§41. Construction of Seamlessly Integrated System between Virtual Environment and Numerical Simulation Environment

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In numerical simulation research, visualization is indispensable method now. Virtual reality technology is also very effective for visualizing numerical data, especially for visualizing complex and large-scale numerical simulation data. But virtual reality system is not friendly for simulation researchers, since computer for simulation is different from visualization computer in general. Especially in immersive virtual reality system (such as the CompleXcoope [1-2]) the researcher cannot simulate and analyze simulation result in one space, since they cannot use keyboard and sit before CRT.

So in this research, we propose seamless and interactive simulation environment by network communication. Under this environment, the researchers need not to recognize these two computers and can do computer simulation and analyze the result interactively.

i) Network Configuration

This seamless integrated system between the compute for numerical simulation and the computer for visualization is accomplished by socket communication (client-server model). In this system, not only numerical simulation result and simulation model, but also the position of observers and actions (e.g. drawing new isosurface, changing magnification) in remote sites, are shared. This system is very simple, but very effective since we cannot communicate with any researcher in any remote site without recognizing what he looks at and is interested in.

At first, the simulation results are sent to the server process every output cycle, which is defined in the simulation program If the observer, in the CompleXcope system, changes some simulation parameters, these information is sent to the server and this server sends information to the calculating server. In the computer for the numerical simulation is restarted the numerical simulation by new parameters. By this system, the observer can simulate interactively without getting out.

ii) Estimation of data transfer rate

For estimating the data transfer rate of the system, we connected the computer for numerical simulation and the computer for the virtual reality system through 100Mbyte LAN. Fig.1 shows the result of estimation. This data shows that no data is lost if the transfer data size is under about 4000Kbyte/sec in this network environment. And the data packet size is not correlated with the success rate of data transfer. So by defining the packet size and total transfer data size per second from the computer for numerical simulation properly, the user can visualize in the CompleXcope system smoothly.

(iii) Conclusion

We developed seamlessly integrated environment. This system enables user of virtual reality system to visualize in the immersive projection display (virtual reality system), calculating with remote computer.

In addition to this, the result of numerical simulation can be shared among remote sites, and the user can visualize and communicate in real time by network communication.

[1] A. Kageyama, Y. Tamura and T. Sato, Prog. Theo. Phys. Supplement 138 (2000).
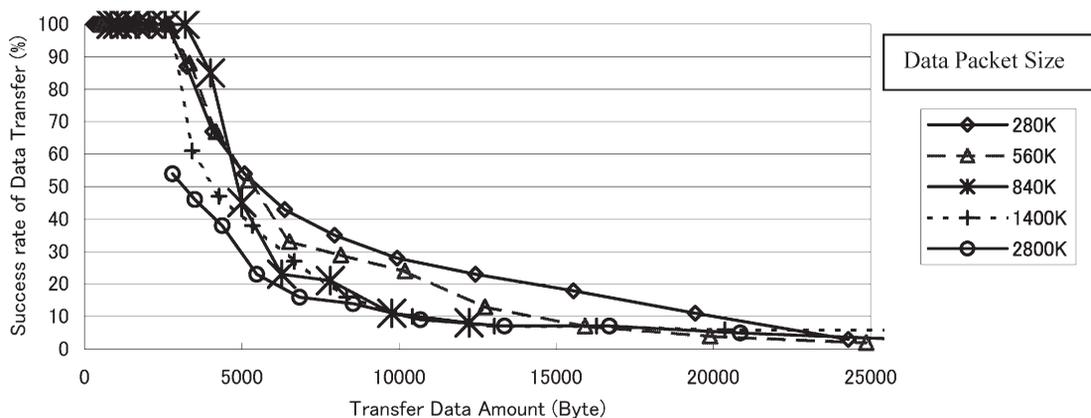[2] Y. Tamura, et al}., Comput. Phys. Communications 142 (2001).

Fig. 1 Difference of success rate of data transfer in transfer data amount