Urban Air Mobility Noise: Current Practice, Gaps, and Recommendations

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Abstract

URBAN Air Mobility (UAM) is an opportunity for aviation to improve transportation systems across the world. Representative UAM vehicle attributes include electrical vertical takeoff and landing (eVTOL) vehicles that can accommodate up to 6 passengers (or equivalent cargo), are possibly autonomous, perform missions of up to 100 nautical miles at altitudes up to 3000 ft. above ground level, have flight speeds up to 200 knots, and weigh between 800 and 8000 pounds. Along with the many anticipated benefits, there will be noise issues that need to be addressed. In 2018, NASA formed an Urban Air Mobility Noise Working Group (UNWG) to assemble noise experts from industry, universities and government agencies to identify, discuss, and address UAM noise issues. This oral presentation summarizes technology gaps and goals associated with four areas of interest: Tools & Technologies, Ground & Flight Testing, Human Response & Metrics, and Regulation & Policy, and is drawn from a draft white paper [1] by the same title.

Tools & Technologies include noise prediction tools and noise reduction technologies that have been developed for conventional rotorcraft and fixed-wing vehicles that may be applicable or need to be modified for UAM. Prediction tools need to be able to account for variable speed rotors and other temporal variation effects that impact community noise. A reprioritization of noise sources needs to be done since UAM vehicles include multiple rotors/propellers, often in proximity to one another and/or the airframe, with dynamic transition, and new noise sources such as electric motors or hybrid-electric propulsion. Scattering and propagation methods need to be developed that include the vehicle components and surfaces near a receiver such as buildings and vertiports. Validation databases are needed to quantify prediction uncertainties. Prediction tools used to evaluate community noise will need source models appropriate for a wide range of UAM vehicles. Existing noise reduction technologies need to be evaluated and new noise reduction technologies should be developed in anticipation of future noise requirements. Although the prediction and treatment of interior cabin noise is a secondary goal, it is recognized that new tools and methods may be needed due to the uniqueness of the vehicle design and the presence of both acoustic and structure-borne loads.

Ground & Flight Testing has been a critical part of validating noise reduction technologies and verifying that an air vehicle is ready for certification. UAM vehicles introduce new challenges for test procedures such as different source noise directivity, unsteady sources due to maneuvers, and a variety of takeoff and approach trajectories. The operating environment will be more complex than current aircraft with the introduction of vertiports in populated areas with "urban canyons" making reflections an important part of noise prediction and annoyance. It is expected that new test procedures and measurement methods will be necessary. Consideration will need to be given for both piloted and autonomous operations.

Human Response & Metrics may be very different for UAM noise compared to current experience with airport noise. Current metrics used to certify rotorcraft and fixed-wing aircraft may not be as useful for evaluating UAM noise. Operations at lower altitudes may influence annoyance. Psychoacoustic and community testing will be needed to quantify annoyance and assess appropriate metrics. In addition to conventional noise level metrics,

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considerations such as audibility and temporal variation of the sound may be required. Differences between indoor or outdoor exposure will have an impact with dependence on urban and residential flight paths.

Aircraft noise is currently regulated at a national level and typically involves partnerships with the industry to establish regulations. Regulators realize that current policies and procedures may not be appropriate for some of the emerging air vehicles and new procedures may be needed to address UAM noise. Development of new policies and procedures are needed so that local communities do not hastily attempt to establish their own restrictions that will both limit growth of the market and create an inconsistent and confusing regulatory environment. To expedite this development, it is crucial early measurement data are shared through partnership arrangements to support both noise certification and noise modeling/noise assessment. At the same time, an effective engagement strategy should be developed to address local community noise issues associated with UAM vehicles and flight operations as they arise.

References

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