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INTEGRATING VISUAL MOTION RESPONSES FROM NEURONS IN CORTICAL AREA MT BY ADAPTIVE FILTER SELECTION.

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A moving object excites many motion-sensitive neurons in the visual cortex. How could this distributed representation of motion be used to estimate the velocity of the object for eye tracking? The integration must be a dynamic process, dependent on properties of the visual stimulus such as contrast, spatial frequency, binocular disparity, color, and transparency or occlusion. We have developed a model for estimating the velocity of an object in visual area MT that is based on adaptive filter selection. The model assumes two sets of units with local receptive fields. One set of units computes local estimates of motion (using the motion energy model of Adelson and Bergen with physiologically determined parameters). The second set of units computes the relevance or reliability of each local motion estimate based on the estimate itself and additional information from the image. Outputs from this second pool of units can "gate" the outputs from the first pool of units through a gain control mechanism. This gating occurs before the local motion estimates are integrated to form more global estimates. The proposed mechanism of gain control is consistent with measured responses of MT cells under conditions of interfering transparent motions. The active process for selecting only a subset of visual motion responses for integration distinguishes our model from previous models of velocity estimation. The model yields accurate velocity estimates from synthetic images of moving targets of varying size, luminance, and spatial frequency profile. In addition, the sensitivity of the output of the model to both the acceleration and the velocity of moving targets is qualitatively similar to that observed in primate smooth pursuit tracking experiments. (Supported by the Howard Hughes Medical Institute).