Problem Statement No.: 666

Urban Air Mobility Noise Modeling

Recommended Allocation: $750,000

Tags: airport-planning, environment, noise-impacts, operations, policy, public-relations, public-safety

Related Emerging Issues/Themes: None

Research Roadmaps: Environment--Noise

Staff Comments: While the budget proposed by the author is higher than for most ACRP projects, the author's budget reflects the anticipated complexity associated with developing an approach for modeling UAM.

Average Airport Employee Review Rating: 2.50

ACRP Oversight Committee (AOC) Disposition: No discussion. Not funded.

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Summary

Community acceptance of the rapidly emerging Urban Air Mobility (UAM) market will be strongly driven by public noise concerns; however, no regulatory tool exists to evaluate potential environmental noise impacts. Whereas conventional helicopters have one or two rotors, UAM vehicles may have large numbers of rotors for different functions that operate at variable speeds. These differences necessitate the development of a UAM noise model which practitioners can use to predict the noise from a range of UAM vehicle configurations, trim states, and operations.

Background

UAM is a rapidly emerging market that is broadly characterized as the movement of people and goods around a metropolitan area by air. This research addresses an emerging issue for ACRP: namely, the impacts of emerging and innovative UAM technologies . The proposed types of UAM operations include (1) air metro, which travels along pre-determined routes with regular schedules and set stops, and (2) air taxi, which provides a door-to-door, on-demand ridesharing service. Both air metro and air taxi operations are expected to transport passengers to and from UAM vertiports co-located with airports. As UAM vehicles prepare to enter service, it is critical that operators have tools in place to evaluate the potential noise impacts from UAM operations. Currently, airports use AEDT to model noise from traditional aviation operations; however, AEDT does not have the ability to predict noise from new types of UAM vehicles and operations.

Numerous types of UAM vehicles are currently under development, and several vehicles have already been built and are undergoing flight testing. Many of these vehicles utilize electrical power and unique configurations of multiple rotors to transition from vertical take-off and landing to forward flight. For example, rotors may be used for different functions (e.g., rotors for vertical lift and pusher propellers for vertical flight) and operate at variable speeds. Thus, UAM vehicles encompass a much wider range of configurations than conventional helicopters. The innovative propulsion technologies used by UAM vehicles require the development of new noise source definitions beyond those available in existing regulatory tools.

Modeling the community noise exposure from UAM operations is critical, as UAM vehicles will operate closer to people and potentially at higher density than traditional aviation operations. The community noise exposure from UAM operations depends on factors such as the vehicle configuration, types of operations, vertiport locations, and atmospheric conditions. The new types of UAM vehicles and operations under development require new noise source definitions and modeling approaches to accurately predict the community noise exposure. Thus, this research addresses critical challenges related to the impacts of emerging and innovative UAM technologies.

Objective

The objective of this research is to (1) develop a UAM noise model designed to be used by industry practitioners to predict the noise emissions from UAM operations; (2) develop an Aviation Environmental Design Tool (AEDT) integration plan to ensure the model is compatible with or can be integrated into AEDT, and (3) identify future measurements and research required to improve and validate the model.

Research Approach

The proposing team will need expertise in noise source and model development, UAM vehicles and operations, and AEDT integration. The research plan should include:

1) A literature review to inform the UAM noise modeling approach. The review should aim to: a) define the range of UAM vehicle configurations and operations in relation to their unique noise characteristics, b) identify publicly available UAM noise source data (measured and modeled), and c) identify existing route-based and area-based noise modeling methodologies which can be leveraged in modeling UAM flight corridors (air metro) and distributed operations (air taxi).

2) The definitions of input and output parameters relevant to UAM operations and noise modeling (including noise source models, flight profiles, number and types of operations, vertiport locations, etc.).

3) The development of a UAM noise modeling approach which utilizes performance-based modeling to define UAM source characteristics, physics-based modeling for noise propagation from defined operations, and statistical modeling for noise from distributed operations. The modeling methods should be detailed in pseudocode for future integration into regulatory toolsets.

4) A plan to integrate UAM noise modeling into the regulatory toolset (i.e., AEDT). The plan should identify challenges associated with implementing the proposed UAM modeling methodologies in AEDT, integrating UAM noise sources into AEDT's fleet database, and updating AEDT's graphical user interface for UAM modeling.

5) The development of a conceptual case study to illustrate the noise modeling approach for air taxi and air metro operations in an urban area.

6) The identification of future measurements and research efforts to improve and validate the model.

Cost Estimate and Backup

The recommended funding to accomplish the stated objectives is $750k.

The cost includes a literature review, a description of UAM modeling inputs/outputs, development of a UAM noise model, a plan for integrating the UAM noise model into the regulatory toolset, a case-study demonstration of the model, and a discussion of future research efforts.

Related Research

No known or pending FAA UAM noise model development research projects are currently planned to address community noise impacts.

TRB, FAA, and NASA have funded research to study the UAM markets and define the concept of operations, including:

1) ACRP 03-50: An Airport-Centric Study of the Urban Air Mobility Market (Ongoing) - TRB

2) UAM Vision Concept of Operations (ConOps) UAM Maturity Level (UML) 4, Version 1.0 (December 2020) – NASA

3) Urban Air Mobility (UAM) Concept of Operations Version 1.0 (June 2020) – FAA

4) ACRP 03-42: Managing Unmanned Aircraft Systems in the Vicinity of Airports (June 2019) - TRB

5) Urban Air Mobility (UAM) Market Study (November 2018) – NASA

A NASA-led team documented a set of high-level goals intended to address barriers associated with UAM noise that may hamper UAM vehicle entry into service (NASA/TP–2020-5007433). Their report includes recommendations to address the gaps in four areas of interest: Tools and Technologies, Ground and Flight Testing, Human Response and Metrics, and Regulation and Policy.

FAA has funded university-led research through the ASCENT program to acquire measurements and develop computational models of UAM noise sources. These computational models and measurements will be evaluated in the development of representative UAM vehicle noise sources:

1) FAA ASCENT Project 049: Modeling of Urban Air Mobility Noise to Enable Innovative Means of Noise Reduction

2) FAA ASCENT Project 077: Measurements to Support Noise Certification for UAS/UAM Vehicles and Identify Noise Reduction Opportunities

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Airport Employee Comments

Anything that would improve AEDT is worthwhile
As the UAM market continues to evolve at a fairly rapid pace, the ability to understand and model the resultant noise effects is crucial to prepare airports and communities as well as have the tools for NEPA analysis.
It is great topic for airports due to the potential huge UAM market. But, FAA ASCENT had done similar works on modeling UAM noise.
Unclear how this would benefit airports.

TRB Committee Comments

Reviewing Committee(s)	Committee Comments
AV095/AV030	NEW USERS OF SHARED AIRSPACE: Significant concerns were raised about research already being conducted in coordination with NASA on this topic that this proposed research would largely duplicate. If ACRP wishes to conduct their own research, specific comments to consider include: AAM noise impacts on vertiports as well as flight paths should be distinguished more clearly; addressing equity and related policy considerations; incorporating demand modeling (e.g. how do various expectations for demand impact noise); and clearly identify who the intended audience of the research would be (compared to the audience intended for the research being conducted with NASA) ENVIRONMENTAL ISSUES IN AVIATION: Not recommended at this time: majority of reviewers support the objective but either the duplicative efforts by NASA or the immaturity of the technology and emerging types of UAM make it a subject best studied later.

IdeaHub Votes and Comments

Idea Number: **666**

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The votes and comments below were provided by the **IdeaHub** community prior to the idea's submission as a problem statement.

Idea Link: http://ideascale.com/t/UKsrZBoAL

Tags: airport-planning, environment, noise-impacts, operations, policy, public-relations, public-safety

Votes:

Votes	
Up	14
Down	1
Total	15

Comments:

Perhaps the greatest challenge in modeling community response to UAM noise is understanding how communities are likely to respond to the noise signatures of UAM vehicles, which are likely to be quite different from conventional aircraft and helicopters for the reasons noted in the topic description, as well as the very different operational characteristics (flight profile, frequency, etc.). It may be impossible to accurately assess community response until enough operational experience is available to conduct field studies of impacted communities. Even so, it would be helpful for the research to identify aspects of the noise signatures of UAM vehicles that may impact community response so that the relevant noise signature data can be collected during tests of prototype vehicles.

PARAS is doing a 2021-22 project on security issues of urban air mobility.