

THREE-DIMENSIONAL VISUALIZATION PROGRAM FOR MEDICAL IMAGING APPLICATIONS IN CLINICAL MEDICINE AND EDUCATION

Steven Parmett(1) Swamy Laxminarayan(1) Masoud Majidi(1) Sombun Reantragoon(1)
Steven Blumenfrucht(1) Jean Louis Coatrieux(2) Jean Louis Dillenseger(2) Marsha Jessup(3)

(1) Medical Imaging & Visualization Grp. & Depts. Of Radiology
& Academic Computing, Univ. of Med. & Dent. Of NJ

(2) Université de Rennes 1

(3) RW Johnson Med. School

ABSTRACT

Computer visualization in medicine is beginning to establish itself as a vital tool in diverse areas such as surgical planning and treatment, orthopedic prosthesis, neuroanatomical modeling and diagnostic medicine. As a novel teaching tool, visualization techniques allow medical students to better comprehend complex anatomical spatial relationships. This paper reviews the utilization of these techniques in research clinical medicine as practiced in a broad-based, multi-campus basic science and medical education environment.

1. INTRODUCTION

During the relatively short span of time that three-dimensional rendering of medical imaging data has been available, diagnostic and therapeutic applications have proliferated [1, 2, 3]. In nuclear medicine such images have provided new means of visualizing bone, liver, and cardiac disorders. CT applications have included the evaluation of craniofacial deformities, assessment of a variety of fractures, and lung imaging. Three-dimensional MRI renderings have facilitated planning surgical treatment of congenital heart defects and seizure disorders. Very promising is work on image registration – the merging of data sets of the same organ obtained by different modalities providing complementary information [1, 4]. CT or MRI data, typically heart or brain images, are merged with nuclear medicine data to provide structural and functional information in a single image. Three-dimensional renderings of the data figure prominently in both the alignment and display of the images.

Until now, applications of three-dimensional renderings of medical imaging data have been largely restricted to clinical (diagnostic or treatment planning) uses. Furthermore, less attention has been paid to the development of efficient, user-friendly means of analysis, manipulation and display of the three-dimensional images than to the means of constructing these images [5].

We have addressed these issues by developing a program emphasizing the anatomical teaching potential of medical image data in addition to its clinical applications.

2. TECHNOLOGY UTILIZATION

The basis of the 3-D visualization applications of our clinical and teaching protocols is the software developed by the INSERM group at the University Rennes in France. The software allows construction of an interactive volume display from a set of 2-D images with surface segmentation and volume cutting techniques. Examples of 3-D displays generated by this program for application in clinical medicine include multiple transverse, sagittal, and coronal slices; two-dimensional mapping studies as applied in myocardial imaging; surface and volume rendering as used in CT, SPECT, etc. Our image data obtained from the various modalities are transferred over the network to the Academic Computing Center for further processing and 3-D image reconstruction where appropriate. The University of Medicine and Dentistry of NJ is a multi-campus institution with an extensive computer networking infrastructure in place. The network provides access to University-operated information and computational resources as well as transparent connection to the NSF Internet via the JVNCnet regional network. The NSF Internet connects the regional research networks in the United States. Links to many foreign networks are maintained by various regionals. Telemedicine capabilities are currently being explored.

Two critical issues presenting major challenges in our studies are storage and computational powers. The computational platform is based on a Hewlett-Packard 9000 Series 835 Supermini Computer located at all of our campus centers, each equipped with large memory and mass storage systems. Typically the speed of computation in this environment is about 60 seconds for the 3-dimensional reconstruction of a $512 \times 512 \times 100$ CT volume. Areas of educational interest that we are currently pursuing in nuclear medicine are in car-

diac perfusion and functional imaging and in the imaging of the brain.

3. REFERENCES

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Steven Parmett, M.D.
Nuclear Medicine Division
University Hospital H—141
150 Bergen Street
Newark, N.J. 07103-2406