AbstractID: 7239 Title: Multidimensional Multimodality and Multitemporal Visualization

Visualization has central importance in radiology for diagnosis and therapy. The detection, localization, and characterization of abnormalities depends on their conspicuity and differentiation from normal structures and their variations. Conventional x-ray radiography and motion tomography has been augmented by medical imaging modalities, such as CT and MRI, that exploit physical and functional differences in normal and pathologic structures to create images with better contrast, spatial resolution and fewer artifacts. Subjective analysis of medical images obtained using computer graphics visualization methods has been studied extensively, and the limitations of commonly used medical imaging methods are well known and understood. Fusion of images obtained with multiple medical imaging modalities presents a new challenge for visualization systems that must handle 3, 4 or higher dimensional image data.

Visualization technology supports decision making and interventions based on increasingly large amounts of image data. The dimensionality of medical images is increased by volume scanning with one or more modalities, including multiple observations over time. Visualization systems are broadly categorized as volumetric, surface or hybrid according to the data representation and image rendering methods employed.

Static and real time applications of multidimensional, multimodality and multitemporal visualization define the state of the art in visualization. Image exploitation, the application of images to serve high level tasks, consists of an interdependent set of technologies for data representation, transformation, analysis, and understanding. Among the most familiar implementations of image exploitation systems are computer aided diagnosis systems that employ pattern recognition based on registration, segmentation, labeling and classification components that aid human observers in performing specific visualization and diagnostic tasks.

In this presentation, the fundamental principles of visualization systems applied to medicine will be defined and illustrated. Basic principles of image formation, subjective interpretation and application needs will be delineated, and limitations of current technology will be described. Multidimensional imaging, especially multispectral, multimodality and multitemporal visualization and analysis will be described in qualitatively and quantitatively. The use of visualization systems for image guidance in minimally invasive diagnostic and therapeutic procedures will be described. The incorporation of a priori information in the reconstruction of images from measurements and their visualization will be defined.

Learning Objectives:

1. To understand the classification of modern visualization systems as surface, volumetric and hybrid, as well as the underlying data representations and applications they support.
2. To appreciate the hardware and software characteristics of visualization systems used for multidimensional, multimodality and multitemporal data sets

3. To define the requirements and evaluate the performance of visualization systems in screening, diagnosis, guidance of therapy and follow-up.

Dr. Vannier is a member of the Board of Directors for Vital Images, Inc., a small business that produces medical visualization systems.