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Title:

Exploring the Role of Loudness and Sound Character in Heat Pump Noise Annoyance

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Abstract:

This study presents a detailed analysis of how sound character influences the perceived annoyance of heat pump noise, based on data from the Annex 63 Heat Pump Listening Experiments of the International Energy Agency (IEA). These large-scale listening experiments were originally designed to investigate the impact of heat pump placement in residential environments, considering factors such as the number of units, their spatial arrangement, operating conditions, background noise, and noise barriers.

Using this dataset, the present work performs a secondary analysis focusing on perceptual sound characteristics. In particular, it examines the hypothesis that perceived loudness provides a more suitable description of annoyance than conventional sound level metrics, including A-weighted level. In addition, the study explores whether further psychoacoustic attributes, such as tonal components, roughness, and sharpness, contribute to annoyance beyond what can be explained by level or loudness alone.

To this end, sounds are systematically compared under controlled conditions of similar level or loudness, allowing the influence of specific sound characteristics to be investigated. While the dataset was not specifically designed for this purpose, it enables an initial assessment of the relevance of these perceptual factors.

The results provide indications that both hypotheses are supported: perceived loudness appears to be more closely related to annoyance than level-based measures, and additional sound characteristics further influence listener responses. These findings highlight the importance of considering both the intensity and the character of sound when analysing heat pump noise annoyance, while also pointing to the need for dedicated studies to confirm these effects.

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