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A COMPUTATIONAL MODEL OF MOTION PROCESSING IN AREA MST: *LEARNING TO SEGMENT THREE-DIMENSIONAL MOVING OBJECTS*

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Many cells in the dorsal part of the medial superior temporal (MSTd) area of visual cortex respond selectively to spiral motions that combine both expansion/contraction and rotation motions (Graziano *et al.*, 1994). It has been suggested that these MST responses convey information about the heading of a moving observer. Models based on this hypothesis (Lappe & Rauschecker, 1993; Perrone & Stone, 1994) have considered cell responses in the limited condition of an observer moving through a static environment. Our model is based on an alternative hypothesis, that MSTd is responsible for segmenting moving objects and that selective tuning of MSTd cells reflects the grouping of object components undergoing coherent motion. Such a grouping operation is essential in interpreting scenes containing multiple objects, each with its own motion based on its three-dimensional (3-D) position and velocity relative to the observer. Inputs to the model were generated from sequences of ray-traced images that contained a variety of shapes undergoing independent 3-D motion under different lighting conditions and settings. Local motion was represented using population codes to model response properties of neurons in area MT, which provides the primary input to area MST; the connectivity between units in the model was based on the receptive field properties of MSTd cells. After applying a self-supervised learning algorithm, the units became tuned to patterns signalling coherent motion, including many spiral patterns, in a manner that was invariant to object shape and position within a unit's receptive field. These results match many of the known properties of MSTd cells and are consistent with recent studies indicating that these cells process 3-D object motion information (Lagae *et al.*, 1994). Supported by the Office of Naval Research.