# Analysis and Simulation of the Neurophonic Potential in the Laminar Nucleus of the Barn Owl

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It is a challenge to understand how the brain represents temporal events. One of the most intriguing questions is how sub-millisecond representations can be achieved despite the large temporal variations at all levels of processing. For example, the neurophonic potential, a frequency-following potential occurring in the network formed by nucleus magnocellularis and nucleus laminaris in the brainstem of the bird, has a temporal precision below 100 microseconds.
Here we address the question of how the neurophonic potential is generated and how its remarkable temporal precision is achieved, using a theoretical model. The neurophonic potential consists of at least three spectral components, and our studies aim at revealing their origin. Our hypothesis is that magnocellular axons are the origin of high-frequency component of the neurophonic, whereas action potentials in the laminar neurons are the origin of the 1-2 kHz component. We present an advanced analysis of in-vivo data, numerical simulations of the neurophonic, and analytical results to test this hypothesis. The analysis of the signal-to-noise ratio of the high frequency component of the neurophonic potential lets us estimate the number of independent sources to be at least 250, further implicating the magnocellular axons and indicating that the laminaris neurons alone can not be the source of neurophonic potential.
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