Artistic Stylization and Rendering

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class Nullspace implements Constants, Cloneable {

    /** The rows of the nullspace */
    Vector rows = new Vector();

    /** A list of the variables currently contained in the nullspace */
    Vector variables = new Vector();

    /** Add a constraint to the nullspace */
    *
    * @param c The new constraint
    * @return True if the new constraint is already consistent with the existing nullspace */
    *
    boolean add(Constraint c)
    {
        // Convert the Constraint into a Row
        // do this first to combine equivalent angles; might zero
        Row newRow = new Row(c);

        // Check if c contains any variables that the nullspace doesn't
        // If so, add them
        for(int i=0;i<newRow.sources.size();i++)
        {
            Object src = newRow.sources.elementAt(i);

            if (src instanceof AngleMeasure)
                src = ((AngleMeasure)src).getEquivalent();

            if (variables.indexOf(src) < 0)
                addVariable(src);
        }

        int nk = rows.size();    // n-k = num vars - num constraints
        int[] Nx = new int[nk];
        boolean zero = true;
        int pivot = -1;

        // compute N * x, where N is the nullspace and x is the new row
        for(int i=0;i<nk;i++)
        {
            Nx[i] = Row.dot((Row)rows.elementAt(i),newRow);
            if (Nx[i] != 0)
            {
                zero = false;
                pivot = i;
            }
        }

        // test if the new constraint was already consistent
        if (zero)
            return true;
    }
Painted Camera
By Gilles DEZEUSTRE
Open iTunes to buy and download apps.

Description
Painted Camera turns your iPhone and iPad into a magical lens that will show you the world through the eye of a painter. Capture beautiful images on the fly at a resolution high enough for gallery quality printing or record amazing painted videos with this unique app by The 11ers, the makers of Glaze, the cult painterly app for still

Gilles DEZEUSTRE Web Site › Painted Camera Support ›

What’s New in Version 1.2
Updated App store screenshots.

$1.99
Category: Photo & Video
Updated: May 28, 2014
Version: 1.2
Size: 3.5 MB
Languages: English, Arabic, Catalan, Czech, Danish, Dutch, Finnish, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Malay, Norwegian Bokmål, Polish, Portuguese, Romanian, Russian, Simplified Chinese, Slovak, Spanish, Swedish, Thai, Traditional Chinese, Turkish, Ukrainian, Vietnamese
Seller: Gilles DEZEUSTRE
© 2013 The 11ers, LLC
Rated 4+

iPhone Screenshots
Amazing “in camera”
real time painterly effect
9 high quality style presets
Infinite random style mixer
Non-photorealistic rendering: computer graphics and animation inspired by natural artistic media
1. Scientific models for art
Research goals

2. Rendering algorithms
Research goals

3. New artistic tools
The development of art and technology have always gone hand-in-hand.
3D Non-Photorealistic Rendering

Smooth surface  Occluding contours  Stylized rendering
Occluding Contours

Weiss 1966
Suggestive Contours

Camera view

Contours

Contours+SC

DeCarlo et al. SIGGRAPH 2003
Studies on line drawing

Cole et al. SIGGRAPH 2008
Stylized Contour Algorithms

[Eisemann et al. 2008]  [Buchholz et al. 2011]  [Grabli et al. 2010]

[Kalnins et al. 2003]  [Hertzmann and Zorin 2000]
Disney's Paperman
Procedural methods

**Pro:** lovely results,
very controllable

**Cons:** hard to design styles,
complex to implement
What is texture?
What is texture?
Early Texture models

Fig. 1. Resolution cells 1 and 5 are $0^\circ$ (horizontal) nearest neighbors to resolution cell $\ast$; resolution cells 2 and 6 are $135^\circ$ nearest neighbors; resolution cells 3 and 7 are $90^\circ$ nearest neighbors; and resolution cells 4 and 8 are $45^\circ$ nearest neighbors to $\ast$. (Note this information is purely spatial, and has nothing to do with gray-tone values.)

Haralick 1973
Higher-Order Statistics

Figure 2. A 3-scale, 4-orientation complex steerable pyramid representation of a disk image. Left: real parts of oriented bandpass images at each scale and the final lowpass image. Right: magnitude (complex modulus) of the same subbands. Note that the highpass residual band is not shown.

Portilla and Simoncelli 2000
Higher-Order Statistics

Figure 10. Block diagram describing the coarse-to-fine adjustment of subband statistics and reconstruction of intermediate scale lowpass image (gray box of Fig. 9).

Portilla and Simoncelli 2000
Higher-Order Statistics

Portilla and Simoncelli 2000
Higher-Order Statistics

Portilla and Simoncelli 1999
Patch-Based Texture

Input texture ➔ Output texture

Efros and Leung 1999
Patch-Based Texture

Efros and Leung 1999
Results

Efros and Leung 1999, Wei and Levoy 2000
Curve stylization
Curve Propagation

Frame 1

Frame 2
Image Analogies

Goal: Process an image by example

A :: A'

B :: ?

Hertzmann et al. SIGGRAPH 2001
Blur

A

A’

B

B’

Hertzmann et al. SIGGRAPH 2001
Superresolution

Hertzmann et al. SIGGRAPH 2001
Texture transfer

(same texture)
Color channels

Input image

Luminance  Color channels
Color channels

Luminance

Blurry color
Color channels

Blurry luminance

Color channels
Color transfer

Input photo → Input luminance → Example luminance

Input colors + Output luminance → Output image
Image Analogies for Animation

Input animation
StyLit
Illumination-Guided Example-Based Stylization of 3D

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Eli Shechtman \(^2\) Paul Asente \(^2\) Jingwan Lu \(^2\)

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Neural texture
Can we model statistical textures with neural networks?
Texture synthesis

Gatys et al., NIPS 2015
Texture synthesis

Gatys et al., NIPS 2015
Neural stylization
Neural Style Transfer
Results
Mark is showing a preview of a new "style transfer" technology that works on video in real time on your phone.

It uses deep learning methods (optimized to run on the phone) to make a video take the style of a painting or drawing.

More information on this will appear over the next couple of weeks. Stay tuned....

I took this impressionist video of Beast on my phone with a new AI technique called "style transfer". The idea is you show the artificial intelligence a painting and then it draws your photos or videos in that style in real time. Looking forward to getting this in your hands soon!
Where are we?

Procedural NPR

Patch-Based
(Analogies)

Neural

How do we get the best of each?
Adding control to neural stylization
Color Control - Color Preservation

Gatys et al., arXiv 2016
Color Control - Luminance Style Transfer

Gatys et al., arXiv 2016
Spatial Control

Gatys et al., arXiv 2016
Spatial Control

Gatys et al., arXiv 2016
Spatial Control

Guidance Channels
Spatial Control

Gatys et al., arXiv 2016
Neural animation
Where are we?

Procedural NPR

Patch-Based (Analogies)

Neural

Open question: How do we get the best of each?
Open problems

How do we author images?
Learning style from large datasets
Detailed control of style
Creating 3D animation
Making the details look good
Make the fast methods better
What is style? What is texture?