
Presentation of several 3D thinning schemes based on Bertrand's P-simple points and critical kernels notions

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Abstract

Within the framework of Digital Topology, Gilles Bertrand has first proposed the notion of topological number. By computing two of these numbers, we can efficiently and locally verify whether a point is simple or not, i.e., whether its deletion of an object preserves both the number of connected components and the number of holes in the image (global concepts). In this case, we say that the topology of the image is well preserved.

Several algorithms based on the removal of simple points have been proposed in order to simplify objects in images, they are called thinning or skeletonization algorithms. Results produced by such algorithms are called skeletons. An algorithm based on the sequential deletion of simple points automatically preserves the topology. If it operates by the simultaneous deletion of simple points, a thinning algorithm must then implement different deletion strategies in order to preserve the topology (for example, do not simultaneously remove two adjacent simple points at one time - subfields strategy).

Gilles Bertrand has then proposed the concept of P-simple point, requiring the definition of a set P inside an object. Once the points of P are labeled in the image, we may locally characterize (by using topological numbers) whether a point is P-simple or not. This is a major contribution in the field of Digital Topology in several ways: - an algorithm removing only P-simple points automatically preserves the topology, no additional proof is required unlike most algorithms that were proposed before the P-simple points introduction, - if the points deleted by an existing algorithm are P-simple with P precisely being all the points deleted by the chosen algorithm, then the algorithm well preserves the topology. Otherwise, it requires a thorough examination.

Then, Bertrand has introduced critical kernels as a general framework to design thinning schemes in the category of abstract complexes. In fact, critical kernels constitute a generalization of P-simple points.

In this talk, several thinning schemes, based on either P-simple points or critical kernels will be recalled.

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