From Drawing to Animation-ready Vector Graphics

Even Entem, Loic Barthe, Marie-Paule Cani, Michiel van de Panne

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Even Entem[a,b], Loïc Barthe[b], Marie-Paule Cani[a], Michiel van de Panne[c]

[a]Université Grenoble-Alpes, LJK, Inria [b]Université de Toulouse, IRIT [c]University of British Columbia

SIGGRAPH2016
Render the Possibilities

Challenge

Given a clean-line drawing of a smooth free-form shape, segment it into a set of simple and smooth 2D shapes adapted for edition and animation.

Motivation & Related Work

Contour drawings are commonly used for shape depiction. However they remain difficult to edit or manipulate.

Some algorithms have been proposed to build 3D representations from Computer Aided Design sketches. Other methods tackle free-form drawings, but are generally dedicated to specific kinds of shapes. While state of the art techniques can beautify, complete hidden contours, complete cusps as in SmoothSketch [2] and segment contour shapes, the problem of complex internal silhouette contours and expressive strokes remains challenging.

We show a novel technique to structure clean-line drawings of smooth shapes into a manipulable representation. Our contribution is an algorithm taking into account complex internal silhouette contours by combining the two usual kind of approaches: contour and region.

Approach

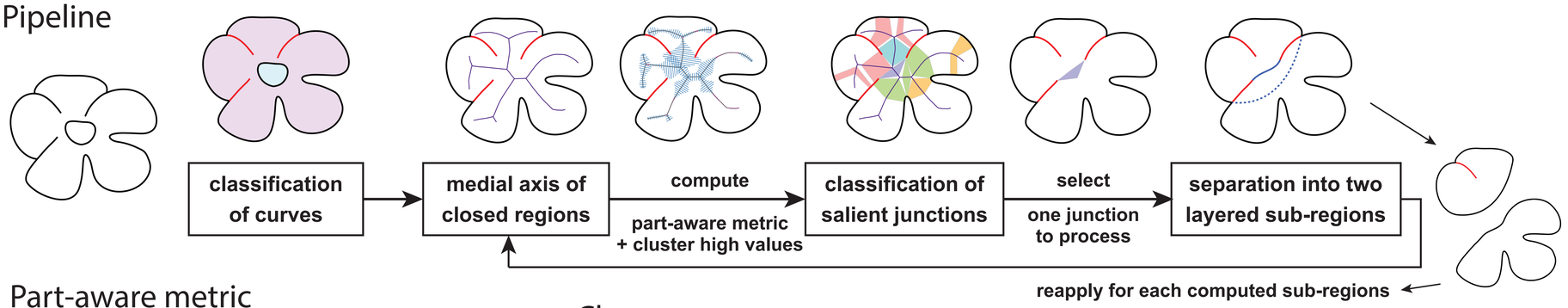
We propose a 2D part-aware metric measuring the relative salience along the medial axis of 2D shapes, that is loosely inspired by the 3D metric in [1].

We cluster medial axis parts using this metric. We then define the area between each pair of contours corresponding to a cluster as a transition zone.

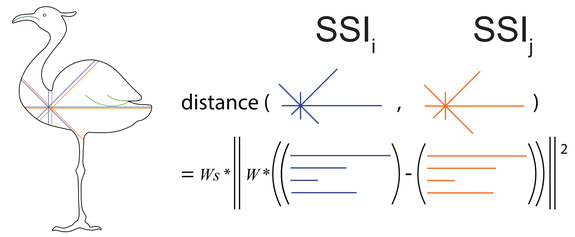
Processing possible transition zones in a specific priority order enables us to achieve a recursive extraction of sub-regions, which handles the challenging case of trees of inner silhouette contours.
The closure of identified sub-regions is performed by minimizing the curvature cost of the pair of closing cubic Bezier curves. Extremities and tangents are constrained by the type of transition zone. The relative depth between sub-regions is inferred from the information around T-junctions.

The structure and layering information we obtain can be used to represent, edit and animate the input sketch in a meaningful way.

Pipeline

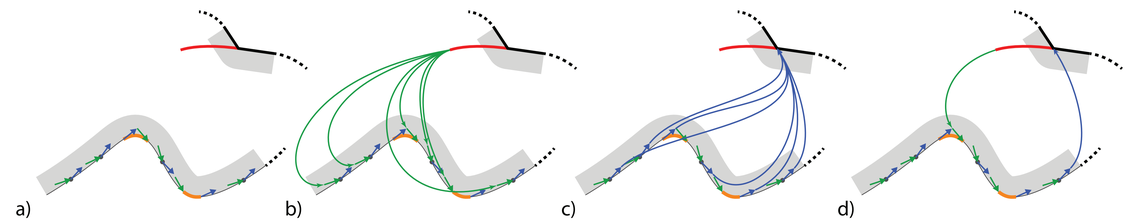


Part-aware metric



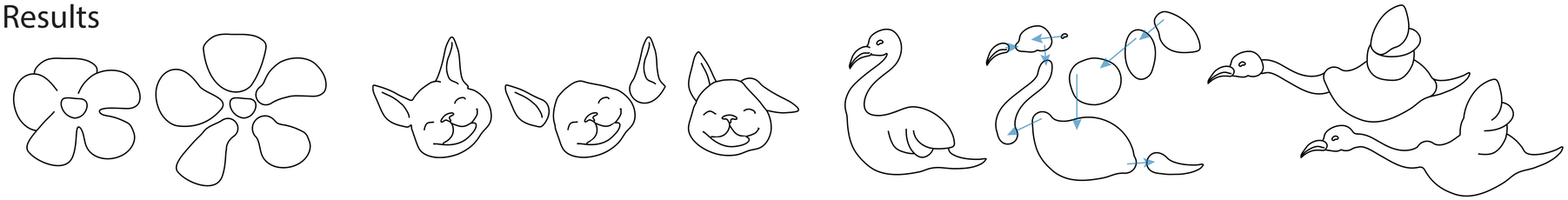
Our metric is based on a part-aware surface metric for shape analysis [1]. It defines a distance between visibility profiles from neighbor points of view inside the shape. It is computed as the sum of the squared differences in visibility distance of an angularly uniformly sampled set of rays. Outliers (occlusions) are smoothed using weighting terms.
Our points of view being uniformly sampled, we avoid the noise produced by variable relative errors in the 3D technique.

Closures



Closure computation in a transition region:
a) Contours of the transition region are in this case described by a silhouette contour at the bottom and a red suggestive contour at the top.
b) All the closure curves corresponding to pairs of one sample point from the contour and the suggestive contour extremity are computed and their plausibility is evaluated for closing the rightmost sub-part. Curves that intersect contours are eliminated.
c) The same closing procedure is applied to the other region, therefore the suggestive contour's T-junction is used instead of its extremity.
d) Resulting closure curves.

Results

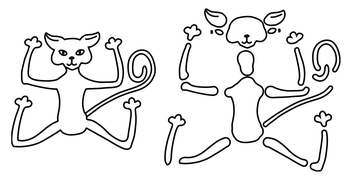


Limitations & future works

The purely expressive strokes are not handled when located in the closure area.

An ambiguity remains between bulgy and flat areas that is hard to formalize even perceptually.

As future works we would like to tackle these limitations and provide a user-friendly interface for our technique.
It would include an assisted positioning of skeleton joints and we could allow the deformation of each part using medial-axis-based manipulators.



References

[1] LIU, R., ZHANG, H., SHAMIR, A., AND COHEN-OR, D. 2009.
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[2] KARPENKO, O. A., AND HUGHES, J. F. 2006.
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