

# PSYCHOACOUSTIC INDEX ESTIMATION FOR FIELD STUDIES: INVESTIGATION OF THEIR POTENTIAL BENEFIT FOR AIRCRAFT NOISE ANNOYANCE

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## ABSTRACT

Different works have shown the interest of psychoacoustic indices to account for annoying auditory sensations evoked by environmental noises. Short-term noise annoyance experiments have shown the relevance of these indices, leading to the proposal of annoyance models based on noise sensitivity and psychoacoustic indices. As these indices have to be calculated from audio recordings, their use is too time-consuming for field studies. For aircraft noise annoyance models based on noise sensitivity and psychoacoustic indices, the current work proposed to build relationships that allow an estimation of these indices from  $L_{den}$  index given by noise maps. The study presents the construction of these relationships, their testing using a new data set, and the testing of annoyance models based on noise sensitivity and these indices using  $L_{den}$  and data from a socio-acoustic survey. The testing of the relationships indicated their relevance for a future use in field studies dealing with environmental noise assessment. Thanks to the proposed relationships, the testing of noise annoyance models using field data was possible. It revealed that the models based on noise sensitivity and psychoacoustic indices estimated from  $L_{den}$  performed better than existing annoyance models based on  $L_{den}$  or on the day-night level  $L_{dn}$  and noise sensitivity.

**Keywords:** *Psychoacoustic index, noise annoyance, aircraft noise.*

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## 1. INTRODUCTION AND RESULTS

Few works have tested noise annoyance models proposed in the literature by using a new set of survey data (e.g. [1]). More rarely is the testing of models considering other variables than the sole energy-averaged index. The lack of model testing contributes to limit the long-term goal of improving noise annoyance prediction.

Different works carried out under laboratory conditions have shown the interest of psychoacoustic indices to account for annoying auditory sensations evoked by environmental noises. Short-term noise annoyance studies have led to the proposal of annoyance models based on noise sensitivity and psychoacoustic indices. But the use of such models in field studies leads to issues, as audio recordings are needed for the calculation of most of the psychoacoustic indices. This is an important limitation to test noise annoyance models based on such indices.

A methodology has been proposed to estimate various psychoacoustic and noise indices from the A-weighted equivalent sound pressure level,  $L_{Aeq}$ , of different transportation noise sources using field index databases. The work was carried out for urban and suburban road traffic noise, railway traffic noise in urban areas, and aircraft noise in cities in the vicinity of French international airports. Using a new set of field index data, the study successfully assessed the prediction quality of the estimation of the psychoacoustic and noise indices from  $L_{Aeq}$  of the transportation noise sources. From the new set of field index data, the methodology proposed in [2] to estimate psychoacoustic indices was also assessed with satisfaction. The obtained relationships between the various indices and  $L_{Aeq}$  of the transportation noise sources might be of interest for field studies assessing transportation noises in urban areas.

The built relationships were used to test noise annoyance models, based on noise sensitivity and various noise and psychoacoustic indices, such as loudness. Prediction quality assessment was carried out using survey data stemming from the study of Ecotière *et al.* [3]. All this work will be presented in a forthcoming paper.

The current communication will concern the part of this work, dealing with aircraft noise. The built relationships allow an estimation of the various indices from  $L_{den}$  index given by noise maps. During the oral presentation, it will be shown the construction of these relationships, their testing using a new field index data set, and the testing of annoyance models [2] based on noise sensitivity and these indices using  $L_{den}$  and socio-acoustic survey data [3]. The testing of the built relationships and the ones proposed in [2] indicated their respective relevance for a future use in field studies dealing with environmental noise assessment. Thanks to the proposed relationships, the testing of noise annoyance models using survey data was possible. It revealed that the models [2] based on noise sensitivity and psychoacoustic indices estimated from  $L_{den}$  led to better correlations with measured noise annoyance than existing annoyance models solely based on  $L_{den}$  [4] or based on the day-night level  $L_{dn}$  and noise sensitivity [5].

The presentation will be structured as follows: 1) a brief presentation of the socio-acoustic survey; 2) the construction and testing of the relationships between  $L_{Aeq}$  of the aircraft noise sources and different psychoacoustic and noise indices using two different field index data sets; 3) the testing of psychoacoustic index-based aircraft noise annoyance models and their comparison with aircraft noise annoyance models solely based on  $L_{den}$  or based on the day-night level  $L_{dn}$  and noise sensitivity; 4) Results, discussions and conclusions.

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