Definition of CT Terms - 2.1

Terms: Equipment Hardware

- **Bow-Tie Filter -** A type of filter added to the CT x-ray tube to compensate for the cylindrical shape of most body parts. The filter is thicker at the ends and helps shape the beam to reduce patient radiation exposure

- **Detector-** Device responsible for measuring transmitted radiation and converting it into a proportionate electronic signal to be used for image reconstruction.

- **Detector Array -** The CT image receptor, consisting of a series of detectors arranged in varying configurations.

- **Patient Collimator** – Collimators that set the slice width and reduce exposure to the patient.

- **Detector Collimator -** Collimators that determining section width in the MSCT system as determined by the defined beam width and the number and thickness of detectors utilized for image reconstruction.

- **Dual-source CT -** CT system that consists of two separate x-ray tubes and detector arrays mounted 90 degrees from each other within the gantry, allowing for dual-energy CT acquisition.

- **Gantry -** The assembly that houses the x-ray tube, detectors, and additional data acquisition components of a CT system. The patient is positioned within the gantry during CT data acquisition.

- **Imaging Console** – Console containing keyboard, mouse and screens where imaging commands are initiated

- **O-arm Portable -** CT-fluoroscopy unit with a telescoping gantry used to acquire 3D CT images and standard fluoroscopy during invasive or surgical procedures.

- **Central Processing Unit (CPU) –**The physical computer what processes the information

- **Patient Couch** – The device that supports the patient during scanning.

- **Photodiode -** Device used by a solid-state CT detector to convert the light emitted by a scintillation crystal into a proportional electronic signal.

Terms: Image Acquisition

- **Absorption Efficiency -** The ability of an individual CT detector to absorb and measure the transmitted x-ray intensity incident upon it. Primarily controlled by the characteristics and physical makeup of the detector material.

- **Geometric Efficiency -** The ability of a detector array to absorb and measure the transmitted x-ray intensity incident upon it. Primarily controlled by the physical arrangement of detectors within the array and the amount of interspace material required between adjacent detectors.

- **Analog-to-digital Converter (ADC) -** Component of the data acquisition system (DAS) responsible for converting the electronic signal emitted by the CT detectors into digital form.

- **Array Processor (AP) -** Component of the CT computer system responsible for receiving raw scan data, performing all of the major processing of the CT image, and returning the reconstructed image to the storage memory of the host computer.

- **Data Acquisition System (DAS) -** The electronic components of a CT system responsible for measuring the transmitted x-radiation absorbed by the detectors.

- **Electron beam CT (EBCT) -** Specialized CT design devoid of moving parts. Utilizes a beam of electrons bombarding a tungsten target to produce x-radiation. EBCT systems are capable of extremely short exposure times and have their greatest application in cardiac imaging

- **Helical -** The type of CT acquisition whereby the x-ray tube and patient continuously move during scanning, yielding a data set in the form of a helix. May also be commonly referred to as spiral.

- **Hybrid Array -** The type of MSCT detector array with narrower detectors positioned midline, flanked by the wider detectors.

- **Response Time -** The ability of a CT detector to quickly measure x-ray and then recover before the next measurement.

- **Scan Delay -** The time between the initiation of contrast agent administration and CT data acquisition. The chosen scan delay determines the phase of contrast enhancement for a given CT acquisition.

- **Scintillation -** The production of light energy by a CT detector material in response to absorbed x-ray energy.

- **Scout Image -** Digital survey radiograph acquired by the CT system for the purpose of prescribing the cross-sectional acquisition. Similar to a conventional radiograph, the scout view is produced by translating the patient through the gantry without tube and detector rotation. May also be referred to as a topogram, scanogram, or survey radiograph.

- **Section Width -** The dimension of a reconstructed CT slice along the longitudinal direction of acquisition (z-axis). Commonly referred to as slice thickness.

- **Single-slice CT (SSCT) -** A CT system with a single row of detectors capable of acquiring only one image section for each gantry rotation.

- **Slip-ring -** The rotating assembly used to enable the passage of electrical signal during continuous rotation of the helical CT system.

- **Uniform Matrix Array -**The type of MSCT detector array that utilizes multiple detectors in the longitudinal direction, each of the same length.

- **Ray -** The portion of the x-ray beam transmitted through the patient and incident upon a single detector.

- **View -** Each data sample made by the DAS during CT data acquisition.

Terms: Quality Control

- **Quality Assurance -** The measurement of the scanner's performance through quality testing procedures and evaluation of the test results.

- **Phantom -** A quality control device typically composed of a radiolucent plastic material containing specialized inserts that is used to measure specific image quality criteria.

- **Quality Control -** The implementation of corrective actions to improve any identified performance inadequacies of the CT system.

- **Aliasing -** A form of streak artifact caused by an insufficient number of views (data samples) obtained during data acquisition.

- **Artifact -** A form of noise on the CT image resulting from errors during the measurement of transmitted radiation by the detector

- **Beam Hardening Artifact -** The phenomenon whereby low-energy photons are absorbed as the x-ray beam passes through an object, resulting in an increase in the average photon energy of the beam.

- **Cupping Artifact -** An error occurring in the superior portion of the skull, where dense bone averages with the low- attenuating brain tissue. This partial volume artifact may result in abnormally dense-appearing brain parenchyma

- **Display Field Of View (DFOV) -** The diameter of the acquired attenuation data displayed across the image matrix. May also be referred to as the zoom factor or target view.

- **Edge Gradient -**Streak artifact that occurs at the interface between a high-density object and the lower-attenuation material surrounding it.

- **Linear Attenuation Coefficient (μ) -** The value assigned to an object to quantify the extent to which it attenuates x-ray.

- **Noise -** Grainy appearance on the CT image due primarily to an insufficient x-ray photon flux per voxel. May also be described as any portion of the signal that contains no useful information, as evident in certain CT image artifacts

- **Misregistration -** Artifact that occurs when patient motion between consecutive acquisitions causes misalignment of data and the potential loss of anatomic information

- **Out-of-field Artifact -** Hyperdense streaking that occurs when a portion of the patient has been positioned outside the scan field of view (SFOV).

- **Partial Volume Artifact -** An error that occurs when a structure is only partly positioned within a voxel and the attenuation for the object is not accurately represented by a pixel value.

- **Pitch -** The relationship between collimation and table movement per gantry rotation.

- **Ring Artifact -** An incorrect ring of density on the reconstructed CT image resulting from detector malfunction.

- **Spatial Resolution -** The ability of a CT imaging system to display fine details separately. Given in units of line pairs per centimeter (lp/cm).

- **Temporal Resolution -** The ability of a CT system to freeze motion and provide an image free of blurring.

- **Step Artifact -** The unwanted appearance of individual sections on a reconstructed image

- **Tube Arcing -** Short circuiting within the x-ray tube during data acquisition that results in severe streak artifacts in the CT image.

- **Cone Beam Artifact –** Lines appearing in a windmill pattern that occur on MDCT units from the come shaped x-ray beam

Terms: Dose

- **Absorbed Dose -**The amount of x-ray energy absorbed in a unit of mass. It is measured in grays (Gy).

- **ALARA -** Acronym for as low as reasonably achievable, the cardinal principle of radiation dose reduction for all radiologic procedures, including CT.

- **CT dose index (CTDI) -** An approximate measure of the radiation dose received in a single CT section or slice

- **Dose Length Product (DLP) -** The measurement of dose for an entire series of CT images. DLP is equal to the calculated dose per section multiplied by the length of a CT acquisition along the z-axis.

- **Effective Dose** - Approximation of the relative risk from exposure to ionizing radiation; it is calculated by assigning weighting factors to different tissues on the basis of their individual radio-sensitivities. It is measured in sieverts (Sv).

- **Kerma -** Quantity of energy deposited in a unit of mass. Kerma is used to describe the absorbed dose of x-radiation.

- **Multiple Scan Average Dose (MSAD) -** A calculation of the average cumulative radiation dose to each anatomic slice within the center of a CT scan consisting of multiple slices.

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Term: Software Storage & Display

- **Archival** - The storage of CT data in either hard (film) or soft (digital) form.

- **Data Transfer Rate** - The speed at which a computerized storage drive is able to transfer data.

- **DICOM -** Acronym for the Digital Imaging and Communications in Medicine standard for the process of recording, storing, printing, and transmitting medical image data.

- **Image Compression -** Complex computer technique that reduces the size of digital CT image data.

- **Operating System (OS) -** The main software of the CT computer, controlling the utilization of the hardware resources including the available memory, central processing unit time, disk space, and so on.

- **Hospital Information Systems (HIS)** – Contain administrative date of patient data and location in the system.

- **Radiology Information Systems (RIS) –** Contains all date pertinent to the patient's radiology history and orders.

- **PACS -** Acronym for a picture archival and communications system. Responsible for storing, retrieving, distributing, and displaying CT and other digital medical images.

- **Windowing -** The process of grayscale mapping of the CT image on the basis of the CT number (Hounsfield value) assigned to each pixel.

- **Window Level (WL) -** The pixel value, given in HU, at the center of the window width. Window level controls the brightness (density) of the CT image.

- **Window Width (WW) -** The range of pixel values assigned a shade of gray in the displayed CT image. Window width controls the contrast of the CT image.

Terms: Image Reconstruction

- **180-degree linear interpolation (180LI) -** Type of algorithm used for multi-slice computed tomography (MSCT) image reconstruction in which data acquired from a shorter distance (180 degrees) away from the reconstructed slice location are interpolated

- **360-degree linear interpolation (360LI) -** Type of algorithm used for MSCT image reconstruction in which two sets of projection data acquired 360 degrees apart are used to form an image at a precise z-axis location

- **Algorithm -** Mathematical filter applied to raw data during CT image reconstruction to remove blurring artifact inherent to back-projection. May also be referred to as a kernel.

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- **Analog-to-digital Converter (ADC)** - Component of the data acquisition system (DAS) responsible for converting the electronic signal emitted by the CT detectors into digital form.

- **Array Processor (AP) -** Component of the CT computer system responsible for receiving raw scan data, performing all of the major processing of the CT image, and returning the reconstructed image to the storage memory of the host computer.

- **Back-projection -** The mathematical process of CT image reconstruction whereby ray sum data are projected back onto a matrix.

- **Filtered Back-projection -**The mathematical process of CT image reconstruction that involves convolution of the raw data before their projection back onto a matrix.

- **Binning -** The process of electronically combining signal from adjacent detector elements to produce a reconstructed CT image that is thicker than the individual detector width.

- **Convolution -** Mathematical filtration used by the CT system to remove blurring artifact during the back-projection method of image reconstruction.

- **CT number** - Relative value assigned to each pixel to quantify the attenuation occurring in each voxel in comparison with the attenuation of water. The calculated CT number for a given pixel is given in Hounsfield units (HU). May also be referred to as pixel value.

- **Display Field Of View (DFOV) -** The diameter of the acquired attenuation data displayed across the image matrix. May also be referred to as the zoom factor or target view.

- **Hounsfield unit (HU) -**The unit of the CT number scale assigned to each pixel to quantify relative attenuation

- **Image Data -** The reconstructed data that have been projected back onto a matrix after convolution by an algorithm and displayed on a monitor as a grayscale CT image

- **Interpolation -** The mathematical process used for helical CT image reconstruction whereby data from tube rotations just above and just below a given slice position are used for image reconstruction

- **Iterative Reconstruction -**A mathematical CT reconstruction method that uses multiple passes (iterations) to arrive at a final image with reduced noise and artifacts, leading to improved overall quality at reduced patient dose.

- **Kernel -** Mathematical filter applied to raw data during CT image reconstruction to remove the blurring artifact inherent to back-projection. May also be referred to as an algorithm

- **Minimum Intensity Projection (min-IP) –** Multi-planar reformation technique that displays the minimum pixel value along each ray to the viewer.

- **Multi-planar Reformation (MPR) -** The process of displaying CT images in a different orientation from the one used in the original reconstruction

- **Perspective Volume Rendering -** Technique yielding a 3D model with the perspective of being within the lumen of the object, similar to an endoscopic view. May also be referred to as immersive rendering

- **Prospective Reconstruction -** The initial construction of the acquired raw data into CT image data with selected display field of view, algorithm, image center, and so on.

- **Raw Data -** The transmission measurements obtained by the detectors used to mathematically reconstruct the CT image.

- **Region Of Interest (ROI) -** A user-defined graphic outline that calculates the average CT number of a given anatomic area.

- **Retrospective Reconstruction -** Reconstruction performed after the initial prospective reconstruction. Multiple retrospective reconstructions of raw data are possible, with changes to display field of view, algorithm, image center, and so on.

- **Scan Field Of View (SFOV) -** A parameter that controls the diameter of the circular data acquisition field within the CT gantry as determined by the number of activated detectors along the x-y axis. May also be referred to as the calibration field.

- **Shaded Surface Display (SSD) -** See surface rendering. signal Electronic current emitted by the CT detector in response to the absorption and measurement of transmitted radiation.

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- **Surface Rendering** - Construction of a 3D model of a specific tissue type by limiting the displayed volumetric data on the basis of an attenuation threshold. May also be referred to as shaded surface display (SSD).

- **Volume Rendering -** A 3D modeling technique that utilizes the entire acquired data set but adjusts the opacity of voxels included in the 3D image according to their tissue characteristics