ACOUSTICS2008/3002
Modeling the precedence effect in inferior colliculus neurons using converging excitatory and inhibitory inputs

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Responses of a population model of low-frequency inferior colliculus (IC) neurons to a pair of broadband clicks were evaluated. IC inputs came from Hodgkin-Huxley models of medial superior olive (MSO) and cochlear nucleus bushy cells driven by a stochastic auditory nerve model. Each IC cell received converging inputs that were excitatory from ipsilateral MSO and inhibitory from contralateral MSO. Convergence of multiple excitatory, ipsilateral MSO inputs with similar interaural time difference (ITD) tuning improved ITD sensitivity and reduced the influence of MSO onset responses caused by monaural, rather than binaural, coincidences. Inhibition that lasted over several milliseconds suppressed IC responses to the lagging click. The effect of the inhibition depended on the ITD tuning of the excitation and inhibition converging on a given IC neuron. With appropriate convergence, the IC population showed no response to the lagging click at short delays, and responded to the lagging click but did not encode its ITD at intermediate delays. Only at longer inter-click delays did IC responses show sensitivity to the lagging click ITD, consistent with the perceptual phenomenon of the precedence effect. [Work supported by NSF and NIH].