High-definition and Multispectral Capturing for Digital Archiving of Large 3D Woven Cultural Artifacts

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Abstract

This paper describes a 3D measurement system with wheel-rail, a capturing system with multi-band camera, and a 3D modeling of large woven cultural artifacts, and show a high-resolution 3D model with multi-band image.

Keywords: Digital Archive, Computer Graphics, 3D Scanning, Multi-band Imaging, Gion Festival

1 Introduction

Recently, research on digital museums received increased attention. In the digital museum project [Tanaka et al. 2010], we are working on the digital archiving of the intangible cultural heritage "Gion Festival in Kyoto", focused on the culture of Kyoto, and developed a multi-modal VR exhibition system.

After the Gion Festival of 2011, the repair work of the Fune-hoko storage was scheduled. Therefore, taking this opportunity, we created a 3D measurement system for the large woven cultural artifacts with the laser range scanner, and measured all 3D woven cultural artifacts. Then we captured high-resolution images with a two-shot type 6-band image capturing system, and modeled woven cultural artifacts in 3D.

2 Capturing System with Multi-band Imaging Camera

In order to reproduce accurate color in digital photography, multi-band imaging technology is a practical solution. Then, we constructed ultra high-definition six-band digital camera system and used for archiving some tapestries and ornaments of Fune-hoko. This system can take more than 100 M pixel images and we archived that the resolution is almost 0.02 mm/pixel. This system consists of a consumer 35 mm-format digital camera and a custom interference filter. Attached in front of the camera lens, a customized filter cuts off the left sides, i.e., the short wavelength domain, of the peaks of both the blue and red in original spectral sensitivity. It also cut off the green's right side, i.e., the long wavelength domain. Sliding the filter horizontally by hand, one can capture two images with and without filter alternately.

First, an image is taken with the filter in front of the lens. Then, another image is taken without the filter by sliding the filter horizontally by hand. Combining the two RGB color images, a six-band image is synthesized.

3 3D Scanning System of Large 3D Woven Cultural Artifacts

Many of the Fune-hoko hangings are extremely large, approximately 1 m×3 m, and so measurement must be conducted in sections. The final process of combining the data from measurements of individual sections is therefore time-consuming. Choosing the textile cultural artifacts with particularly strong three-dimensionality among the Fune-hoko hangings as our subjects, we have constructed a scanning system that takes into account the process of measurement and ease of combined processing. In order to simplify the process of integration processing after measurement as much as possible, we laid out a rail so that a wheeled platform could run along it from left to right, and set up the laser-range scanner on another wheeled platform on top of the first; we then conducted the measurements without moving the target object, by moving the scanner at set intervals and recording the necessary shots.

Figure 1: *Comparative results. Multi-band Image(first image), 3D Surface (second image), 3D Model with Multi-band Image(third and fourth images).*

We analyzed the measurement data, and modeled by the denoising, the interpolating of the lost part, the alignment, and the integration of the overlapped point. Figure 1 shows a comparative result of a multi-band image and a 3D model with multi-band image. Third and fourth images are rendering results which estimated through the use of a multi-band image, directional light source, and normal vector of 3D surface.

4 Conclusions and Future Work

This paper described a 3D measurement system with wheel-rail, a capturing system with multi-band camera, and a 3D modeling of large woven cultural artifacts. In future work, we plan to develop a real-time point-based visuo-haptic exhibition system and multi-finger elastic interaction.

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