

Frequency Selectivity of Auditory-Nerve Fibers Studied with Band-Reject Noise

Leonardo Cedolin¹, Bertrand Delgutte² *¹Speech and Hearing Sciences Program, Harvard-MIT Division of Health Sciences and Technology, 77 Massachusetts Ave., Cambridge, MA 02139, ²Eaton-Peabody Laboratory, Massachusetts Eye & Ear Infirmary, 243 Charles Street, Boston, MA 2114*

The notched-noise method (Patterson, J. Acoust. Soc. Am. 59:640-654) is widely used for estimating auditory filters in humans and other species based on psychophysical masking data. To test the physiological validity of this technique, we recorded from auditory-nerve fibers in anesthetized cats using the same stimulus paradigms as in psychophysics. Neural auditory filters derived by the notched-noise method were compared with pure-tone tuning curves measured in the same fibers.

Stimuli were pure tones in band-reject noise, with rejection bands placed both symmetrically and asymmetrically around the tone frequency. The tone was always near the fiber's characteristic frequency (CF), 10-20 dB above threshold. For each notch width, we determined the threshold noise level which just masked the increment in average rate produced by the tone. Auditory filter models were fit to neural threshold curves by assuming that, for each fiber, threshold corresponds to a constant signal-to-masker ratio at the filter output.

Patterson's rounded exponential function gave good fits (0.5-4 dB rms error) to neural masked thresholds throughout the 0.2-23 kHz range of CFs. Models with a low-frequency tail produced the best fits for high-CF (> 3 kHz) fibers, while models without a tail sufficed for low-CF fibers. Both the center frequencies and the bandwidths of the fitted filters were, on the average, consistent with comparable measures for pure-tone tuning curves. However, for some fibers, the model filters were more symmetric than the tuning curves around their center frequency.

Our results indicate that the notched-noise method is applicable to auditory-nerve fibers, and gives estimates of frequency selectivity broadly consistent with pure-tone tuning curves. This quantitative description of auditory filters for individual fibers will allow us to devise neural population models for testing whether psychophysical auditory filters match the corresponding neural filters.

Supported by NIH Grant RO1 DC02258