§30. Integrated Scientific Visualization of Simulation and Device Data in Virtual Reality System

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In 1997, the National Institute for Fusion Science (NIFS), Japan, installed the CompleXcope virtual-reality (VR) System based on CAVE system [1] as an instrument for scientifically analyzing simulation results (Fig.1).

NIFS has developed new softwares including VFIVE, AVS for CAVE, a sonification system, and a reactor design aid tool. Through the use of these new tools, CompleXcope was adapted for scientific investigations, such as analysis of magnetohydrodynamics (MHD) simulation results for MHD dynamo and spherical tokamak, analysis of molecular dynamics simulation results for chemical sputtering of plasma particle on a diverter, and analysis of particle simulation for magnetic reconnection.

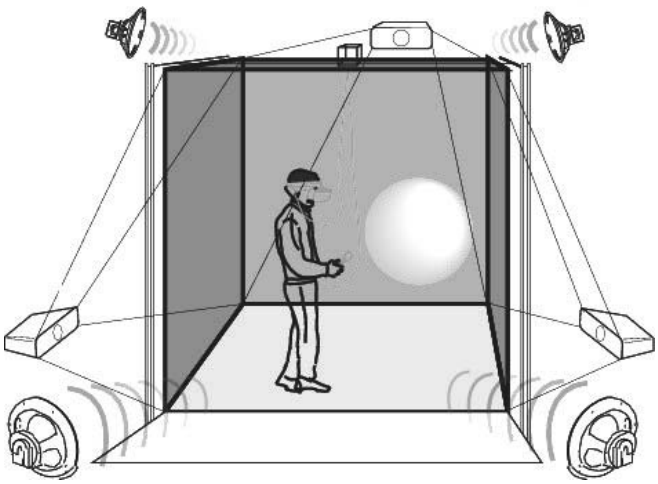

Fig. 1: CAVE system.

As one of scientific VR visualizations using CompleXcope system, we construct a method to display both simulation results and experimental device data integrally in the VR world [2,3].

An equilibrium plasma of the Large Helical Device (LHD) by magnetohydrodynamics (MHD) equilibrium simulation code "HINT" [4] is visualized by software "Virtual LHD" [5]. An isosurface of a plasma pressure, a magnetic field line and an orbit of drift particle can be calculated and displayed in VR space. The three-dimensional mouse "Wand" designates the initial position and the pitch angle of a drift particle, and the starting point of a magnetic field line in the VR space.

Experimental device data (LHD vessel) based on a CAD softwere is visualized by the commercially available software with an objective description in the VR space.

Objects by different visualization software are integrally visualized in the single VR space as one visualized data by the commercially available software. This software captures the OpenGL graphic data generated by the different multiple software, and combine them into one data in one VR space on a real-time basis.

Figure 2 shows integrated scientific VR visualization of simulation results of the equilibrium plasma in the LHD vessel device with the objective description in the VR space. You can walk through inside of the vessel, and look at the plasma from any view point. Since it is possible to put the starting point of a particle trajectory and a magnetic field line at any place in the vessel by the function of the Virtual LHD interactively, it can be found where their final reachable points are in the experimental vessel.

Fig. 2. Scientific VR visualization of simulation results of an equilibrium plasma in the Large Helical Device (LHD) and the objective description of the LHD vessel device integratelly in the VR space.

We summarize these results as follows. Image of plasma simulation results is presented in an experimental vessel device with objectively description in VR space. From this success, a lot of attractive potentialities have opened up for intuitively understanding the physics of plasma, for aiding in the design and arrangement of the devices, and for confirming the field of vision from the observation port in VR space.

1) Cruz-Neira C. *et al*: Proc. SIG-GRAPH'93. (1993) 135-142.
2) Ohtani, H. *et al*: PFR accepted (2011).
3) Ohtani, H. *et al*: IEEE Trans. Plasma Sci. accepted (2011).
4) Harafuji, K. *et al*: J. Comput. Phys. **81** (1989) 169-192.
5) Kageyama, A. *et al*: Porc. ICNSP, (1998) 138.