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Human perception of dichotic high-frequency complex sounds simulated with a two-channel count comparison model

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Abstract

The human auditory system uses binaural cues to localize sound sources. Sounds originating from off-midline directions are received with an interaural time difference (ITD) and an interaural level difference (ILD). Previous models simulating psychoacoustic results extracted ITDs using a cross-correlation approach that resembles so-called delay lines. However, mammals, including humans, are likely to extract ITD information without delay lines. Published physiological data have shown that lateral superior olive (LSO) cells are sensitive to envelope ITDs of sinusoidally amplitude-modulated (SAM) tones. Here, we propose a physiologically plausible model, by combining the well-established auditory periphery model by Bruce et al. (Hearing Research 2018) with a coincidence counting model of the LSO (Ashida et al. PLOS Comp. Biol. 12, e1004997, 2016). The latter integrates ipsilateral excitatory signals together with negatively weighted inhibitory signals from the contralateral ear using millisecond short coincidence windows. This version of the model uses very few free parameters to quantitatively account for a wide range of psychoacoustic data. It is demonstrated that the same binaural model neurons account for both ILD-based and ITD-based lateralization as well as their combinations.

Keywords: Binaural, Modelling

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