VOLUMETRIC CONFOCAL IMAGE PROCESSING

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1. INTRODUCTION

The fast advancement of computing and graphic powers has made it possible now to do real-time processing on volumetric confocal datasets. In this work, we discuss some of our novel techniques under development [1]. Instead of doing 2D image processing slice-by-slice, we take image stack as an integrated volume with an emphasis on 3D structure. This global strategy enables consistent, efficient and effective processing of volume data to obtain results of image restoration, enhancement and segmentation. This can be further enhanced by the application of latest volumetric visualization and Virtual Reality technology for interactive 3D image processing and analysis.

2. METHOD

Often, original confocal volumetric data is not in an isometric voxel form. The z-depth of a confocal volume is usually limited by the laser penetration ability. We are developing a Look Up Table based method to enhance the axial resolution of raw confocal image stacks. Due to light scattering and absorption and photo-bleaching, when a 3D confocal image stack is obtained, deeper layers in the specimen are imaged with lower photon intensity. By detecting and employing the intensity changes between neighboring optical sections, we are developing a novel method for adaptive compensation of attenuation of light intensity for 3D confocal microscopic images. The applications of volume rendering, surface extraction and VR techniques have facilitated better interactive exploration of cellular structures both quantitatively and qualitatively. Tools are being developed allowing users to interactively manipulate and locate cellular structures for cell biology and clinical research.

3. RESULTS

Figure 1a shows the rendered images of an anisotropic 3D confocal image stack of propidium iodide-stained nuclei from a frozen section of mouse brain while Figure 1b shows the generated stack after the operation of axial resolution enhancement. Figure 2a illustrates the rendered image of a confocal image stack suffered from intensity attenuation and Figure 2b is the result after we applied our adaptive attenuation correction method to this dataset. Figure 3a presents a desktop VR environment and Figure 3b presents an immersive projection VR environment for confocal study. Tracking devices and data-gloves can be used to assist the interaction in the stereographic virtual space.