Measurement and analysis of reflection and subsurface scattering

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On the surface of an opaque object, an incident ray reflects at the incident point. The property of the reflection is described by the bidirectional reflectance distribution function (BRDF) that is a four-parameter function. On the other hand, an incident ray to a translucent object scatters in the material. This phenomenon is called as subsurface scattering, and described by the bidirectional scattering surface reflectance distribution function (BSSRDF) that is a six-parameter function. The measurement and analysis of the BRDF and BSSRDF are important for a variety of applications such as computer graphics and inspection of painted surfaces.

This talk introduces our two recent works. One is for measuring BRDFs of opaque objects using a special optical hardware. The other is for analyzing BSSRDFs of translucent objects in the framework of the inverse rendering.

Multiplexed Illumination for Measuring BRDF using an Ellipsoidal Mirror and a Projector[1]

Abstract
Measuring a bidirectional reflectance distribution function (BRDF) requires long time because a target object must be illuminated from all incident angles and the reflected light must be measured from all reflected angles. A high-speed method is presented to measure BRDFs using an ellipsoidal mirror and a projector. The method can change incident angles without a mechanical drive. Moreover, it is shown that the dynamic range of the measured BRDF can be significantly increased by multiplexed illumination based on the Hadamard matrix.

Analysis of Subsurface Scattering under Generic Illumination [2]

Abstract
We present a new method of analyzing subsurface scattering occurring in a translucent object from a single image taken under generic illumination. In our method, diffuse subsurface reflectance in the subsurface scattering model can be linearly solved by quantizing the distances between each pair of surface points. Then, the dipole approximation is fit to the diffuse subsurface reflectance. By applying our method to real images, we confirm that the parameters of subsurface scattering can be computed for different materials.

References

[1] Y.Mukaigawa, K.Sumino, Y.Yagi, "Multiplexed Illumination for Measuring BRDF using an Ellipsoidal Mirror and a Projector", Proc. of Asian Conference on Computer Vision (ACCV2007), LNCS-4844, pp.246-257, Nov. 2007.

[2] Y.Mukaigawa, K.Suzuki, Y.Yagi, "Analysis of Subsurface Scattering under Generic Illumination", Proc. of International Conference on Pattern Recognition (ICPR2008), Dec. 2008.