Abstract

1. Title : Highly realistic remote communication environment with data sharing capability

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3. Abstract :

As the number of interdisciplinary collaborations between remotely located researchers increases, a highly realistic communication environment becomes essential as a collaboration support tool.

In this dissertation, the author describes an approach for this collaboration tool.

The author targeted to develop and evaluate a highly realistic remote communication environment which supports remote collaboration in the research and development application area. To realize this environment, the author proposed a voxel communication method (VC method) which realizes remote communication environment by a combination of a virtual conference room (VCR) method and the voxel processing method.

The VCR method set up a virtual communication space in a computer system, and allocates three-dimensional (3D) video image objects in the VCR. A 3D video avatar of researchers attending from remote locations and shared data objects which are referred to in discussion are treated as video objects. 3D video images of shared data, 3D simulation results data and measured data are treated as shared data objects.

The voxel processing method treats all 3D objects as voxel data.

The VC method was developed by applying three methods, a distributed processing between remotely located communicating sites (site distributed method), voxel data reduction method, and object distributing visualization method.

Instead of site centralized visualization method, the site distributed method distributes all visualization processes to remotely located sites, and aims to reduce computer resources usage and achieve high speed visualization. The voxel data reduction method aims to reduce network load by converting voxel data to surface voxel data which represents only geometric surfaces of objects. The distributed visualization method visualizes each object in parallel on a PC cluster system and aims to achieve high speed visualization.

The author developed an experimental VC system and evaluated functionality and performance of the VC method by using medical application data as shared objects.

The results of the functional experiment show that the VC method can provide multiple object allocation in the VCR and 3D visualization of the VCR from any observation point. Participants are shown seated at a table, so gaze awareness between participants and body motion, such as pointing at objects including precise details, can be shown.

The results of the performance experiment and an investigation of speeding up methods show that the 3D human object visualization speed will be up to twenty frames per second, and 3D shared data object visualization speed will be up to a few frames per second. This 3D human object visualization speed is sufficient for natural communication between participants. The 3D shared-data-object visualization speed is also sufficient for practical applications for remote collaboration.

These results proved that the VC method can realize a highly realistic virtual communication environment. All participants can discuss with each other in this environment, as if they are in the same conference room and sit at a round table. This remote communication environment will support remote collaboration in the research and development application area.