

Painterly Rendering with Curved Strokes of Multiple sizes

Aaron Hertzmann

Presented by Ran Chen

Outline

- Motivation
- Related work
- Painting Techniques
 - Varying the brush size
 - Creating curved brush strokes
- Style Parameters
- Experiments
- Apply to Video
- Conclusion

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Motivation

- Most current systems: brush strokes
 - Manual
 - Equal size and shape
 - Looks mechanical !
- Idea: automatic painting + painterly effect
 - Multiple size
 - Long and curved strokes
 - Looks natural!



Pointillist filter from Haeberli 90_{3/20}

Related Work

- Automatic Painting
 - Pen-and-ink illustration from 3D models: Winkenbach and Salesin 94', 96', *Computer-Generated Pen-and-ink Illustration (week 9)*;
 - Pen-and-ink illustration for images: Salisbury et al. 97'
 - Semi-automatically produced watercolor: Curties et al. 97', *Computer-Generated Watercolor (week 9)*.
- No visible (oil) brush stroke, lack of painterly effect!

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Related Work

- Painterly Effect
 - Strokes with same size and shape: Litwinowicz 97', *Processing Images and Video for An Impressionist Effect (week 2)*.
 - Statistical analysis to guide stroke size: Treavett and Chen, 97'.
 - Local detail level to guide stroke size: Microsoft Image Composer 1.5, Treavett and Chen, 97'.
- Paint image in a single pass, cannot refine the painting!

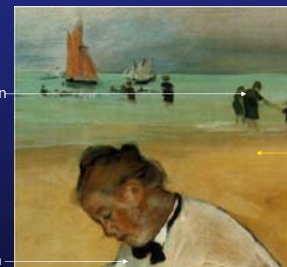
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Painting Technique

Draw most attention

Fine strokes!

Draw most attention



Draw little attention

Coarse strokes!



At the Seashore by Degas

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Painting Technique

- Input
 - Source image
 - A list brush sizes B1, ..., Bn (e.g. 8, 4, 2)
 - Canvas
- Methods
 - Varying the brush size to create layers
 - Creating curved brush strokes (B-spline)
- Output
 - A destination image with painterly effect and using different brush strokes to capture fine and coarse details.

A.Klein, 557 course notes 04' 7/20


Impressionist: soleil levant Varying brush strokes sizes

	Artist	Computer
Brush stroke	Mix fine and coarse strokes for better effect	Finer strokes on the top of coarse strokes (multi-pass)
Stroke location	The position where the canvas color differs from painted objects.	

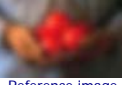
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Varying the brush size

Brush stroke: location, color, size, direction, shape

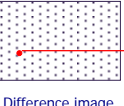


Source image




Reference image

$(\sum \text{pixelDiff})/\text{grid}^2 > T ?$



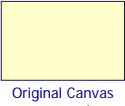
Difference image

The largest error point(x, y), stroke location!



Grid size $f_g R$, Region

Original Canvas constant color




Original Canvas constant color

Stroke list: $\{(x1, y1), \dots, (xn, yn)\}$, render in random order for better effect!

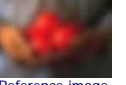
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Varying the brush size

Brush stroke: location, color, size, direction, shape




Source image



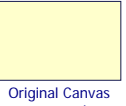
Reference image

The canvas after first layer Painting



The canvas after first layer Painting


Original Canvas constant color




Original Canvas constant color

Stroke list: $\{(x1, y1), \dots, (xn, yn)\}$, render in random order for better effect!


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Source image




Reference image




canvas


Blur * $G_{8\sigma}$




Blur * $G_{4\sigma}$




Blur * $G_{2\sigma}$





Curved Brush Strokes

- Idea:
 - B-Spline
 - Control points following the normal of the image gradient
 - If colors differ too much, or stroke gets too long, end stroke.

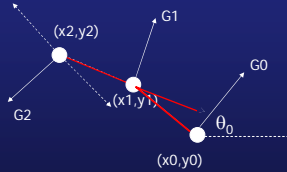


Brush stroke shape: circle
Too mechanical!

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Creating curved brush strokes

Task: Find the control points



Stroke:

- Brush radius
- A list control points, distance between CP=brush radius, follow normal of image gradient;
- Color (as first control point)

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Style Parameter

Artist	Computer
A bunch of brushes	A list of brush sizes $\{R_1, \dots, R_n\}$
Capture fine/coarse details	Blur factor f_σ : $\text{img} * G_{f_\sigma R_i}$
Closely or roughly match color in source object	Approximation threshold T : $(\sum \text{pixelDiff})/\text{grid}^2 > T?$
Control the spacing of brush strokes	Grid size: f_{gR_i}

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Style Parameter

Artist	Computer
Opacity, transparency (wash-like effect)	Opacity α . (low opacity)
Loose and tight curves	Curvature Filter f_c .
Brush stroke length	Minimum and maximum stroke length: minLength , maxLength
Color noise	Color jitter: add jitter to HSV or RGB

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Experiment



Impressionist: $T=100$, $R=(8,4,2)$, $f_c=1$, $f_s=.5$, $f_g=1$, $\text{minLength}=4$, $\text{maxLength}=8$

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Experiment



Expressionist: long brush strokes, jitter to color value; $T=50$, $R=(8,4,2)$, $f_c=.25$, $f_s=.5$, $f_g=.7$, $\text{minLength}=10$, $\text{maxLength}=16$

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Experiment



Colorist Wash: Loose semi-transparent brush strokes, jitter to RGB; $T=200$, $R=(8,4,2)$, $f_c=1$, $f_s=.5$, $f_g=1$, $\text{minLength}=4$, $\text{maxLength}=16$, $j_r=j_b=j_g=.3$

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Apply to Video

- Interactive painterly video processing
 - Only paint the regions where the source video is changing.
 - Without optical flow, subjective impression of "hand-made"; with optical flow, painting surface flows and deforms.
 - For music video, different painting styles enhance the changing mood and intensity of the music.

Hertzmann & Perlin, 00'

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Music Video Play

- Larger strokes: more abstract, for intense and meditative passages;
- Smaller strokes: less abstract, for transitional passages;
- Expressionist: more active and abstract, for most intense passage and during the solos

Hertzmann & Perlin, 00'

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Conclusion

- Strength: Looks nicer than previous work;
- Weakness: Artists use fine strokes to wherever they want to draw attention; here fine strokes are used where color changes much.

Remember!

- Different brush stroke sizes convey level of details of source image.
- Long, curved strokes can express different painting styles.

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