3D Visualization analysis of time-dependent change of magnetic topology in the Earth's magnetosphere

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It is known that the Earth's magnetosphere becomes complex configuration when IMF southward turning with large By component. However, it is difficult to analyze a 3D complex configuration by using conventional methods. The generation and propagation mechanism of 3D phenomena with complex magnetic field such as plasmoid or magnetic flux rope is still far from fully understood. Therefore, to understand the 3D configuration of magnetic field line's topology, 3D scientific visualization (including Visual Data Mining) techniques and virtual reality system are powerful methods.

In this study, we performed a global magnetohydrodynamics (MHD) simulation to study the Sun-Earth's magnetosphere coupling system. The Earth's magnetosphere was modeled on a 120x120x88 point unstructured grid. As input parameter, solar wind and IMF data with large By component and southward turning observed by ACE satellite at 11/12/2002 UT is given to simulation at upstream region (x=20RE). First, we visualized 3D distribution of magnetic field line's topology and its separatrix surface. We tracked magnetic field lines and 3D separatrix between 'open and closed', 'open and detached' and 'closed and detached' magnetic field line accurately. To compare time-dependent change of 3D distribution, magnetic reconnection region are detected in 3D space.

In this presentation, we will show the time-dependent change of magnetic field lines including magnetic reconnection by using of high temporal and spatial resolution data analysis. We will also discuss the 3D visualization, application to virtual reality system, and Visual Data Mining methods to analyze the time-dependent changes of 3D magnetic field line's topology.