Realistic Rendering and Dynamical Simulation

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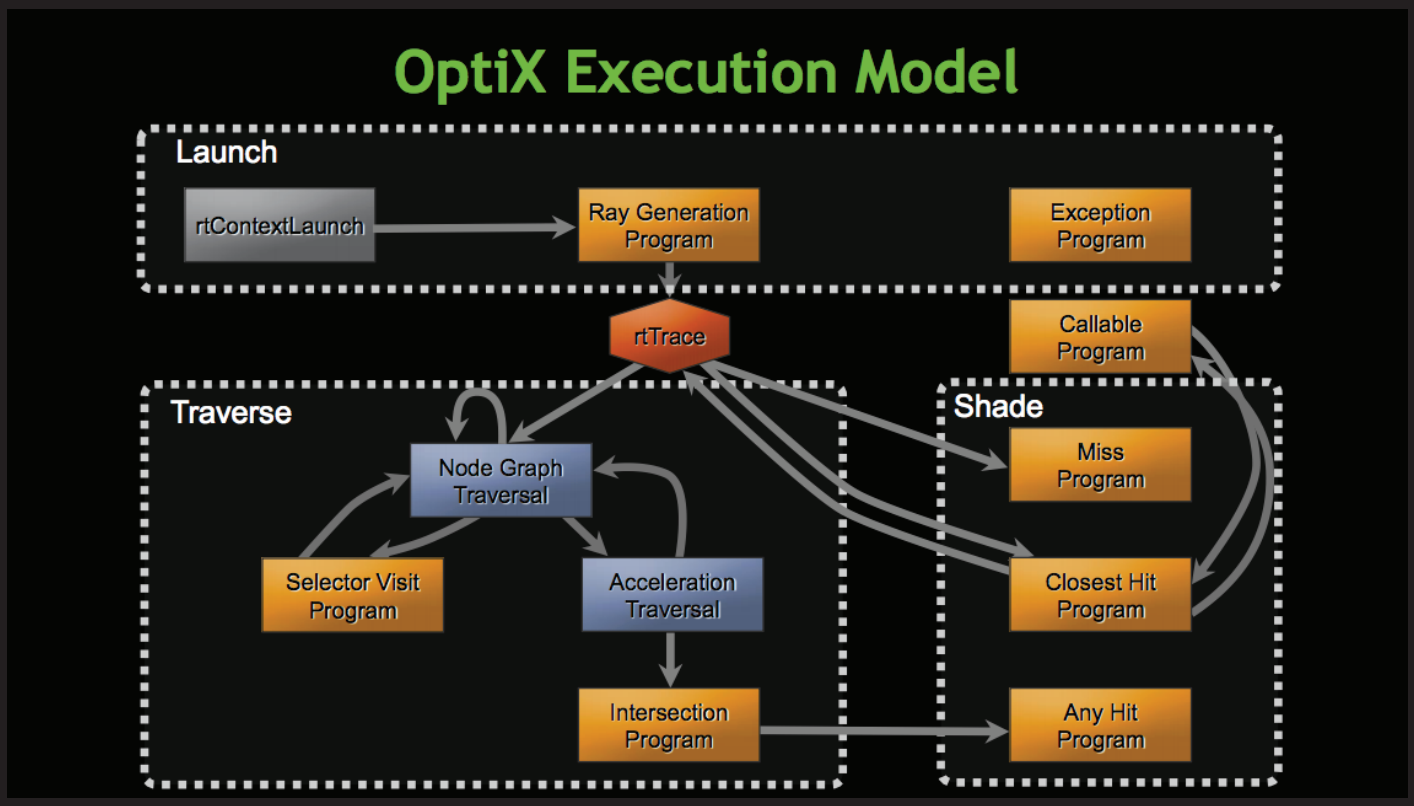
Abstract

We present a realistic rendering engine that supports both real-time and offline rendering combined with dynamical simulation. By leveraging the parallel processing power of graphics cards, we are able to achieve realistic rendering based on ray tracing in real time. In addition, a offline rendering system combined with dynamical simulation allows high quality pictures and videos to be produced. In this project, we study the difference between CPU and GPU based rendering, digging deeper into the performance increase brought by GPUs.

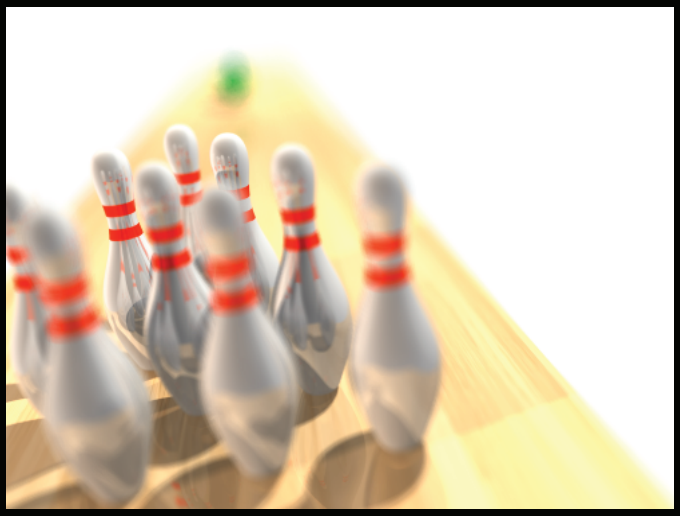
GPU Based Rendering with Optix



With the increasing GPU processing power, realistic rendering based on ray tracing is now achievable in real-time. With the help of the Optix Ray Tracing Framework, we created our rendering engine able for both real-time and offline rendering.

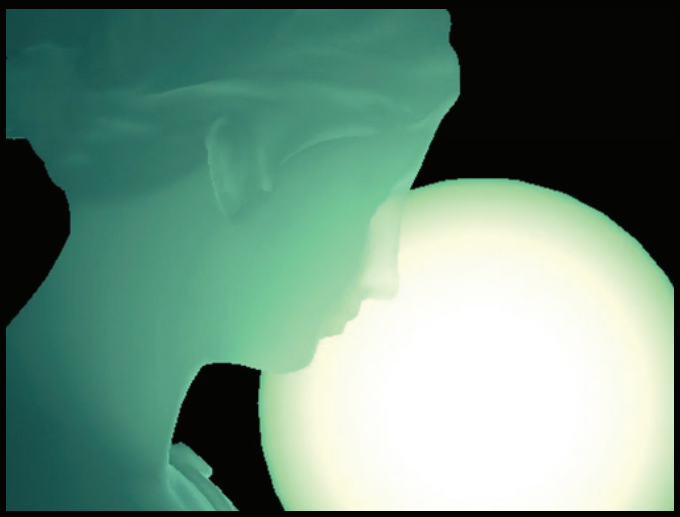
Realistic Rendering Effects

We combined different rendering effects including but not limited to:

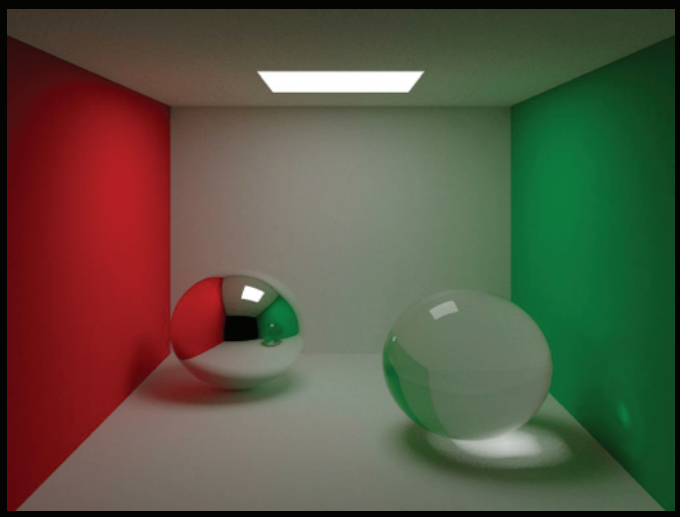


Depth of Field

Global Illumination



Subsurface Scattering

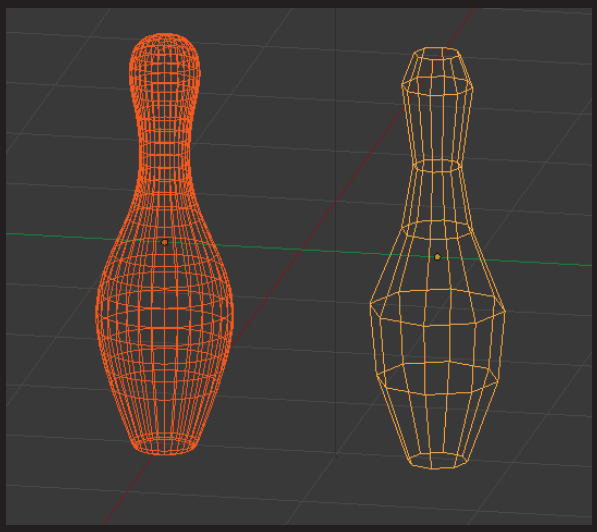


Path Tracing

These advanced rendering techniques were able to make the result much more realistic compared to images produced traditional ray tracing. For example, with global illumination, the richness of the lighting was greatly enhanced. These features are available in the offline rendering mode of our system.

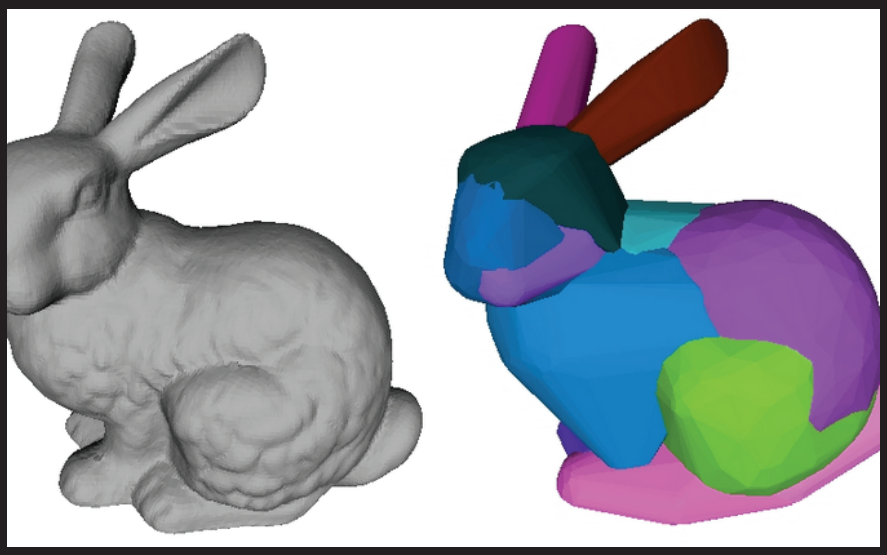
Dynamical Simulation

Apart from the realistic rendering engine, we also have a dynamical simulation engine for simulating physical effects, e.g., collisions. The dynamical simulation engine is built upon the Bullet Physics Engine, with an additional layer to interface with the rendering system.



Different approaches were used to accelerate the dynamical simulation, including simplifying meshes to reduce the number of vertices and faces, and using approximate enclosing volumes for objects with shapes close to simpler geometric primitives, e.g., cylinders, boxes, etc.

Concaves objects are not supported in the Bullet Physics Engine by default. Thus convex decomposition was performed to separate them into several convex components.



Conclusion

Combining our rendering system that supports both real-time and offline rendering with the dynamical simulation system, our application can be used in static picture rendering, video production and games.