Qualitative and Quantitative Comparison of Curve and Surface Skeletons - A State of the Art Review

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Qualitative and Quantitative Comparison of Curve and Surface Skeletons – A State of the Art Review

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3D shape skeletons are useful in many fields such as shape representation, shape matching and animation. Both curve and surface skeletons can be extracted by a variety of methods that work on either polygonal mesh or voxel representations. However, the latest extensive comparison of such methods dates from 2007 [1].

In this work, we compare six mesh-based curve-skeletonization methods and ten voxel-based curve- and surface-skeletonization methods along criteria proposed in [1]: homotopy, invariance, thinness, centeredness, smoothness, detail preservation, and resolution robustness. Most tested methods were not included in [1]. Besides this qualitative comparison, we also propose a quantitative comparison based on the Haussdorff distance. Thereby, we extend our earlier work [2] which compared only mesh-based curve skeletonization methods qualitatively. All methods were tested on the same platform, for input volume resolutions ranging from 128^3 to 1000^3 voxels, and mesh resolutions from 10K to 500K faces respectively.

Figures 1 and 2 show a selection of our results. These show that, despite recent advances in the field, the fundamental robustness problem of skeletons is still open. Also, different methods produce significantly different skeletons from the same input. Both these observations apply to curve and surface, as well as to mesh-based and voxel-based skeletonization methods. This supports the claim that further fundamental and applied research is needed in the skeletonization field.

[1] N. Cornea, D. Silver and P. Min (2007) *Curve-Skeleton Properties, Applications and Algorithms*, IEEE TVCG 13(3):530-548.

[2] A. Sobiecki, H. Yasan, A. Jalba, and A. Telea (2013) *Qualitative Comparison of Contraction-based Curve Skeletonization Methods.* In Proc. ISMM, Springer LNCS 7883, 452-439

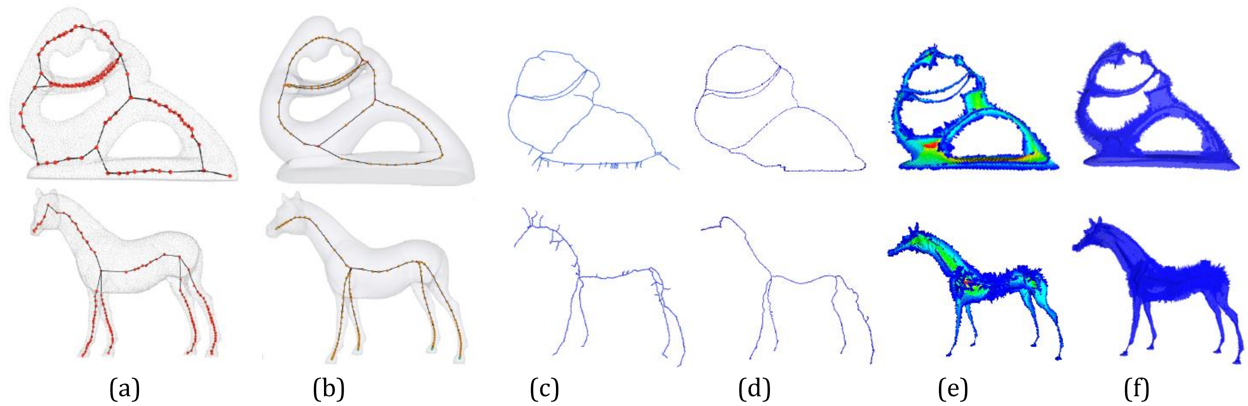

Figure 1: Skeleton comparison: (a) Tagliasacchi et al, 2009; (b) Cao *et al.*, 2010; (c) Arcelli *et al.*, 2011; (d) Siddiqi e*t al,.* 2002; (e) surface skeletons, Reniers *et al.*, 2008; (f) Hesselink and Roerdink, 2009**.**

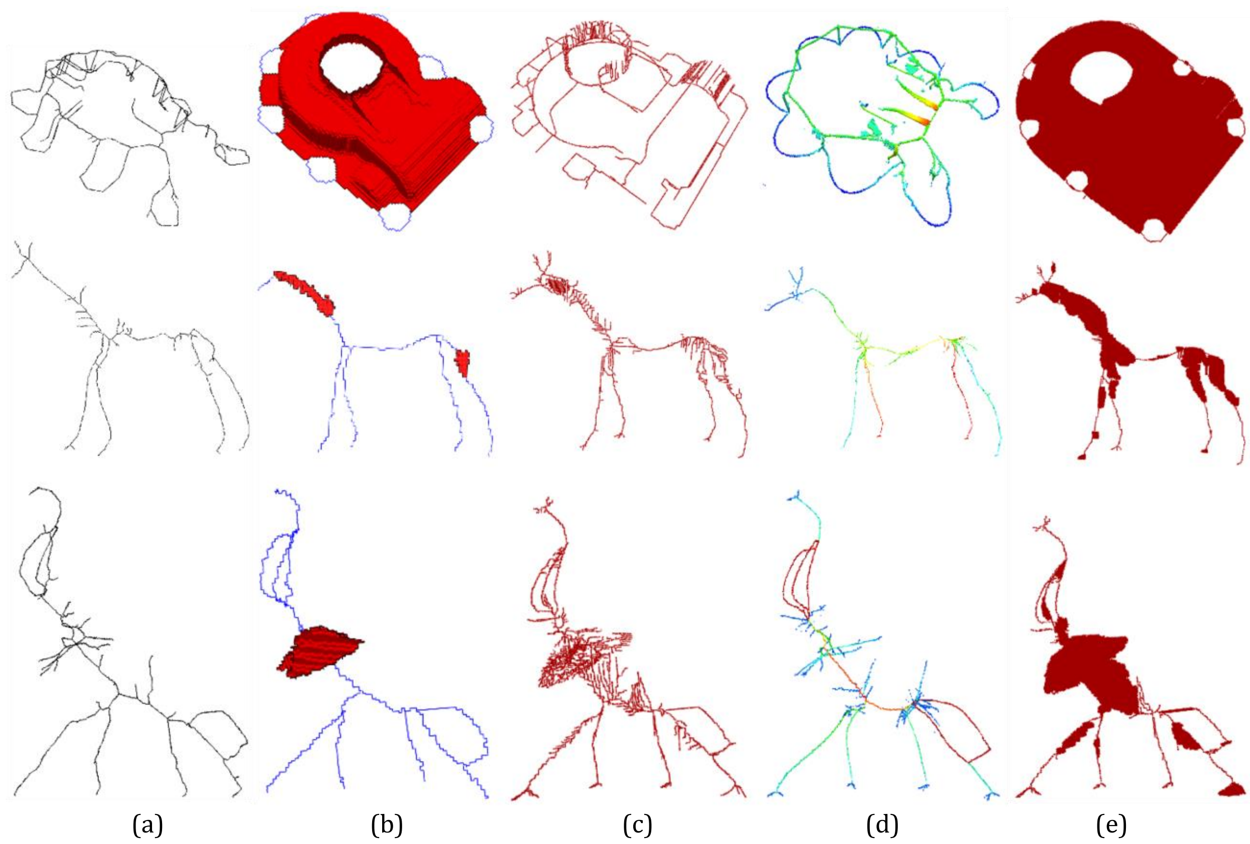

Figure 2: Skeleton comparison (cont.): (a) Palagyi *et al.*, 1999; (b) Liu *et al.*, 2010; (c) curve skeletons, Ju *et al.*, 2006; (d) curve skeletons, Reniers e*t al,.* 2008; (e) surface skeletons, Ju *et al.*, 2006;