SNS COLLEGE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

Approved by AICTE & Affiliated to Anna University
Accredited by NBA & Accrediated by NAAC with ‘A++’ Grade,
Recognized by UGC saravanampatti (post), Coimbatore-641035.

Department of Biomedical Engineering

Course Name: 19BMT302 : **Radiological Equipment**

III Year : V Semester

Unit 2 – COMPUTED TOMOGRAPHY

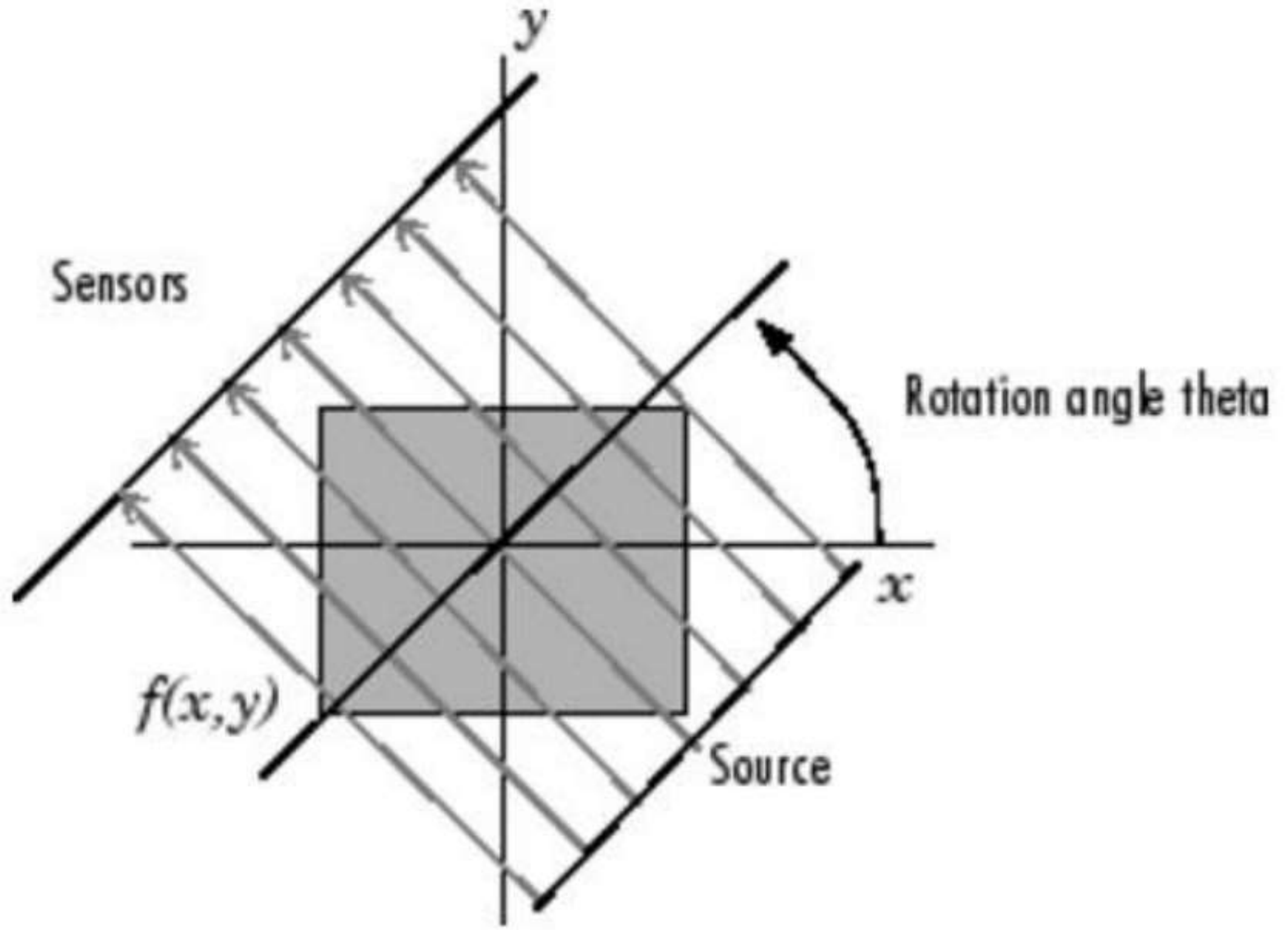
Topic : PARALLEL BEAM RECONSTRUCTION

INTRODUCTION

- Parallel beam reconstruction is a technique used in medical imaging, particularly in computed tomography (CT) and some other imaging modalities.
- It refers to a method of reconstructing a two-dimensional (2D) or three-dimensional (3D) image from a set of projection data acquired when a parallel beam of radiation or X-rays passes through an object from multiple angles.

Parallel beam reconstruction

Parallel Beam Geometry



HISTORICAL CONTEST

- The history of parallel beam reconstruction is intertwined with the evolution of CT imaging technology, which has revolutionized medical diagnosis and treatment planning.
- It remains a foundational technique in medical imaging, allowing clinicians to obtain detailed, non-invasive, and cross-sectional views of the human body for a wide range of medical applications.

WORKING PRINCIPLES

- A parallel beam refers to a specific arrangement of X-ray or radiation beams used in medical imaging, particularly in computed tomography (CT) and certain other imaging techniques.
- In a parallel beam configuration, the X-ray or radiation source emits a beam of radiation, and the detectors or sensor arrays are positioned directly opposite the source, creating a straight and parallel path for the radiation.

Here's a more detailed explanation of parallel beam imaging:

1.X-ray Source: In medical imaging, a source of X-rays or other forms of radiation is used to produce the primary beam. This source is typically an X-ray tube, which generates a beam of X-rays when energized.

WORKING PRINCIPLES

2.Patient or Object: The patient or object being imaged is positioned between the X-ray source and the detectors. The X-rays pass through the patient or object and are partially absorbed or scattered based on the density and composition of the tissues they encounter.

3.Parallel Beam Geometry: In a parallel beam configuration, the X-ray beam emitted by the source remains parallel as it travels through the patient or object. This means that the rays of radiation maintain a constant direction and do not converge or diverge significantly.

4.Detectors: On the opposite side of the patient or object from the X-ray source, there is an array of detectors or sensor elements that capture the X-rays that pass through. These detectors record the intensity of the X-rays after they have interacted with the tissues within the patient or object.

To be continued...

5.Multiple Angles: To create a cross-sectional image of the patient's internal structures, multiple X-ray projections are acquired. This is achieved by rotating either the X-ray source and detectors around the patient (as in traditional CT) or by moving the patient through the X-ray beam (as in helical or spiral CT).

6.Projection Data: Each X-ray projection represents a 2D view of the patient's internal structures from a particular angle. These projections are essentially shadow grams or profiles of the tissues and structures along the path of the X-rays.

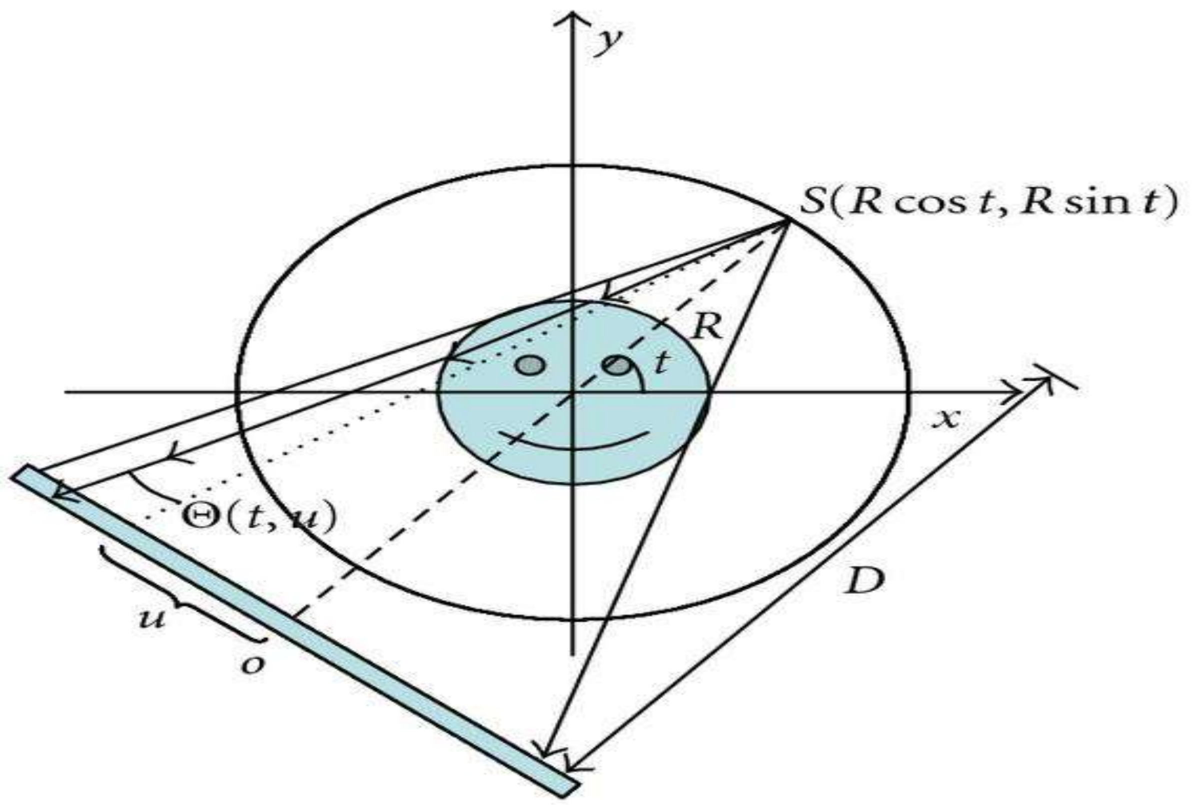
7.Reconstruction: To create a 2D or 3D image from these projections, mathematical algorithms like the Radon transform or filtered back projection are used. These algorithms take into account the varying absorption or scattering of X-rays at different angles and reconstruct cross-sectional images of the patient's anatomy.

TYPES OF PARALLEL BEAM RECONSTRUCTION

- ❑Fan – Beam reconstruction
- ❑Cone – Beam Reconstruction
- ❑Helical and spiral Reconstruction

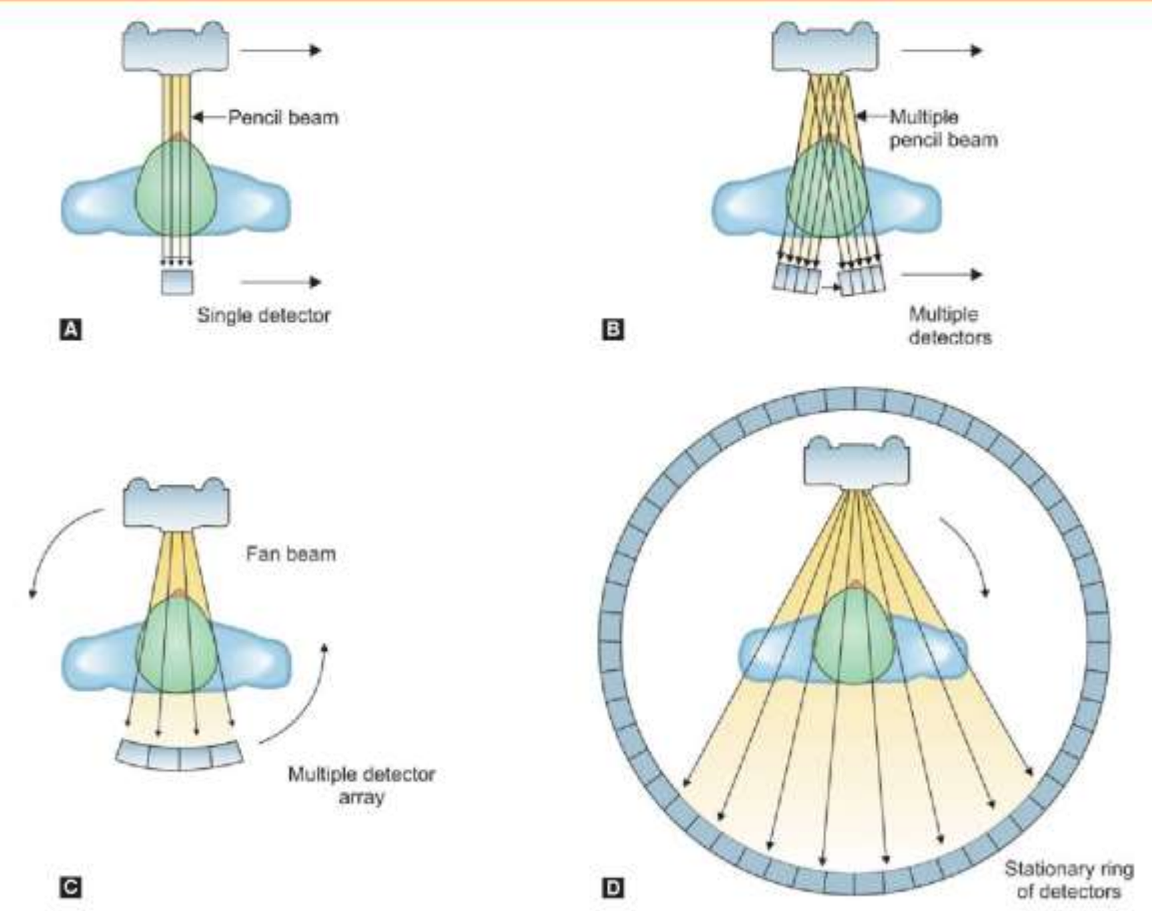
FAN – BEAM RECONSTRUCTION

Fan-Beam Reconstruction Formula for Short Scan Case. In absorption X-ray CT, it has been proven that the data are sufficient to reconstruct the entire image object when the angular range is greater than + fan angle, where the fan angle is defined as the entire angle subtended by the detector from the source position



CONE – BEAM RECONSTRUCTION

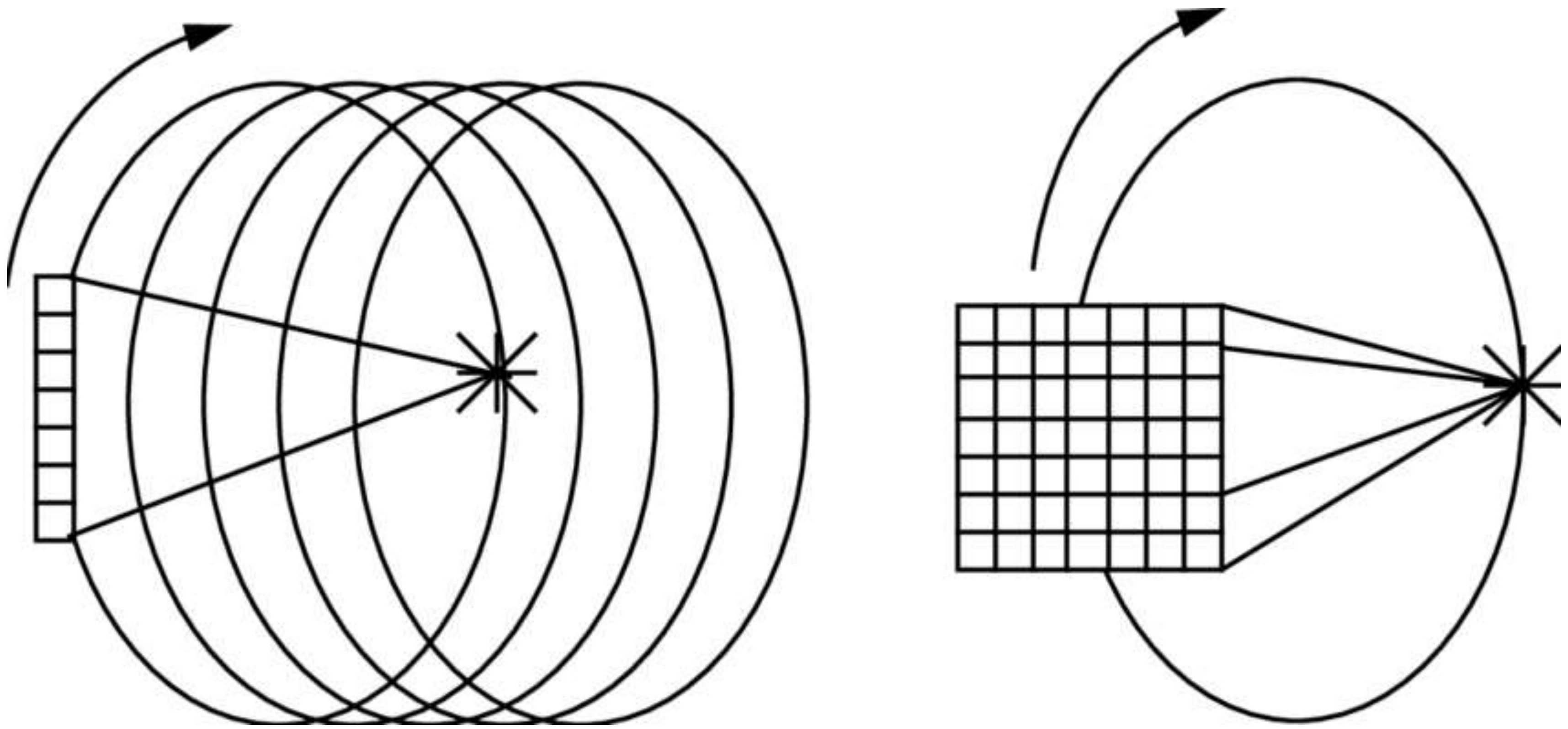
In microtomography X-ray scanners, cone beam reconstruction is one of two common scanning methods, the other being Fan beam reconstruction. Cone beam reconstruction uses a 2-dimensional approach for obtaining projection data



Figs 1A to D: Four basic scanning methods or systems: (A) first generation, (B) second generation

HELICAL AND SPIRAL RECONSTRUCTION

Helical (Spiral) CT is a vast improvement over conventional CT scans. The patient lies on an exam table that passes through a doughnut-shaped scanner, while an X-ray tube rotates around the table. This movement results in a spiral shaped continuous data set without any gaps.



THANK YOU