

In-situ visualization for spherical simulations using Yin-Yang grid and its variant

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We propose an in-situ visualization method for computer simulations in the spherical geometry using the Yin-Yang grid. Numerical data that are produced by supercomputer simulations are usually stored in a disk system before visualization processes. While the post-process visualization approach is becoming impractical these days due to the exponential growth of the simulation size, another approach to the visualization, called in-situ visualization, is gaining attention. In the in-situ visualization, both the simulation and visualization are applied simultaneously on a supercomputer. The output of an in-situ visualization is a set of two-dimensional images, rather than three-dimensional numerical data. The size of the output in an in-situ visualization is not a serious bottleneck on the contrary to the post-process visualizations. In this study, we focus on supercomputer simulations in the spherical geometry that uses the Yin-Yang (or recently proposed Yin-Yang-Zhong) grid. Although the Yin-Yang grid system was originally proposed for geodynamo simulations, it is applied in various fields such as geophysics, astrophysics, image processing, and so on, and the data are visualized in the post-process. The demands to visualize them with the in-situ method will be intense in future. Although general-purpose visualization applications with built-in in-situ visualization features exist, they are difficult to use on a supercomputer. Therefore, we propose an in-situ visualization method that has the following functions: (i) It is suitable for Yin-Yang(-Zhong) grid simulations; (ii) it has minimum visualization features; (iii) it is easy to use for simulation researchers; and (iv) it does not damage the simulation speed. We report the development of a Fortran90 library for this in-situ visualization method and its applications to MHD (magnetohydrodynamics) simulations in the spherical geometry.

Keywords: scientific visualization, in-situ visualization, spherical system, Yin-Yang grid, Yin-Yang-Zhong grid