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3-D Image Synthesis
by Radiosity Method on Parallel Computers

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1 Introduction

The radiosity method, one of the rendering technique, is a way of image generation by global illumination model based on principles from the field of thermal engineering. It is widely used for generate graceful computer graphics with the room illumination. The radiosity method enable to generate photo-realistic images, because of the computing with consider not only direct rays from the light source but also diffuse inter-reflection among the objects.

In radiosity calculation, it takes very very long time to get the form-factors. 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 is proposed that divide patch hierarchically, it is difficult to parallelize so there is not effective way.

The goal of this research is to propose the parallel computation model for radiosity method with consider dynamic load balancing, and to confirm its effectiveness.

Based on the algorithm, divide the hemicube when form-factor calculation. Also some patches shoot the radiosity energy on the part of the progressive refinement approach, parallelize the this approach.

I implement this algorithm for the massive parallel computer Parsytec GC-PowerPlus, make a comparative algorithm and the problem to implement for the massive parallel computers.

2 Radiosity and 3-D Image Synthesis

In the radiosity method, we can get realistic images which have following characteristic by taking account of diffused inter-reflection. Those are the dim shadow, color breeding, and reach the inter-reflecting indirect 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 equations.

A form-factor shows that how much energy reach from a patch to the other patch. In hemicube method, we assume the imagination 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 approach.

Early radiosity method is, first of all, getting completed all the form-factor in the environment, the next, apply the form-factors to the radiosity equation, and solve the equation using of Gauss-Seidel method.

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. And this approach is progress to greater realism be graceful. Since the progressive refinement approach has been proposed, almost all the people researching radiosity are used this approach.

3 Parallel Radiosity Method

To parallelize the radiosity method, we usually assumed a polygon or a patch as the parallelizing unit. Or we divided rays shot from the patch based on the ray-tracing method.

In this research, I divide the hemicube like mesh into the cell, and distribute the cells for processors. And shooting the energy on the part of the progressive refinement approach, shoot from some patches at the same time, so parallelize the progressive refinement approach. These works are repeated until the unshot energy is down to the fixed level. the got radiosity value is rendered by the Z-buffer method. I implemented this algorithm for Parsytec GC-PowerPlus.

As a result of the experiment, as the number of the processors increase, the speed-up ratio is increased. But at a certain extent, speed-up radio is saturated, and number of processors is much many, the speed-up ratio is decreased. The communication time is account for close in amount of whole the processing time. So the calculation quantity is decrease in each processors, but whole the processing time is increased. The number of the times for communication must be reduced, that is why the size of message is had to maked larger per once communication.

4 Conclusion

In this research, I proposed that divide the hemicube and that distribute to each processor. Then, I implemented for the massively parallel computer, Parsytec GC-PowerPlus.

As the number of processors increase, at a certain extant, speed-up ratio is decreased. So, communication quantity must be reduced. Generally, when communicating between the processors, it take a time to make a connection, it is important to parallelize with consider the point.