

Effects of interaural time differences in fine structure and envelope on lateral discrimination in bilateral electrical hearing

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Localization of sound sources is partly based on interaural time differences (ITDs). For lower frequencies, the neural stimulation pattern is synchronized to the phase of the carrier signal. Interaural difference of the phase, so called fine structure ITD, is important for determining the lateral position of the sound source. Bilateral cochlear implant (CI) listeners currently use stimulation strategies which encode ITD in the temporal envelope but which do not transmit ITD in the fine structure due to the constant phase in the electrical pulse train. The arbitrary interaural phase difference between the pulse trains causes uncontrolled fine structure ITD.

To determine the necessity for encoding ITD in the fine structure, ITD-based lateralization was investigated systematically with CI listeners and normal hearing (NH) subjects. Lateralization discrimination was tested at different pulse rates for various combinations of independently controlled envelope ITD and fine structure ITD. Special stimuli were used whose basic parameters are based on speech signals.

Fine structure ITD had the strongest impact on lateralization at lower pulse rates, with significant effects for pulse rates up to 800 pulses per second. At higher pulse rates, lateralization discrimination depended on the envelope ITD only. It is concluded that bilateral CI listeners benefit from transmitting fine structure ITD at lower pulse rates.

A comparison of the performance between CI and NH listeners reveals sufficient comparability, suggesting that tests with NH subjects could predict performance of CI listeners.