# Inverse Raytracing

Daisuke Miyazaki        Katsushi Ikeuchi

We propose a novel method for estimating the surface shape of transparent objects. Realistic 2D images of transparent objects can be rendered by raytracing method from 3D shape data of the objects. Such forward problem is quite easy and many researches have done since 1980s. In contrast, our research is to solve the inverse problem of raytracing: estimate the 3D surface shape of transparent objects from 2D data. First, we measure the polarization states of the light while observing the transparent object. Next, we minimize the squared difference between the obtained polarization data and the calculated polarization data, by changing the surface shape of the transparent object. Polarization data are calculated by polarization raytracing method. This minimization finally produces the 3D surface shape of the transparent object.

**Publication**

[1] D. Miyazaki and K. Ikeuchi, "Estimating Surface Shape of Transparent Objects by using Polarization Raytracing Method," *in Proc. of Meeting on Image Recognition and Understanding*, July, 2004, to appear (in Japanese).

[2] D. Miyazaki and K. Ikeuchi, "Ability and Limitation to Simultaneous Estimation of Frontal and Backward Surface Shape of Transparent Objects by using Polarization Raytracing Method," *in Proc. of Meeting on Image Recognition and Understanding*, July, 2004, to appear (in Japanese).

[3] D. Miyazaki and K. Ikeuchi, "Analyzing Interreflections of Transparent Objects by using Polarization Raytracing Method," *in Proc. of Meeting on Image Recognition and Understanding*, July, 2004, to appear (in Japanese).

Camera Adapter
PC
Monochrome TV Camera
IR/UV Cut Filter
Controllable Linear Polarizer
Geodesic Dome
Spherical Diffuser
40W Lamp
Polarizer Controller
Transparent object [inside]

Measurement System "Cocoon"



Obtained Polarization Image        Calculated Polarization Image

Polarization Data



Previous Method        Proposed Method

1 Iteration        10 Iteration        100 Iteration

Result of Shape Estimation