May 6, 2010

RT0904
Computer Science 3 pages

Research Report

Collision-based Partitioning for 3D Virtual World

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1. Background

In 3D virtual world, such as MMOG and 3D internet, massive multiple avatars co-exists in one virtual world. In order to realize “real” virtual world for their players, servers must handle and response their requests quickly. Because quick handles and responses require a lot of CPU resources, most of these systems use multiple servers for one virtual world.

One of problems of systems, in which multiple servers manage one virtual world, is deciding the boundaries of territories for each server. In these systems, interactions among avatars across boundaries become slow caused by physical network interaction among servers.

2. Collision-based partitioning

In this letter, we propose a conceptual method for portioning of 3D virtual world, collision-based partitioning method.

In this method, programmers of a virtual world define a collision-define-function for the world. The function outputs “two positions in the virtual world” and “their strength” from the virtual world status. A system connects two positions as a collision-line with the strength for each output and memory them. For each constant interval, the system decides boundaries for each server to minimize (1) sum of strengths of lines across deciding boundaries and (2) differences of sums of strengths of lines for each territory, by using graph-cutting-algorithm (cutting algorithm is out of this patent).

For example of car racing games, a function that outputs positions of two virtual cars and a constant strength is defined. The function is invoked when two virtual cars conflict each other in the road of the virtual world. This function calculates center positions of two cars which are hit eath other and sends these positions to the system as collision-lines. Then the system received collision-lines, it memorizes them like Figure 1. In Figure 1, there are crowd areas (red dotted circles). If boundaries cross these areas, the sum of strength of collision-lines becomes large. Therefore, the system decides boundaries that don’t cross these areas like Figure 2.

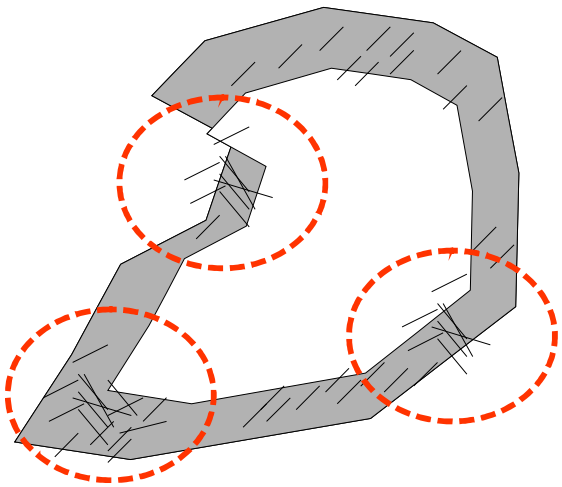

Figure 1: collision-lines in a racing world

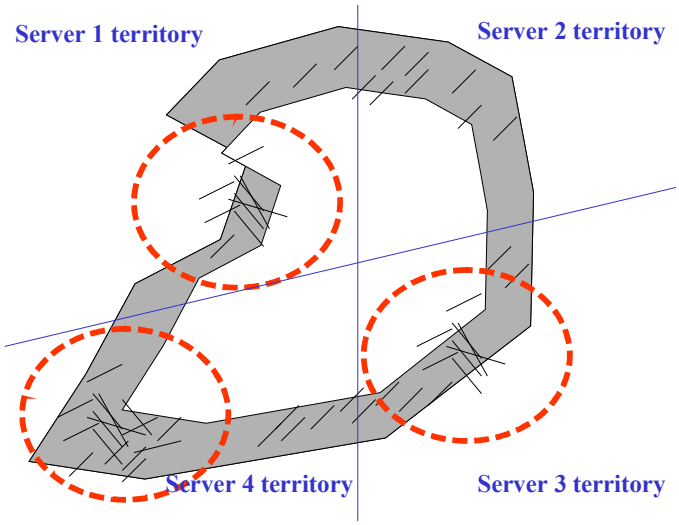

Figure 2: boundaries for 4 servers

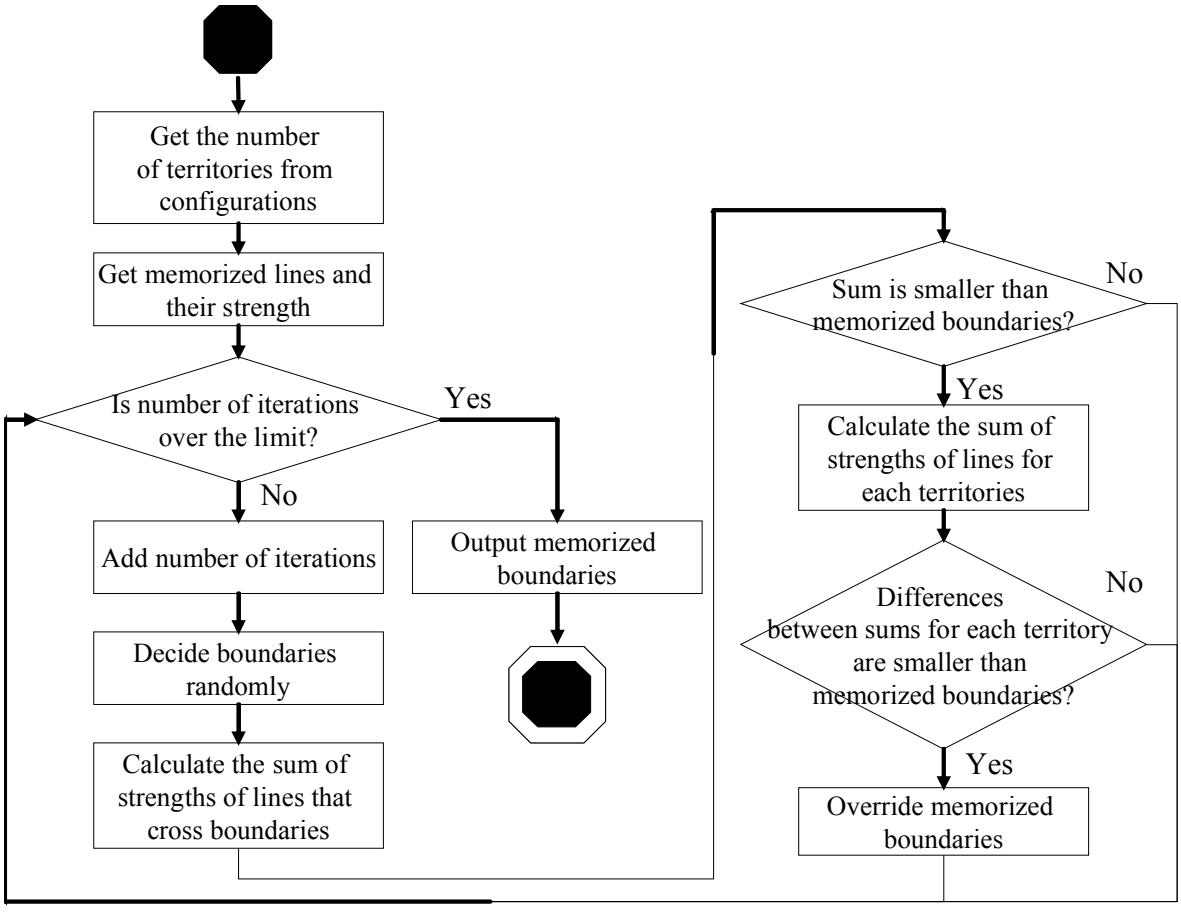

Figure 3: an algorithm to decide boundaries

Figure 3 shows an algorithm to decide boundaries. In the algorithm, boundaries are decided randomly and evaluate whether (1) sum of strengths of lines that cross boundaries are smaller than memorized one and (2) the differences between sums of strengths for each territory are

smaller than memorized one.

3. Conclusion

In this letter, we have proposed a conceptual method for portioning of 3D virtual world, collision-based partitioning method. In this method, “collision” of the world is profiled and partitions are dynamically decided and allocated to servers by the runtime. The definition of collision depends on the 3D virtual world. In future, we will evaluate this method for the realistic application.