and Tiffany Hoi Ching Wong

Our goal is to analyze existing aviation incident reports to document the main safety issues with compelling data that can improve aviation safety through the analysis of data that is currently collected, supporting the desires of the FAA and Department of Transportation. We focus on runway incursions, which we had originally proposed as our focus and unfortunately have been alarmingly increasing in the last few months. By examining the underlying factors behind incursions, excursions, and unstable approaches based on the incident report data already available, we hope to help improve aviation safety and the operational efficiency of the National Airspace System (NAS).

UNIVERSITY OF SOUTHERN CALIFORNIA

"Probabilistic Learning and Optimization for Real-Time Flight Management with Safety and Environmental Constraints"

Faculty Advisor: Dr. Roger Ghanem

Team Members: Reagan Arvidson, Nicholas Lototsky, Kelli McCoy, and Emma Silverstein

A machine learning (ML) workflow was developed that answers the following question: given prior flight schedules over an airspace, how should these schedules be modified in response to evolving delays, in a manner that adheres to safety and emissions requirements? In order to enable the resolution of this problem, flight path samples are assembled from NASA's Sherlock database. Nominal weather conditions are applied from NASA Merra-2 weather sources, and the Aviation Environmental Design Tool (AEDT) calculates emissions over a given flight path for the expected weather conditions. Our goal is to use a learning algorithm, Probabilistic Learning on Manifolds (PLoM), to generate a large dataset of augmented samples, with the same properties of the training set. With a larger dataset in place, a genetic algorithm (GA) finds alternate emission-optimal flight paths that resolve safety constraints. This workflow facilitates an assessment of safety risk, while minimizing emissions and enabling efficient replanning of flight paths in the face of rescheduling needs like weather delays.