

Environmental Noise Contamination Detector

Project statement for UW Master's in Data Science Capstone Course

Sponsor

Steve Underbrink, Manager

steven.l.underbrink@boeing.com

206-662-0677

Boeing Test & Evaluation

The Boeing Company

Situation

Community noise flight testing requires extensive equipment and personnel to achieve efficient and effective results. For example, three engineers aided with custom workstation computers are used to provide real-time monitoring and detection of environmental noise contamination in the acoustic recordings. Typical sources of the environmental noise contamination include bird chirps and other wildlife/livestock vocalizations, insect noises, traffic noise, and aircraft noise from other than the test airplane. The goal of the monitoring is to detect, or classify, the presence of environmental noise contamination in the acoustic signals as they are acquired. Furthermore, from that classification, to provide guidance whether the contamination has corrupted the data, whether the flight condition should be repeated, or to react and remove the noise sources before the airplane is on-condition and thus avoid repeating the condition. Overall, the current process of using humans to assess and decide is reasonably effective, but it is expensive and subject to inconsistencies. It also does not take advantage of the capabilities that an automated detection and classification system might provide. The cost of the current monitoring includes:

- Three engineers for the full duration of the community noise portion of the test.
- Travel costs for the engineers.
- Three workstation computers with software licenses.
- Storage, shipping, setup, and networking support for the workstation computers.
- Validation and testing of the analysis applications, especially the communications with other data acquisition systems at the test.

The current situation is also subject to:

- Mental fatigue of the engineers from the repetitive menial task, resulting in a reduction of the quality and consistency of the classification over time.
- Inconsistencies and subjectivities of the classification from engineer to engineer.
- Limited ability or knowledge to accurately account for noise contamination corrections available to analysis staff at post-acquisition data reduction.
- Limited post-test review opportunities for training and enhancements.

Thus the current situation is costly to maintain, deploy, and staff, and difficult to assess the effectiveness of the results and to continually improve the methodology.

Target

Create an automated environmental noise contamination detector. Eventually, this automated system would remove the need for the multiple work stations and staff providing significant cost reductions for the community noise fly-over capability. The automated system also would provide increased accuracy and consistency of the classification thus increased efficacy of the test for further significant cost reductions. The detector should alert community noise test crews of the presence of environmental noise contamination continually, in real-time, thus allowing them to respond by either removing the sources from the measurement area before the arrival of the airplane or by declaring the on-condition recording out of tolerance and requesting a repeat of the condition.

Constraints

- All software code and data must not limit the commercial use by The Boeing Company of such code or data, or models depending on such code or data.
- All software codes must be executable in MATLAB, the preferred computational environment for Boeing Test & Evaluation noise testing.

Deliverables

The project should consist of the following deliverables.

- Trained algorithm for detecting audio signals contaminated by environmental noise sources.
- Estimates of algorithm performance.
- Listing of algorithm limitations.
- Documented process for retraining the algorithms.

Information required from the sponsor

- Example acoustic signals with known classifications.

Proposal

Research, develop, and implement automated algorithms for detecting the presence of environmental noise contamination for community noise flyover acoustic measurements. Some suggested topics for literature search include:

- Binary classification
- Pattern recognition
- Signal detection