

The effects of contrast adaptation during natural stimulation

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Neurons in the early visual pathway are known to adapt their response properties to the statistical properties of the visual stimulus. While many studies have characterized this adaptation during simple stimulation (gratings, white-noise, etc.), there have been no studies of the functional effects of adaptation during natural stimulation. In this study, we analyze the responses of LGN cells (recorded extracellularly in anesthetized cats) to natural scene movies of different contrasts. To characterize the functional effects of adaptation, we fit independent linear-nonlinear (LN) models to the responses to high and low contrast movies. We characterize the linear part of the model by using least-squares estimation to estimate the spatiotemporal RF directly from the natural scene responses, correcting the estimate for the autocorrelations in the stimulus. We characterize the nonlinear part of the model by using the RF estimate to predict the response of the neuron, and comparing this linear prediction to the actual response. Contrast adaptation appears to affect both the linear (latency, spatial and temporal tuning) and nonlinear (gain, offset) components of the model in a manner that is consistent with results from previous studies. The results suggest that adaptation may play an especially important role in the processing of natural stimuli, as the adaptive changes that we observe appear to be well suited to the processing of stimuli with natural statistics.

Keywords: lateral geniculate nucleus, thalamus, LGN, vision, adaptation, receptive field, natural scenes, contrast

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