

Urban Air Mobility Generation 1 Acoustic Database

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Background

An acoustic database has been generated in support of the NASA Revolutionary Vertical Lift Technology (RVLT) project, Technical Challenge (TC) TC.UAM.Noise.1, entitled “Urban Air Mobility Operational Fleet Noise Assessment.” As part of that TC, a periodic (approximately annual) development of an acoustic database will be performed based on the latest available information. The release of the first such database, namely, the “Gen 1 database for fleet noise assessments,” developed in support of RVLT milestone RVLT.23.02.L350, is the subject of this document.

Description

The database is comprised of the following data:

- 1) Source noise description of rotor/propeller noise for each vehicle (see below list of vehicles). The source noise data are provided at a set of points at a constant radius around the source, typically referred to as a source noise hemisphere. The data at each point on the hemisphere are numerical predictions of only the loading and thickness noise components, in the form of pressure time histories and 1/3 octave band sound pressure levels.

The source noise hemispheres can be used as the basis for i) auralization [1], that is, turning the prediction into a sound that can be listened to using a code such as the NASA Auralization Framework (NAF) [2], or ii) for ground noise predictions using simulation codes such as the NASA Aircraft Noise Prediction Program 2 (ANOPP2) [3] or the Department of Transportation (Volpe) Advanced Acoustic Model (AAM) [4] codes. The data may also be used as input to prediction cabin noise, although there are no plans to do so at the present time.

- 2) Propagated noise at a ground observer in the form of Noise-Operating Condition-Distance data, suitable for use in the Federal Aviation Administration (FAA) Aviation Environmental Design Tool (AEDT) [5]. These data are commonly referred to as NPD data, and consist of four quantities used in AEDT, namely: the maximum A-weighted sound pressure level, the sound exposure level, the maximum tone-corrected perceived noise level, and the effective perceived noise level. The operating condition is defined by the simulated flight speed and climb angle, and is vehicle-specific (see below).

The NPD data may be used in integrated noise modeling tools, including the FAA AEDT and the NASA AIRNOISE too. AIRNOISE is a tool developed and used by NASA to support flight operations research.

Expected Usage

The data are expected to be used within and outside of NASA for urban air mobility noise studies.

Within NASA usage includes i) support of RVLT TC.UAM.Noise.1, ii) auralization of a representative multirotor vehicle in support of the NASA Transformational Tools and Technologies (TTT) project, and iii) flight operations research in support of the NASA Air Traffic Management-eXploration (ATM-X) project.

Outside NASA usage includes i) FAA and DOT Volpe, including but not limited to their support for fleet noise assessments under RVLTC.UAM.Noise.1, ii) companies working on NASA funded contracts, notably Small Business Innovative Research (SBIR) projects, and iii) companies supporting other local, state, and federally funded projects. It is possible that requests for the data are from outside the US, so a general release is sought that excludes only designated countries.

Vehicle Description

The predicted Gen-1 noise data correspond to the following vehicles –

- 1) A NASA model of the Robinson R66 helicopter [6]. The model is based on publicly available information and contains no proprietary data.
- 2) A NASA concept electric vertical takeoff and landing (eVTOL) reference vehicle referred to as the RVLTC Quadrotor, described in reference [7].
- 3) A NASA concept eVTOL reference vehicle referred to as the RVLTC Lift+Cruise aircraft, also described in reference [7].

Flight Conditions

Particular to each vehicle, provided in Table 1 - Table 3.

Table 1: Flight conditions for NASA model of Robinson R66.

Air Speed	Climb Angle (deg)*
100 ft/min	90
0 knots	0
60 knots	9.5
110 knots	0
60 knots	-6
100 ft/min	-90

* Positive angle = climb, negative angle = descent

Table 2: Flight conditions for NASA Quadrotor reference vehicle.

Air Speed (knots)	Climb Angle (deg)
0	-90
0	90
10	-35
10	-30
10	-25
10	-20
10	20
10	25
10	30
10	40
10	50
10	65
10	85
20	-20
20	-15
20	-10
20	10
20	15
30	-10
30	10
40	-10
40	-5
40	5
40	10
50	-5
50	5
60	-5
60	0
60	5
70	-5
70	0
80	-5
80	0
90	-5
90	0

Table 3: Flight conditions for NASA Lift+Cruise reference vehicle.

Air Speed (knots)	Climb Angle (deg)
0	-90
0	90
10	-45
10	-35
10	-30
10	-25
10	-20
10	20
10	25
10	30
10	40
10	50
10	65
10	85
20	-20
20	-15
20	-10
20	10
20	15
30	-10
30	10
40	-10
40	-5
40	5
40	10
50	-5
50	5
60	-5
60	5
70	-5
70	0
70	5
80	-5
80	0
90	-5
90	0
100	-5
100	0
110	0

Availability

Data are available upon written request to the author at stephen.a.rizzi@nasa.gov.

References

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- [2] Aumann, A.R., Tuttle, B.C., Chapin, W.L., and Rizzi, S.A., "The NASA Auralization Framework and plugin architecture," *InterNoise 2015*, San Francisco, CA, August 9-12, 2015.
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