

**NUSU**

**Radiography and medical  
imaging sciences**


**3rd year**

**CT Technique**

**Introduction to course**


# CT TECHNIQUE


- ▶ Course content :
- ▶ Introduction to the course.
- ▶ Technical parameters.
- ▶ CT of the brain .
- ▶ CT of the neck .
- ▶ CT of the chest .
- ▶ CT of the abdomen .


- 
- ▶ CT of the renal system.
  - ▶ CT of the pelvis.
  - ▶ CT of the upper limbs .
  - ▶ CT of the lower limbs.
  - ▶ CT Angiography.
  - ▶ Multiplaner reconstructions.


# Computed tomography term:

- ▶ **Artifact (Structured Noise):** The appearance in the CT image of details not present in the scanned object.
- ▶ **Attenuation:** Reduction of the radiation **intensity**, upon passage through matter, resulting from all types of interaction.


- 
- ▶ **Back projection:** Mathematical procedure for the reconstruction of the CT image, based on the smearing of the individual **rays** within a view (projection) back along the direction in which they were measured.
  - ▶ **Collimation:** Geometrical limitation of the extent of the radiation beam in the z-direction.


- 
- ▶ **Computed tomography number (CT number):**
  - ▶ Number used to represent the mean X-ray attenuation associated with each elemental area of the CT image.
  - ▶ **Convolution:** The mathematical process by which raw data undergo spatial filtration prior to back projection


- 
- ▶ **Contrast enhancement:** Administration of intravenous or intra-arterial contrast increase the visibility of low contrast structures due to increased density of vessels and organs/tissue containing contrast media.
  - ▶ **Couch increment:** Distance by which position of patient couch (table) is changed between individual slices in serial scanning or the distance the couch position is changed during one 360° rotation of the tube during helical scanning.


- 
- ▶ **Detector:** A single element of a **detector array**, which produces an electrical or light signal in response to stimulation by X-rays.
  - ▶ **Display matrix:** The array of rows and columns of **pixels** in the displayed image, typically between  $512 \times 512$  and  $1024 \times 1024$ . It may be equal to or larger than the size of the **reconstruction matrix** due to **interpolation** procedures.





- 
- ▶ **Exposure time:** Duration of emission of radiation by the X-ray tube (seconds) for an individual slice in axial scanning or total acquisition time for helical scanning.
  - ▶ **Field of view (FOV):** The maximum diameter of the reconstructed image.

- 
- ▶ **Filter:** Mathematical procedure used for the **convolution** of the attenuation profiles and the consequent reconstruction of the CT image.
  - ▶ **Focal spot:** The effective area on the X-ray tube anode from which X-rays are emitted. The size of the focal spot has influence on **spatial resolution**.

- 
- ▶ **Gantry:** Scanner structure containing the X-ray tube, collimators and the **detector array**.
  - ▶ **Gantry aperture:** Diameter of the physical opening of the **gantry** through which the patient is moved for the examination.
  - ▶ **Gantry tilt:** The angle between the vertical plane, and the plane containing the X-ray fan beam and the **detector array**.

- 
- ▶ **Helical CT:** A particular technique of scanning in which there is continuous rotation of the X-ray tube coupled with continuous linear translation of the patient through the **gantry aperture** in order to achieve volumetric data acquisition. Also known as **spiral** or **volume CT**. **Intensity:** The quantity of radiation energy flowing through unit area in unit time.


- 
- ▶ **Interpolation:** A mathematical method of averaging or smoothing images that are being displayed on a larger number of **pixels** than that for which they were originally reconstructed.
  - ▶ **Linear attenuation coefficient:** The fractional reduction in intensity per unit thickness of material as an X-ray beam passes through an absorber.

- 
- ▶ **Noise:** Noise is the point-to-point variation in image density that does not contain useful information.
  - ▶ **Pixel:** Individual square picture element of a digital image display, being the two-dimensional representation in **HU** of a **voxel** within the scanned slice. Pixel size is determined by the diameter of the **field of view** and the number of elements in the **display matrix**.




► **Reconstruction algorithm:** Mathematical procedure used to convert **raw data** into an image.

**Reconstruction matrix:** The array of rows and columns of **pixels** in the reconstructed image.


- 
- ▶ **Region of interest (ROI):** Localized part of an image defined by the operator which is of particular interest at a given time.
  - ▶ **Ring artifacts:** Circular artifacts, usually found in third generation. scanners, caused by fault calibration or a defect in detector function.





► **Scan time:** The time interval between the beginning and the end of the acquisition of **attenuation** data for a single exposure.

**Signal to noise ratio:** The ratio of the strength of the signal for information content in the image to the noise level (the standard deviation of the signal).

- 
- ▶ **Window level:** The central value of the window (in **HU**) used for the display of the reconstructed image on the image monitor of the CT scanner.
  - ▶ **Window width:** The range of **CT numbers** within which the entire grey scale is displayed on the image monitor of the CT scanner.