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Schrödinger's Cat Resolved

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Introduction

In the early 1930's Erwin Schrödinger published what became known as "Schrödinger's Cat Paradox". The idea consists of putting a cat into a closed box together with a device that would release a poisonous gas inside the box, as soon as one atom of a contained radioactive substance decays. The radioactive substance and it's amount are chosen such, that within one hour, the chances that an atom decays are 50%. After one hour, the chances of the cat being still alive, would thus be 50%. But according to the understanding of quantum mechanics, the cat would be both dead and alive at the same time, unless one would open the box and look inside, to ascertain the state of the cat.

In this work, we propose an alternative to opening the box of Schrödinger's Cat.

Intuitive Interactive Display

In this demonstration we show a distributed interactive Augmented Reality (AR) application for the co-located visualization of large volumetric datasets. The co-located visualization of a dataset together with physical objects with which they are associated (i.e. a patient) provides significant new possibilities. Examples of these are found in image assisted minimally invasive surgery and non-destructive sample analyses. The method that was developed in this project uses object tracking techniques, high performance visualization algorithms and advanced display techniques to create the illusion that the display has opened a virtual window into a real object.

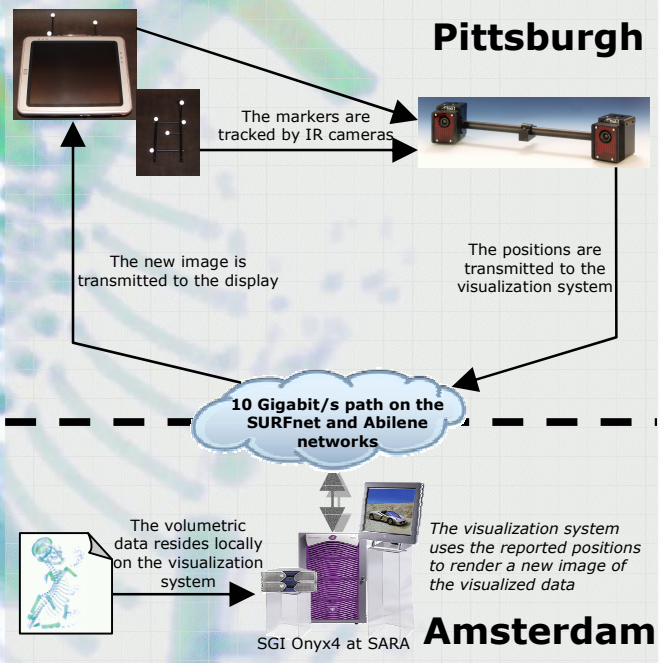
Using object tracking techniques, the display method is "aware" of its location and orientation. This information is used to create an accurate representation of the data with respect to the viewer and his environment. Using this "context", the display method can also be used to provide additional information on the environment, overlaying real objects with computer generated images.

High Performance Visualization on the Grid

The real-time volumetric visualization of these data sets is often beyond the capabilities of local computing resources. The graphics computing resources required to display medical data volumes at interactive rates will not always be present on site. Although modern accelerated graphics cards have increased in performance enormously over the last decade, they still lack the necessary features and power provided by professional solutions. Unfortunately, the cost of these professional solutions prohibits the introduction of these systems in medical organizations. Moreover, the cost-effectiveness of these systems suffers if they are under-utilized.

Grid computing provides methods that enable access to computational resources across organizational domains. Amongst others, Grids allow access to resources that are too specialized for in-house acquisition.

To achieve its goal, the design of this interactive display uses this Grid paradigm to access graphics computing resources like high throughput graphics rendering pipelines, high performance computing devices and high capacity storage systems. Based on the current position and orientation of the display, a volumetric rendering is computed on a remote computing site from a previously obtained volumetric scan of the object. The rendered image is sent back to the display over the optical testbed so that it appears as if the display has opened a window into the virtual object.



Applications

Applications for the proposed display method are multitude; already mentioned were medical diagnostics, image assisted minimally invasive surgery and non-destructive sample analyses. The method also has great potential for training and educational purposes. One of the reasons why 3D visualization techniques are currently not routinely used in hospitals is because 3D has not been integrated into medical training. Apart from medical science, volumetric datasets are also generated in other scientific areas, including physics, biology and computational science. Additional application areas are expected within these areas.

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