Multi-interfaces based Refractive Rendering

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Figure 1: *The first three images are the comparisons between our rendering result and two interface rendering method; the fourth is the ray intersection problem; the last one is our final rendering result with caustics.*

Abstract

We presented an multi-interfaces image based method to simulate the refraction and related light effects in real time on a normal graphic card. The multi-interfaces based representation of the refractor is obtained by hiring depth peeling ideas. This leads to significantly better results than two interfaces refraction where only the front and back face of the object was captured.

Keywords: Real-time Rendering;Refraction;Deformable Objects

1 Introduction and Motivation

Real-time simulation of the natural phenomenon caused by the light transmit through objects are always a challenge in Computer Graphics.

Recent work has show refraction and caustic effects can be performed on graphics hardware to obtain an impressive realistic result through a two interfaces representation [Wyman and Nichols 2009]. The two interfaces representation method reasonably ignore the internal information of one refractor. However, the for sophisticated refractive model which is also very common in real world such like a cup, such assumption is not accurate. The other ideas rendering on an accelerating space representation methods such like volumetric dataset and K-D tree organized mesh can achieve an more accurate result but with a slow speed. We focus on how to represent the refractor with multi-interfaces and implement the ray tracing idea on it to obtain an accurate result.

2 Technical Approach

The first step of our work is inspired by the depth peeling idea. We implemented the similar method with the [Liu et al. 2009]. The idea is simple: during the process of rendering the whole model, for each reached pixel we perform a depth comparison with the previous arrived pixel and store the depth and normal information in a sorted order. And this step outputs a texture array of sorted depths and normals.

Then we implement a multi-interfaces based refraction algorithm. For most of cases the ray transport from a lower index interface to a higher index interface. However, due to the representation obtained by the depth peeling process, few rays may transport back from a higher index to a lower index. So we implement a look-back mechanism. The pseudocode is showed as follows.

Setting with Max_binary_steps and $Linear\_probe\_div$
while not reach the highest interface **do**
  Current direction T, position P, interface N, depth D_P;
  Depth of N interface D_N;
  while $D_{N+1} < D_P$ **do**
    sample D_N and D_{N+1};
    if $D_P < D_N$ **then**
      $N--$
    else
      $P = P + T * \frac{D_{N+1} - D_N}{linear\_probe\_div}$
    end if
  end while
  Binary search with Max_binary_steps;
end while

3 Results and Future work

The measurements were performed by rendering images with 1024x1024 pixels using an Intel 2 Duo E4600 (2.40GHz) PC and a PCI express GeForece 8800 GT with 256 MB of memory and without much optimization. And the same with previous methods, all the models could be under deformation. Currently we are working on many other effects such like total internal reflection and subsurface scattering.

Table 1: *Performance in fps.MIR(multi-interfaces refraction), TIR(two interfaces refraction), MIRC(MIR with simple caustics)*

Model	polygons	MIR	TIR	MIRC
Cup	7100	60	72	30
Mug	3746	61	65	29
Buddha	50000	45	53	21

References

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