

Painterly Rendering for Animation

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An interpretation and presentation by me:

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Disclaimer: This is my understanding of the paper.
It may be incorrect. Please feel free to correct me.

What we will discuss:

1. Motivation
2. Problems with naïve methods
3. Solution
4. Polishing
5. Questions
6. Summary

MOTIVATION

We have seen painterly rendered stills that use 3D models as a source image (Haerberli paper).

These methods take advantage of the 3D geometry and lighting to choose characteristics of the brush strokes (most importantly orientation).



Painterly Rendering with 3D models

Questions:

Can we do painterly rendered animations using Haerberli's techniques?

Yes!

How?

Just apply Haerberli's process to every frame.

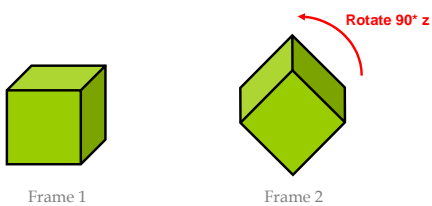
Hmmm?

There are problems with this naïve method! ☹

This paper discusses ways to solve some of these problems. ☺

PROBLEMS WITH NAÏVE METHODS

Example:



Frame 1

Frame 2

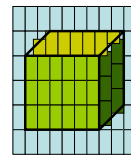
If we keep brush strokes between frames then we get...

1. Shower Door Effect

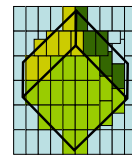
(Strokes are stuck to the image plane, they should be stuck to the animated objects)

Why?

Bad positioning of brush strokes between frames.



Frame 1:
Painterly Rendered



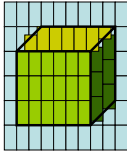
Frame 2: BAD!
Stroke position, size, and orientation stuck on image plane

If we recalculate our brush strokes between frames then we get...

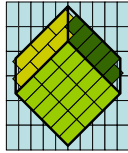
2. Inadequate frame-to-frame coherence
(stroke properties are not consistent between frames)

Why?

The chosen position, color, size, and orientation of brush strokes appear random (relative to successive frames).



Frame 1:
Painterly Rendered

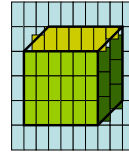


Frame 2: BAD!
Stroke position, size, and orientation
not consistent

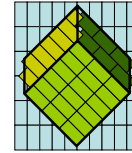
What do we want?

In a nutshell:

We want to recalculate our brush strokes TO maintain consistency.



Frame 1:
Painterly Rendered



Frame 2: GOOD!

SOLUTION

Overview:

Position: Particle Placer

Pin down the location of all brush strokes to all objects in 3D.

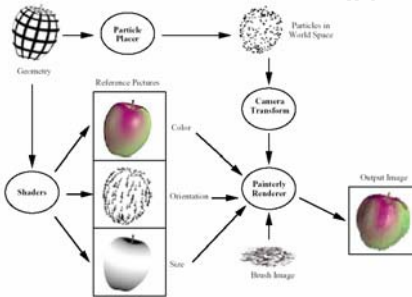
Color, Size, and Orientation: Reference Pictures

Use geometry buffers* produced from shading.

*Like a frame or depth buffer, just holds the values of some other parameter.

Painterly Rendering Animation Pipeline and Algorithm

create particle surfaces
for each frame
create reference pictures
transform particles to view
for each particle
use ref. pics for stroke attr.
apply stroke



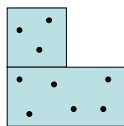
Particle Placer

How many particles per polygon?

Intuitively, distribute particles based upon it's surface area.

$$\frac{\text{Number of particles for polygon}}{\text{Total number of particles for object}} = \frac{\text{Surface area of polygon}}{\text{Total surface area of object}}$$

Where exactly on polygon do we place particles? Random



Particle placement on
2 polygons

Yields an even distribution. But is this what we want? Hmm...

Reference Pictures

Stroke Color

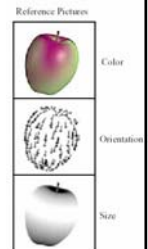
Use regular smooth shading.

Stroke Orientation

Project surface normal onto view plane.
Orientation perpendicular to projected normal.

Stroke Size:

No specific technique mentioned.
-Suggestion of using geometry buffers.
-Hertzmann (more detail use smaller brush)?
-Shouldn't this be related to particle placement?
Hmmm...



Producing different styles of paintings (and animation)

- Use parameters and randomness to change style
- different brush textures
 - apply randomness to stroke application/position
 - apply randomness to reference pictures



Different styles using parameters and randomness

Problem:

If we use randomness for each frame then we lose the consistency we worked so hard for.

Sneaky Solution:

Store deviation in particle. Now have randomness but with consistency between frames.



No parameters or randomness

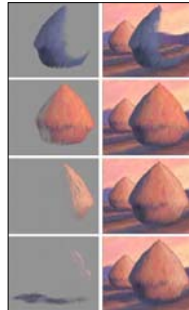
Using parameters and randomness

POLISHING

Layering

Each frame is produced through several iterations.

- Apply different strokes to different objects
- Blend strokes on the same object



Layering Example

Stroke Popping

Strokes around the silhouette of an object will pop on or off when back face culling is enabled.

If culling is disabled then front facing strokes must be dense enough to cover back facing strokes.

Can use stencil and depth buffers to paint strokes that are about to become front facing or just turned back facing.

Grow Reference Pictures

Particles lying around the silhouette of an object may not hit the reference picture.

Store Stroke Attributes in Particles

Alternatively we can store attributes directly in the particle and not use the shaders/reference pictures.



An Experiment on a Bird
in the Air Pump
Joseph Wright, 1768

QUESTIONS

Particle placement, brush sizes, layering

- Does there exist a better function to distribute particles?
- Is it related to brush size?
- Can we determine brush sizes automatically?
- What happens in camera zoom (scale)?
- Would this save the (non)artist effort with all the layering?

Photorealistic Rendering?

Can the same process be used for trees or other models of high detail?

Why not just texture map?

The edges would be too sharp. A cube would look like a wrapped present.
No randomness associated with hand painting.



Still Life with Basket of Fruit
Caravaggio, 1601

SUMMARY

This is a paper about painterly rendering of animations.

To maintain stroke consistency between frames we “pin down” strokes to the 3D model first.

Need fluency in painting to get good results (layering and parameters).