Smooth Panning and Zooming in Virtual Reality Visualization of Large-Scale Datasets

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The project addresses the issue of non-standard navigation techniques in large-scale volumetric data such as the large tree model of the cardiovascular system currently developed at Creative Interactive Visualization Laboratory (CIVL). This system emphasizes small details that can lead to enhanced risk assessment of heart failure and utilizes multiple level-of-detail visualization methods. This and other datasets that involve enormous amounts of data can not be fitted into main memory and utilize out-of-core processing that makes regular zooming and panning methods useless. The navigation system designed in this project aims to solve this problem by providing intuitive controls that keep the end user well oriented within the virtual space of the simulation. Provided with such controls, the user will be able to interactively run complex simulation without having to know the underlying details of the process being simulated. A vital step includes the calculation of necessary preprocessing steps based on the coordinate pairs of initial and target subvolumes and their positions within the simulation environment. Based on a given amount of discrete animation steps, a buffer is filled with data slices read from octree volume files, and timing intervals for each animation step are calculated to assure that the animation sequence is smooth and seamless. Despite a noteworthy tradeoff in preprocessing speed caused by reading the file, resizing textures, and filling the buffer, the actual animation step will not exhibit any time delays, since the animation sequence itself only includes placing textures into card buffer and stepping through necessary OpenGL transformations.