Project 94
Probabilistic Unmanned Aircraft Systems Trajectory and Noise Estimation Tool

Georgia Tech Aerospace Systems Design Laboratory

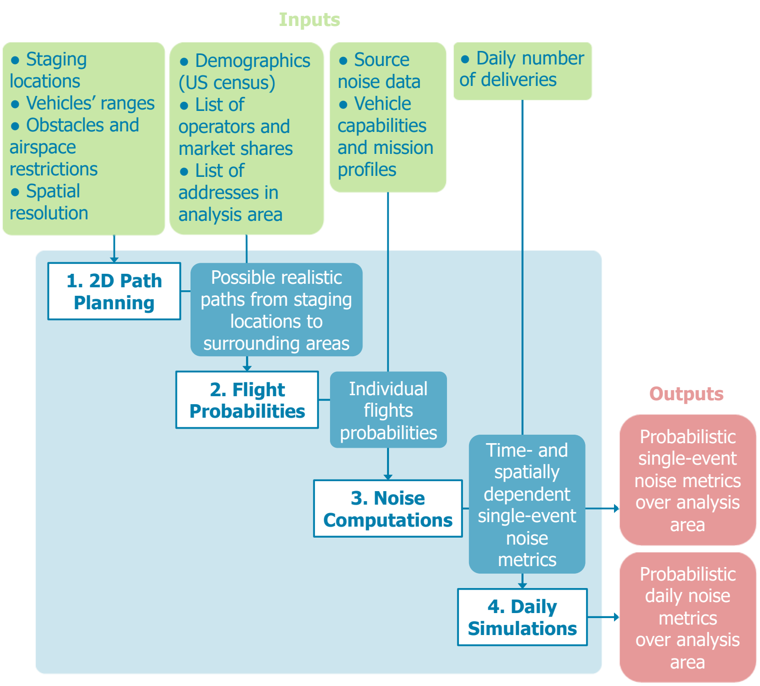
Summary

ASCENT Project 94 aims to develop computationally efficient capabilities to enable large-scale noise assessments of novel drone package delivery and urban air mobility operations.

Motivation & Objectives

- Package delivery by unmanned aircraft systems (UAS) and urban air mobility (UAM) markets are poised for **rapid growth**
- Introducing UAS/UAM to the airspace brings **unique requirements**
  - Increase in volume of operations by orders of magnitude
  - Smaller and quieter vehicle with more localized noise footprint
  - Operations over whole urban areas with large day-to-day variability
- Accordingly, **innovative analysis approaches are needed**
  - Existing noise modeling tools are not suited to 1) uncertain non-scheduled operations, 2) large volumes of operations and 3) fine analysis granularity over a large analysis area

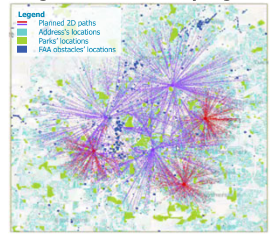
Methods and Materials



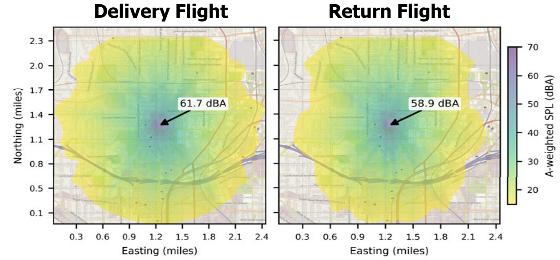
Drone Package Delivery

Use Case Definition:
Notional **Atlanta** package delivery scenario

Flight Paths of Delivery Flights

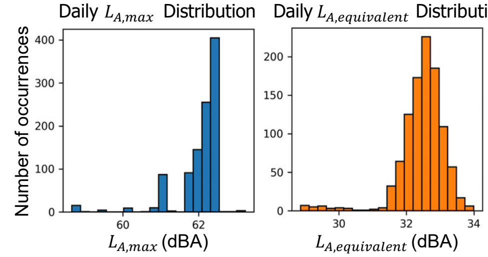


Single-Event Noise Footprints: source noise is propagated to grid receivers along individual flight trajectories



Daily Simulations: simulates daily flight activity accounting for variability in operations

Daily Noise Exposure Distributions of a Receiver in Test Case

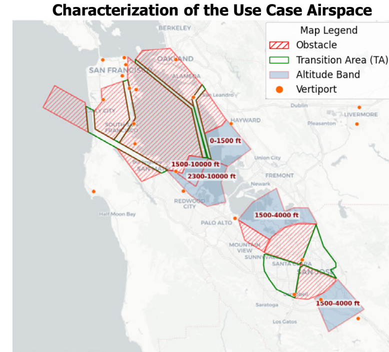


Urban Air Mobility Results

Use Case Definition

Selected **San Francisco Bay Area** as use case based on industrial and academic interests

Characterization of the Use Case Airspace

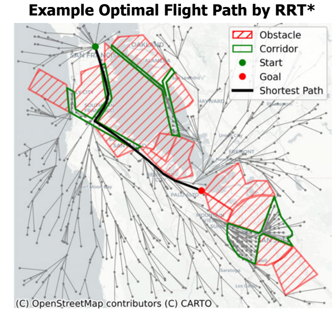


Airspace Discretization

- Define obstacle and transitional areas in 3-D space
- Assume eVTOL cruise at 2,500 ft if no altitude restriction
- **Red regions:** Areas in Class B and C airspaces aircraft are not allowed to enter
- **Green regions:** Transition areas, mandatory corridors/routes that aircraft must follow within Class B and C airspaces
- **Blue regions:** Conditional areas where aircraft must fly below or above specific altitudes to avoid Class B or C shelfs

Flight Path Planning : RRT* (Rapidly-exploring Random Tree Star) algorithm finds optimal paths in the complex airspace

Example Optimal Flight Path by RRT*



Conclusions

- Established a simulation environment for UAS fleet operational noise assessment with demand model, flight trajectory optimization, and noise propagation integrated
- Validated the noise computation module by comparing propagation results to AAM/ART using Causey UAS measurement data
- Extended the developed analysis flow to UAM noise assessment
- Determined vertiport sites and airspace constraints for the UAM use case and applied RRT* algorithm to flight path optimization

Next Steps

- Reduce computational and storage demands for the single-event simulation database created for daily simulations for the UAS task
- Visualize uncertainty and spatial distribution with contour maps for the UAS community noise exposure metrics
- Include demand model for the UAM task to determine operational frequency of each flight trajectory
- Create noise spheres for eVTOL and extend the noise computation module for the UAM noise propagation analysis

Lead investigators: Mavris, Pfaender, Georgia Institute of Technology
Project manager: Joe DiPardo, FAA
October 15, 2025

This research was funded by the U.S. Federal Aviation Administration Office of Environment and Energy through ASCENT, the FAA Center of Excellence for Alternative Jet Fuels and the Environment, project 094 through FAA Award Number 13-C-AJFE-GIT-143 under the supervision of Joe DiPardo. Any opinions, findings, conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the FAA.