§48. Construction of Virtual Assembly System with Interference Detection Function

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The design using large-scale virtual reality (VR) device like CAVE is tried in various fields. There are two main purposes to use the VR system in design. One is to observe objects in real three dimensional space and the other is to be used in the operation of assembling parts. Many works have been done in the former field, but the researches on the assembly of parts have not been done so much.

On the other hand, there is some 3D CAD software that has the function of the interference detection. However, in 3D CAD, real time processing of the interference detection is not always required. But the real time processing is indispensable for the VR system. Then, this study aims to build the virtual realty system with the collision and the interference detection function in real time.

1) System Configuration

This system consists of two computers, one is for the virtual environment and the other is for collision detection and these computers are connected on the network. It is necessary to preserve the above-mentioned shape data in each computer beforehand.

This shape (object) data is shared beforehand and these objects are distinguished by the object that can be operated and the static one that cannot be operated.

Fig. 1 shows the data flow between these two computers. When those who operate the operation object with the VR device, the translation and rotation information are sent to the computer for the interference detection in the form of the model view matrix. On the computer for the interference detection, the interference is calculated and if the objects interfere, the model view matrix which removes interference is sent back to the computer for VR. And this matrix is applied to a present scene and the caused interference is removed.

2) Evaluation

Fig. 2 shows the result of the evaluation of the influence on the interference detection speed when the number of polygons of operation objects is changed. In this data, the case when the interference has not occurred is not included. The number of total polygons of models used for this evaluation was 385,806, and the number of total vertices was 96,942. In the evaluation, this model size was fixed, and the number of polygons of the operation object and static object was changed.

In this evaluation, the computer for the interference detection was the AMD Opteron Processor 254 and 3.75 GB main memory, ant the one for the VR was SGI Onyx4. Moreover, the refresh rate of this model was about 15fps-20fps in Onyx4.

The error bar in the graph shows the difference of the calculation speed on various conditions, since the calculation speed depends on the position and the direction between the operation objects and the static objects. So this data may not show the whole conditions and cases. But we evaluated it from various positions and angles, so this data may cover the most range of the calculation time. This data shows that the interference detection calculation is done at the frequency of about 60Hz without depending on the size. But in the worst case, the calculation speed decreases at the frequency of a few Hz to 10Hz. However these phenomena ware observed for very short time of 0.5 seconds even in the longest case. Moreover, these phenomena ware occurred once per 10 times to 20 times.

These result shows that this system can draw and calculate the interference in real time. This system can actually use for design in VR system.

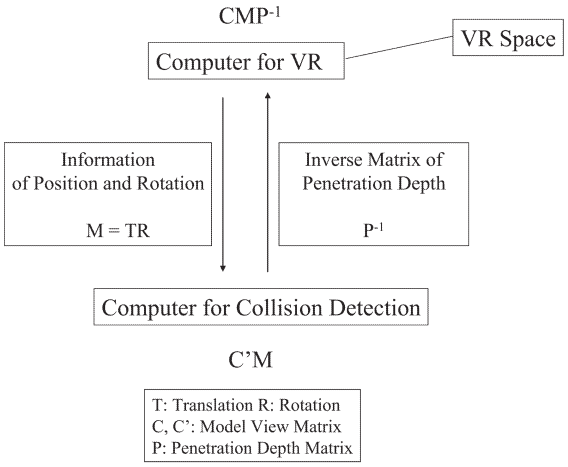

Fig. 1 Data flow between the computer for VR and the computer for collision detection

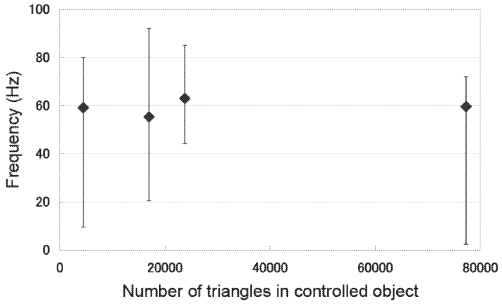

Fig. 2 Performance evaluation of collision detection system