

Example-based NPR

Aaron Hertzmann
University of Washington

Designing styles



Procedural

Hand-drawn

Example-based rendering

- Design by *example*
- One mechanism, many styles

Problems

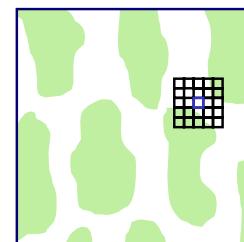
- No unique model
- What aspects of the examples are important?

Outline

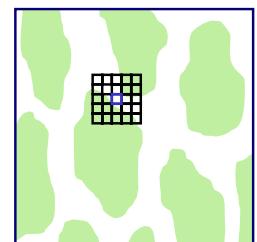
- Image texture synthesis
- Image processing
- Strokes
- A hybrid algorithm

Texture synthesis

- Goal: Match image statistics

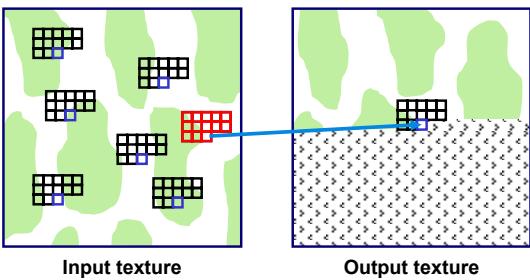


Input texture



Output texture

Texture synthesis



Synthesis result



Texture synthesis

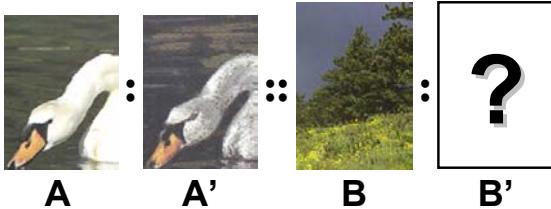
- Nearest neighbors
 - Efros and Leung, ICCV 99
 - Wei and Levoy, SIGGRAPH 00
- Coherence
 - Ashikhmin, I3DG 01
 - Hertzmann et al, SIGGRAPH 01
- Tiles
 - Efros and Freeman, SIGGRAPH 01
 - Liang et al., TOG 01

Image analogies



Hertzmann et al.; Efros and Freeman, SIGGRAPH 01

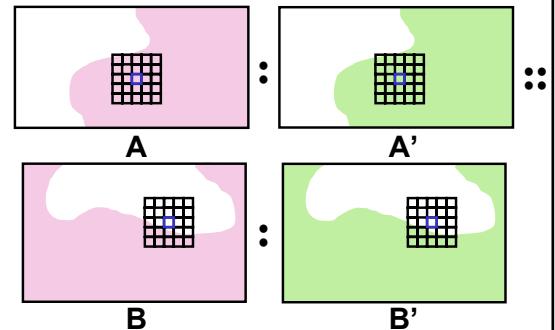
Image analogies



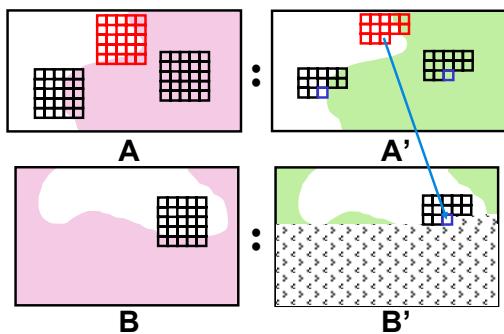
Hertzmann et al.; Efros and Freeman, SIGGRAPH 01

Image analogies

- Goal: Match *joint* image statistics



Analyses synthesis

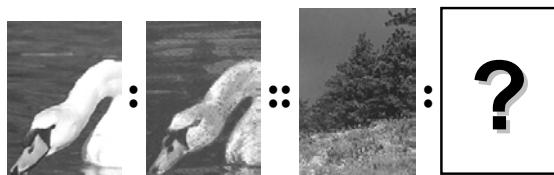


Feature vectors



Hertzmann et al.; Efros and Freeman, SIGGRAPH 01

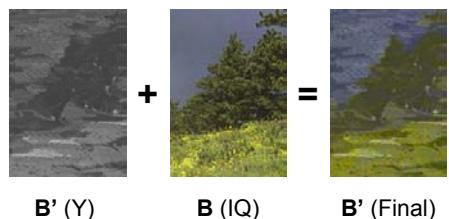
Feature vectors



Hertzmann et al.; Efros and Freeman, SIGGRAPH 01

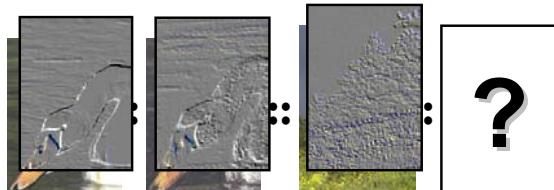
Color

- Combine new luminance with source color B



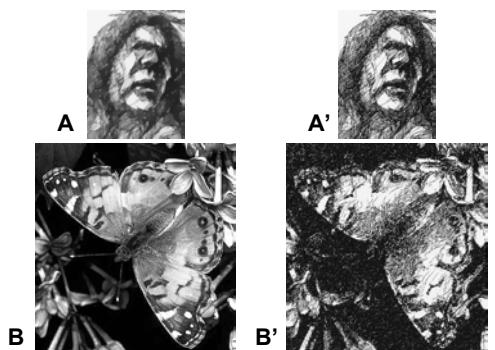
Hertzmann et al., SIGGRAPH 01

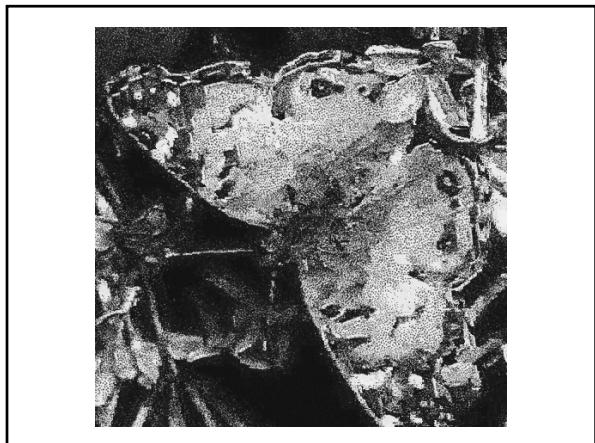
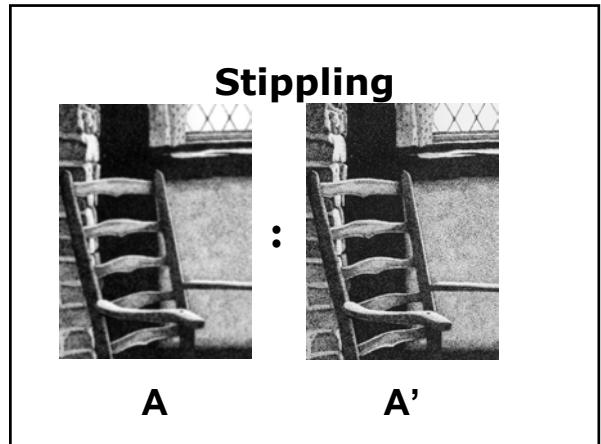
Feature vectors



Hertzmann et al., SIGGRAPH 01

Pen-and-ink



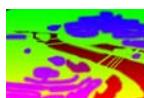


From *Starry Night over the Rhône*, by Vincent Van Gogh , 1888





Texture-by-numbers



:



A

A'

Texture-by-numbers



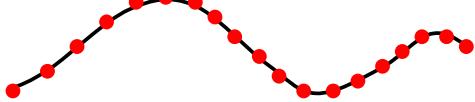
B

B'

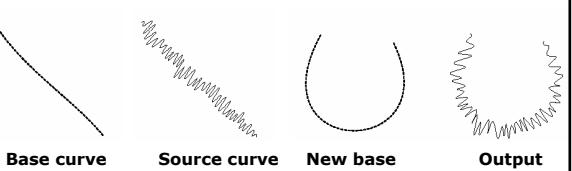
Strokes

Strokes

Represented as curves

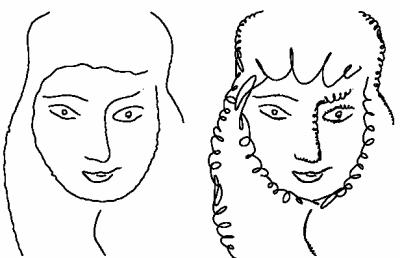


Multiresolution curves



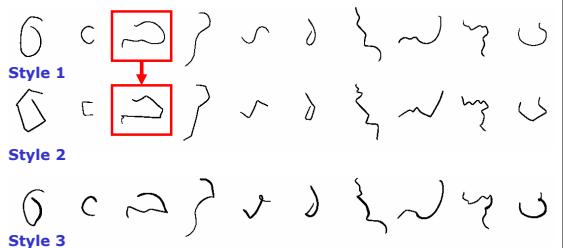
Finkelstein and Salesin, SIGGRAPH 94

Multiresolution curves



Finkelstein and Salesin, SIGGRAPH 94

Style transfer for line drawings



Freeman et al, MERL Tech report 99-11

Style transfer for line drawings



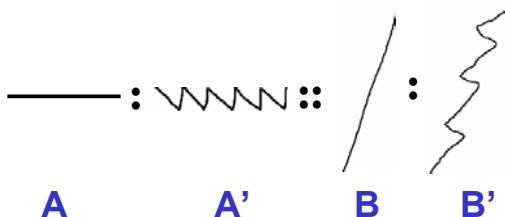
Freeman et al, MERL Tech report 99-11

Style transfer for line drawings



Freeman et al, MERL Tech report 99-11

Curve analogies



Hertzmann et al, EGWR 02; sketch tomorrow

Curve texture synthesis

Problem statement

Example



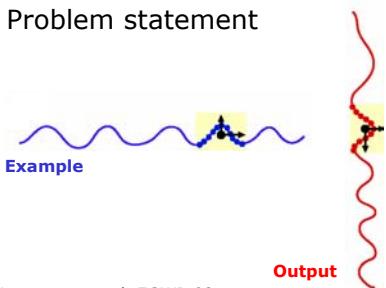
Output



Hertzmann et al, EGWR 02

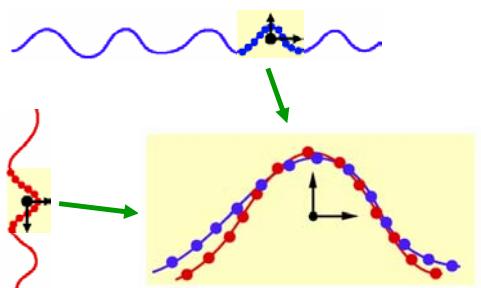
Curve texture synthesis

Problem statement

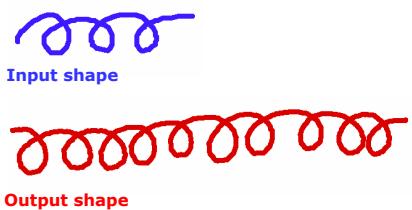


Hertzmann et al, EGWR 02

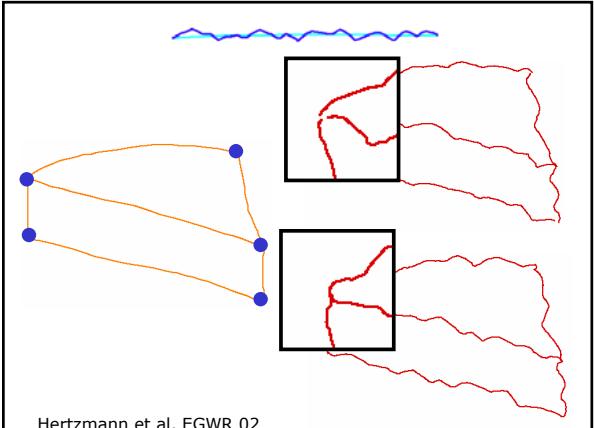
Neighborhood comparison



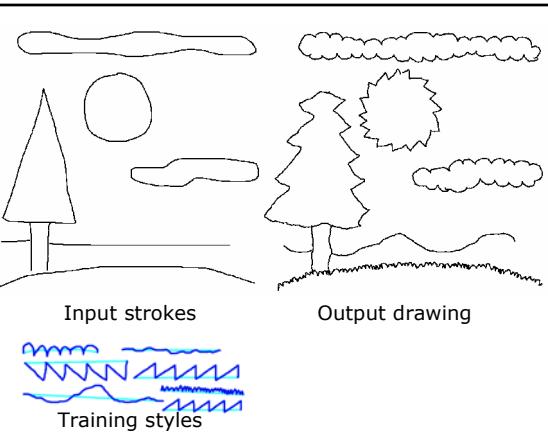
Results



Hertzmann et al, EGWR 02



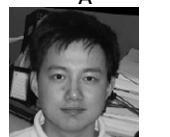
Hertzmann et al, EGWR 02



Facial portraiture



Chen et al., ICCV 01

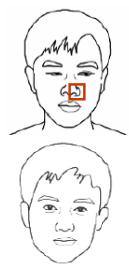
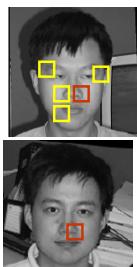


B



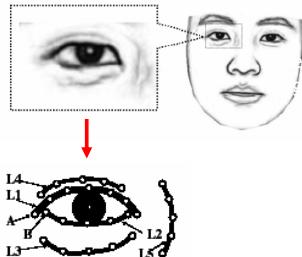
B'

Facial portraiture



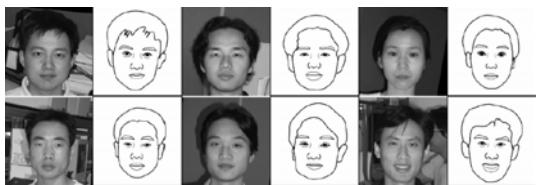
Chen et al., ICCV 01

Sketch model



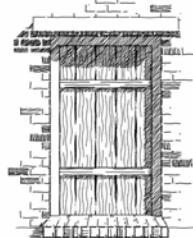
Chen et al., ICCV 01

Results



Chen et al., ICCV 01

Other EBNPR work



Salisbury et al,
SIGGRAPH 94, 96, 97



Kalnins et al
SIGGRAPH 02 (Friday)

Summary

- Example-based NPR
- Image texture synthesis
- Example-based image processing
- Example-based curve processing

Oil



A



A'

From *Still life with Melon and Peaches*, Edouard Manet, 1866



From (Curtis 97)



Style transfer for line drawings

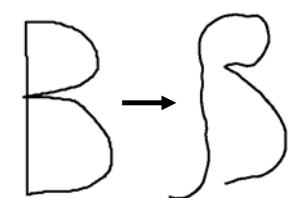


Input drawing



Output drawing

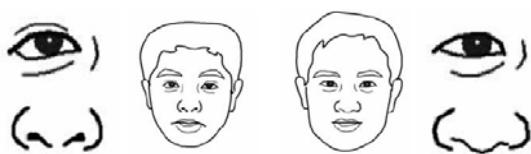
Freeman et al, MERL Tech report 99-11



$M \rightarrow M$

$B \rightarrow B$

Results



Chen et al., ICCV 01

Machine learning for graphics

Build models from data

Common concerns

- Good features and choice of model

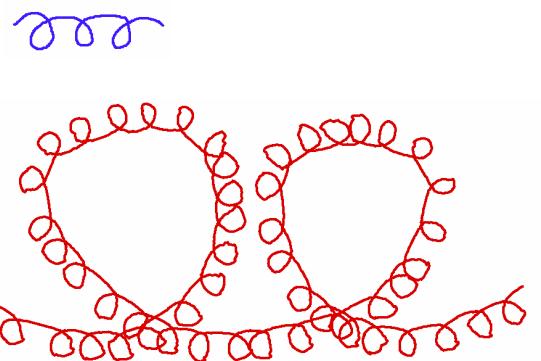
- Sufficient training data

This talk: "instance-based learning"

Face registration

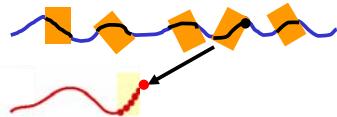


Chen et al., ICCV 01



Hertzmann et al, EGWR 02

Algorithm



Hertzmann et al, EGWR 02