Spatiotemporal Receptive Fields of MT Cells during Smooth Eye Movements

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Psychophysical studies have revealed systematic localization errors during eye-movements. These localization errors may provide insight into the mechanisms underlying perceptual space constancy. Yet, the neural basis of these localization errors remains unknown. Accordingly, we have developed a method that allows us to map spatial receptive fields (RF) continuously during gaze changes. We are currently using this dynamic noise mapping stimulus in area MT of awake, behaving monkeys (M. mulatta) to study the changes in space-time RF properties during smooth eye-movements.

The mapping stimulus is composed of randomly positioned, flickering bars, which are spatially low-pass filtered. The stimulus is displayed during fixation or while optokinetic nystagmus is induced by a random dot pattern that moves either to the left or to the right and fills the entire screen. In the analysis we correct for eye position and use reverse correlation to determine the linear RF kernels in retinal coordinates.

The spatiotemporal kernels mapped this way during fixation agree well with both the spatial RF and direction preferences mapped with traditional methods. We employed cross correlation analysis (CCA) to determine the shift that resulted in the best match of the RF kernels for the different experimental conditions. For a considerable proportion of cells the peak of the CCA was obtained for spatial shifts different from zero indicating a modulation or shift of the RF kernel during OKN. We suggest that these eye-movement induced changes in the RF kernel could be the neural basis for spatial mislocalization during smooth eye movements.