Deformable Primitives in Axial Representations of Shapes †

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RESUMÉ : Plusieurs critères ont été jusqu'ici proposés pour l'évaluation de la qualité d'une représentation de formes. En particulier, la richesse du support local et l'aptitude à résumer l'information (Brady[1983]) sont considérés comme des conditions primordiales dans l'élaboration d'un mode de représentation efficace. Cet article présente un mode de représentation régionale de formes bidimensionnelles, qui tout en satisfaisant ces critères mène à une description extrèmement concise. Partant de la représentation axiale d'une forme, la procédure proposée définit un ensemble de primitives déformables choisies de façon à améliorer la consistance locale de chaque primitive avec la forme étudiée, tout en maximisant sa contribution spatiale à l'intérieur de la forme.

ABSTRACT: Several important criteria have been suggested in the literature for assessing the adequacy of a representation of shape. In particular, rich local support and subsumption (Brady[1983]) are considered to be key requirements for an efficient representation. This paper presents a region-based representation of two- dimensional shapes which tries to satisfy these requirements and leads to extremely concise descriptions. Starting from an axial representation of the shape under consideration, the proposed procedure defines new locally deformable primitives in such a way as to improve the local consistency between the shape and the primitives, while maximizing the spatial contribution of each primitive to the inside of the shape.

KEYWORDS: Region-based Representation, Axial Representation, Primitive Deformation, Medial Axis Transform.

1. Introduction.

The search for rich representations of the information available in images constitutes one of the main problems in computer vision. Any process of image analysis has two associate representations: one corresponding to its input and the other corresponding to its output (or equivalently to the input of the subsequent processing stage). A crucial dependency thus exists between the performance of a computer vision task and the qualities of the representations on which it is based. Several criteria have been proposed, by Marr[1982], Brady[1983] and others, for assessing the adequacy of a representation:

- a representation should be efficiently computable (accessibility).
- it should represent information at a variety of scales (scope and sensitivity).
- it should preserve information and be locally computable (rich local support).
- whenever possible, local descriptions should give rise to more global ones (subsumption).

In the particular case of two-dimensional shapes, the bibliography is extensive (see Ballard[1982], Davis[1986]) and reveals two classes of representations: those that refer to the one-dimensional contours of objects and those that describe the two-dimensional region occupied by an object.

1.1 Contour-based representations.

Although shape is intrinsically a two-dimensional notion, contour-based description are sometimes preferred owing to their simplicity and their robustness to partial occlusion. The various polygonal approximation methods (Ramer[1977]) are examples of this type of representation. Although, such methods are widely used, the resulting descriptions often suffer from lack of stability and do not easily lend themselves to the computation of shape characteristics such as surface, main axes, etc. More elaborate contour-based representations based on generalized Hough transform (Ballard[1981]), on curvature primitives (Asada[1986], Mokhtarian[1986]), or on autoregressive models (Dubois[1986]) produce better descriptions in terms of the above criteria, but involve more computation.

1.2 Region-based representations.

Region-based representations, for the most part, involve covering the shape under consideration with a series of instances of a simple standard-shaped primitive. The covering strategy may involve either decomposition or construction.

The decomposition approach attempts to subdivide the original shape into a minimal set of non-overlapping simpler elements which, when combined, form an approximation of the original shape. The main difficulty with this approach lies in the selection of a primitive element which lead to concise and yet precise representations of shapes under consideration. Representation through decomposition into quadtree (Grotsky[1983]) is based on this idea.

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