Art Directed Watercolor Shader for Non-Photorealistic Rendering with a Focus on Reflections

Yolanda Cheng
January 10, 2017

Abstract

In this research, I will develop a shader, a surface material that can be assigned to 3D objects within a scene to create computer generated watercolor style renderings. My shader will have the application to reflections, specularity, shadow, diffuse, contours and with an emphasis on reflections.

The methodology I will develop can be summarized as: (1) A Barycentric shader that is based on degree zero B-spline basis functions; (2) A set of hand-drawn watercolor control texture images that naturally provide the targeting watercolor look. (3) An artistic hierarchy for watercolor paintings.

Keywords: non-photorealistic rendering, watercolor rendering, watercolor reflections, reflections

A. Introduction and Motivation

(a) The windmills in watercolor with three different types of reflection by Andy Walker [7]
Nowadays, more and more traditional artworks are transforming to digital forms, which provide artists with a more efficient, flexible platform with easy accessing, changing and sharing features. For example, today’s Japanese anime use an increasing amount of the 3D elements for an easier control in their 2D animation production. To achieve a variety of 2D styles in the 3D environment is an important topic in the film and animation fields.

Watercolor is like no other medium. Its vibrant colors and spontaneous shapes give it a distinctive charm. [8] Watercolor offers a very rich medium for graphical expression. As such, it is used in a variety of applications including illustration, image processing and animation. [5] Among all kinds of traditional media, watercolor has its own charm of the unpredictable freeform quality, which many artists are fond of. Personally, I find it shares a similar nature with the Chinese traditional ink painting/sumie painting. I have had many years of experience in Chinese traditional ink painting and have always been fascinated by watercolor although my study focus is shading and texturing in CG. Thus, I find it interesting to work on something that combines both my interests: watercolor and CG together. In fact, watercolor look rendering in computer graphics is a very popular topic over the years. However, there’s no research study the reflections of watercolor.

The reflection in the natural world is a special form of beauty as shown in the figures (b). Many artists tend to study and express this kind of beauty in their artwork. In figure (a) Andy Walker demonstrates three different types of reflections of the windmills in watercolor paintings. They all look believable while representing the same object, the windmills, with different looks of the reflections on the lake surface in different weather conditions eg: sunny, windy, cloudy/gloomy. In my research, I will recreate the windmills scene in the three-dimensional space and will then study and create the reflections of the windmills for different reflection looks by using my watercolor shader. My goal is to achieve a believable watercolor painterly look when the scene is rendered.
B. Literature Review

B.1 Why NPR?

The advent of photography and computers has not replaced artists, illustrators, or draftsmen, despite rising salaries and the decreasing cost of photographic and computer rendering technology. [10] Although photorealistic rendering in CG is achieving a more and more advanced level of realism, which could fool human eyes, artists never stop exploring non-photorealistic work. The good example could be Disney’s shorts Paperman as in figure (c) and Feast in figure (d). Paperman (stylized as paperman) is a 2012 black-and-white 3D romantic comedy short film. Produced by Walt Disney Animation Studios and directed by John Kahrs, the short blends traditional animation and computer animation. [6] So does the Feast the 2014 American 3D hand-drawn/computer-animated romantic comedy short film. There’s a trend for these kinds of more stylized painterly looking animation in the animated film field, similarly, Reel FX studio has been creating their new full length featured film Wish Police with a very stylized painterly look rendering as shown in figure (e) the recently released concept art of the film.
B.2 Current Studies and Limits

Examples of NPR uses: (f) render of a scene in Chinese ink painting style with reflections on the river. [3] (g) render of a scene in charcoal drawing style with reflections on the vases. [2] (h) render of a hedgehog character in watercolor style. [4] A new approach, called Barycentric Shaders, is developed to simplify shader development through a more intuitive and streamlined process [1] This method has successfully been used in some specific artistic styles and has achieved some promising results in Chinese ink painting look [3] and charcoal drawing look [2] in the computer rendered 3D scenes. A recent study conducted by scholars in Nanyang Technological University presents some advanced results in watercolor style rendering with art-directed control. [4] However, the result is achieved through the real-time Autodesk Maya viewport render system developed. In my research, I’ll focus on achieving the render results offline as in the mainstream film production pipeline and adding the application of watercolor effects to the reflections of the 3D objects with the considerations of global illumination.

C. Methodology

The scene will be constructed in Autodesk Maya and rendered with Mental Ray. The node editor system in Maya could create customized shading networks which provides the maximum flexibilities and possibilities for testing and tailoring shaders without code required. It is very artists-friendly and easy accessing. When creating my shader, I used the charcoal shader that Du [2] created as foundational base and modified some crucial key elements to fit the norm of watercolor.

1. Barycentric Basis Functions for Watercolor Painting

2. Control Images for Watercolor Paintings
   Hand drawn watercolor textures are created manually. When painting the
texture maps, I pay extra attention to the brush strokes, water amount in order to have a consistent looking when the maps applied to the 3D objects. I will then scan the maps and transfer them into digital files with an additional editing in Photoshop to ensure the map is seamless and tileable. Currently, for the initial testing, there are three main control maps, which are highlights, medium tone and shadows with a single color of the watercolor paint. The shifts of the colors for the shader could be achieved by added a hue shift node in the watercolor-shading network. So the users can choose any color they want by an easy control for the hue. More control maps would be created for a smoother transfer from light to dark when the shader responses to the lights.

3. Watercolor Painting Hierarchy
The shader will be created considering the real life order of the watercolor painters when they are creating their painting. One of the most common techniques used in watercolor is the application of thin washes of watered paint to regions of the paper. [9] In Andy Walker’s painting as shown in figure (a), the reflections come last, where many artist will use an extra water drops to blur the reflections. Similarly, I will use the same hierarchy principle for my watercolor shader parameters.

D. Conclusion
The barycentric shader method provides intuitive art-directed control, and its framework allows the shaders to be included in any rendering pipeline without major changes. [1] In my research, the barycentric shader would be the ideal method to start from and with adding the customized elements to eventually achieve the stylized watercolor look in 3D. The methodology makes the shader highly controllable as the artist has the full access to the diffuse, shadow, reflection, specular and contours. The key part is that all the values could be control by texture maps that artist created which may be time consuming but allows the artists have the freedom and authority over the overall look that they want to achieve.

References
Non-Photorealistic Animation and Rendering, Expressive 2016.


