Multi-interfaces based Refractive Rendering

Lei Ma, Shuangjiu Xiao and Xubo Yang
Shanghai Jiao Tong University

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 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.

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.

```plaintext
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)

<table>
<thead>
<tr>
<th>Model</th>
<th>polygons</th>
<th>MIR</th>
<th>TIR</th>
<th>MIRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cup</td>
<td>7100</td>
<td>60</td>
<td>72</td>
<td>30</td>
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<tr>
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References
