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Title: Application of a new perceptually-accurate tonality assessment method

Abstract:

For many years in vehicle and other product noise assessments, tonality measurement procedures such as the Tone-to-Noise Ratio, Prominence Ratio and DIN 45681 Tonality have been available to quantify the audibility of prominent tones. Especially through the recent past as product sound pressure levels have become lower, disagreements between perceptions and measurements have increased across a wide range of product categories including automotive, Information Technology and residential products. One factor is that tonality perceptions are caused by spectrally-elevated noise bands of various widths and slopes as well as by pure tones, and usually escape measure in extant tools. Near-superpositions of discrete tones and elevated narrow noise bands are increasingly found in low-level technical sounds. Existing pure-tone methodologies tend to misrecognize an elevated noise band as general masking lowering the audibility of a tone in the measured vicinity, whereas perceptually they add. To address such issues a new psychoacoustically-based tonality model is presented which evaluates the nonlinear and time-dependent loudness of both tonal and broadband components, separating them via the autocorrelation function (ACF). Based on a hearing model of Sottek, the model has been validated by many listening tests. The model's background and current state are presented, with particular attention to automotive situations such as tonality perceptions inside electric and hybrid vehicles in stationary or low-speed operation, and IC sound design criteria balancing desired order tonalities and order-caused roughness.

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