§59. Visualization of Complex Systems Using Virtual Reality Technology

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The virtual model of human body has been anticipated as a useful tool for the medical education and diagnosis. As an example to visualize complex phenomena with a three dimensional virtual image, we have developed a software to visualize virtual images of whole human body and/or internal organs such as beating heart in the CompleXcope 1) with high sense of immersiveness 2) (see, Fig. 1). The software is based upon three-Dimensional Computer Tomography (3DCT) for CompleXcope, which principally volume-renders slice data of human body and/or the internal organs obtained from computer tomography and projects the rendered virtual 3D-image on screens of the CompleXcope.

The volume rendering of slice data such as human body requires high-speed computational performance and high interactiveness. General-purpose video cards, however, cannot render a volume image interactively with normal rendering method (for instance, ray casting method). Accordingly, we developed a software, adapting a texture-mapping method to display the 3DCT of highly interactive volume rendering in the CompleXcope 3).

First, we obtained CT images of a volunteer of an adult Japanese male for rendering of 3DCT. All CT images were scanned using a CT scanner (GE Medical Systems) of Kitasato University Hospital. Data obtained were formatted in Digital Imaging and Communications in Medicine (DICOM).

Second, we devised several soft wares to display the volume-rendered image of 3DCT data in the CompleXcope, using the C language and OpenGL library, which enable to effectively display 3DCT image with changing the opacity of the image and animating moving organs such as beating heart.

All functions can be controlled using the WAND (three-dimensional mouse), which enables the operator to display 3DCT on arbitrary scales. Resultant 3DCT appeared very useful for understanding the intrigue of human body, such as bones and various internal organs including beating heart.

We demonstrated 3D-visualized images of the human body manipulated to display only bone and/or partial organ such as the inside of beating heart to medical doctors, biologists, and virtual reality engineers. Almost of them highly evaluated the software we developed for medical education as well as diagnosis with some of suggestions. For instance, Multi Planner Reconstruction (MPR) images should be on the front screen to interpret 3DCT, picture quality, functional operation of the software, and so forth. Now, we are improving these points and further developing the system not only for the educational use but also for the diagnosis as well as the human body simulation for various purposes.

To refine the software as the medical education and diagnosis, we developed the function of visualizing the multi planer reconstruction (MPR) images, and imported the function to the software which we have been developed. MPR images are the cross sectional planes of the axial, coronal, sagittal direction.

A user of our software can confirm some region of interest (ROI) on a 3D volume data image and 2D plane images by the function of project MPR. In addition, we modified the pointing action to use a ray-type pointer. The ray-type pointer helps the users to point a panel which activate a function such as opacity changing.

Now, we are planning to apply the software for the medical education which targets the medical workers, and for the human body simulations for various purposes.

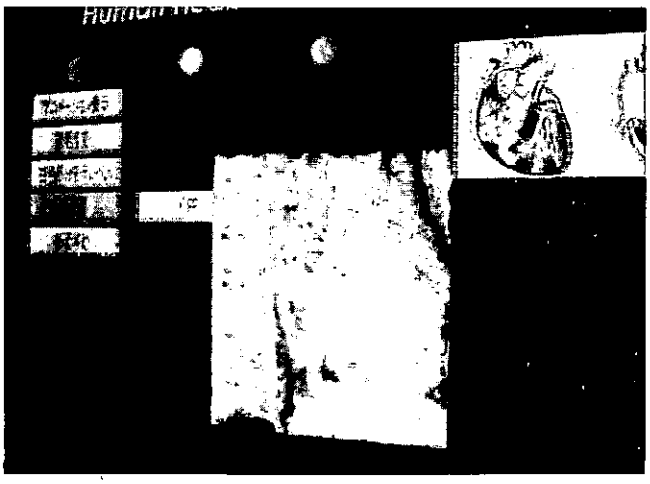

Fig. 1. Visualization of the beating heart on the CompleXcope.

Reference

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