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THE OPTIMAL VISUAL CODING RELATED TO EYE MOVEMENTS

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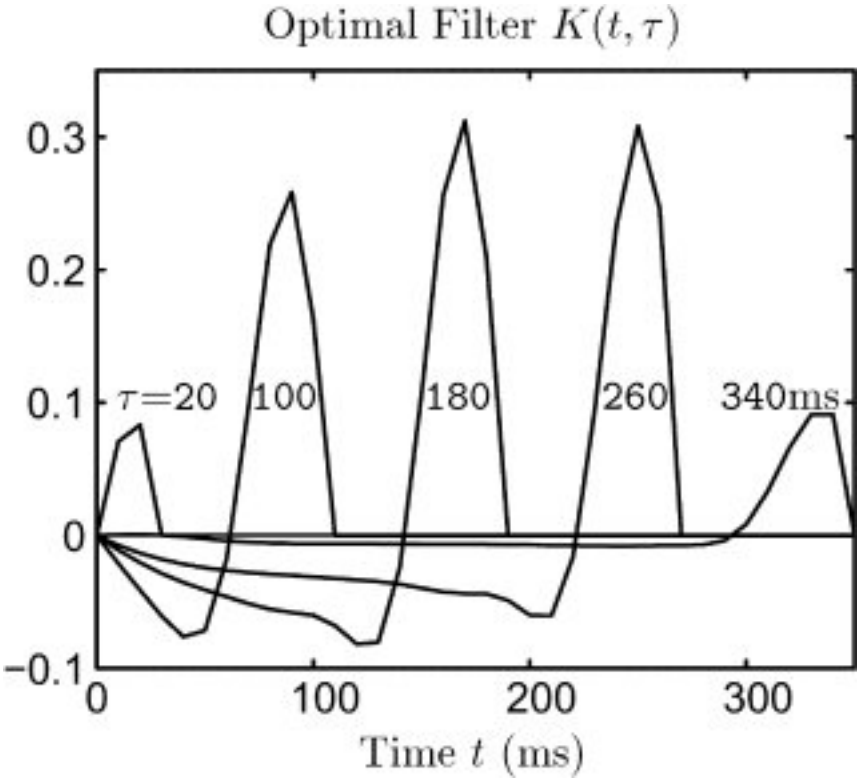
Purpose: We explore the hypothesis that the lateral geniculate nucleus (LGN) is responsible, among other things, for the improvement of the visual representation efficiency through temporal decorrelation of the retinal signal (Dong and Atick 1995). Based on the measurements of temporal correlations of visual input during free viewing of natural time-varying images, we predict that the optimal temporal coding changes dynamically according to the relative timing to saccades.

Methods: Since the macro saccades effectively remove the temporal correlation between two signals before and after a saccade (Woods, Stringer, and Dong 2001), the optimal coding requires decorrelation of the highly correlated temporal signal between saccades, i.e., during fixations and smooth pursuits.

Results: The efficiency of coding is further improved by removing the correlations during fixations and smooth pursuits. The predicted optimal temporal filter K(t, τ) in the time interval between two saccades is shown in the figure, in which τ is the time since the first saccade (the causality requires that a temporal filter only has non-zero values for t < τ).

Conclusions: The optimal filters for different relative timing between two saccades have different shapes ranging from low-pass to band-pass, as required by the efficiency coding of visual information during eye movements.



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