Dependence of (NoSπ)tau detection thresholds on noise statistics and its implication for binaural modelling

Steven Van De Par*[1], Constantine Trahiotis[2], Leslie Bernstein[2], and Armin Kohlrausch[3]

[1]Carl von Ossietzky University Oldenburg, Cluster of Excellence Hearing4all, Acoustics Group – Germany

[2]University of Connecticut Health Center, Departments of Neuroscience and Surgery (Otolaryngology) – United States

[3]Eindhoven University of Technology, Human-Technology Interaction, Dept. of Industrial Engineering Innovation Sciences – Netherlands

Abstract

An interaurally out-of-phase tone added to a diotic narrow-band noise can be detected based on the interaural cues it creates. Accounts for such NoSπ detection thresholds have been made based on cross-correlation models, Equalization Cancellation models, and on models that evaluate the fluctuations of interaural phase differences (IPDs) caused by the addition of the signal. When the complete NoSπ stimulus is interaurally delayed (referred to as (NoSπ)tau), detection thresholds have been found to increase gradually. In cross-correlation-based models this is attributed to the ability to evaluate the interaural cross correlation at a compensatory delay which has increased internal noise. At the same time accounts based on IPD processing will also predict increased detection thresholds because with increasing delays of the (NoSπ)tau stimulus, IPDs in the noise alone condition will show increased fluctuations. This is due to variations in instantaneous frequency of the delayed narrow-band noise alone which will convert the applied constant time delay into fluctuating IPDs. The goal of the present study is to contribute new data that may have the potential to distinguish between the competing approaches for modelling binaural detection. The main idea is to perform binaural detection experiments for noise maskers with highly different statistics which affect the statistics of the discussed binaural detection cues in different ways. In this study we will present data with three different types of noise centred at 500 Hz with a bandwidth of 80 Hz, that differ in terms of both their instantaneous frequency and their envelope properties. The binaural configuration was (NoSπ)tau with 11 tau-values ranging from 0 to 3 ms. Besides Gaussian noise, single-multiplied noise with the signal added in 90 degrees phase relative to the masker fine structure, and low-noise noise maskers were used. For a cross-correlation based detection the change in correlation as a function of signal level is the same for all three masker types, provided that no peripheral compression is assumed. In contrast, strong differences exist in the distribution of IPDs when an interaural delay in the stimulus is introduced.

The presented data, therefore, should provide material for critically testing binaural detection models. The data reveal minor influences of noise statistics on the detection thresholds which seems to indicate that these data are difficult to explain with a metric based on pure stimulus IPD fluctuations.

*Speaker