Quiet Drones

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Title:

Comparing a general sound quality metric for aircraft noise using a pre-trained neural network model to traditional psychoacoustics

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Abstract:

When dealing with sound perception, psychoacoustic is often the go-to solution to produce accurate and interpretable results. However, its meaning is very context-dependent, so that a general psychoacoustics-based sound quality metric for different sound types is challenging. This paper investigates a data-driven alternative to obtain sound-quality ratings of various types of aircraft noise using a pre-trained neural network model. As baseline, traditional psychoacoustic approaches are used. The idea of using a pre-trained acoustic model is that it should be able to identify the context where a sound is usually present and thus provide, in general, better predictions. All approaches are trained on diverse listening-test data from various datasets including diverse drones, airplanes and helicopters. Our psychoacoustic baselines use mainly psychoacoustic descriptors from the Sottek Hearing Model (SHM), standardized on ECMA 418-2, as features to a regression model with different degrees of non-linearity, namely: linear models, KANs, and Tree-based models (XGBoost). Those represent also different levels of interpretability from which an accuracy-interpretability trade-off is identified. Our results indicate that pre-trained acoustic representations can provide a more general solution for aircraft-noise sound-quality prediction, while non-linear regression on psychoacoustic features improves performance relative to linear baselines but may remain constrained by the lack of flexibility/contextual cues. These findings support the use of efficient pre-trained models as a practical route to general sound-quality metrics for aircraft-noise assessment. Additionally, if interpretability is desired, a hybrid approach of identifying annoying sounds with a neural network and then performing a fine-grained analysis with psychoacoustic parameters is also a promising approach.

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