Order Independent Transparency for Image Composition Parallel Rendering Machines

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Abstract. In this paper, a hybrid architecture composed of both the object-order and the image-order rendering engines is proposed to achieve the order independent transparency on the image composition architecture. The proposed architecture utilizes the features of the object-order which may provide high performance and the image-order which can obtain the depth order of all primitives from a viewpoint for a given pixel. We will discuss a scalable architecture for image order rendering engines to improve the processing capability of the transparent primitives, a load distribution technique for hardware efficiency, and a preliminary timing analysis.

1 Introduction

3D computer graphics is a core field of study in developing multi media computing environment. In order to support realistic scene using 3D computer graphics, a special purpose high performance 3D accelerator is required. Recently, low cost and high performance 3D graphics accelerators are adopted rapidly in PCs and game machines[1,2,3].

To generate high-quality images, solid models composed of more than several millions polygons are often used. To display such a model at a rate of 30 frames per second, more than one hundred million polygons must be processed in one second. To achieve this goal in current technology, several tens of the graphic processors are required. Thus, parallel rendering using many graphics processors is an essential research issue.

According to [4], graphics machine architectures can be categorized into the three types: *sort-first architecture*, *sort-middle architecture*, *sort-last architecture*. Among them, sort-last architecture is a scalable architecture because the required bandwidth of its communication network is almost constant against the number of polygons. Thus, sort-last architecture is quite suitable for a large-scale rendering system.

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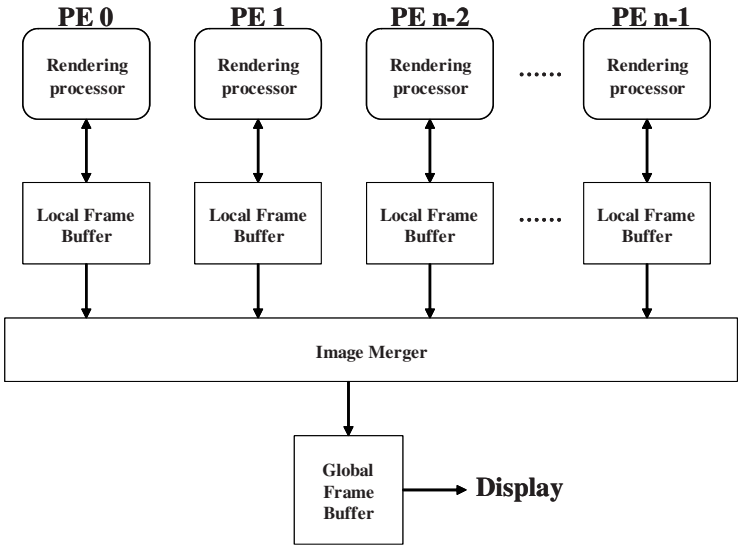

Fig. 1. An image composition architecture

One of the typical sort-last architectures is an image composition architecture [5,6,7,8,9]. Figure 1 shows the overall structure of image composition architecture. All polygonal model data are distributed into each rendering processor which generates a subimage with its own frame buffer, called a local frame buffer. The contents of all the local frame buffers are merged periodically by the image merger. During image merging, the depth comparisons with the contents of the same screen address for each local frame buffer should be performed to accomplish hidden surface removal. The final merged image is then transmitted into the global frame buffer.

In a realistic 3D scene, both opaque and transparent primitives are mixed each other. To generate a rendered final image properly with the transparent primitives, the order dependent transparency problem must be solved. That is, the processing order depends on the depth order by a viewpoint, not on the input order. Order dependent transparency problem may cause the serious performance degradation as the number of transparent primitives increases rapidly. Therefore, the order independent transparency, the opposite concept of the order dependent transparency, is a major for providing high performance rendering systems. But up until now we have not found any parallel 3D rendering machine supporting hardware accelerated order independent transparency.

In this paper, we propose a new method of the hardware accelerated order independent transparency for image composition in the parallel rendering architecture. To achieve this goal, we suggest a hybrid architecture composed of both the object order and the image order rendering engines. The proposed mechanism utilizes the features of the object order which may provide high performance and the image order which can obtain the depth order of all primitives from a viewpoint for a given pixel.