Painterly Rendering

Types of Computer Painting

Physical simulation
- User applies strokes
- Computer simulates media (e.g. watercolor on paper)

Automatic painting
- User provides input image or 3D model and painting parameters
- Computer generates all strokes

Two Painterly Rendering Systems

“Painterly Rendering for Animation”
- Meier, SIGGRAPH 96

“Painterly Rendering with Curved Brush Strokes of Multiple Sizes”
- Hertzmann, SIGGRAPH 98

Painterly Rendering Pipeline

Basic Approach

Algorithm
- Surface particles placed in world space
- Reference images rendered
- Each particle becomes a screen-space stroke

Features
- Greater temporal coherence than purely screen-space approaches
- More natural style than purely geometry (texture-mapped) approaches

Particle Generation

Compute area of surface primitives
Randomly place particles on primitives
- number proportional to area
Reference Images

Used to determine stroke attributes
- color
- orientation
- size
- many others possible

Rendered with programmable shaders

Stroke Rendering

Particle transformed to screen-space
Stroke parameters from reference images
- perturbed according to user-specified variation

Brush image rendered according to stroke parameters
- oblong brush shapes work best
- grayscale brushes typically sufficient
  —color brush textures may be used to modify particle colors

Example - Haystacks

Haystacks without random parameter perturbation

Similar view with random parameter perturbation

from Meier, “Painterly Rendering for Animation, Proceedings of SIGGRAPH 96, pages 483 and 478.

Example - fruit


Layered Approach

Similar objects rendered together
Dissimilar objects often rendered as separate layers and composited later
- Large strokes intrude less onto nearby objects

Video (or .mov movie files)

Meier, “Painterly Rendering for Animation”,
Proceedings of SIGGRAPH 96.
Hertzmann’s Approach

- Apply to color images with no 3D model information
- Allow longer, curved brush strokes
  - makes different styles possible
- Multiple rendering passes
  - larger strokes first
  - add detail with smaller strokes

Stroke Description

- Constant color per stroke
- B-spline path
- Constant radius circle (or other shape)
  - swept along path
- Applied in layers, with opacity control

Building Up Layers

- Start with large strokes
- Each pass reduces stroke size
- New strokes placed according to error metric of current painting

Painting a Layer

- Select stroke size for layer
- Blur input image
- Start strokes within uniform grid cells
- Start each stroke at point of maximum error within grid cell
- Walk perpendicular to image gradient to place control points
- Render strokes in random order as circles along cubic B-spline path

Style Parameters

- Approximation threshold
- Brush sizes
- Curvature filter
- Blur Factor
- Min/Max stroke lengths
- Opacity
- Grid size
- Color jitter

Example Styles

- “Impressionist”
- “Expressionist”
  - long strokes, color value jitter
- “Colorist Wash”
  - transparency, RGB color jitter
- “Pointillist”
  - densely placed circles, random hue and saturation
Example - adding passes

Figure 6: Painting with these brushes, one is basic and one of the four types of passes, after painting with a texture of 7, 4 and 1, the red brush stroke on the left is entirely visible, the blue one 40%, and the green one 90%.


Example - styles

Three styles: impressionist, expressionist, colorist wash

from Herzmann, “Painterly Rendering with Curved Brush Strokes of Multiple Sizes”, Proceedings of SIGGRAPH 98, page 460.

Video

Hertzmann, “Painterly Rendering with Curved Brush Strokes of Multiple Sizes”, Proceedings of SIGGRAPH 98.