

## Comments

### Comment by de Cheveigné:

In your talk you pointed out that EPSPs are as short in NA as in NM (which is thought to relay accurate temporal features). This is obvious when comparing Figs. 3A and 3B. If NA plays the role of coding the relatively slowly varying sound intensity information needed for example for localization on the basis of ILD, it is hard to see how short EPSPs are of use. Maass (1997,1998) has suggested that filters with arbitrary impulse responses can be synthesized by combining EPSPs and IPSPs, appropriately delayed by presynaptic delays. The shorter the PSPs, the wider the frequency range over which the filter is effective. One might make the following conjecture: input patterns undergo temporal (or spatiotemporal) filtering within the dendrites of NA cells. The reliability of such processing would require stability of synaptic strength, as observed overall in NA but not NM. Short-term plasticity effects observed might reflect adjustments of this filtering. If this conjecture is true, it would imply that non-trivial processing occurs at a very peripheral stage.

Maass, W. (1997) Networks of spiking neurons: the third generation of neural network models. *Neural Networks* 10, 1659-1671.

Maass, W. (1998) On the role of time and space in neural computation. Lecture notes in computer science 1450, 72-83.

### Reply:

While it is true that the excitatory postsynaptic currents in NA neurons are nearly as short as those in NM, the resulting excitatory postsynaptic potentials are generally longer in NA (~9 ms half-decay, unpublished observations) compared to NM (~1.5 ms half-decay, Zhang and Trussell 1994). This is likely to be due to the larger membrane capacitance and slower membrane time constant in NA (NA: 3.2-16.4 ms, Soares *et al.* 2002; NM: 1.9 ms, Reyes *et al.* 1994). Many NA neurons can and do integrate spatially and temporally the incoming EPSPs arriving from the auditory nerve afferents, which carry intensity information in their rate.

In fact, *in vivo* data suggest that input patterns may undergo filtering within the dendrites of NA cells, because different response patterns emerge in NA (Köppl and Carr 2003). There are 5 main physiological types in the barn owl which show basic similarities to responses in the mammalian cochlear nucleus. In this paper, we propose that one particular measure of intensity information coding depends on maintaining EPSC (and thus EPSP) amplitude, but this does not preclude other (non-ILD) computational effects for which a constant-amplitude input would be desirable, such as the specific filtering properties you propose. We agree that differentially tuned plasticity implies that non-trivial processing occurs at the cochlear nucleus, and we hope that understanding the plasticity will help us understand the computational capacity of these nuclei.

- Reyes, A.D., Rubel, E.W., and Spain, W.J. (1994) Membrane properties underlying the firing of neurons in the avian cochlear nucleus. *J Neurosci* 14, 5352-5364.
- Zhang, S. and Trussell, L.O. (1994) A characterization of excitatory postsynaptic potentials in the avian nucleus magnocellularis. *J Neurophysiol* 72, 705-18.