Image-Based Rendering for Photo-realistic Animation

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Introduction

This technical sketch presents a description of how an image-based rendering (IBR) technique can be used to produce photo-realistic animation of real-world objects which usually have non-rigid-surface effects (e.g., animal fur, velvet, specular and transparency).

In recent years, principles and various kinds of implementation and theoretical analyses of IBR have been proposed and published one after another. However, for practical use of IBR, for example, for animation production, little research has been done and few actual applications have been developed. Although there may be many reasons for this, the following two reasons are significantly important:

- **Huge data size**
- **Lack of Interactivity among objects, illumination and motion**

The data size of IBR is very large and crucial issue for actual implementation and there have been many attempts to reduce the data size for IBR. On the other hand, little research has been devoted to realize interactivity for IBR. Therefore, for the time being, we leave the data size problem for future research and we concentrate upon the interactivity problem encountered when making photo-realistic animations. Our method is based on the technique *the surface light field*, a term coined by Miller et al.[1]. Our research is inspired by the work done by Nishino et al.[2] and Daniel N.Wood et al.[3] in which they extend *the surface light field rendering* in an efficient and practical manner.

Interactivity and Animation

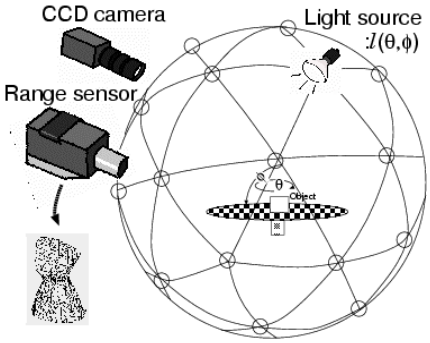
The word "interactivity" has many meanings and ambiguities depending on individual applications; therefore, it is necessary for us to define the word precisely, especially with regard to animation.

[Interactivity] Basically, we assume that the interactivity has three key elements. The first element is the arbitrary motion of the object, including deformation of the object. The second is the arbitrary illumination change which usually causes shadow changes .The third is real time rendering.

[Purpose and Goal] Based on the previous definition, the purpose of our system to achieve interactivity for IBR can be translated as **rendering arbitrarily positioned objects with arbitrary deformation and illumination in real time**[1]. However, real time rendering is not necessary for animation and we are not particularly interested in real time at this time.

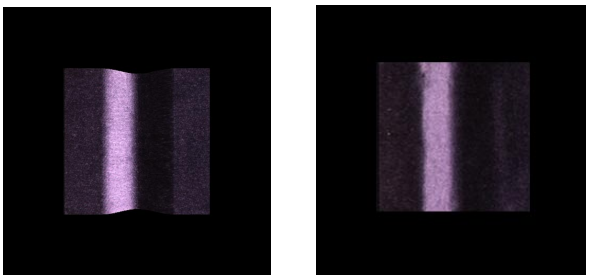
System

To synthesize an object whose position and pose change arbitrarily, we re-use the actual ray derived from the object's surface. To achieve photo-realistic rendering, we developed a mesh-based rendering algorithm which selects the appropriate ray from whole ray based on BRDF (bidirectional reflectance distribution function) for individual mesh. Also, because the data acquisition process is considerably important for this system, we configured the original data acquisition system *"light dome"* shown in the following figure. The "*light dome"* can automatically acquire the 4D data which is necessary for image synthesis.

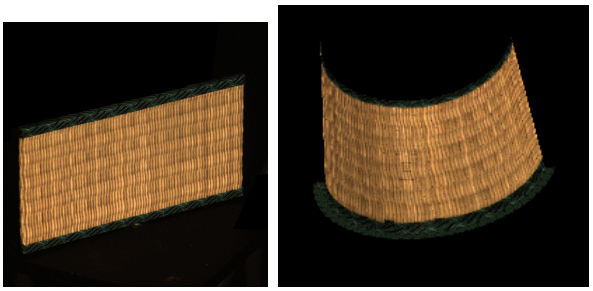


Results

We performed several experiments to show the effectiveness of our method. In the following figure, the left image is the image synthesized by using our method; the right image is the actual velvet cloth[2] taken by CCD camera which was carefully set up so as to be same as the rendered image's illumination, camera position and deformation of the cloth.



Next figure shows another result which was achieved by using a *Tatami* block[3]. The image on the left is the actual captured image, while the image on the right is the synthesized image after deformation.



These results demonstrate the effectiveness of our proposed method to render photo-realistic images of the deformed objects with non-rigid surface effects. In the future, we need to realize the synthesis of the object under arbitrary illumination changes.

References

[1]G.Miller, S.Rubin and D.Ponceleon, Lazy decompression of surface light fields for precomputed global illumination. Rendering Techniques (Eurographics Proceedings), June 1998

[2]K.Nishino, Y.Sato and K.Ikeuchi,Appearance compression and synthesis based on 3D model for mixed reality. Proc. of SeventhInternational Conference on Computer Vision 1999

[3]D.Wood, D.Azuma, W.Aldinger, B.Curless, T.Duchamp, D. Salesin and W Steutzle,Surface light fields for 3d photography.ACM SIGGRAPH 2000.

1) rendering such a deformed object with consistency of illumination and geometry is always difficult to achieve
2) Velvet is usually difficult to synthesize because of complicated BRDF
3) A 3D block made of tightly bound straw. This material also has non-rigid effects on surface