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Perceptual Organization and the Representation of Natural Form

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ABSTRACT

To support our reasoning abilities perception must recover environmental regularitiesâ€"e.g., rigidity, â€œobjectness,â€ axes of symmetryâ€"for later use by cognition. To create a theory of how our perceptual apparatus can produce meaningful cognitive primitives from an array of image intensities we require a representation whose elements may be lawfully related to important physical regularities, and that correctly describes the perceptual organization people impose on the stimulus. Unfortunately, the representations that are currently available were originally developed for other purposes (e.g., physics, engineering) and have so far proven unsuitable for the problems of perception or common-sense reasoning. In answer to this problem we present a representation that has proven competent to accurately describe an extensive variety of natural forms (e.g., people, mountains, clouds, trees), as well as man-made forms, in a succinct and natural manner. The approach taken in this representational system is to describe scene structure at a scale that is similar to our naive perceptual notion of â€œa

part,†by use of descriptions that reflect a possible formative history of the object, e.g., how the object might have been constructed from lumps of clay. For this representation to be useful it must be possible to recover such descriptions from image data; we show that the primitive elements of such descriptions may be recovered in an overconstrained and therefore reliable manner. We believe that this descriptive system makes an important contribution towards solving current problems in perceiving and reasoning about natural forms by allowing us to construct accurate descriptions that are extremely compact and that capture people's intuitive notions about the part structure of three-dimensional forms.

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