# §1. Networked Virtual Reality System for Collaborating with Remote Sites

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It is very important issue to develop a multilateral communication network system where any researcher in any remote site can equally take an initiative action in controlling the display of the image in virtual space and the control is transmitted simultaneously to all sites.

But the CompleXcope system (including the CAVE system) is originally stand-alone system. The users of such VR systems can watch their own numerical simulation data or visualized something interesting, but they cannot discuss their data with partners in remote site data if they have VR systems.

Since products from the CompleXcope system are real 3D movies, images and sounds, they cannot be shared perfectly. So if they want to discuss these data, they must meet together in spite of using VR systems. To improve these issues, connecting each VR systems through a public network is very effective.

Fig.1 shows an example of connecting between remote sites. One VR system locates in Yokosuka, Kanagawa and the other system does in NIFS. These VR systems are connected by Japan Gigabit Network (JGN). In this system, virtual reality network is accomplished by socket communication (client-server model).

The client programs can connect to this network group in any time, if the server program is running. In this system, all clients already have the same numerical simulation data and are installed the same application for representation.

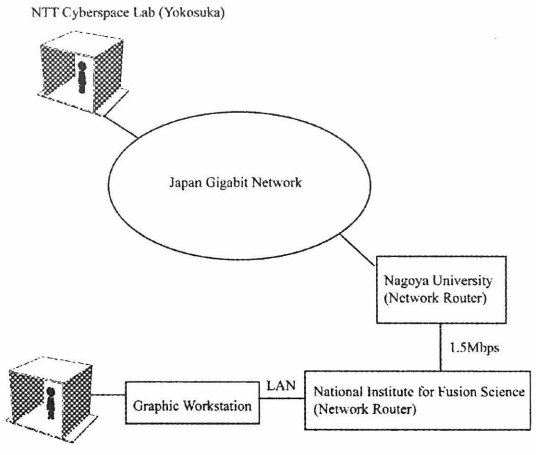


Fig.1 Network connection between remote sites

Server process manages the condition of visualized simulation results and the positions of observers in the remote sites. By sending this information to remote sites, the VR environment is shared.

Fig. 2 shows an example using VFIVE [1] where not only numerical simulation result, but also observer's hand position is shared. In this case, head and hand positions are shared and 3D avatar is visualized. Moreover, if there are more magnetic sensors in VR system, it is possible to increase the shared information from the sensors. (This research is accomplished by 2 magnetic sensors and these sensors are appended in an observer's head and an input device.)

I mentioned about collaboration among any remote sites using socket communication. In this network configuration, bottleneck network speed between remote sites is 1.5Mbps (between Nagoya University and NIFS), whose speed can be achieved in most institutes.

In these conditions, the speed of processing command communication, which means the number of times of sharing the information of conditions of visualized numerical simulation result, is 21.9 times per second in the worst case, so this software can fulfill its function and is very useful to communicate among remote sites.

By achieving this system, we can enjoy VR system in scientific research, especially, large-scale numerical simulation research.

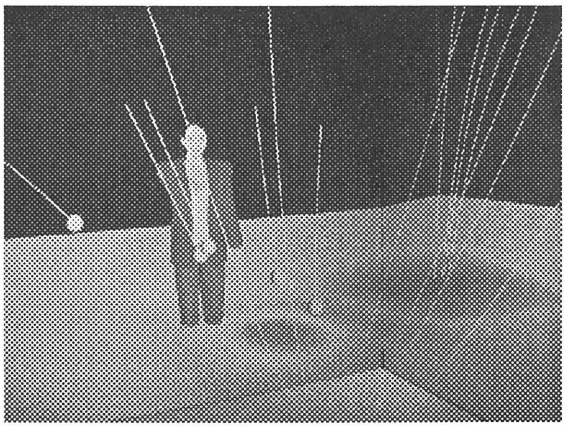

Fig.2 Video avatar in visualized simulation result

Reference

1) A. Kageyama, Y. Tamura and T. Sato, "Visualization of vector field by virtual reality," Progress of Theoretical Physics Supplement, Vol.138, pp.665, 2000.