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POSTER PRESENTATION

The effect of synchronized pauses on the coding strategies of cerebellar nuclear neurons: a modeling study

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Purkinje cells (PC) of the cerebellar cortex have two distinct firing signatures: simple and complex spikes. The simple spikes are due to the intrinsic mechanisms of the cell and synaptic inputs coming through the parallel fibers and molecular layer interneurons [1-3]. The PCs also emit complex spikes, which are due to strong excitation coming from the axons of the inferior olive cells, the climbing fibers [2]. The simple spikes are highly regular intertwined with short pauses [4] while complex spikes occur sporadically and consist of burst of spikelets [5-7]. How can the cerebellar nuclei neurons downstream of the PCs make sense of this complex firing pattern?

In this study we analyze how PC synchrony in the context of "pauses" in simple spikes affects different coding mechanisms of the neurons of the cerebellar nuclei. To this end, we use a computational model of a cerebellar nuclear neuron [8] and synthetic PC spike trains. The coding mechanisms of cerebellar nuclear neuron can be broadly categorized as rate [9,10] and time coding [11]. We define PC synchrony as synchronized Purkinje neuron pauses with either pause beginning or pause ending spikes precisely synchronized [4]. With varying amount of pause synchrony for the above mentioned synchrony types, we analyzed its effects on time locking and rate coding in a nuclear cell.

We find that both the amount and type of pause synchrony is encoded as rate increases in the firing of the nuclear cell. Synchronized pauses briefly release the nuclear neuron from inhibition giving rise to well-timed spikes. Further, pauses synchronized with pause ending spikes caused greater firing rate modulation in the nuclear cell while pause beginning type synchrony enhanced the degree of timelocking. We also analyze the effect of pause length and spike jitter on the timelocking phenomenon of the nuclear neuron. We argue that these results lead to better understanding of how PC pause synchrony is processed in its target nuclear neuron.

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