NPR in Production: Animating the Sung dynasty painting "Children at Play"

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1 Introduction

Research on Non-Photorealistic Rendering (NPR) [Ma et al. 2002] has produced an array of techniques such as outline detection, simulation of brush strokes, cartoon shading, etc. However, the practical application of these techniques to reproduce a specific masterpiece is seldom discussed. During a recent project in cooperation with the National Palace Museum of Taiwan, we were given the task of rendering animated characters in the style of a well-known Chinese Sung dynasty painting, "Children at Play." This sketch describes a step-by-step method for achieving this effect using a variety of NPR techniques.

2 Methodology

Many individual elements combined to create the distinctive style of Sung dynasty painting. Our goal was to duplicate each of these elements in a CG workflow.

2.1 Canvas

The first step was to examine the surface on which the paint was applied. "Children at Play" was painted on cotton cloth. The cloth texture is much more apparent in the background than within the shaded foreground figures. A sample of the cloth texture was captured by scanning and filtering a portion of the original painting. This texture formed the background of the renderings. In order to mimic the weaker cloth texture inside the foreground figures, a contrast-reducing filter was applied selectively to those areas.

2.2 Outlines

Most NPR research on Chinese painting has focused on simulating complex brush strokes and ink flow. However, "Children at Play" features especially smooth, meticulous outline strokes, a style referred to as *Gong-bi* or "court-style" painting [Cahill 1960]. Changes in stroke thickness are negligible, and the segmentation of outlines occurs mostly in regions of high curvature. Therefore it was not necessary to simulate brush behavior – a shader with silhouette edge detection was sufficient to render convincing outlines. The underlying cotton texture was used to perturb outlines slightly.

2.3 Shading

In *Gong-bi* paintings, foreground figures are shaded nearly uniformly. Individual brush strokes are not visible. This appearance was easily achieved with a standard flat "cartoon" shader.

2.4 Aging

The "Children at Play" painting that was to be animated has suffered roughly 800 years of storage and handling. Pieces of the cotton canvas have peeled away and the paint has faded. Different parts of the painting have faded at different rates, leading to a mottled appearance. The foreground characters have faded less than the background due to heavier paint coverage. Peeling was simulated by partially matting out areas of the canvas, and the renderings were desaturated using a mask to select mottled areas of the background for stronger fading.

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Figure 1: *Our result. One frame of a short animation "Adventures in the National Palace Museum", which is produced by animating a Sung dynasty painting "Children at Play".*

2.5 Animating

Some brush stroke rendering techniques are susceptible to frame coherence artifacts during animation. Fortunately, the simple *Gong-bi* strokes could be animated coherently without special attention, as they were derived from smoothly-varying surface parameters.

2.6 Lighting

The painting was to be rendered as it appears hung on the wall of the museum. An overhead spotlight provided the virtual light source, and surface reflectance was determined using a standard cloth BRDF (Bi-directional Reflectance Distribution Function).

3 Result

These techniques were brought together in a five-shot sequence for the animated short *Adventures in the National Palace Museum*. Figure 1 shows one frame. The Museum's experts on Chinese painting praised our renderings as extremely accurate to the Sung painting style.

We would like to thank the staff of the National Palace Museum of Taiwan for their advice on characteristics of Chinese paintings.

References

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