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Title:

Loudness of sounds with a subcritical bandwidth: improved prediction with the concept of tonal loudness

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Abstract:

For narrowband signals with subcritical bandwidths, it is generally assumed that loudness is independent of bandwidth. This assumption is also demonstrated by standardized loudness models.

However, there are several published experimental studies that show different results. For example, Zwicker (1974) measured a positive level difference between a critical bandwidth noise and an equally loud pure tone. In 2010, our own experiments on loudness matching of a tone and bandpass-filtered pink noises showed similar results. In 2013, Hots et al. published two papers on the loudness of subcritical bandwidth sounds as a function of bandwidth, center frequency and level, and obtained similar results.

This implies that the loudness of pure tones compared to noise is underestimated by existing standards. Sottek's hearing model standardized in ECMA 418-2 for tonality and roughness calculation uses the specific loudness in an input step. An autocorrelation function separates tonal and non-tonal parts of a sound, resulting in two loudness components. This paper shows how Sottek's hearing model can be improved to achieve higher accuracy of overall loudness based on a suitable combination of these two partial loudnesses.

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