Speedup of Radiosity with Distributed Memory Parallel Computer

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1 Introduction

The radiosity method,one of the 3-D rendering technique, is a way of image generation with consider not only direct rays from the light source but also diffuse inter-reflection among the object. The radiosity method enable to generate photo-realistic images.

In radiosity calculation, it takes very very long time to get the form-factor. The hemicube method for approximation also takes a long time, so it is important to parallel computing.

In usual parallelizing, it is general to divide into polygon or patch. And exist the method that divide the hemicube like mesh into the same size cell when calculate form-factor, and distribute the cells for prosessors. But to improbe the image quality in hemicube method, it is necessary to subdivide the mesh of hemicube. According to subdivide the mesh, radiosity calculation time become very long.

The goal of this researh is to confirm of paralell radiosity method use of hierarchical hemicube method. Using hierarchical division, the hierarchical hemicube method can keep image quality. And it bring down calculation quantity compared with the hemicube method useing the same size division.

2 Radiosity

In the radiosity method, we can realistic images which have following characteristic by taking account of diffused imter-reflection. Those are the dim shadow, color breeding,

and reach the inter-reflect rays to the point that unreachable by the rays directly. We can represent a mild atmosphere.

A radiosity equation shows that amount of energy shot by a patch is equal to the sum of the self-radiant and the reflectance of the patch. We can get the radiosity value of all the patches in the environment to solve all the radiosity.

A form-factor shows that how much energy reach from a patch to the other patch. In hemicube method, we assume the imagenation hemicube on the center of the patch. The viewpoint is on the center of the patch, the screen is as the surface of the hemicube, and other patches project on the screen, so we can find the form-factor between two patches.

The radiosity method is divided into two classes, usual method namely early radiosity method and progressive refinement aproach.

Early radiosity method is, first of all, getting completed all the form-factor in the environment, the next, apply the form-factor to the radiosity equation, and solve the equation using of Gauss-Seidel method. This is the method examining a patch recieve energy from the environment.

Progressive refinement approach is the method examining a patch affect to the environment. This thinking is the reversed of the thinking of the usual method. THis method request the memory capacity smaller than the usual method.

3 Parallel Radiosity Method

To parallelize the radiosity method, we usually assumed a polygon or a patch as the parallelizing unit. And exist the method that divide the hemicube like mesh into the same size cell when calculate form-factor, and distribute the cells for prosessors.

In this research, I divide the hemicube hierarchically like mesh into the cell, and distribute the cells for processors. In hierarchical divide of hemicube, after calculate form-factor on hemicube with same size mesh, calculate form-factor with large value again to get exact form-factor. And shooting the energy on the part of the progressive refinement approach, each processor shoot energy at the same time, so parallelize the progressive refinement approach. These works are repeated until the unshot energy is down to the fixed level. Finally, radiosity value is rendered by the Z-buffer method.

I implemented this algorithm on a distributed memory parallel computer T3E. As a result of the measurement of parallel processing performance, the speed-up ratio and processing time is good result compared with radiosity that use of dividing hemicube with same size mesh.

4 Conclusion

In this research, I proposed that divide the hemicube and that distribute to each processor.Then I implemented for the distributed memory parallel computer T3E. The distribute method which proposed in this research is effective for the radiosity method that use of dividing hemicube with same size mesh.

But parallelizing form-factor calculation with hierarcical division hemicube method, the number of times of the same period come into problem. To solve that problem, it is necessary to examine the method that can change dividing mesh size of hemicube to match object image data.