Free treatments using the concepts of three-dimensional and cross-sectional anato...

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Introduction

Radiographic treatments are based on the novel concepts of three-dimensional anatomy along with cross-sectional anatomy. The advancement in the art of computer science proposes the enhanced knowledge about the human body organized in a stronger and conceptual way. This is a computer's era where dealing with plain text has become outdated. Knowledge engineering facilitates the designing and creation of symbolic information in a much more steady and supple manner. Computer graphics crafts the realistic interactive three-dimensional (3D) models of human anatomy and physiology. CT and MR provided information of various types like multiplanar reconstruction (MPR), 3D maximum intensity projection (MIP), virtual endoscopy and volume rendering (VR) (Höhne et al., 1995). VR is particularly very attractive and informative technique for understanding the cross-sectional anatomy. VR comes up with a perfect perception of body structures on diverse spatial planes allowing the cross-section to be viewed 3-dimensionally. Virtual endoscopy also presents video images of high resolution of the interior side of the hollow organs and cavities. Magnetic Resonance Imaging (MRI) and X-Ray Computed Tomography (CT) are imaging techniques that illustrate the internal anatomy in cross sections known as slices. Earlier the radiologists could see the 2D cross sections or 3D compositions of the slices and created a mental 3D image of the structures. Now, this novel approach of computer science enabled these techniques to generate data from internal exploration through CT or MRI, reconstructed into 3D surfaces (Sempere et al., 2011).

This paper aims to describe the radiographic treatment approach using the concept of cross-sectional and 3D anatomical analysis of a human body. The main concept underlying this approach is to unite in one single frame a descriptive spatial model that enables the realistic image with a figurative model of a human body (Höhne et al., 1995).

Cross-sectional anatomy in three-dimensional presentation

The main radiographic treatment methods based on cross-sectional method primarily employ the axial, sagittal or coronal planes. The oblique plane can also be used if suitable for presenting the anatomy (Höhne et al., 1995). Sectional anatomy relatively new so little known and is spatially complicated to comprehend. So it is recommended to analyze it sequentially to avoid any mistakes in understanding. Often it needs significant software support to observe the images (Sempere et al., 2011).

Ultrasound

This sectional method is extensively applied that is based on the sound waves. It is quite different from other techniques due to the real-time and dynamic visualization of anatomical structures. It presents information about the target region through the sections of that particular anatomy, though it does not present all the region’s structures via a single section. The resulting image is complicated to interpret because it relies completely on operator who knows that at which angle the images are taken (Sempere et al., 2011).

Computed tomography

This technique provides absolute anatomical information of the target region because it images the complete region. Consequently, it provides images in the axial plane that can be regenerated into other planes and even transformed into three-dimensional images accredited to volumetric data attainment. The introduction of multi-slice and helical CT has amplified its significance as a diagnostic tool in treatments (Sempere et al., 2011).

Figure 1: Derived from a radiographic cross-sectional technique the radiological cross-sections (from magnetic resonance tomography) can be sighted in the context of basic anatomy (Höhne et al., 1995)

Nowadays it has become an essential tool for diagnosis and follow-up in many diseases. This technique requires precaution while employment due to its use of ionizing radiation. However, multi-slice technology and novel low-radiation techniques have noticeably reduced the scanning period that in turn, reduced the radiation dose. To enhance the visuals iodinated non-ionic contrast media are administered by an injector that allows more refined and direct visualization of vessels. It also increases the density of tissues and organs thus facilitating a better characterization and diagnosis (Sempere et al., 2011).

Magnetic resonance

The cross-sectional method that works on the basis of radio waves application to a magnetic field. It offers an indispensable image of the CNS (central nervous system) and soft musculoskeletal tissues. It is not harmful in comparison of CT because it does not employ ionizing radiation. This technique is supposed to be safe on children and the second trimester onwards in pregnancy. It takes long scanning time and restricted spaces that result in claustrophobia in several patients. Due to the magnetic field this is not recommended to patients with metal implants or pacemakers (Sempere et al., 2011).

Figure 2: View produced with the interactive 3D atlas of a human fetus, extracted from magnetic resonance imaging (MRI) (Höhne et al., 1995)

During resulted image analysis and post processing the acquired images are transformed from an analogic to a digital format with the help of computer systems and powerful softwares. They are now incorporated into the storage systems databases for the study as DICOM images (Digital Imaging and Communications in Medicine) (Sempere et al., 2011).

Multiplanar reconstruction (MPR)

Multiplanar reconstruction is two-dimensional image regenerated secondarily from the volumetric data attained during the study. The newly created images can be attained on any spatial plane including axial, sagittal and coronal or any obliquity). MPR approach represents significant development in the area of computed tomography, which is now no longer confined to the axial plane (Sempere et al., 2011).

Maximum Intensity Projection (MIP)

Maximum Intensity Projection (MIP) is a volume-processing technique. MIP scrutinizes all present rows of voxels in any direction and generates them in two-dimensional patterns. The choice of Volume thickness is independent and can be revolved in any direction. It consists of two modalities, positive and negative. Positive MIP with contrast media and Angio-CT techniques provides a huge expansion in the vascular disease analysis, while negative MIP offers an outstanding generalized visual of the airways (Sempere et al., 2011).

Shaded surface rendering (3D SSR)

3D SSR technique observes and presents the voxels reaching an established threshold of density. 3D SSR is a surface demonstration where image is interposed with colors similar to the actual structures. In this technique a theoretical spot of lighting is customized so the hidden parts are shaded, and the adjoining parts are elucidated, resulting in a three-dimensional image. This restructuring provides superfine visualization and compression from the perspective of bone and vascular structures. It offers a magnificent result for analyzing the complicated bone fractures (Sempere et al., 2011).

Volume Rendering (VR)

VR techniques present structures to be sighted in three dimensions. For this, the volumetric data attained during the scan is restructured to generate a three-dimensional image.

It is the most constructive and versatile technique of current time, and also a complicated procedure that coalesce the 3D surface with MIP (Maximum Intensity Projection). It utilizes the whole volumetric data and presents manifold tissues and their relations. The technique generates excellent spatial information of anatomy and provides enhanced clinical information than other technique. It delivers with inserted colors that are based on the density values. The representation, color scale, opacity or transparency, slope and point of enlightenment and window level are adjustable. In fact, Volume Rendering can be applied as MIP or 3D techniques, reliant on the transparency or as a multi-planar re-enactment by merging the 3D view with cross-sectional anatomy. The latter approach permits an excellent understanding of sectional anatomy.

Therefore, the Volume Rendering is very edifying, and grants simply understood anatomical information (Sempere et al., 2011).

The Virtual Endoscope and its Advantages

Virtual Endoscope is a highly developed three-dimensional technique that permits the visualization of the interior side of different human body structures. It imitates endoluminal endoscopic methods and results into attractive insight into bronchial, vascular, gastrointestinal and laryngeal anatomy (Höhne et al., 1995).

Contrary of real endoscopic views, the virtual endoscope owns the following advantages:

1. Capability to pass through the organs walls to inspect the neighboring anatomy.
2. Intelligent control of all virtual parameters of camera.
3. It has ability to fix the 3D position of the virtual endoscope.
4. Controlled movement depending on the user via a computer generated path.
5. An inestimable depth of field.

The virtual endoscope is made up of several subsystems:

1. An image possession system that has the capability to deliver the cross-sectional images of the interior anatomy.

2. A surface extractor which develops the polygonal models of every target tissue.

4. A pathfinder to estimate a safe trajectory and a renderer proficient of converting and operating the polygonal dataset (Sempere et al., 2011).

Perspectives and Conclusion

The novel knowledge illustration of human anatomy and function has exceeded the all earlier approaches in adaptability and usefulness. Accredited to computer science, the pictures and text obtained very attractive representing the user's perception of the knowledge depiction. This concept of combining the cross-sectional anatomy with 3D anatomical description has delivered a promising technique for future. Through it, the user can compile his personal perspective on the spatial as well as the symbolic content of the information base. With the help of a 3D atlas of the human organs and tissues, it has broadened the scope of superior visualization of anatomical and functional knowledge.

The resulting images extracted via this technique represent vast advancement in understanding and diagnosing pathology and facilitates the planning of surgical intrusions. It also plays a momentous role in the teaching of anatomy and inherited anomalies.

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