Moezzi, Bahar; **Iannella, Nicolangelo**; **McDonnell, Mark D.**

Ion channel noise can explain firing correlation in auditory nerves. (English) Zbl 1382.92071

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Summary: Neural spike trains are commonly characterized as a Poisson point process. However, the Poisson assumption is a poor model for spiking in auditory nerve fibres because it is known that interspike intervals display positive correlation over long time scales and negative correlation over shorter time scales. We have therefore developed a biophysical model based on the well-known Meddis model of the peripheral auditory system, to produce simulated auditory nerve fibre spiking statistics that more closely match the firing correlations observed in empirical data. We achieve this by introducing biophysically realistic ion channel noise to an inner hair cell membrane potential model that includes fractal fast potassium channels and deterministic slow potassium channels. We succeed in producing simulated spike train statistics that match empirically observed firing correlations. Our model thus replicates macro-scale stochastic spiking statistics in the auditory nerve fibres due to modeling stochasticity at the micro-scale of potassium channels.

MSC:

92C20 Neural biology
92C05 Biophysics

Keywords:

inner hair cell; auditory nerve; neural variability; channel noise; correlation; potassium channel

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