Poster 2

SEPARATION OF CONCURRENT BROADBAND NOISE SOURCES
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The effect of spatial separation on the ability of subjects to hear both sounds in a pair of concurrent broadband sounds was examined. Noise bursts were filtered using the listeners' outer ear filter functions and delivered through in-ear tube-phones to create realistic sounds in virtual auditory space. Subjects were presented with pairs of these stimuli, which could come from the same or different locations in space, and responded as to whether they perceived one or two sources. Stimuli were separated (horizontally or vertically) about one of five reference locations on the audiovisual horizon (0, 22.5, 45, 67.5 and 90°). Angular separation and reference location were varied randomly from trial to trial and psychometric functions were obtained. Results showed that at more lateral locations, a larger horizontal separation was required for the perception of two sounds. The reverse was true for vertical separation. Furthermore, it was observed that subjects were unable to separate stimulus pairs if they delivered the same interaural differences in time (ITD) and level (ILD). This suggests strongly that the auditory system exploits differences in one or both of the binaural cues in detecting multiple sources, and cannot use monaural spectral cues effectively for this task. To examine the role of differences in ongoing ITDs, the experiment was repeated using high-passed (2 kHz) noise stimuli. Performance was degraded only for locations away from the midline. To remove all interaural timing information, the high-passed experiment was repeated at 0° with onset ITDs set to zero. Here performance deteriorated markedly, ruling out a major role for ILD under these conditions. In conclusion, the results indicate that the auditory system can perform the difficult task of separating concurrent noises, relying strongly on differences in onset ITDs and aided by differences in ongoing ITDs.

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THE RELATIONSHIP BETWEEN THE OUTPUT SYNCHRONY OF COCHLEAR NUCLEUS NEURONS AND THE SITE OF STIMULATION IN THE COCHLEA
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A model has been developed to determine the relationship between the output synchrony of cochlear nucleus neurons and the site of stimulation in the cochlea. This is an Integrate and Fire Neuron Model in which noisy periodic synaptic inputs to the neuron are summed and a spike is generated when the membrane potential reaches threshold. The model describes the stochastic input that auditory nerve fibres provide to a cochlear nucleus neuron and the corresponding stochastic output. To investigate the relationship between the output synchrony of cochlear nucleus neurons (namely globular bushy cells) and the site of stimulation in the cochlea, phase differences between the periodic inputs of the model were incorporated, in order to mimic how the travelling wave consecutively activates auditory nerve fibres originating over a spatial spread of the basilar membrane. Analysis of the model found that output synchrony decreased with an increase in frequency and spatial spread. Furthermore, enhancement of the output synchrony relative to the input synchrony occurred for small spatial spreads of the basilar membrane over which input primary afferent fibres originate. Adding noise helped to make the model more realistic. As a result enhancement of synchrony occurred with a spatial spread of less than 1.25 mm and 0.75 mm for 0.5 kHz and 1 kHz respectively, while for the higher frequencies analysed (2 kHz and 5 kHz) enhancement of synchrony did not occur. This research has implications for the design of electrode arrays in cochlear implants. The number and geometry of the electrodes and the stimulus patterns to be used will depend on the degree of convergence of fibres and how phase information is processed by neurons in the brainstem.
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