Abstract

The central theme of this thesis is a description of information processing in the sound localization circuit of the auditory pathway. The focus is on principal neurons of the medial superior olive (MSO), the first major convergence point for binaural information. Selected properties and relations of MSO neurons are derived and expressed through models.

In the thesis we present three modeling studies. The first one clarifies a relationship between biophysical parameters of the MSO neuron and its ability to detect coincidental spikes from the left and the right ear. The second study describes the statistical behavior of spike trains on the input and output of the MSO neuron. In the third work, we studied how interaural coherence could guide localization of sound sources in complex listening situations with multiple sound sources in reverberant environments.

The main results are analytical and numerical models describing the aforementioned relations and behaviors. Secondary results include that inhibitory input to the MSO neuron narrows and shifts the time range of coincidence detection, that ergodic assumption from statistical physics and circular statistics are beneficial in the description of spike trains in the auditory pathway, and that interaural level difference of parts of the signal with high interaural coherence could explain human localization performance in complex listening scenarios.

Keywords

binaural hearing, binaural neuron, model, sound localization