

Smartvis with Kinect Support

Report

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We want to enable the user to explore volume data in a novel way. The user should have an easy and intuitive interface to travel through the data. Defining a good cutting plane is not an easy task, therefore we wanted to implement a new interactive way to create and modify the clipping plane. Using the Kinect Camera, we obtain depth information that is then used to calculate this cutting plane. Moving objects in front of the camera, e.g. a sheet of paper or ones hands, back and forth, the cutting plane is moved through the volume data, creating an intuitive way for exploration. Additional parameters are exposed in the GUI to modify depth information. With our approach, the user gets constant feedback about the results while changing the clipping plane.

Architecture

The project is implemented as a plug-in for VolumeShop. We adapted the Smartvisrenderer Plug-In to incorporate the new functionality. One of the different rendering modes of this Plug-In generates an arbitrary cutting plane for cut-away views. We adapted this algorithm so the filtered depth information from the Kinect Camera is used to receive the control points for the cutting plane calculation. These are then passed on to the already existing smartvis algorithm. The resulting plane is used to cut away parts of the volume, this gives insight to occluded parts of the data. The plane is also visualized in a separate canvas along with the control points.

Tasks and problems (in chronological order)

The obvious first task was to implement Kinect Camera support for the smartvis renderer plug-in. This was quite challenging, as the existing VolumeShop code was completely new to us. We created an event handler to retrieve depth data updates from the camera continuously after a certain time.

For a comfortable interaction with the camera, we restricted the incoming depth information to a certain hard-coded range. This also removes depth errors from the surroundings.

The original smartvis algorithm calculates the control points from the MIP image generated. For our solution we extract the control points from the already filtered Kinect depth data.

When we visualized the cutting plane we found we had to flip the y-axis of the depth data output. Additionally the data had to be dynamically rescaled to fit the canvas for the visualized volume data.

Till now the range-filtering of the Kinect data was hardcoded. For a more comfortable use and freedom of interaction some GUI elements were added to enable a dynamic user defined range and scale of the Kinect data.

The given algorithm was quite slow. After investigation we concluded that the creation of the volume to visualize cutting plane and control points was very time consuming. We decided to disable the auto-update of this functionality. Now by pressing the left mouse button the visualization is updated.

Now that the interactivity and continuous calculation of the cutting plane was implemented a new problem occurred. The data retrieved by the Kinect Camera is not steady. This means that even if the scenery is not changed the Kinect Camera gives slightly different data from one frame to the other. Due to this the view on the cut volume is very unsteady. We reduced this by implementing temporal filtering. The average of the last 5 Kinect depth images leads to a steadier view.



Figure 1: A user exploring the volume



Figure 2: The filtered Kinect Data

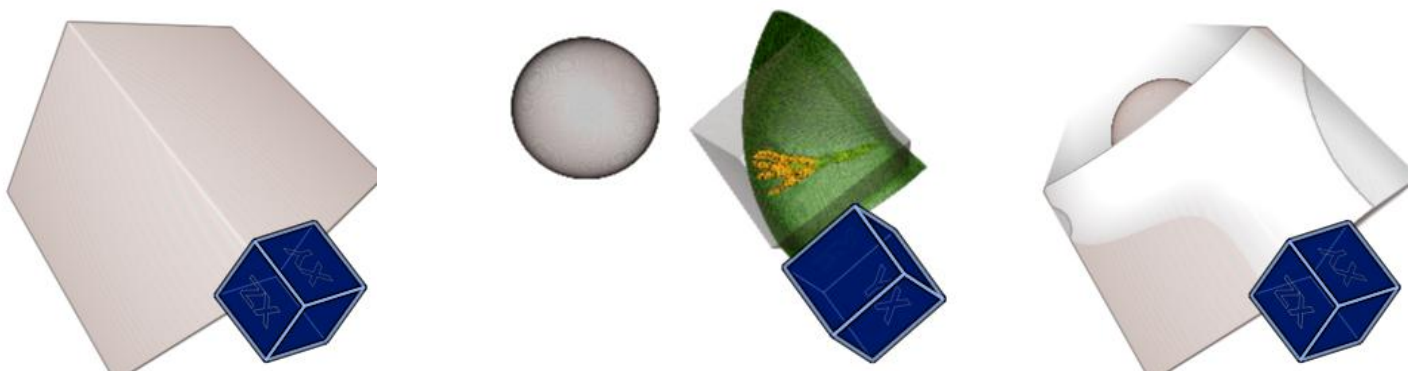


Figure 3: (left) Standard view on the volume, note that the sphere is occluded by the cube
(middle) The control points are shown in yellow and the resulting cutting plane in green.
(right) Using the cutting plane the sphere can be revealed.