



JOHNS HOPKINS

WHITING SCHOOL
of ENGINEERING

Applied Medical Image Processing

Medical Image Modalities – CT Scan

Introduction

- Medical Images play critical role in medical diagnosis and/or treatment planning or evaluating response to treatment.
- Several imaging modalities are routinely used in clinics including:
 - Planar X-ray
 - Computed X-ray tomography (CT)
 - Ultrasound
 - Magnetic Resonance Imaging (MRI)
 - PET, SPECT

Outline

- A brief history of scientists contributing to the development of CT scan
- Back projection reconstruction example
- CT generations
- Example CT data of brain

1917 - Johann Radon

Austrian mathematician who showed that a three-dimensional object could be produced from many projections or views of that object (Radon transform).



(Pauser)

1959 - William Oldendorf (UCLA)



- In 1959, Oldendorf came with an idea for scanning a head through a transmitted beam of X-rays and being able to reconstruct the radiodensity patterns of a plane through the head.
- When suggested to a leading X-ray manufacturer of the time, the president of the company retorted:
 - "Even if it could be made to work as you suggest, we cannot imagine a significant market for such an expensive apparatus which would do nothing but make a radiographic cross-section of a head."

(American Society of Neuroimaging, 1993)

1963 - Allen Cormack

- Was a South African American physicist who won the 1979 Nobel Prize in Physiology or Medicine (along with Godfrey Hounsfield) for his work on X-ray computed tomography (CT).
- Developed the mathematics behind computerized tomography



(Nobel Prize Outreach, 2023)

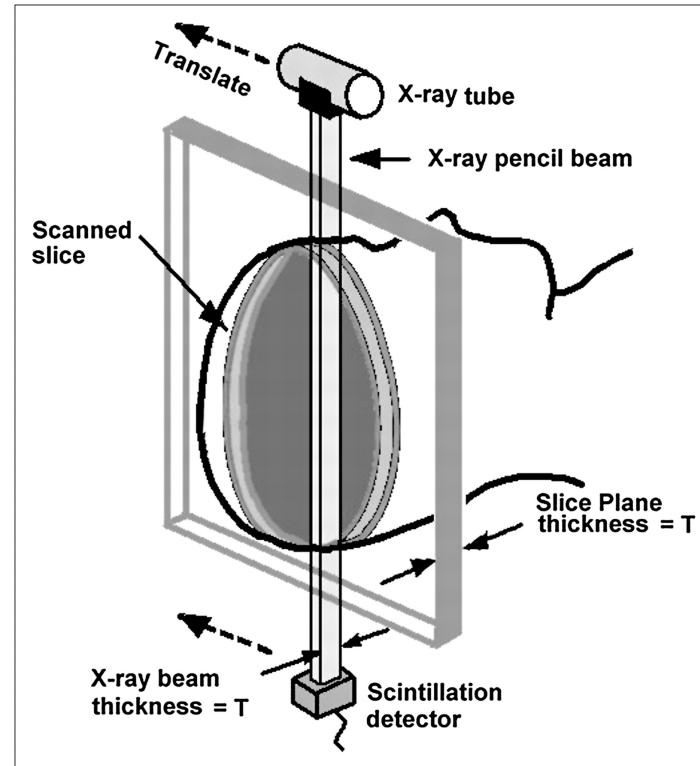
1967 - Godfry Hounsfield



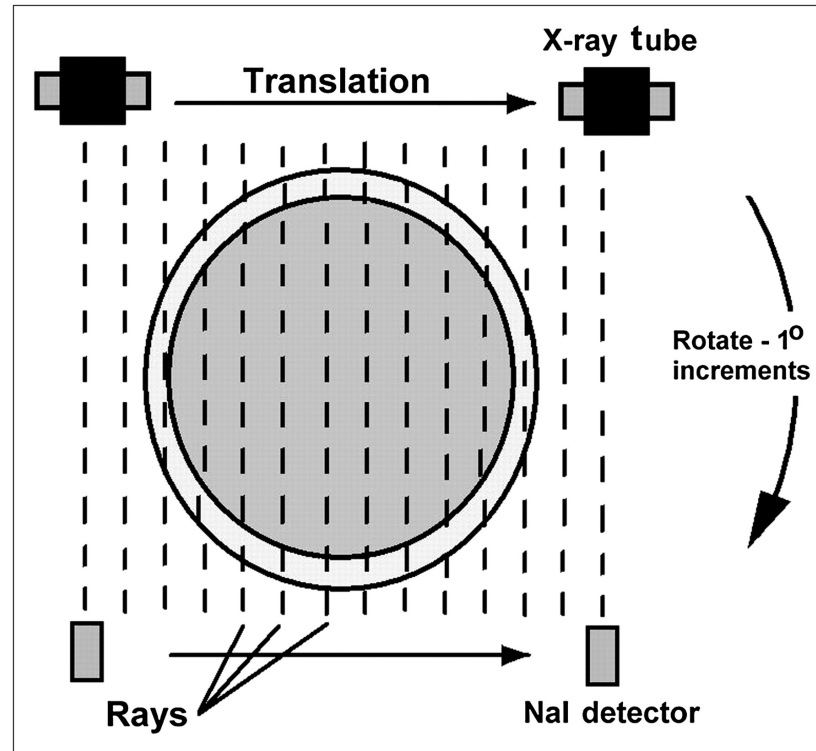
- English electrical engineer
- Worked on digital pattern reconstruction techniques
- Came up with the idea of determining objects inside a box by taking X-ray readings from different angles.
- He was not aware of Cormack's work.
- Hounsfield built a prototype head scanner and tested it first on a preserved human brain, then on a fresh cow brain, and later on himself.

(PA Images via Getty Image, 1972)

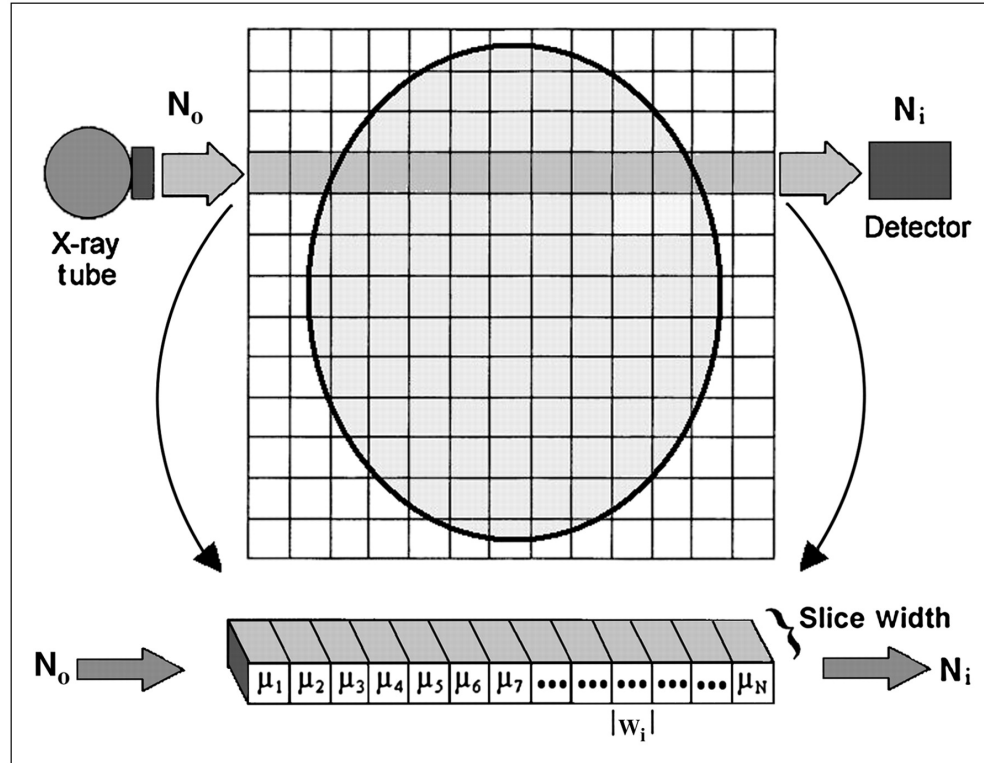
CT Arrangement



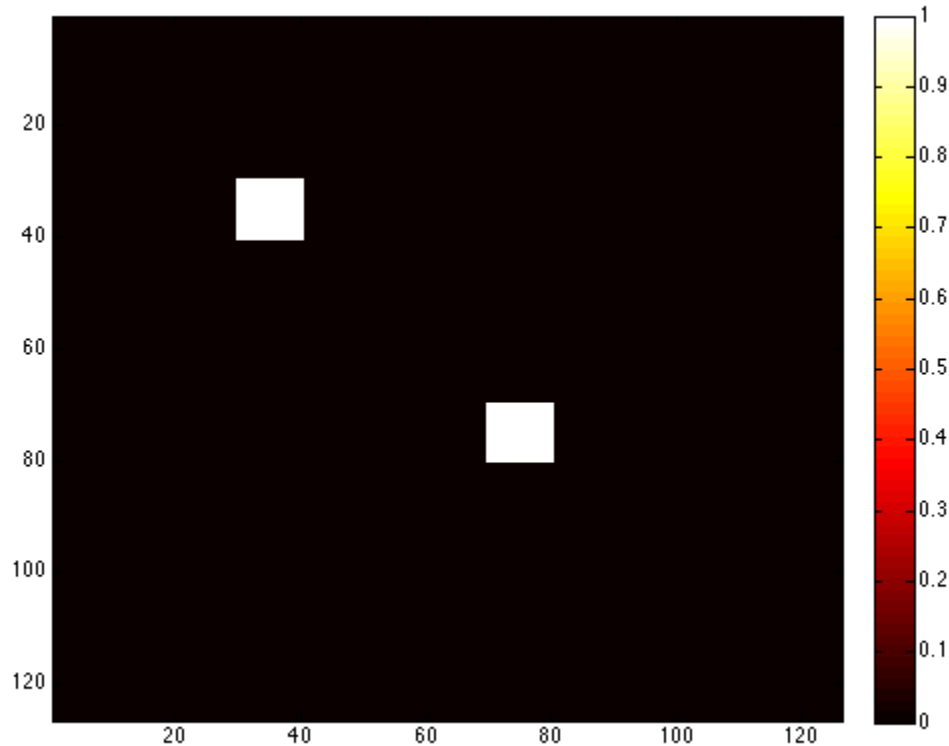
X-ray Transmission Measurements



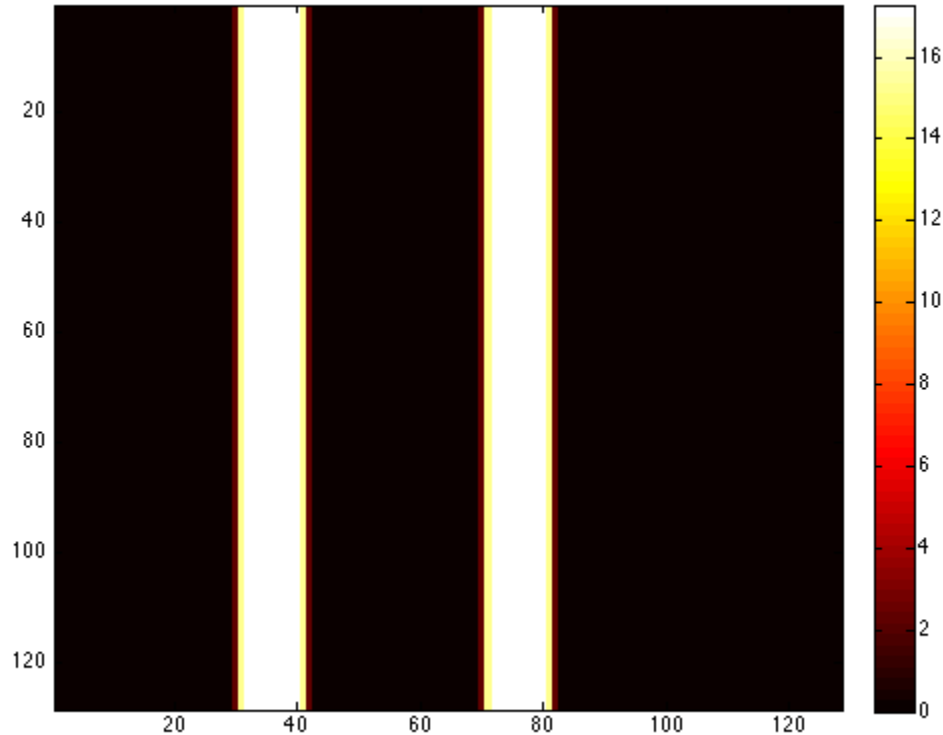
Reconstruction Matrix



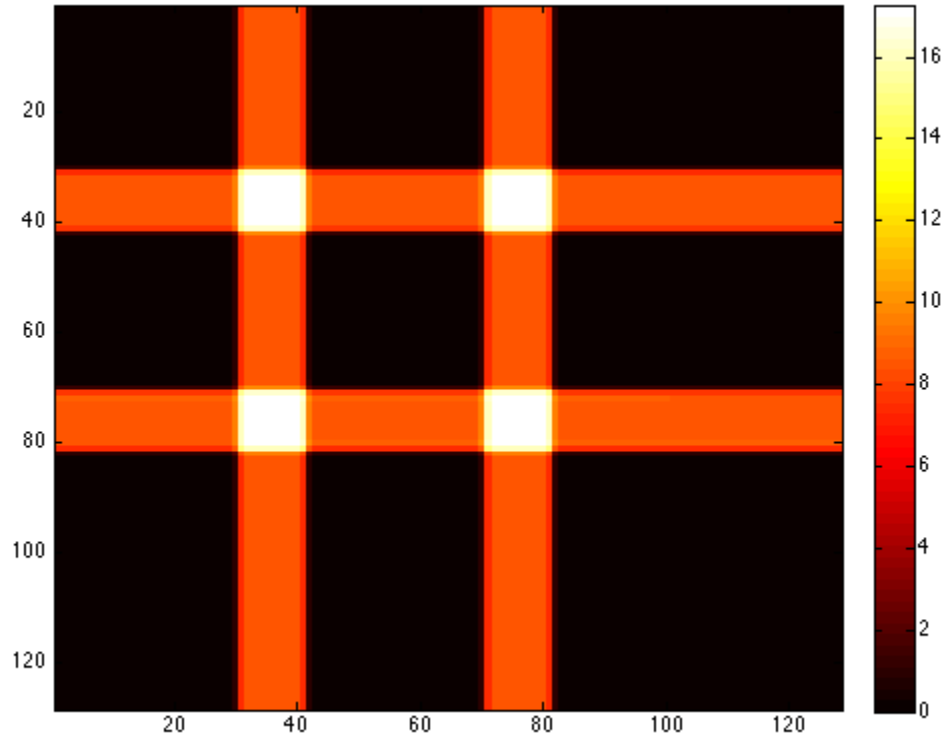
CT Reconstruction Backprojection - 1



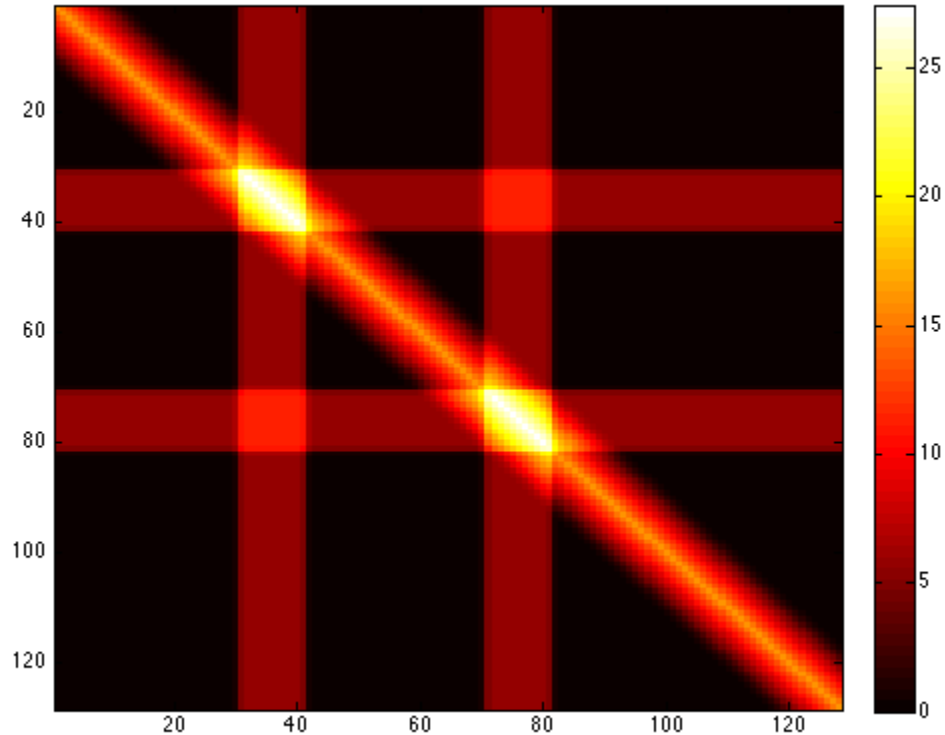
CT Reconstruction Backprojection - 2



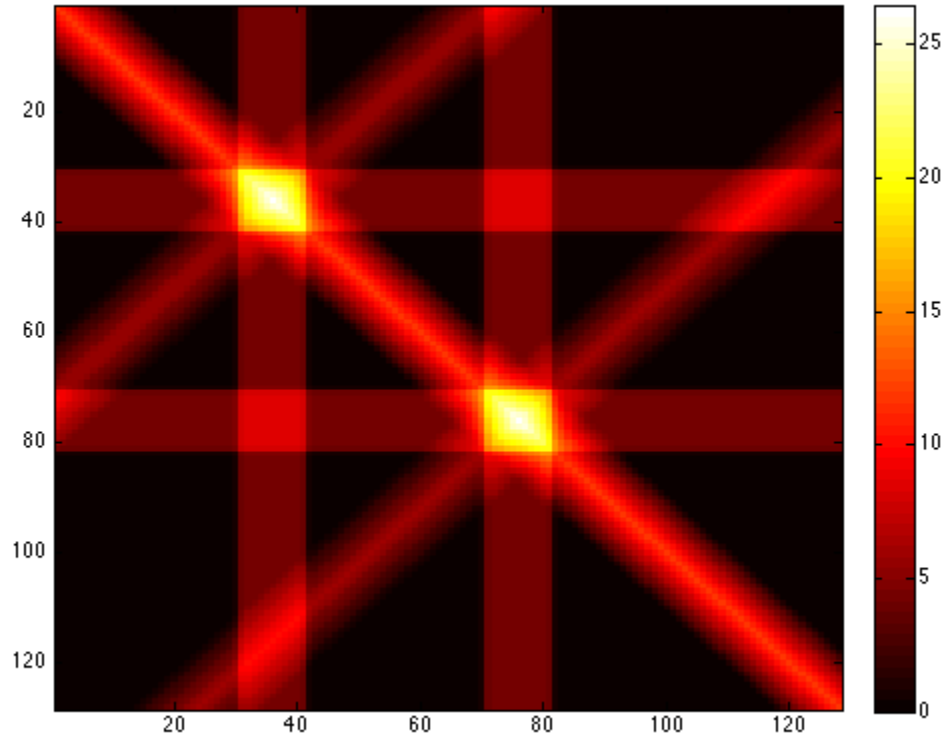
CT Reconstruction Backprojection - 3



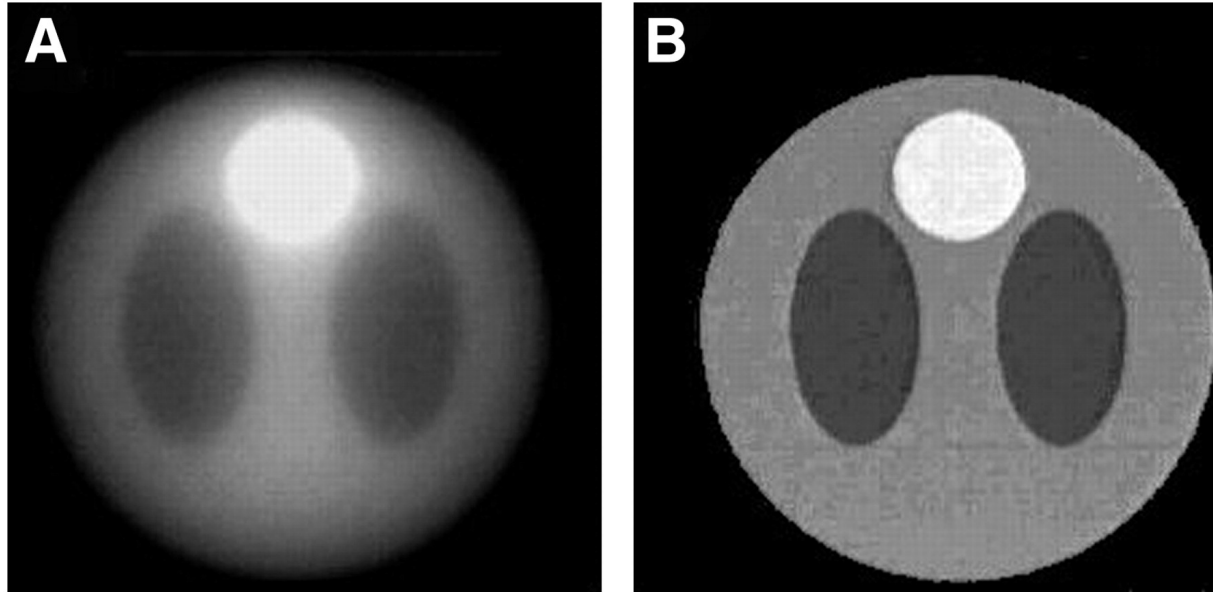
CT Reconstruction Backprojection - 4



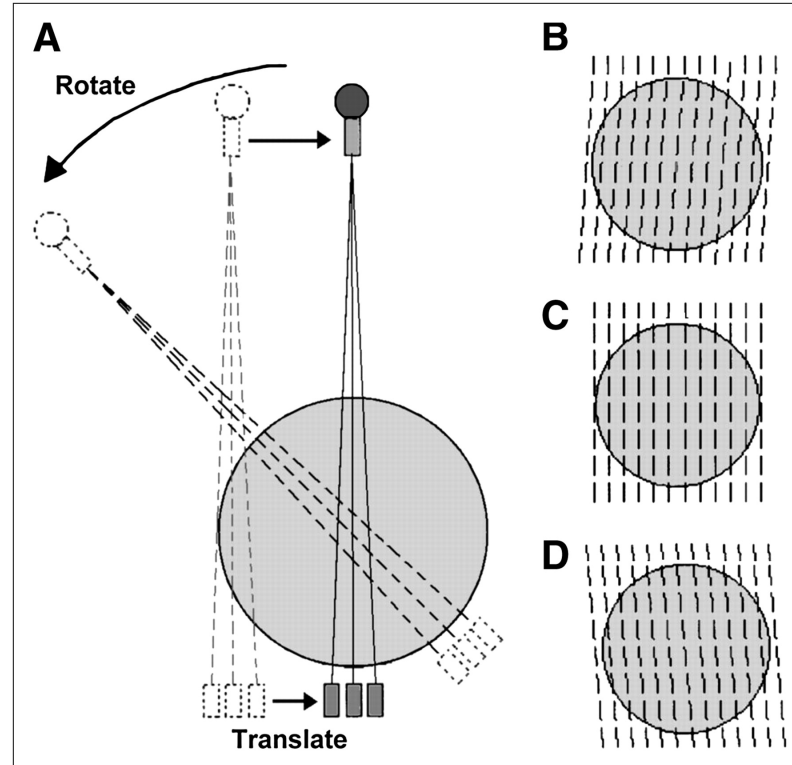
CT Reconstruction Backprojection - 5



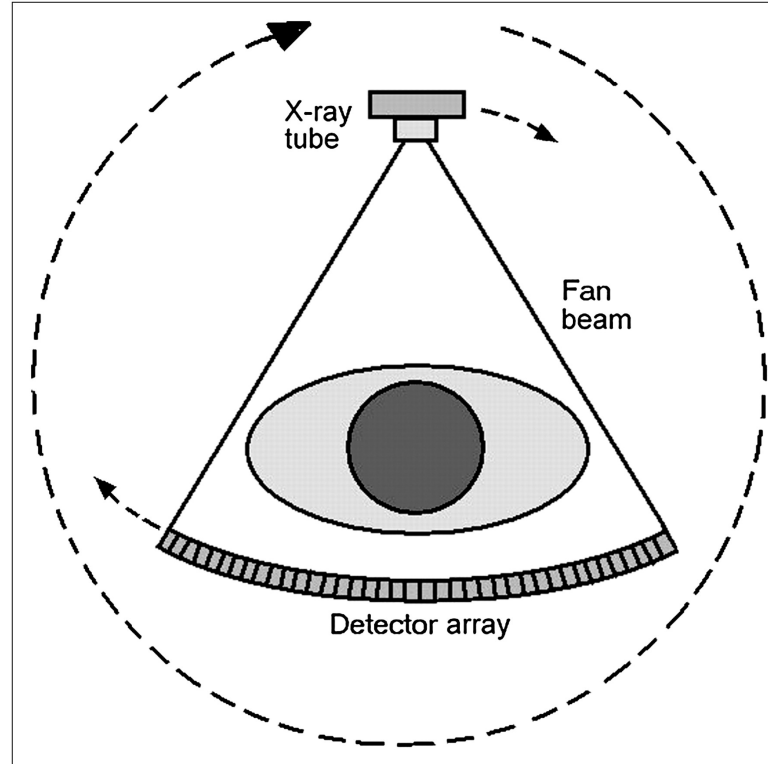
Filtered Backprojection



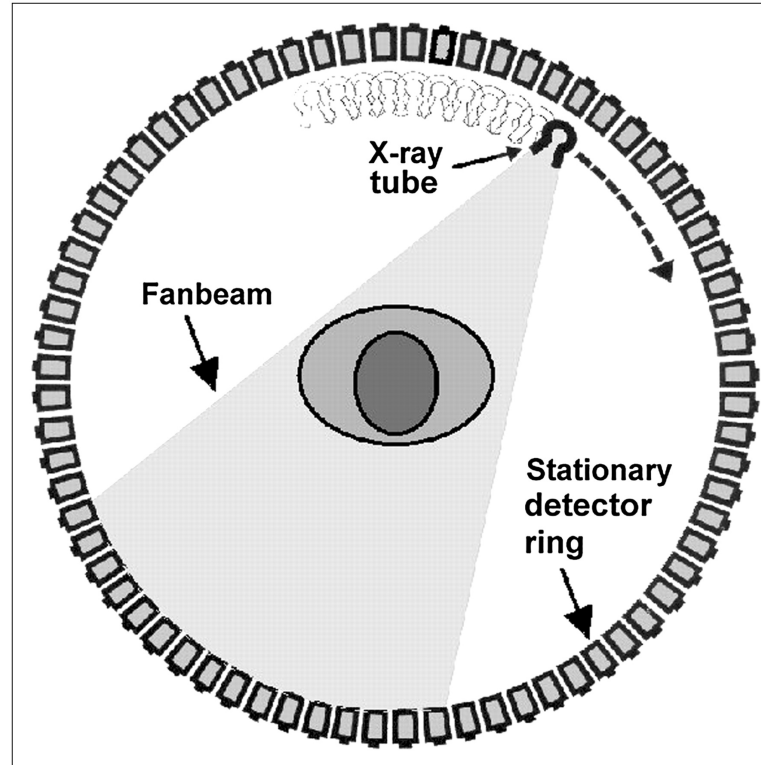
Second-Generation Data Collection



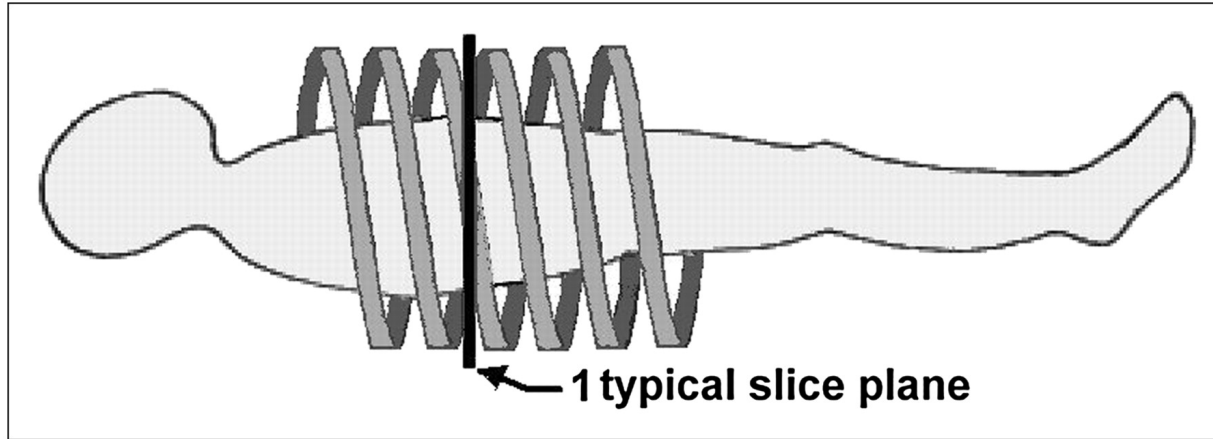
Third-Generation Geometry



Fourth-Generation Scan Geometry

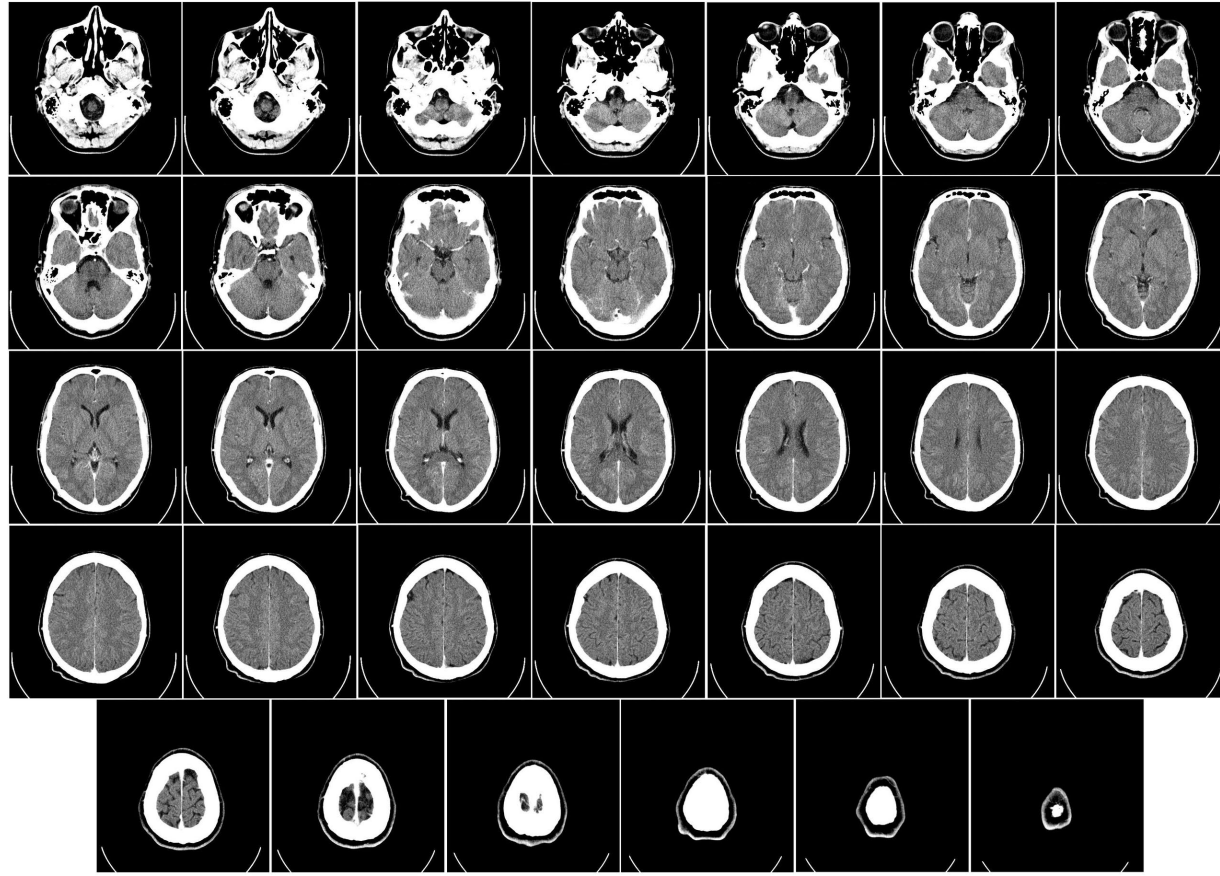


Helical CT Scan



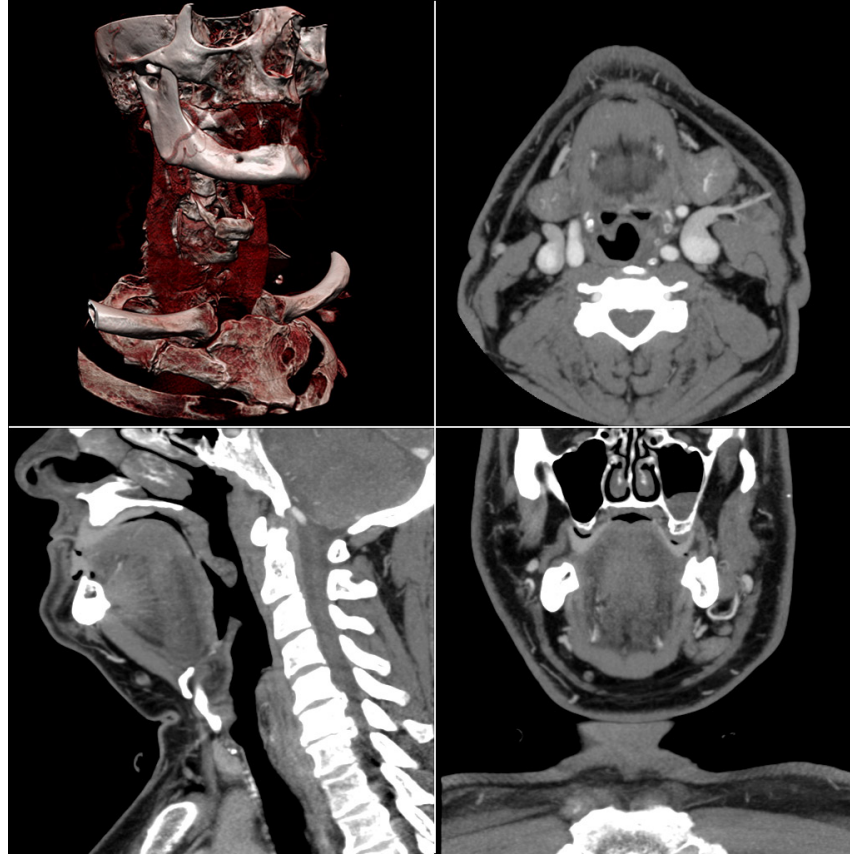
Improved body CT was made possible with advent of helical CT (or spiral CT).

An Example of the CT of the Brain - 1



Department of Radiology,
Uppsala University
Hospital. Uploaded by
Mikael Häggström.

An example of the CT of the brain - 2



Source :
<http://en.wikipedia.org/wiki/File:Ct-workstation-neck.jpg>



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