Shape from a Symmetric Universe

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Abstract

The problem of recovering shape from contour is generally context-sensitive and cannot be solved for from a single contour. This paper presents an approach to the shape from contour problem that does not rely on models, except in a very general sense. The underlying heuristic of this paper is that the world exhibits a high degree of symmetry and, wherever possible, a symmetric interpretation is preferred over an asymmetric one. A hierarchical approach is used where approximately planar skew symmetric regions are first detected in the image, and then axes of skew are recovered using SYMAN, a symmetry analyzer developed by the author. These skew symmetric regions tend to have several possible solutions for the set of skew axes; this *axial ambiguity* is resolved using context, determining which of these skew axes is globally consistent with a symmetric shape in the scene. There is also a second degree of ambiguity, referred to as gradient ambiguity. By using a context-sensitive gradient constraint, due to Stevens, the gradient solution of symmetric regions can be constrained but not determined uniquely. A set of image axes forming an image basis for the object space can be determined. From the set of image axes comprising the projected object basis, the corresponding 3D scene vectors can be found. Using this 3D orthogonal object basis, the gradients at symmetric regions are then solved for uniquely.

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