Real-time Dynamic Visualization Techniques for the Massive Geospatial Data

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Abstract: Visualization of the massive geospatial data is a research hotspot in the field of Digital Earth. Since it is time-consuming and resource-intensive to read and render the massive geospatial data(especially the remotely sensed images), the available Digital Earth platforms, such as Google Earth, ArcGloble and World Wind just statically display map tiles prebuilted from geospatial data. These static platforms thereby aren't able to respond to various human-computer interactions of visualization in real time, to perform computation and analysis on the geospatial data. To address those problems, we proposed a complete technically solution for real-time interactive visualization of the massive geospatial data in this article. To address those problems, we propose a complete technically solution for real-time dynamic visualization of the massive geospatial data in this article. Firstly, we construct a saleable visualization platform, composed of multiple rendering nodes, visualization servers and clients. Then we improve performance of the platform, mainly focusing on three aspects as follows. A) On rendering nodes, we design a new pyramid structure to store individual remotely sensed image. The pyramid structure not only reserves all the information of original data, but also greatly improves the efficiencies of reading and rendering of geospatial data. B) On visualization servers, we employ a 'distributed storage, centralized management' strategy to organize and manage the massive geospatial data which is stored at rendering node redundantly. And we further introduce a 'data-performance-consistent' scheme for distribution of rendering task, to reduce the data exchange between rendering nodes during data rendering as much as possible. C) On clients, a slicing cache storage and a cache update mechanism are proposed for rapid switchover of map layers and geospatial analysis. Finally, we illustrate the dynamic interactive visualization of our platform in visual indexing of geospatial data, browsing data in time series, alterable false color composite and layer switchover. And we also compare performances of our platform with that of the state-of-the-art in rendering of nodes, response of visualization servers and in efficiency of platforms, and discuss the superiority of our real-time dynamic visualization.

Key word: Digital Earth, visualization; massive geospatial data; real time; dynamic interactions