

Task 2- Community Instrumentation and Monitoring

The Pennsylvania State University

Objective

This is part of a series of research efforts that were designed to devise scientific evidence to help answer the question: "What data is needed through a standard to reconsider 14 CFR part 91.817, which currently prohibits civil supersonic flight over land?" This effort supports research on the human perception of *low level* sonic booms and the exploration to enhance capabilities for the assessment of community impact by aviation noise field tests.

The research supports the standard development process and the identification of noise acceptance onset. The tasks were conducted in support of NASA in the development of protocols, methods and planning for execution of human response studies and community exposure testing.

Research Approach

This research encompassed several topics that were investigated in support of future field tests to assess community noise impact and public acceptability of low boom signatures. Community noise impact research requires gathering noise data as well as community response data. This effort is finalizing the design of low cost noise monitors (LCNM) that could be used as a rapid deploy monitor to augment the use of standard higher fidelity instrumentation to gather noise data. A review of the aviation noise literature is underway. The intent is to assess differences in perception between urban and rural environments to better understand the potential impact that background environmental noise has on community noise impact.

Milestone(s)

This research was conducted in support of future NASA sponsored low boom noise community field tests. The LCNM design is being finalized. PSU researchers are sharing the design with researchers from Volpe, The National Transportation Systems Center for further testing and development. The literature review of urban vs. rural aviation noise impact is ongoing to assess the role of environmental background noise.

Major Accomplishments

The Low Cost Noise Monitor design is being finalized. This task was conducted in support of efforts to gather objective measurements community noise tests. The literature review of the impact of environmental background noise on community noise impact is ongoing. The review of environmental masking was initiated to understand the potential impact that masking has on noise field test results for human impact. Accomplishments on each of these tasks follow.

Low Cost Noise Monitor (LCNM) Design

A report that provides an overview of the design for the Low Cost Noise Monitors (See Figure 1 and Table 1) is in development. The design will be shared with Volpe for further development and testing. The LCNM was designed as a prototype with the potential for project specific modifications when building future monitors.



Figure 1. LCNM prototype

Table 1. LCNM Components

LCNM Components
2 Microphones
GPS Sensor
Environmental Sensor
Accelerometer Sensor
Single Board Computer (SBC)

Several low cost options were explored, assessing the electrical power considerations, mechanical components, and the electrical data flow and data storage. Design selection was contingent on the availability of low cost parts for the monitor. The noise monitoring is provided through a single board computer, microphones, and batteries. The design includes two microphone channels that can be set with different dynamic ranges. This affords the ability to capture low level signals with integrity, and affords a second microphone channel set with a higher dynamic range. The monitor also includes temperature and humidity sensors as well as an accelerometer channel to provide greater applicability for a range of noise monitoring projects. The monitor will require the development of software to facilitate the ability to readily download the field data.

Environmental Masking (urban vs suburban/rural) Literature Review and Survey Development

This task includes a review of concepts and available literature of noise studies related to the role masking plays on the perception of noise. Masking is the extent that one noise source “covers” or masks another noise source. The low boom noise has been described as sounding like distant thunder, or two car door slams in quick succession. In urban areas, a car door slam may not be noticed, due to other noise sources. The same car door slam would be more clearly noticed in a quiet rural environment. The noise impact is measured by both objective noise metrics and subjective human response.



The task will initially review and compile information on urban vs. rural impact of aviation noise. While the preferred noise source to investigate is aviation noise, data gathered on analysis methods for other noise sources may also prove to be relevant. A review of noise impact and analysis methods for various noise sources and environments could further identify patterns in noise impact and response, and provide a more informed approach to illuminate those patterns in future data sets. An attempt is being made to include a range of publications such as The Journal of the Acoustical Society of America, Journal of Sound and Vibration, Journal of Environmental Psychology, and Environment and Behavior. The literature review is intended to further understanding of potential differences in noise impact between such communities that could inform future research efforts. The results of this study should provide insight into the influence of background noise on the annoyance rating of aviation noise pertaining to low sonic boom noise.

Publications

None

Outreach Efforts

This research task supports NASA activities on supersonics and low boom research. The team has provided information to the NASA sponsored Waveforms Sonicboom Perception and Response Risk Reduction (WSPRRR) team as warranted.

Awards

None

Student Involvement

Annelise Hagedorn started this effort as an Eric Walker Graduate student, looking at aviation environmental impacts on urban vs rural communities. She left the university this past year for an excellent job opportunity.

Plans for Next Period

The LCNM instrumentation task is being finalized. The outcome is the development of noise monitoring technology that can be used to supplement existing noise measurement methods for greater quantification of coverage at lower cost and complexity. Such technology could be used as intermediate measures among the standard higher fidelity instrumentation to confirm and interpolate data.

The literature review will be continued on noise studies related to the role masking plays on the potential low boom noise impact in differing background noise for urban, suburban or rural noise environments. The findings of the Environmental Masking literature review will facilitate interpreting noise field test results and masking due to environmental surrounding (community density), and the relevance masking has on low boom noise for such varying background environments.

References

Brambilla, G. & L. Maffei (2006) Responses to noise in urban parks and in rural quiet areas. Acta Acustica United with Acustica, 92, 881-886.

Brink, M., K. E. Wirth, C. Schierz, G. Thomann & G. Bauer (2008) Annoyance responses to stable and changing aircraft noise exposure. Journal of the Acoustical Society of America, 124, 2930-2941.

Fields, J. M. (1998) Reactions to environmental noise in an ambient noise context in residential areas. Journal of the Acoustical Society of America, 104, 2245-2260.

Maris, E., P. J. Stallen, R. Vermunt & H. Steensma (2007) Noise within the social context: Annoyance reduction through fair procedures. Journal of the Acoustical Society of America, 121, 2000-2010.

Miedema, H. M. E. & H. Vos (1999) Demographic and attitudinal factors that modify annoyance from transportation noise. Journal of the Acoustical Society of America, 105, 3336-3344.