



Personal Inquiry Project

HOW TO ACHIEVE A NPR WATERCOLOUR SHADER

Introduction

- ▶ Definition of NPR
- ▶ Functionality of NPR compared to real watercolour works of art.
- ▶ List of ways to recreate the effect of watercolour in 3D environments and characters, through 3D computer graphic software.
- ▶ Case studies (reference films and a documentary)
- ▶ Advantages and disadvantages of the NPR techniques and best practice.



Non Photorealistic Render (NPR)

- ▶ Any computer-generated imagery explicitly rendered using techniques designed not to mimic physical reality.
- ▶ Contrary to Photorealistic Renders, NPR is inspired by artistic styles such as painting, drawing, illustration, and cartoons.
- ▶ NPR attempts to render models believably, rather than realistically.
- ▶ Abstraction plays an important role in non-photorealistic rendering since a visual level-of-detail or the selective abstraction of a rendering can introduce regions of interest.
- ▶ NPR can be seen in films and video games in the form of "toon shading", as well as in scientific visualization, architectural illustration and experimental animation.



Non Photorealistic Render (NPR)



Pinterest image of a
watercolour painting



Watercolour NPR of Van Gogh's CGI room,
by Ruslan Sokolovsky

Basics of Watercolour Shader

- ▶ Watercolour is a media consisting of a complex series of interactions between multiple **layers** of paint that diffuse pigment and water.
- ▶ Each **layer** contains certain characteristics, such as: colour dilution; colour bleed; pigment turbulence; hand tremors; edge darkening; paper distortion and granulation.
- ▶ According to research, watercolour rendering can be grouped into two broad categories: **physical simulation** of the media and **image filters**.
- ▶ **Physical simulations** attempt to simulate all fluid, pigment and paper interactions.
- ▶ **Image processing filters** consist of using image, and other Gbuffers (like depth or normal buffer) as input to create a watercolour like image.



Basics of Watercolour Shader



(a)



(b)



(c)



(d)

Image abstraction:

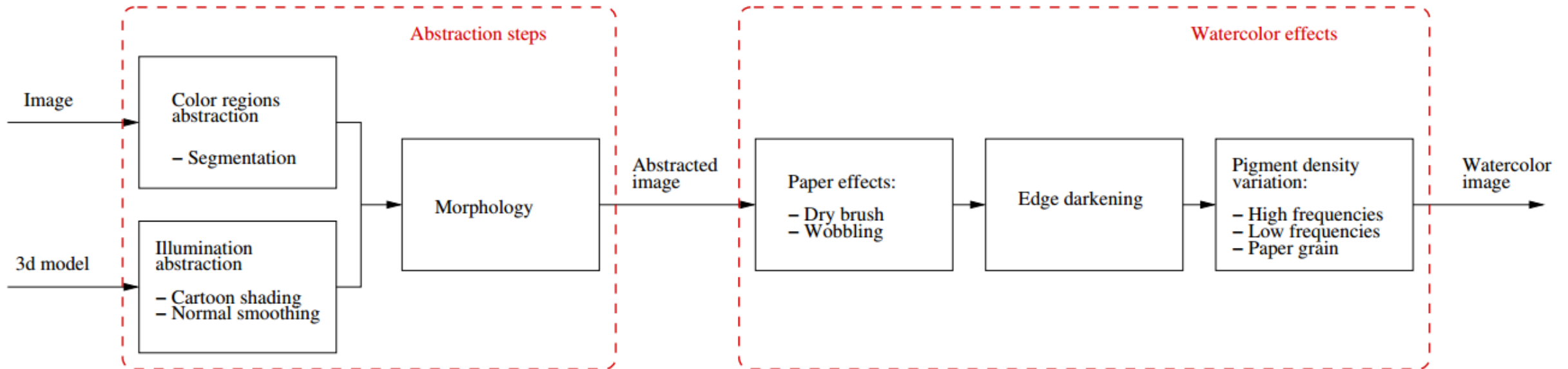
- a) Original Image
- b) Without abstraction: direct application of physical simulations
- c) Result after filters
- d) Final result with filters and morphological smoothing

Basics of Watercolour Shader

- ▶ The main effect in watercolour is the **colour variation** that occurs in uniformly painted regions. The base colour in the virtual pigment, has a variation in the painted layer consisting of **darkening** and **lightening**.
- ▶ The **density of pigments** varies in several ways, so usually three filters are used: turbulent flow, pigment dispersion and paper variations. All flow and granulation effects are then encoded in a 1d texture and rendered in a manner similar to a **toon rendering**.
- ▶ A smooth transition between areas can be obtained by smoothing the toon texture.
- ▶ The final render is done by using a **fragment shader** (colour). The paper filter is applied on top of the image whereas the other filters are applied only on the object projection. The edges are darkened using the gradient of the abstracted image.

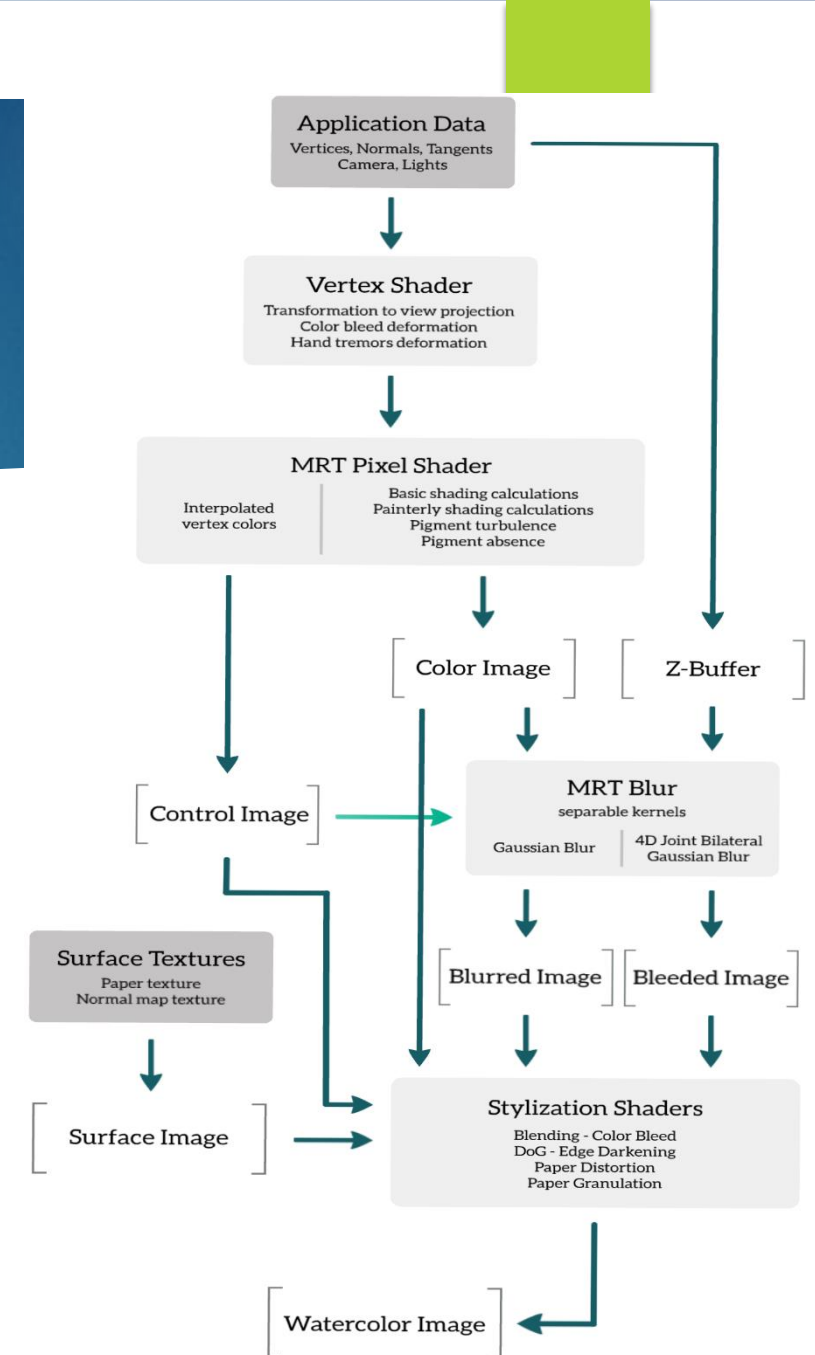


Basics of Watercolour Shader



Basics of Watercolour Shader

- ▶ The first step in the direct **stylization pipeline** consists of processing the application data at the **vertex shader** stage. At this stage, vertices are usually just transformed from object space to their respective projection space.
- ▶ To enhance the look of the shader, we support basic shading requirements such as the ability to use **texture**, **normal** and **specular maps**.
- ▶ At the **MRT blur fragment shader** blurring algorithms are run over the rendered colour image, generating intermediates for edge darkening and colour bleeding effects.



Edge Darkening Effect

Early solutions involve analyzing nearby pixels for a difference in depth and object identifiers, and subtracting a blurred intensity from the alpha values of the object identifiers.



Blurred image



Color image

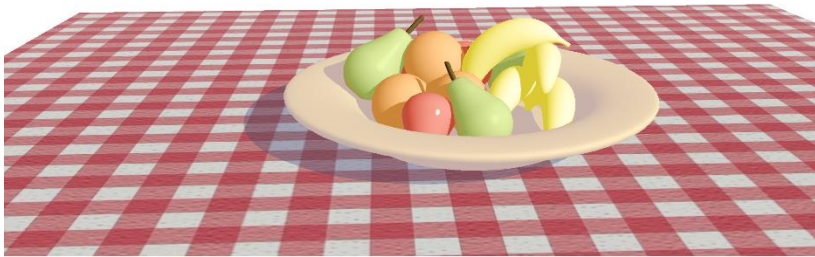


1 - edge mask



Darker edge

Basics of Watercolour Shader



color image rendered without stylization

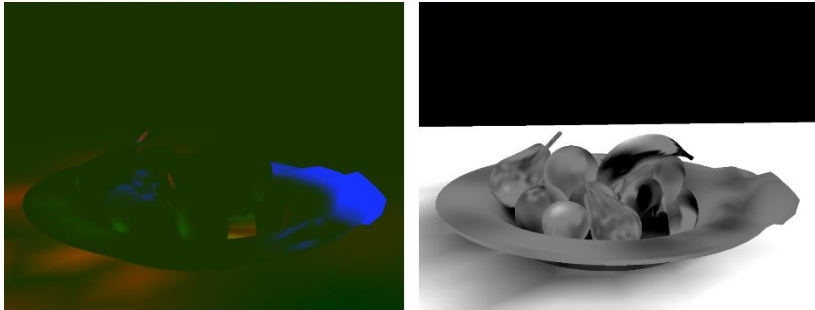


Image showing the rasterized control masks [vertex colors], (Left: RGB channels — Right: Alpha channel)



Watercolour simulation

Basics of Watercolour Shader



Breakdown of a watercolor stylized character

3D computer graphic software

- ▶ **CAD** - specialized for designing furniture and infrastructure for private houses.
- ▶ **Paint FX Maya**(Maya) - used to quickly and easily paint brush strokes and particle effects on a 2D canvas or on or between 3D geometry.
- ▶ **VideoGogh** (After Effects) - automatically paints video by tracking video and applying brush strokes.
- ▶ **Unity** - primarily used to develop video games and simulations for PC, consoles, mobile devices and websites.
- ▶ **Ubiart Framework** - organizes 2D animated vector graphics into a playable video game.



“Fishing” by David Gainey (film)



Rendered in a watercolour simulation process which creates a two-dimensional matte from the three-dimensional target object. (Isaac V. Kerlow, 2009. “The Art of 3D Computer Animation and Effects, 4th Edition”)

“The girls who cried flowers” by Umesh Shukla (film)



- ▶ This was the first animated film created with Auryn's proprietary watercolor system Btrix.

“Portraits de voyage” by Bastien Dubois (documentary)



This documentary not only used Watercolour textures, but also sketch, painting, china ink, and photos.

The 3D models were textured through motion capture, rotoscoping, and mapping.

“Beyond Eyes” by Team 17 (game)



- ▶ **Unity game engine**
- ▶ Shaders were designed to look like blotting ink or running watercolours.

“Child of Light” by Ubisoft Montreal (game)



- ▶ **UbiArt Framework game Engine**
- ▶ The main character stands out of the world around her through her 3D shape, while the world around her is made in 2D matte paintings.

Conclusion



- ▶ Five software to achieve watercolour NPR, fully controllable by the user allowing the production of either coherent animations or images starting from a 3d model.
- ▶ Creating texture maps in the static version of watercolour NPR may lead to the “shower door” effect, where the objects slide over the pigments textures.
- ▶ NDR can achieve some resemblances to watercolour paintings, although it can have limited simulated effects and the characteristic vibrancy of the image.
- ▶ The watercolour obtained by NPR generally seems too detailed compared to a painting done by hand.
- ▶ The skill-set to achieve a Watercolour NPR is quite unique and involves both, technical and artistic knowledge.

References (Articles)

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- ▶ Luft, Thomas; Kobs, Frank; Zinser, Walter and Deussen, Oliver, 2008. Watercolor Illustrations of CAD Data, Computational Aesthetics in Graphics, Visualization, and Imaging. P. Brown, D. W. Cunningham, V. Interrante, and J. McCormack (Editors).
- ▶ Montesdeoca, S. E.; Seah, H. S.; Rall, H.-M.; and Benvenuti, Davide, 2016. Art-directed watercolor stylization of 3D animations in real-time. Nanyang Technological University, Singapore.

References (Films)

- ▶ Fishing, 1999. [Short film]. Directed by Gainey, David. Pacific Data Images. USA
- ▶ *Portraits de voyage*, series, 2013. [Television program]. Sacrebleau Productions. Directed by Dubois, Bastien. Paris, France.
- ▶ *The girls who cried flowers*, 2008. [Short film]. Directed by Umesh Shukla. USA.

References (Games)

- ▶ Halatoe, Sherida, 2015. *Beyond Eyes*. [Video Game]. Xbox One, Playstation 4, and Microsoft Windows, OS X & Linux. Team 17. England.
- ▶ Plourde, Patrick; Rollus, Thomas, 2014. *Child of Light*. [Video game]. Playstation 3, 4 and Vita; Wii U; Xbox 360 and One. Ubisoft. Montreal, Canada.