DOWNLOAD PDF INTRODUCTION TO COMPUTED TOMOGRAPHY

Chapter 1 : Radiology-TIP - Computed Tomography - Intro to Computed Tomography CT

Abstract: This tutorial explains how computed tomography (CT) imaging systems generate 3-D images of internal body structures. The high-end spiral CT technique is explained, as is the method by which light collected from photodiodes is processed into an electrical signal and eventually converted to.

CT is an accurate technique for diagnosis of abdominal diseases. Its uses include diagnosis and staging of cancer, as well as follow up after cancer treatment to assess response. It is commonly used to investigate acute abdominal pain. Extremities[edit] CT is often used to image complex fractures , especially ones around joints, because of its ability to reconstruct the area of interest in multiple planes. Fractures, ligamentous injuries and dislocations can easily be recognised with a 0. First, CT completely eliminates the superimposition of images of structures outside the area of interest. Finally, data from a single CT imaging procedure consisting of either multiple contiguous or one helical scan can be viewed as images in the axial , coronal , or sagittal planes, depending on the diagnostic task. This is referred to as multiplanar reformatted imaging. CT is regarded as a moderate- to high- radiation diagnostic technique. The improved resolution of CT has permitted the development of new investigations, which may have advantages; compared to conventional radiography, for example, CT angiography avoids the invasive insertion of a catheter. CT colonography also known as virtual colonoscopy or VC for short is far more accurate than a barium enema for detection of tumors, and uses a lower radiation dose. CT VC is increasingly being used in the UK and US as a screening test for colon polyps and colon cancer and can negate the need for a colonoscopy in some cases. The radiation dose for a particular study depends on multiple factors: Computed tomography CT scan has been shown to be more accurate than radiographs in evaluating anterior interbody fusion but may still over-read the extent of fusion. The radiation doses received from CT scans is variable. Compared to the lowest dose x-ray techniques, CT scans can have to 1, times higher dose than conventional X-rays. In general, the radiation dose associated with a routine abdominal CT has a radiation dose similar to 3 years average background radiation from cosmic radiation. Some experts project that in the future, between three and five percent of all cancers would result from medical imaging. In this group one in every CT scans was followed by an excess cancer. People with mild kidney impairment are usually advised to ensure full hydration for several hours before and after the injection. For moderate kidney failure, the use of iodinated contrast should be avoided; this may mean using an alternative technique instead of CT. Those with severe renal failure requiring dialysis require less strict precautions, as their kidneys have so little function remaining that any further damage would not be noticeable and the dialysis will remove the contrast agent; it is normally recommended, however, to arrange dialysis as soon as possible following contrast administration to minimize any adverse effects of the contrast. In addition to the use of intravenous contrast, orally administered contrast agents are frequently used when examining the abdomen. However, oral alternatives to iodinated contrast exist, such as very dilute 0. Dilute barium sulfate has the advantage that it does not cause allergic-type reactions or kidney failure, but cannot be used in patients with suspected bowel perforation or suspected bowel injury, as leakage of barium sulfate from damaged bowel can cause fatal peritonitis. CT scanner with cover removed to show internal components. Gantry rotation Left image is a sinogram which is a graphic representation of the raw data obtained from a CT scan. At right is an image sample derived from the raw data. Operation of computed tomography Computed tomography operates by using an X-ray generator that rotates around the object; X-ray detectors are positioned on the opposite side of the circle from the X-ray source. A visual representation of the raw data obtained is called a sinogram, yet it is not sufficient for interpretation. Once the scan data has been acquired, the data must be processed using a form of tomographic reconstruction , which produces a series of cross-sectional images. Pixels in an image obtained by CT scanning are displayed in terms of relative radiodensity. Pixel is a two dimensional unit based on the matrix size and the field of view. When the CT slice thickness is also factored in, the unit is known as a Voxel , which is a three-dimensional unit. The phenomenon that one part of the detector cannot differentiate between different tissues is called the "Partial Volume Effect". That means that a big amount of cartilage and a thin layer of compact bone can cause the same attenuation in a voxel as hyperdense cartilage alone. The attenuation of metallic implants depends on atomic number of the element used: Artifacts are caused by abrupt transitions between low- and high-density materials, which results in data values that exceed the dynamic range of the processing electronics. This left-right interchange corresponds to the view that physicians generally have in reality when positioned in front of patients. CT data sets have a very high dynamic range which must be reduced for display or printing. This is typically done via a process of "windowing", which maps a range the "window" of pixel values to a grayscale ramp. Pixel values of 0 and lower, are displayed as black; values of 80 and higher are displayed as white; values within the window are displayed as a grey intensity proportional to position within the window. The window used for display must be matched to the X-ray density of the object of interest, in order to optimize the visible detail. Radiocontrasts for X-ray CT are, in general, iodine-based. Using contrast material can also help to obtain functional information about tissues. Often, images are taken both with and without radiocontrast.

Chapter 2 : RAD â€“ Introduction to Computed Tomography | Technical College of the LowCountry

Chapter 1 Introduction This chapter provides a short introduction to computed tomography (CT), covering the main milestones from the discovery of X-ray till modern applications of CT in the ï¬•eld of.

Those that have undergone serious medical examination are probably familiar with computed tomography, although they may not immediately realize it. Since its conception in , computed tomography CT scans have proven to be one of the most helpful medical imaging technologies developed in the modern world. With this invention, scientists and medical professionals were able to utilize x-ray equipment to create internal images of a human body to detect a wide array of potential health problems. Although it was developed in, CT scans were not implemented within a clinical setting until the years Yet despite this implementation, CT scanners were not widely used or available until the 80s. Similar to traditional computers, CT scanners initially took quite a long time to generate and process data. In fact, the first scanner developed by Hounsfield took several hours to generate the necessary data for a single scan and days to process this data. This pace put severe strains on patient care, particularly in relation to diseases or treatments requiring time-sensitive diagnosis. To improve speed and patient care, CT scans have vastly improved throughout the years. For example, modern CT scanners can generate four scans of data in approximately milliseconds and develop a x matrix image in less than one second. Furthermore, modern CT scanners are able to cover an entire human chest in approximately 5 to 10 seconds, a speed deemed nearly impossible only twenty years prior. Considering that CT scanners are able to take images inside the human body, CT has been crucial in detecting internal diseases, such as cancer. In detecting cancer, CT is often used in a wide variety of ways. For example, CT is often used to detect internal growths that are unable to be identified externally. CT can also be used within the treatment process where radiologic technologists will leverage this technology to determine where to perform procedures or whether treatment is working effectively. In particular, CT scans have proven time and time again to be extremely effective screening for colorectal and lung cancer. This statistic is possible largely because of early detection from using a CT scan. CT scans are also used to detect a wide array of internal health conditions beyond cancer, such as blood system conditions, spinal conditions, kidney stones, as well as wounds afflicting the head or internal organs. What is its role within Radiologic Technology? Computed tomography plays a particularly important role within radiologic technology. While other imaging technologies provide insight into the human body, it is CT scans which provide radiologic technologists with the capability to capture images inside of internal organs. Thus, CT scans further expand the detection and treatment potentials of radiologic technology. Although computed tomography CT and positron emission tomography PET are often grouped together, they are not the same imaging procedure. PET involves nuclear medicine imaging which measures important functions of the body in order to provide doctors with insight as to how the body or individual organs are functioning. Some of the specific bodily functions that a PET scan measures include blood flow, metabolism, and oxygen use. The images produced by PET scans are often used in conjunction with CT to provide doctors with specialized images that would not be possible without this collaboration. Examples of such specialized images include combining data from two different imaging procedures to form one single image that combines function and structure. Considering this, the future of radiology looks both exciting and promising, particularly in regard to the current trend of moving beyond anatomy and into molecular medicine. With this, physicians will be able to provide patients with more individualized and personalized care. Another development includes the continuous reduction of radiation. Currently, there is some health risk associated with radiation technologies, but experts are working hard to develop technologies â€" such as phase contrast X-ray imaging â€" that reduce radiation levels to such degree that they are no longer a concern. If you are interested in becoming an educational or management professional in the field of medical imaging and radiologic sciences, click here to learn about the University of Cincinnati Blue Ash College Online Bachelor of Radiation Science Technology program. Delivered online and designed to be convenient and flexible for working professionals, the program seeks to develop proficient leaders who can manage, innovate and lead change within the evolving industry.

Chapter 3 : What is Computed Tomography?

And this is the second video in our Introduction to Radiology video series. In this video, we'll be covering computed tomography, or CT imaging. A big objective to get out of this is to recognize the significance of.

Despite this early advancement, the first clinical CT scanner was not developed until , when Sir Godfrey Hounsfield developed a computer that could analyze input from X-rays that were taken at multiple angles [1]. Before this advancement, x-ray film radiography was the only medical imaging technique available for examining the internal anatomy [1]. Conventional radiography is poor at differentiating between soft tissues because it uses only one projection angle [2]. This limits the diagnostic potential of conventional radiography to diseases of the lungs and skeleton2. On the other hand, CT imaging is more accurate at differentiating between soft tissues, including tissues of abdomen and brain [2]. In honour of Godfrey Hounsfield, the quantitative values representing the radiodensity of a volume are named Hounsfield units HU 1. Computed tomography CT imaging is sometimes referred to as computerized tomography imaging or a computerized axial tomography CAT scan. To appreciate the basics of CT, it is essential to understand the principles that were discussed in the radiography chapter. As a reminder, radiography involves the projection of x-rays towards an object and the detection of the attenuation of x-rays on a film or digital detector. The 2D image that is created is a superimposition of 3D anatomy because the brightness in the image is determined by the anatomy the x-ray passed through. Thus information that is parallel to the x-ray beam is lost [3] and conspicuity is reduced. One can create postero-anterior and lateral projections of the body to obtain anatomical information of height, width and depth. However, this may not be enough for subtle and complex pathologies [3]. The goal of CT is to eliminate the disadvantage of superimposition from radiography while improving image contrast to detect finer soft tissue differences [4]. CT imaging was first introduced to the medical imaging field in the s [5]. One of the most important factors contributing to the development of CT imaging was the invention of the computer, without which, CT would not exist. Due to the level of sophistication that this new technology brought to the medical community, people rapidly began to discuss the diagnostic possibilities that could be accomplished using CT imaging. In fact, CT imaging was seen as such an incredible medical advance that in Allan Cormack who developed the mathematical solutions to the problems of CT and Godfrey Hounsfield who created the first CT machine received the Nobel Prize in Medicine for their contribution to the development of CT [5] [3]. Together, Cormack and Hounsfield made it possible for CT imaging to be available in clinical practice and hence have been named the fathers of medical computed tomography. CT has now been used for over forty years in a clinical setting and truly has became a fundamental medical imaging modality [5]. Among many other applications, CT imaging is capable of diagnosing cancer, examining trauma cases, and screening for osteoporosis. Not only is CT able to image multiple parts of the body and various pathologies, it was the first non-invasive imaging technique available to physicians that allowed for the visualization of the body in a three-dimensional form [6]. Because of this development of three-dimensional reconstruction, CT imaging is not limited by the superposition of different body parts. This is one of the largest advantages that CT has over radiography. Additionally, radiography allows for very minimal soft tissue contrast, whereas CT imaging achieves high soft tissue contrast [3]. Just as in conventional radiography, an x-ray source directs x-rays towards a patient. X-rays get attenuated while passing through the body and are detected once they have passed through. There are a number of ways in which CT machines can be set up however it is important to note that since when the first CT scanner was developed, the technology surrounding CT imaging has improved immensely. This chapter will explain the specifics as to how CT machines are set up and how they have matured and become more sophisticated over the past four decades. To put it into perspective, the first CT scanner acquired images that had 80 x 80 pixel resolution with each pixel being 3 mm in size [3]. Additionally, each single two-dimensional slice required approximately five minutes to acquire and another three minutes to reconstruct [3]. Obviously for application of CT technology in a clinical setting, such a long acquisition time was not ideal. Due to these initial lengthy scan times, it was believed that CT could only be used to scan the head. In fact, when magnetic resonance imaging MRI was introduced to the field of medical imaging in the s, it was predicted that MRI would completely replace the use of CT imaging [7]. This has not turned out to be the case as CT imaging is still one of the most widely used imaging modalities in clinical settings. This is due to advances in CT technology including changes to the acquisition geometry, detector technology, and the setup of the x-ray tube that have dramatically decreased the amount of time required to obtain CT images [3]. The time it requires to reconstruct the CT images has also decreased substantially due to major advances in computer technology over the past few decades. Therefore, while in the beginning it took hours for reconstruction of the images, nowadays reconstruction of the images can be carried out in seconds. Evidently, due to many improvements along the way, CT has without a doubt become one of the most standard medical imaging modalities in clinical practice.

Chapter 4 : Introduction to Computed Tomography - The University of Nottingham

An Introduction to Computed Tomography (CT) This monograph is designed to provide vascular technologists with a conceptual understanding of Computed Tomography, for the purpose of understanding its role as a diagnostic imaging modality used in conjunction with testing in the vascular laboratory.

Chapter 5 : Untitled Document

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Chapter 6 : Computed Tomography (CT)

An Introduction to computed tomography of the head.. [Meredith A Weinstein; A Jan Berlin] -- Discusses CT brain scans, normal anatomy of the brain, atrophy, infarctions, bleeds, infections, etc. Also deals with CT of the orbit, thyroid opthalmopathy, vascular lesions, etc.

Chapter 7 : CT Introduction - ProProfs Quiz

RAD - Introduction to Computed Tomography Course Description This course is the study of the technological developments behind computed tomography, an overview of scanner, components, terminology, data acquisition, digital imaging, image reconstruction, display and manipulations.

Chapter 8 : Human Health Campus - Computed tomography

Computed tomography units with multiple detectors are known by several terms but the most appropriate term to use is multi section computed tomography (MSCT) MSCT units represent a major change in CT technology because multiple detectors are exposed simultaneously.

Chapter 9 : High Resolution X-ray Computed Tomography: An Emerging Tool for Small Animal Cancer Res

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