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

Ishiguro, S., Ohtani, H., Suzuki, Y., Kanno, R., Kageyama, A. (Kobe Univ.), Shoji, M., Tamura, Y. (Konan Univ.), Ito, A.M.

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. 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. In 2012, we updated the CAVE system. The computer resources of the updated system are as follows; 64bit Windows7 works on Hewlett-Packard Z820 Workstation with two Intel Xeon E5-2690 Processors (Clock speed is 2.90GHz and 8 Cores are on it), 64GB RAM and two graphic cards (NVIDIA Quadro 5000). This updated system will help us to visualize larger-scale simulation results and complex CAD data.

As one of the scientific VR visualizations using CompleXcope system, we introduced a method to display both simulation results and experimental device data integrally in the VR world[2,3,4]. In the previous annual report, we succeeded in visualizing the data of HINT2 code[5,6] by a visualization software "Virtual LHD[7]" through the interface program for the simulation results.

In this paper, we added a function which draws punctures of sampled field lines on a Poincaré section in the VR space to the visualization software. Poincaré map can characterize the structure of magnetic field. Figure 1 shows the Poincaré maps (shown by six different colored points) of the six magnetic-field lines in a Poincaré section colored by the blue and the streamlines of two single magnetic field lines colored by green and red from the different view point. It is found from the Poincaré maps that green and red field lines form a magnetic surface and a magnetic island, respectively. Figure 2 is the same figure as Fig. 1 but the different starting point of filed liens. It is found the field line is characterized as a stochastic structure. A magnetic island is also shown by a red line. In this way, we can watch the three-dimensional structure of the magnetic field lines in the VR space, and characterize the orbits of magnetic-field lines by the Poincaré map to identify topological features of them.

VR technology is powerful equipment for analyzing simulation data and developing experimental devices. We believe that the buildup in this paper will boost up the research of the plasma physics and fusion plasmas.

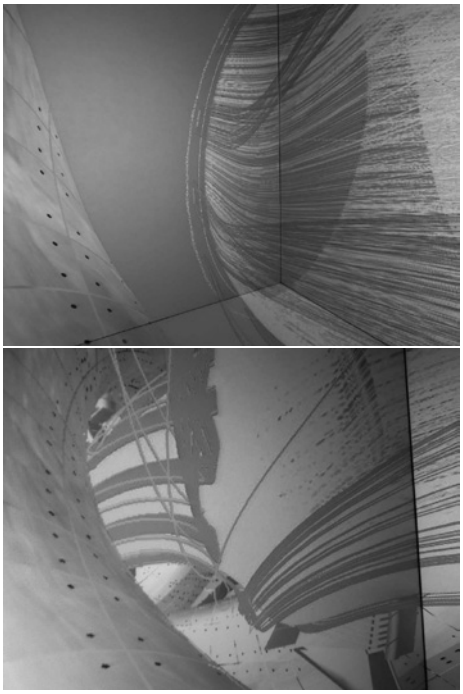

Fig. 1. Magnetic field lines and Poincaré map. The figures are the same field lines but from the different view point. Green and red lines are single field lines, respectively.

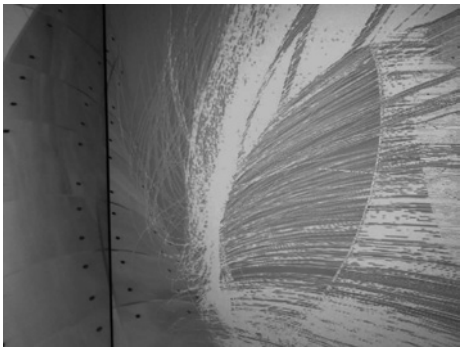

Fig. 2. Same figure as Fig. 1 but different starting point of field line.

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