Interpreting Line Drawings of Smooth Shapes

Forrester Cole, William T. Freeman, Frédo Durand, Edward H. Adelson
Massachusetts Institute of Technology

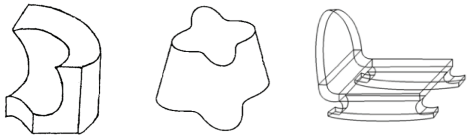
Goal: 3D shape interpretation from line drawings of blobby, "organic" shapes

[Cole et al. 2008] [DeCarlo et al. 2003]

(drawings are computer-generated from 3D models)

Success if: Output matches human shape perception (not original 3D shape)

Prior work focused on precise, "blocks world" shapes:

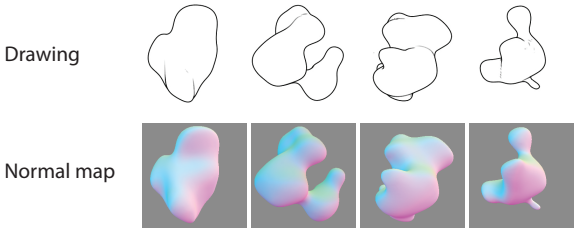


[Malik 1987] [Ulupinar and Nevatia 1993] [Wang et al. 2009]

Approach: Example-based

1. Find keypoints in drawing, connect with graph
2. Select set of examples at each keypoint
3. Find most consistent global configuration
4. (Optional) Fit surface to solution

Training Set: Random blobby shapes



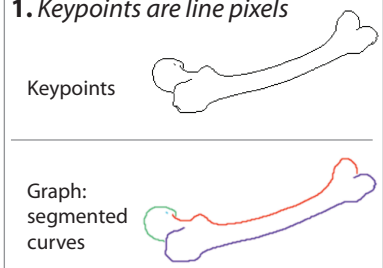
100 blobs x 20 views per blob = 2000 training pairs

drawn with occluding and suggestive contours [DeCarlo et al. 2003]

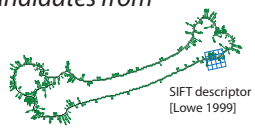
Algorithm 1: Label contour orientation and inflate

PROS: matches human perception on some shapes
CONS: brittle; hard to extend beyond occluding contours

1. *Keypoints are line pixels*

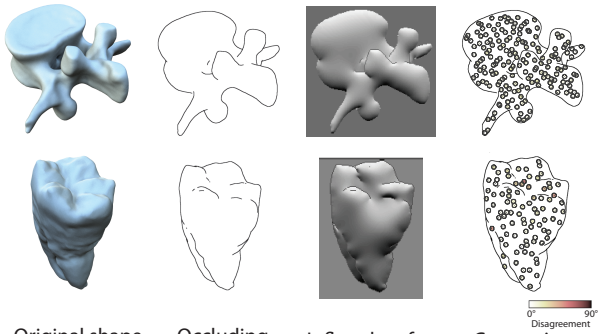


2. *Look up candidates from training data*



3. *Average guesses over graph*

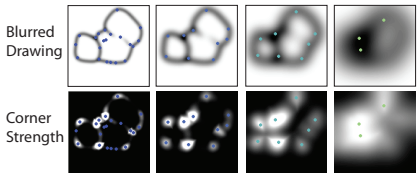
4. *Inflate surface and compare with human perception*



Algorithm 2: Reconstruct surface normals from patches

PROS: flexible; generalizes to any kind of line
CONS: ??? (too early to say)

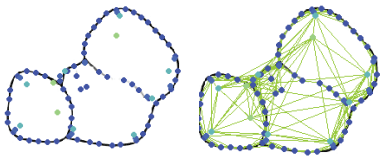
1a. *Place keypoints at image corners at varying scales*



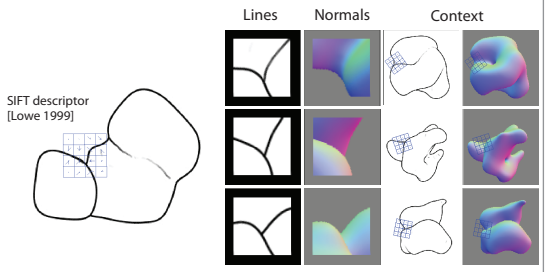
Corner strength as defined by [Harris and Stephens 1988]

1a.i. Add extra points to cover all line pixels:

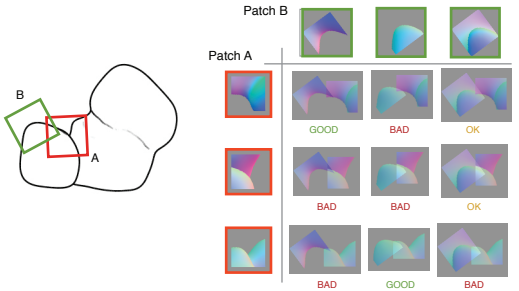
1b. *Connect keypoints based on image proximity*



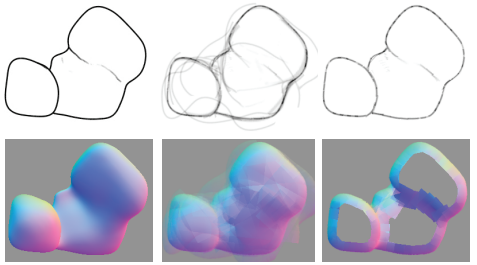
2a. *Find patch candidates based on appearance*



2b. *Rate compatibility of neighboring patches*



3. *Find best global solution with inference on Markov Random Field from keypoint graph*



4. *Fit surface to fine-scale patches*