3-D volume communication system and its application to e-Learning

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To help our intuitive understanding of structures or dynamics of the geo-space, such as the Earth's magnetosphere, 3-D visualizations and consequent virtual realities of 3-D computer simulations are effective techniques. Large-scale computer simulations are often performed on super-computers. The number of high performance super-computers is not large, thus many users access them through the networks. However, we don't usually have a large-scale visualization server. Most of the simulation data are downloaded to the user's local site, then visualized individually in 3-D. We need a system to share 3-D visualization and preview environment. Although recent networks often show high-speed through-puts, it is still not enough to transport the large-size data for real-time visualization over the wide-area network (WAN). In the present study, we developed a 3-D volume communication system. In the present system, we don't exchange 3-D data in real-time. We first download and share the same 3-D object data. Then, we in real-time exchange two types of parameters to share the same preview of the 3-D object. One is for geometric viewpoints and the other is for time steps. The geometric viewpoint parameter is for geometric conversions and is composed of a 4x4 matrix. Even over the low through-put network it is easy to exchange these small-size parameters in real-time. Using multicast for the communication, the remote communication in the multiple points is possible. It should be noted that the system is independent of the number of attendances without control of sessions. However, in a WAN environment, there are some problems: no packet can pass through the firewall and no multicast packet is usually transferred by most of the routers. We had overcome this issue by using software-based VPN (Virtual Private Network). The MPEG-7 is one of the ISO/IEC standards developed by a group of MPEG. The MPEG-7 standard, formally named Multimedia Content Description Interface, provides a rich set of standardized tools to describe multimedia content by XML. In the present system, the MPEG-7 is used to save history records (journal) of 3-D object operations. Using this journal file described in the MPEG-7, it is easy to create an e- Learning content which presents both 3-D visualization contents and movies to give commentary of the contents. It is convenient to reuse the online conference results by the accumulation/reference and to apply them for e-Learning.