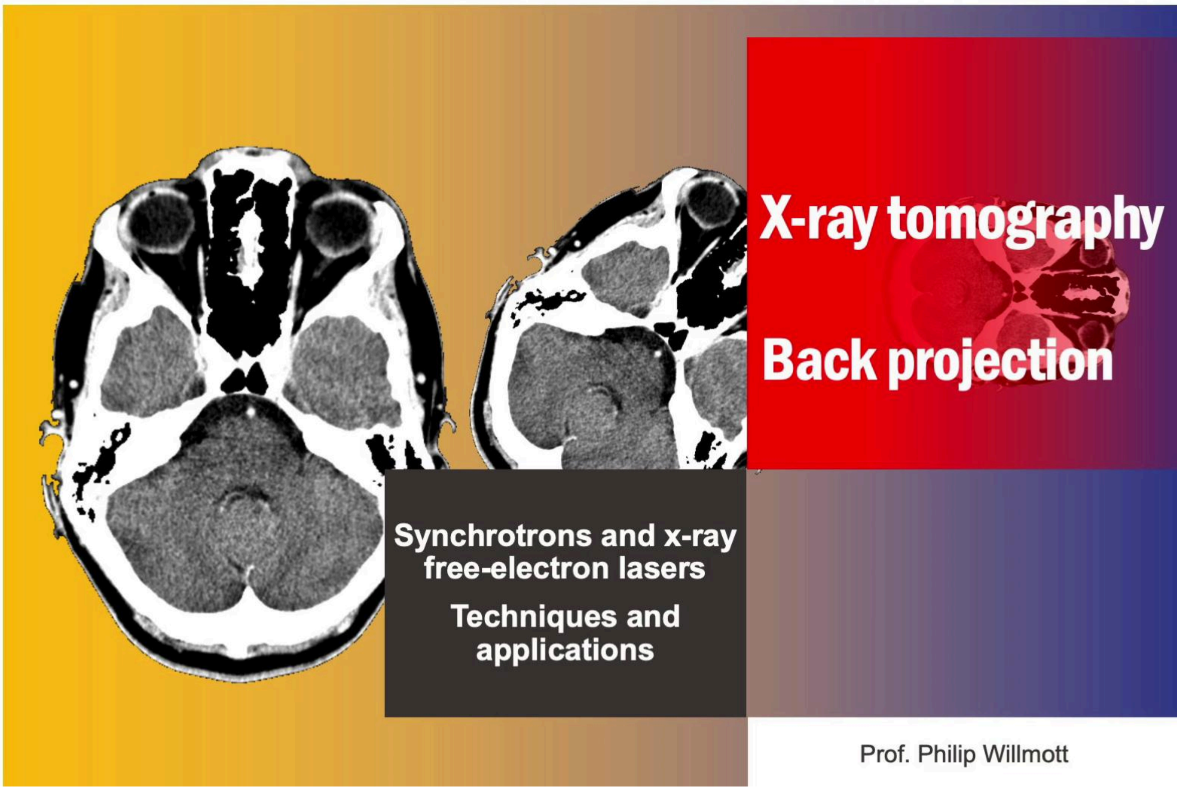
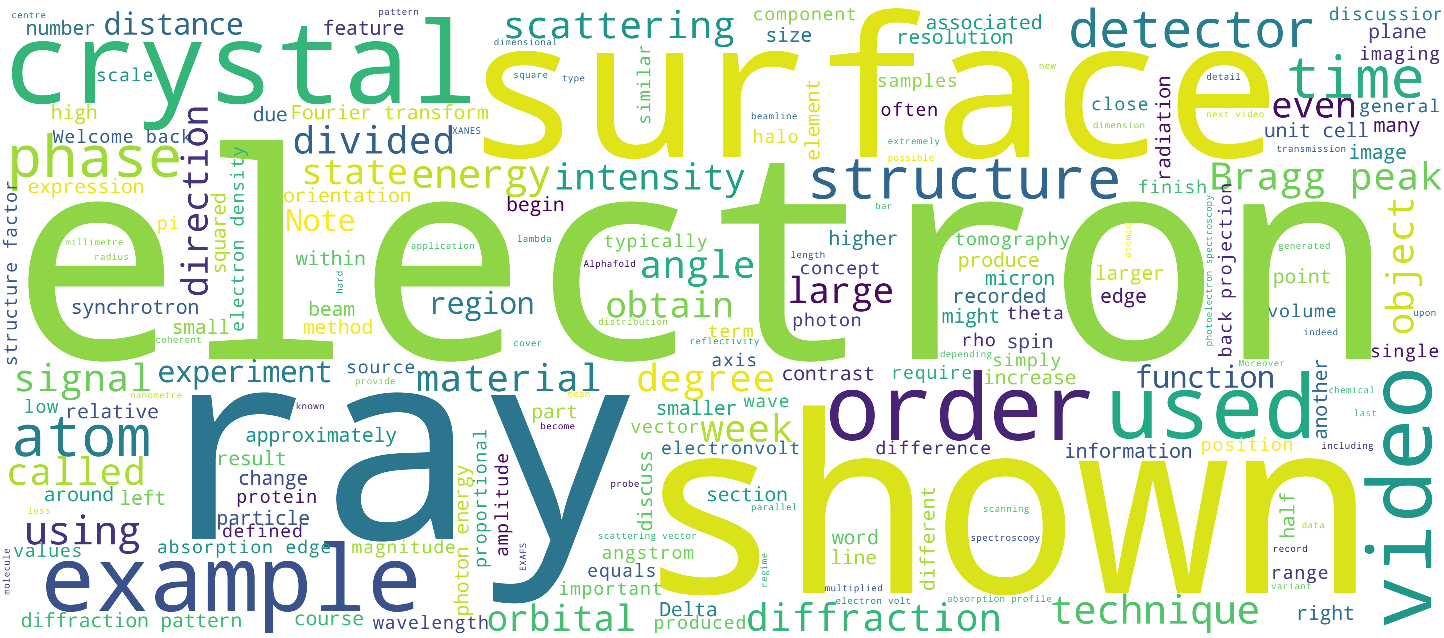
EPFL



École polytechnique fédérale de Lausanne

Prof. Philip Willmott



Search MOOC

Video

EPFL

Contents and objectives of this video

- Projections
- The simplest case – a circle
- The concept of back projection
- The halo problem

Hi again. In this video, we will discuss the concept of projections and back projections, and demonstrate that if untreated, back projections can lead to the so-called halo problem.

Notes

Summary

0m 05s

Nobel Prize in Physiology or Medicine, 1979

Allan Cormack

Godfrey Hounsfield

- For the development of computer assisted tomography
  - Cormack: theoretical description to generate radiographic cross-sections
  - Hounsfield: constructed first practicable computer tomography system

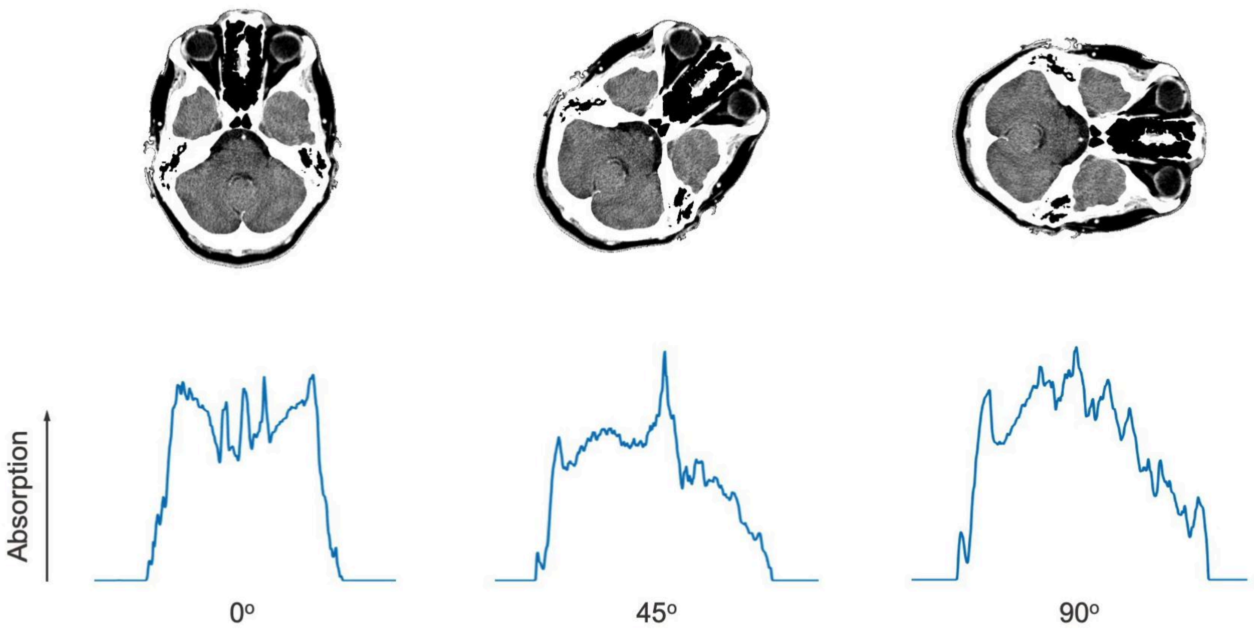
For their work and insights into computed tomography, Allan Cormack and Godfrey Hounsfield, would be awarded in 1979, the Nobel Prize in Physiology or Medicine. Cormack laid out the theoretical mathematical description needed to generate radiographic cross-sections, while the electrical engineer Hounsfield constructed the first practicable CT system.

Notes

Summary

0m 19s

Image reconstruction from projections



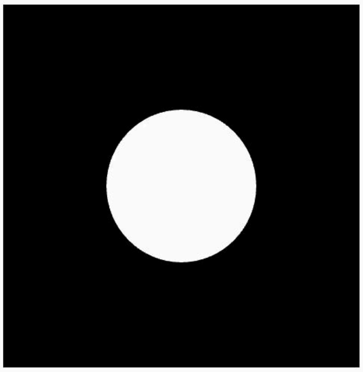
Consider a thin slice through a sample as shown here for a human head. Each different angle between 0 and 180 degrees produces a unique absorption profile.

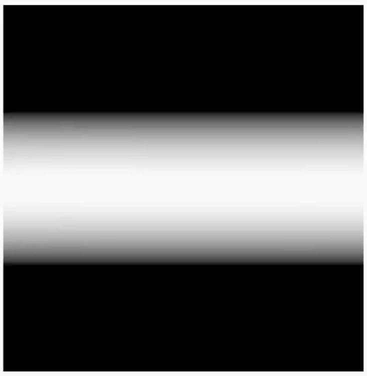
Notes

Summary

0m 46s

Simplest case – a homogeneous circle





Back projection,
one angle only (90°)

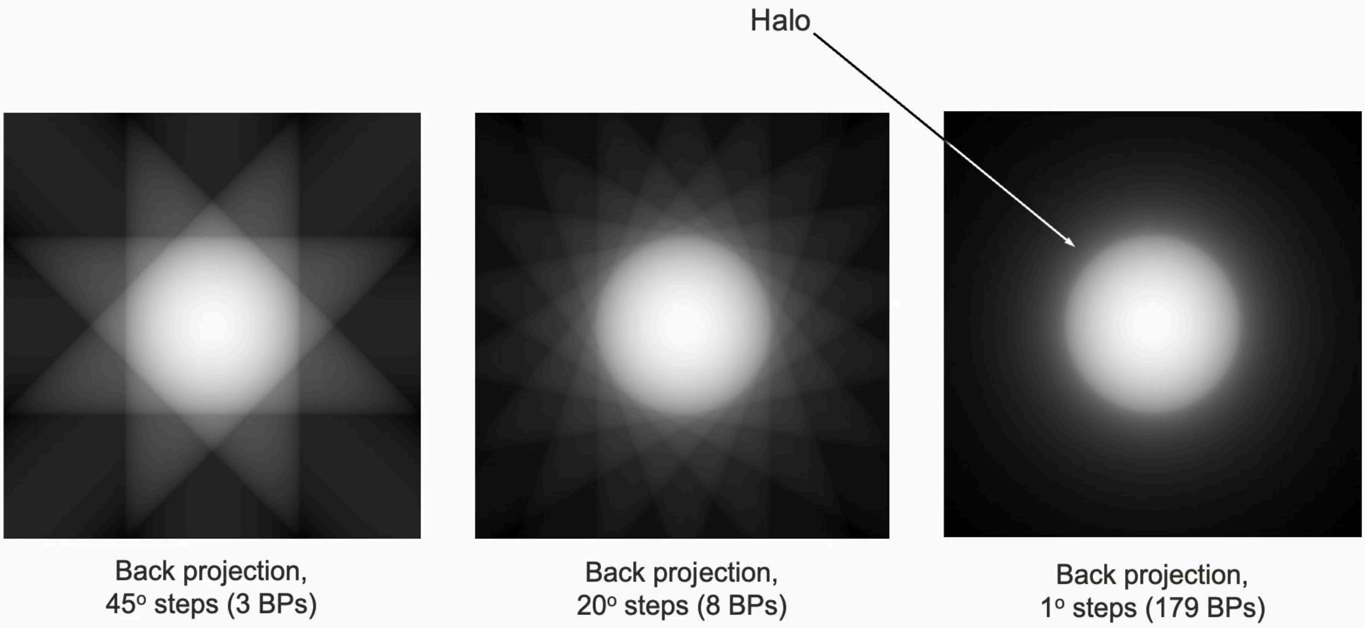
However, the simplest case of a circle being rotated about its centre will produce identical absorption profiles. For a given rotation angle, we can take this absorption profile and project or smear it back along the axis it was generated with.

Notes

Summary

0m 58s

Simplest case – a homogeneous circle



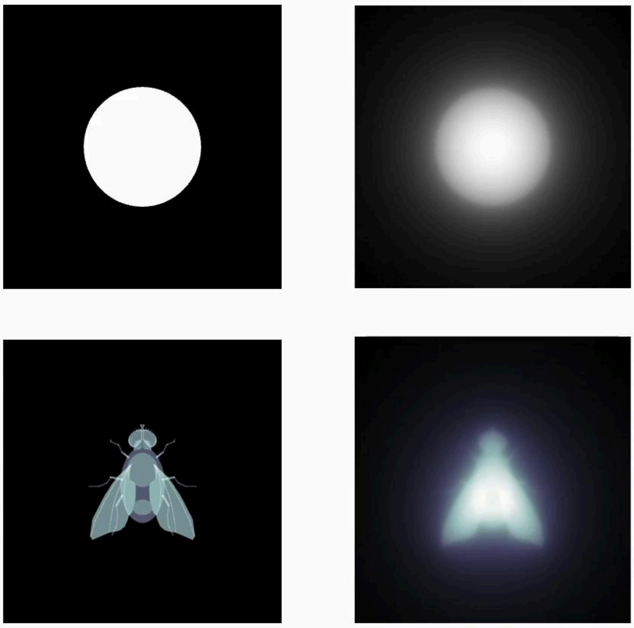
If we do this at two angles, say, 0 and 90 degrees, we will obtain a central, quasi square-like region of higher absorption strength. As we increase the number of steps between 0 and 180 degrees, this central region, not very surprisingly, becomes more and more like the original object. The obvious problem, however, is we obtain a halo from the back projections in regions where the original object doesn't exist.

Notes

Summary

1m 19s

The halo in unfiltered back projections



- Due to smearing in all angular directions
- Can hide detail close to bright (i.e. strongly absorbing) parts of object
- We need to get rid of this phenomenon

This halo is produced by smearing of the projections along their respective axes. This can hide details close to bright, in other words, strongly absorbing parts of the object. This isn't too much of a tragedy for this boring circle, but can be game-changing for more complex objects with fine detail. We need to get rid of this phenomenon.

Notes

Summary

1m 49s

In the next video...

In the following video and the one following that, we will look in mathematical detail at how to manipulate tomographic data in order to remove the halo. Be warned that this is probably the most mathematically demanding of all the videos in this course, but it's totally worth it. So don't despair.

Notes

Summary

2m 16s