3D Thinning Algorithms

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Related projects:
- Assessment of tracheal stenoses, infra-renal aortic aneurysms, and colorectal polyps [7]  
- Quantitative analysis of tubular tree structures [8]  
- 3D Thinning Algorithms [9]  
- Thinning algorithms based on sufficient conditions for topology preservation [10]  

Lifetime from: 1997  
Lifetime to: 2012  

Short description: The thinning is an iterative layer by layer erosion until only the "skeletons" of the objects are left. We proposed various 3D thinning algorithms capable of extracting medial lines or medial surfaces as well.

Description:
Skeleton is a region-based shape descriptor which summarizes the general form of objects/shapes. An illustrative definition of the skeleton is given using the prairie-fire analogy: the object boundary is set on fire and the skeleton is formed by the loci where the fire fronts meet and extinguish each other.

Thinning is a frequently used method for making an approximation to the skeleton in a topology-preserving way. It is based on a digital simulation of the fire front propagation: the border points of a binary object that satisfy certain topological and geometric constraints are deleted in iteration steps. The entire process is then repeated until only the "skeleton" is left.

There are two types of 3D thinning algorithms: the curve--thinning type is used to extract medial lines or centerlines, while a surface--thinning type produces medial surfaces. We proposed various 3D thinning algorithms capable of extracting medial lines or medial surfaces as well.

Examples of different types of skeletal shape features in 3D:
The original object (left), its medial surface (middle), and its medial lines (right).

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A 3-subiteration surface-thinning algorithm [18], Palágyi, Kálmán [12], Computer Analysis of Images and Patterns, Aug 2007, Number 4673, Vienna, Austria, p.628 - 635, (2007)

A subiteration-based surface-thinning algorithm with a period of three [19], Palágyi, Kálmán [12], Pattern Recognition, Sep 2007, Number 4713, Heidelberg, Germany, p.294 - 303, (2007)


A family of topology-preserving 3d parallel 6-subiteration thinning algorithms [28], Németh, Gábor [24], Kardos Péter [26], and Palágyi Kálmán [12], Combinatorial Image Analysis (IWCA), May 2011, Number 6636, Madrid, Spain, p.17 - 30, (2011)


Isthmus-based Order-Independent Sequential Thinning [30], Kardos, Péter [26], and Palágyi Kálmán [12], IASTED International Conference on Signal Processing, Pattern Recognition and Applications (SPPRA), June 2012, Crete, Greek, p.28 - 34, (2012)


3D Parallel Thinning Algorithms Based on Isthmuses [32], Németh, Gábor [33], and Palágyi Kálmán [12], Advanced Concepts for Intelligent Vision Systems (ACIVS), Sep 2012, Volume 7517, Brno, Czech Republic, p.325 - 335, (2012)

Kategória: Skeletonization
http://www.inf.u-szeged.hu/ipcg/projects/3D_Thinning

Links:
[16] http://www.inf.u-szeged.hu/publication/a-3d-6-subiteration-thinning-algorithm-for-extracting-medial-lines
[26] http://www.inf.u-szeged.hu/biblio?f%5Bauthor%5D=413
[33] http://www.inf.u-szeged.hu/biblio?f%5Bauthor%5D=248