

Three-dimensional Visualization and Representation of Simulation Data with the Earth Simulator

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By the remarkable performance improvement with super computers such as the Earth Simulator, we have been able to achieve a high resolution simulation that outputs data more than orders of GB. Under these circumstances, there is an urgent need for revolution in techniques or fundamental ideas of analysis and visualization.

It is evident that there is a need in high-performance system for analysis to process mass data by the high resolution simulation. However, there are limits of human ability to extract phenomena from highly complex data, even if the system is arranged to deal with such data. In the case of the observation of the phenomena that hid behind some layers of multilayer structure, if one simply delete layers that obstructs to observe inner phenomena, then it becomes difficult to find the correlation between the inner side and its surroundings. In the case of simulations of complicatedly intertwined turbulent flow, its intertwined aspect might be lost when data are reduced. The translucent isosurface and the volume rendering are the solutions of these problems. However, the effectiveness of these methods is lost when these are used for very complicated multilayer structures.

Up to now, many of the visualization styles have been just looking at the two dimensional image projected on the surface, which its normal direction is from outer to inner world produced by data. In the case of the visualization using cross sections, it is difficult to set a cross section for the complicated three-dimensional phenomena such as turbulent flow. In other words, it has reached the methodological limit to understand the meaning of highly complex data. The method, that one can observe the virtual world from arbitrary viewpoints such as inside of the world, could be one of the effective measures to lead new discoveries from highly complex data.

Moreover, we have been able to reproduce the natural phenomena more realistically as the resolution of the simulation becomes higher. In other words, not only data is shared among some researchers but also it becomes easy for people to understand its meanings sensuously. However, an advanced representation techniques in visualization are essential for it.

Based on the above, we are researching intensively the representation methods in the visualization of mass data by simulation using the Earth Simulator. First, we will show some CG animations of the high resolution simulations of the atmospheric and oceanic global circulation. Secondly, we will show the visualization result using a virtual reality system that we call BRAVE, for the high resolution simulations. Furthermore, we will show other visualization results such as images and animations for the simulations.