In search of the best stimulus: an optimization procedure for finding efficient stimuli in the cat auditory cortex.

By elsec_admin
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By elsec_admin November 13, 2011


Abstract:

Units in the auditory cortex of cats respond to a large variety of stimuli: pure tones, AM- and FM-modulated signals, clicks, wideband noise, natural sounds, and more. However, no single family of sounds was found to be optimal (in the sense that oriented lines are optimal in the visual cortex). The search for optimal complex sounds is hard because of the high dimensionality of the space of interesting sounds. In an effort to overcome this problem, an automatic search procedure for finding efficient stimuli in high-dimensional sound spaces was developed. This procedure chooses the stimuli to be presented according to the responses to past stimuli, trying to increase the strength of the response. The results of applying this method to recordings of population activity in the primary auditory cortex of cats are described. The search was applied to single tones, two-tone stimuli, four-tone stimuli and to a two-dimensional subset of nine-tone stimuli, parametrized by the center frequency and the fixed difference between adjacent frequencies. The method was able to find efficient stimuli, and its performance improved with the dimension of the sound spaces. Efficient stimuli, found in different optimization runs using population activity recorded from the same electrode, often shared similar frequencies and pairs of frequencies, and tended to evoke similar levels of activity. This result indicates that a global analysis of the location of spectral peaks is performed at the level of the auditory cortex.

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