The CVMT/AAU Sphere Gantry

Madsen, Claus B.

Published in:
Proceedings of the 16th Danish Conference on Pattern Recognition and Image Analysis

Publication date:
2008

Document Version
Publisher's PDF, also known as Version of record

The CVMT/AAU Sphere Gantry

Claus B. Madsen
Laboratory of Computer Vision and Media Technology, Aalborg University, Denmark
cbm@cvmt.aau.dk

1. Introduction

The reflectance characteristics of real world surfaces/materials are very complex and hard to model analytically. Image based techniques are rapidly gaining popularity in computer graphics, in particular for special effects.

With image based techniques the computer graphics rendering is somehow based on real images (hence the name). There is work on image-based modeling, rendering and lighting.

The computer vision and media technology lab at Aalborg University (CVMT/AAU) has designed and contructed a "Sphere Gantry", essentially a rig with two rotational degrees of freedom, allowing for placing a camera or a light source at any position on a sphere around a test object.

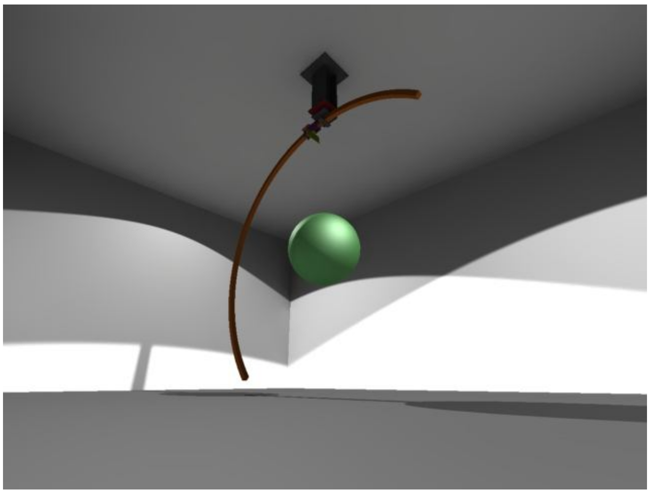

Figure 1: 3D rendering of the CVMT/AAU sphere gantry

With the sphere gantry it is possible to acquire images of test objects in a very systematic and controlled manner. We are using it for two different types of acquisition: 1) static illumination, moving camera, and 2) static camera, moving illumination.

Figure 2: The actual sphere gantry on the lab. Unfortunately the rig is not motorized so it is manually moved during acquisition.

2. Static illumination, moving camera

By mounting a high quality digital SLR camera on the application tray of the sphere gantry, placing an object in the gantry's center, and making sure the illumination is held constant, we can acquire a large number of images of the test object from every possible angle.

We have used such data sets with around 300 images for modeling the appearance of a surface with spherical harmonics and made a real-time graphics rendering system to recreate the view-dependent appearance of the surfaces in real-time.

We have demonstrated that it is possible to very convincingly visualize complex glossy surfaces with highlights, and minute creases. The changes in glossiness caused by fingerprint left by humans while handling the material are also easily visible, see Figure 3.

Figure 3: View dependent appearance of glossy surface recreated in real-time based on 300 images acquired with the sphere gantry.

3. Static camera, moving illumination

If, conversely, the camera is mounted on a tripod and the *light source* is placed on the sphere gantry application tray then it is possible to acquire a completely different data set for a set of objects. We basically take an image for every different illumination angle, and this sequence can subsequently be used for synthesizing the appearance of the scene under arbitrary illumination conditions.

Figure 4: Image 15 in an 348 image sequence with a scene illuminated from all positions on a sphere around the scene. In this image the light source is roughly vertically above the scene.

Figure 5: Image number 154 of the same sequence showing a completely different illumination direction.

Figure 6: Average image of the entire sequence corresponding to the appearance of the scene had it been illuminated by a spherical light source placed around the scene (a “sky dome”).

Figure 7: Average of 3 randomly selected light source positions.

4. Conclusions

We have designed and constructed a rig which allows to make systematic acquisitions where either the camera or the light source is placed on all possible locations on a sphere around a test object.

Current experimentation involves using acquired datasets to synthesize view-direction-dependent appearance and illumination-direction-dependent appearance.

Acknowledgments

This research is funded by the CoSPE project (grant number 26-04-0171) under the Danish Research Agency. This support is gratefully acknowledged.

References

[1] C.B. Madsen, B. Mortensen, and J. Andersen. Real-Time View-Dependent Visualization of Real World Glossy Surfaces. In *Proceedings:International Conference on Graphics Theory and Applications(GRAPP), Funchal, Madeira – Portugal, page 231 - 240, January 2008.*