Changes in functional properties of LGN neurons with contrast and their significance in information transmission

DA Butts1, C Weng2, JZ Jin2, CI Yeh2, NA Lesica1, JM Alonso2, GB Stanley1

Neurons in the early visual pathway encode visual stimuli changes over the wide range of contrasts present in the visual world. Here, we describe contrast adaptation of neurons in the lateral geniculate nucleus (LGN) of anesthetized cat, and interpret the significance of the changes in their functional properties in the context of information processing. Multiple LGN neurons were recorded during the presentation of temporal white noise (full-field flicker), spatiotemporal white noise, and natural movies in two different contrasts (low contrast LC and high contrast HC). Preliminary analysis shows that while the firing rates were slightly lower in LC, they were significantly higher than what would be expected if no contrast adaptation occurred. Furthermore, neurons responded to the similar stimulus features in high and low contrast with only slightly different temporal precision. However, responses in the HC condition were more reliable, meaning spiking events were more consistent across multiple repeats of the same stimulus. Conversely, neurons in the LC condition responded at more times during the experiment, *i.e.*, their responses were less sparse. These extra firing events in LC had the effect of nearly maintaining the average firing rate of the neuron across contrasts (despite lower reliability in LC), but these combined effects resulted in less information about the LC visual stimulus being conveyed. Overall, our findings are consistent with LGN neurons using multiple strategies to preserve their functional role in visual processing over nearly an order of magnitude change in contrast.

Supported by Charles King Trust Postdoctoral Fellowship and NGIA Grant HM1582-05-C-0009 to DAB and GBS, NIH-EY05253 and SUNY Research Foundation to CW, JZJ, CIY, and JMA.

Keywords: lateral geniculate nucleus, LGN, vision, information, contrast, thalamus, physiology

1Division of Engineering and Applied Science (DEAS), Harvard University, Cambridge, MA 02138
2Department of Biological Sciences, State University of New York – State College of Optometry, New York, NY 10036