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Abstract:

Modeling the Receptive Field Organization Of Optic Flow Selective MST Neurons

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The visual motion in optic flow informs moving observers about their heading direction, in part, by activating medial superior temporal (MST) neurons. We presented large-scale optic flow stimuli and smaller local planar motion stimuli while recording the responses of macaque MST neurons. Our goal is to assess receptive field mechanisms of MST neuronal responses and test the hypothesis that that interactions between simultaneously activated directional sub-fields contributes to optic flow selectivity.

Two monkeys were trained to maintain centered visual fixation while viewing optic flow stimuli, single local motion stimuli, and simultaneously presented dual local motion stimuli. Most MST neurons responded vigorously to select sub-sets of the optic flow and single local motion stimuli. Responses to dual local motion stimuli revealed direction selectivities that were different from those obtained with single site local motion stimuli.

We used Gaussian functions to model the direction selective sub-fields of MST neuronal receptive fields. A genetic algorithm was implemented to search for optimal parameters to fit the neuronal data. Optimization across preferred directions, strength of direction selectivity, excitatory or inhibitory influences, and sub-field number, location, and dimensions were included along with terms to incorporate non-linear interactions between sub-fields. Some neurons yielded good fits without sub-field interactions, whereas others required the imposition of substantial interaction effects to fit the data.

We find that MST receptive fields can be modeled as combined excitatory and inhibitory sub-fields with different planar direction selective response properties. Interactions between the sub-fields appear to contribute to response selectivity for large field optic flow stimuli relevant to the perception of self-movement heading direction.