X-ray Waves And Their Application In Different Fields

After reviewing the literature available on the application of x-ray waves in different fields, I have concluded that the most popular use of X-ray waves is in the medical field, and specifically medical imaging.

First of all, the use in projectional radiographs which is also called conventional radiography in obtaining radiographs of the breast, chest, abdomen, axial skeleton and extremities.

Projectional radiography of the breast is called mammography and is now widely used for detection of breast pathology and especially screening for breast cancer.

The radiation used for mammography tends to be softer (has a lower photon energy) than that used for the harder tissues.

Chest radiographs are used to diagnose many conditions involving the chest wall, including its bones, and also structures contained within the thoracic cavity including the lungs, heart, and great vessels. Conditions commonly identified by chest radiography include pneumonia, pneumothorax, interstitial lung disease, heart failure, bone fracture and hiatal hernia. Typically an erect postero-anterior (PA) projection is the preferred projection. Chest radiographs are also used to screen for job-related lung disease in industries such as mining where workers are exposed to dust.

Abdominal radiographs are indicated in the acute setting in suspected bowel obstruction, gastrointestinal perforation, foreign body in the alimentary tract, suspected abdominal mass and Intussusception (latter as part of the differential diagnosis). Yet, CT scan is the best alternative for diagnosing intra-abdominal injury in children.

Axial skeleton radiography includes the head (Cerebral angiography/ orbital radiography /Dental radiography/Sinuses and Facial bones)

It also includes the spine (Cervical, Thoracic, Lumbar and the Pelvis) as well as the ribs and the sternum.

Shoulders and extremities can also be radiographed.

In the medical field, CT scanning is also an imaging modality where tomographic images or slices of specific areas of the body are obtained from a large series of two-dimensional X-ray images taken in different directions.

Since its introduction in the 1970s, CT has become an important tool in medical imaging to supplement X-rays and medical ultrasonography. It has more recently been used for preventive medicine or screening for disease, for example CT colonography for people with a high risk of colon cancer, or full-motion heart scans for people with high risk of heart disease. A number of institutions offer full-body scans for the general population although this practice goes against the advice and official position of many professional organizations in the field primarily due to

the radiation dose applied.

CT scanning is generally the initial study of choice for major pathologies involving the head (infarction / hemorrhage/ trauma and calcifications) and neck (Neck masses and thyroid masses).

It is also used for detecting both acute and chronic changes in the lung parenchyma, the tissue of the lungs. It is particularly relevant here because normal two-dimensional X-rays do not show such defects.

A special tupe of CT radiography is Computed tomography angiography (CTA) which is a contrast CT used to visualize the arteries and veins throughout the body. This ranges from arteries serving the brain to those bringing blood to the lungs, kidneys, arms and legs. An example of this type of exam is CT pulmonary angiogram (CTPA) used to diagnose pulmonary embolism (PE). It employs computed tomography and an iodine-based contrast agent to obtain an image of the pulmonary arteries.

A CT scan of the heart can also be performed to gain knowledge about cardiac or coronary anatomy. Traditionally, cardiac CT scans are used to detect, diagnose, or follow up coronary artery disease.

It is also 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.

For the axial skeleton and extremities, 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.

But it’s of importance to note that CT imaging isn’t only used in the medical field, it is used in geological studies to quickly reveal materials inside drill core.

Dense minerals such as pyrite and barite appear brighter and less dense components such as clay appear dull in CT images.

X-ray CT and micro-CT can also be used for the conservation and preservation of objects of cultural heritage. For many fragile objects, direct research and observation can be damaging and can degrade the object over time. Using CT scans, conservators and researchers are able to determine the material composition of the objects they are exploring, such as the position of ink along the layers of a scroll, without any additional harm.

Fluoroscopy is an imaging technique commonly used by physicians or radiation therapists to obtain real-time moving images of the internal structures of a patient through the use of a fluoroscope. In its simplest form, a fluoroscope consists of an X-ray source and a fluorescent screen, between which a patient is placed. However, modern fluoroscopes couple the screen to an X-ray image intensifier and CCD video camera allowing the images to be recorded and played on a monitor. This method may use a contrast material. Examples include cardiac catheterization (to examine for coronary artery blockages) and barium swallows (to examine for esophageal disorders and swallowing disorders).

Fluoroscopy can be used to examine the digestive system using a substance which is opaque to X-rays (usually barium sulfate or gastrografin), which is introduced into the digestive system either by swallowing or as an enema. This is normally as part of a double contrast technique, using positive and negative contrast. Barium sulfate coats the walls of the digestive tract (positive contrast), which allows the shape of the digestive tract to be outlined as white or clear on an X-ray. Air may then be introduced (negative contrast), which looks black on the film. The barium meal is an example of a contrast agent swallowed to examine the upper digestive tract. Note that while soluble barium compounds are very toxic, the insoluble barium sulfate is non-toxic because its low solubility prevents the body from absorbing it.

Eventually, X-ray waves in the medical field can be used in radiotherapy, which is a therapy using ionizing radiation, generally as part of cancer treatment to control or kill malignant cells and normally delivered by a linear accelerator. Radiation therapy may be curative in a number of types of cancer if they are localized to one area of the body. It may also be used as part of adjuvant therapy, to prevent tumor recurrence after surgery to remove a primary malignant tumor (for example, early stages of breast cancer).