BMC Neuroscience

Poster presentation

Open Access

Sources of interspike interval variability in locust auditory receptor cells

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from Eighteenth Annual Computational Neuroscience Meeting: CNS*2009
Berlin, Germany. 18–23 July 2009

Published: 13 July 2009

BMC Neuroscience 2009, **10**(Suppl 1):P311 doi:10.1186/1471-2202-10-S1-P311

This abstract is available from: http://www.biomedcentral.com/1471-2202/10/S1/P311

The functional properties of auditory receptor neurons of locusts are well understood in terms of a signalling cascade composed of a sequence of linear filters and static nonlinearities [1,2]. The filter elements were measured indirectly from the spike response recorded from the auditory nerve, thus leaving the ear intact. However, little is known about the biophysical mechanisms of the underlying auditory transduction process. In this study, we investigate properties of the receptor current that can be indirectly inferred from the interspike interval statistics of the spike train response.

Intracellular recordings were performed from auditory nerve fibres of *Locusta migratoria* during simultaneous acoustic stimulation with pure tones of various intensities. The obtained interspike intervals (ISIs) showed high variability with CVs up to 0.8 depending on sound intensity. The ISI histograms were successfully fitted with the probability density function of ISIs that was derived for the perfect integrate-and-fire (PIF) neuron driven by white noise [3], suggesting that the receptor current drives the spike generator in the superthreshold limit-cycle regime. In addition, the PIF theory potentially allows inferring indirectly the noise strength of the receptor current from the ISI distribution of the spike trains recorded from the auditory nerve, hence leaving the ear intact. This noise strength as a function of sound intensity shows a pronounced peak in the lower part of the receptor cells' dynamic range. By means of simulations of single-compartment conductance-based models we test different assumptions of possible noise sources. In particular we focus on the stochastic opening of the receptor channels and other ion channels whose activation is strongly correlated to sound intensity, like the ones carrying the adaptation current and channels that play a significant role in spike initiation. The results from the indirect methods are important to ensure that direct measurements do not severely damage the auditory transduction machinery.

References

1. Gollisch T, Schütze H, Benda J, Herz A: **Energy integration describes sound-intensity coding in an insect auditory system.** *J Neurosci* 2002, **22:**10434-10448.
2. Gollisch T, Herz A: **Disentangling sub-millisecond processes within an auditory transduction chain.** *PLoS Biol* 2005, **3:**e8.
3. Gerstein GL, Mandelbrot B: **Random walk models for the spike activity of a single neuron.** *Biophys J* 1964, **4:**41-68.