A model of extra-classical surround suppression in the lateral geniculate nucleus (LGN)

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We have developed a large scale spiking neuron model of LGN constrained by anatomical and physiological data taken from monkey magno and parvo layers and cat layer A X-cells. Here we present simulations that address extra-classical surround suppression as well the direction tuning of this suppression for stimuli composed of drifting gratings. The suppression we observe in the model is exclusively generated by inhibitory inter-neurons and agrees well with experimental data. Its mechanism relies on the retinotopy and LGN cell density in the model, but does not require more subtle features such as extra-classical surround suppression of retinal ganglion cells, synaptic depression/facilitation, adaptation, cortical-LGN feedback etc. The direction tuning of the surround suppression observed in the model is generated by a combination of the stimulus discontinuity at the aperture-annulus border, sparseness of the LGN connectivity and sparsity in visual space. The model predicts that a difference in sparseness of the LGN connectivity may explain the difference in the degree of surround orientation tuning observed in monkey and cat.

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