The propagated skeleton: a robust detail-preserving approach

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Abstract

A skeleton is a centered geometric representation of a shape that describes the shape in a simple and intuitive way, typically reducing the dimension by at least one. Skeletons are useful in shape analysis and recognition since they provide a framework for part decomposition, are stable under topology preserving deformation, and supply information about the topology and connectivity of the shape. The main drawback to skeletonization algorithms is their sensitivity to small boundary perturbations: noise on a shape boundary, such as pixelation, will produce many spurious branches within a skeleton. As a result, skeletonizations often require a second pruning step. In this article, we propose a new 2D skeletonization algorithm that directly produces a clean skeleton for a shape, avoiding the creation of noisy branches. The approach propagates a circle inside the shape, maintaining neighborhood-based contact with the boundary and bypassing boundary oscillations below a chosen threshold. By explicitly modeling the scale of noise via two parameters that are shape-independent, the algorithm is robust to noise while preserving important shape details. Neither preprocessing of the shape boundary nor pruning of the skeleton is required. Our method produces skeletons with fewer spurious branches than other state-of-the-art methods, while outperforming them visually and according to error measures such as Hausdorff distance and symmetric difference, as evaluated on the MPEG-7 database (1033 images).

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