

Medical Image Processing for Diagnostic Applications

Reconstruction in 3-D

Online Course – Unit 50

Andreas Maier, Joachim Hornegger, Markus Kowarschik, Frank Schebesch

Pattern Recognition Lab (CS 5)



Topics

Exact vs. Approximate Reconstruction

Final Remarks

Summary

Take Home Messages

Further Readings

Exact vs. Approximate Reconstruction

The Defrise phantom is often used to investigate the cone beam artifact:

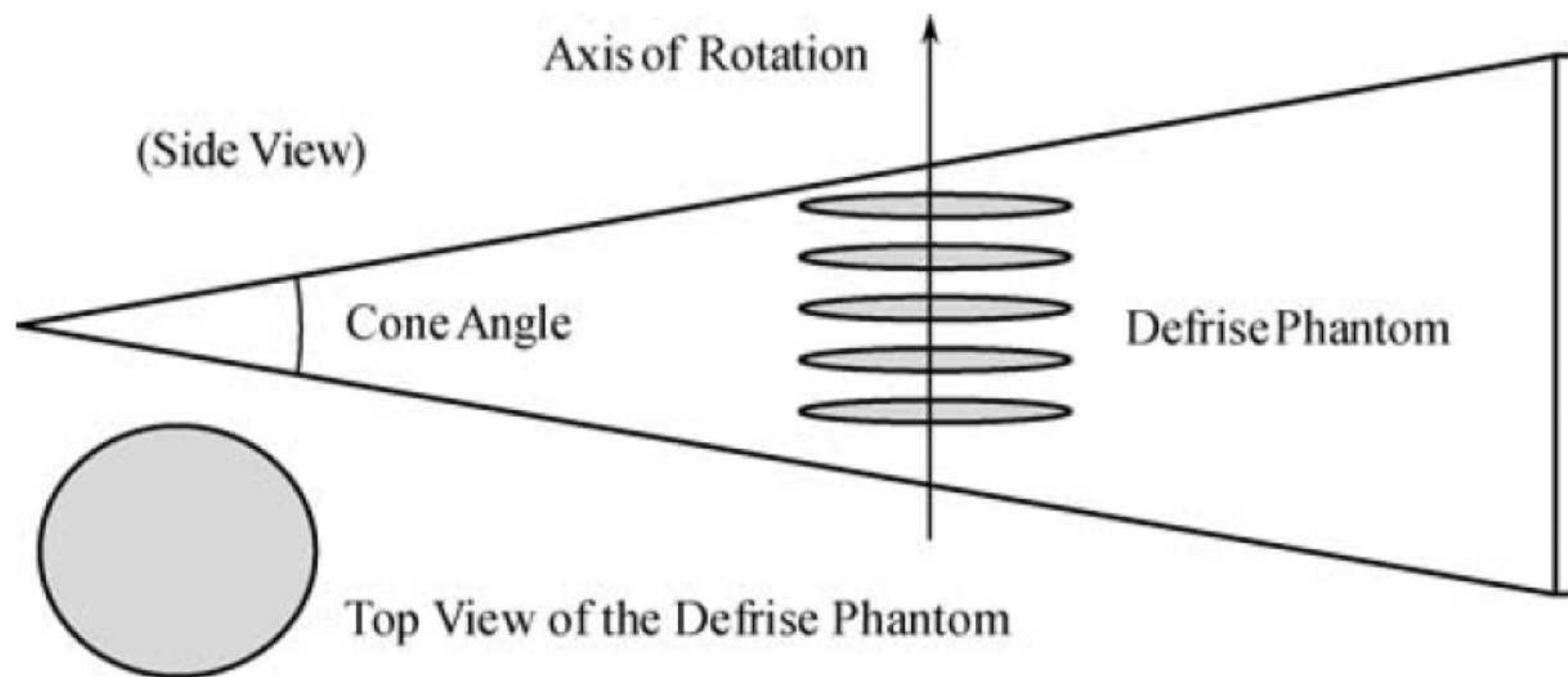


Figure 1: Scheme of studying the cone beam artifact with the Defrise phantom (Zeng, 2009)

Exact vs. Approximate Reconstruction

The higher the cone angle the stronger the cone beam artifact will appear:

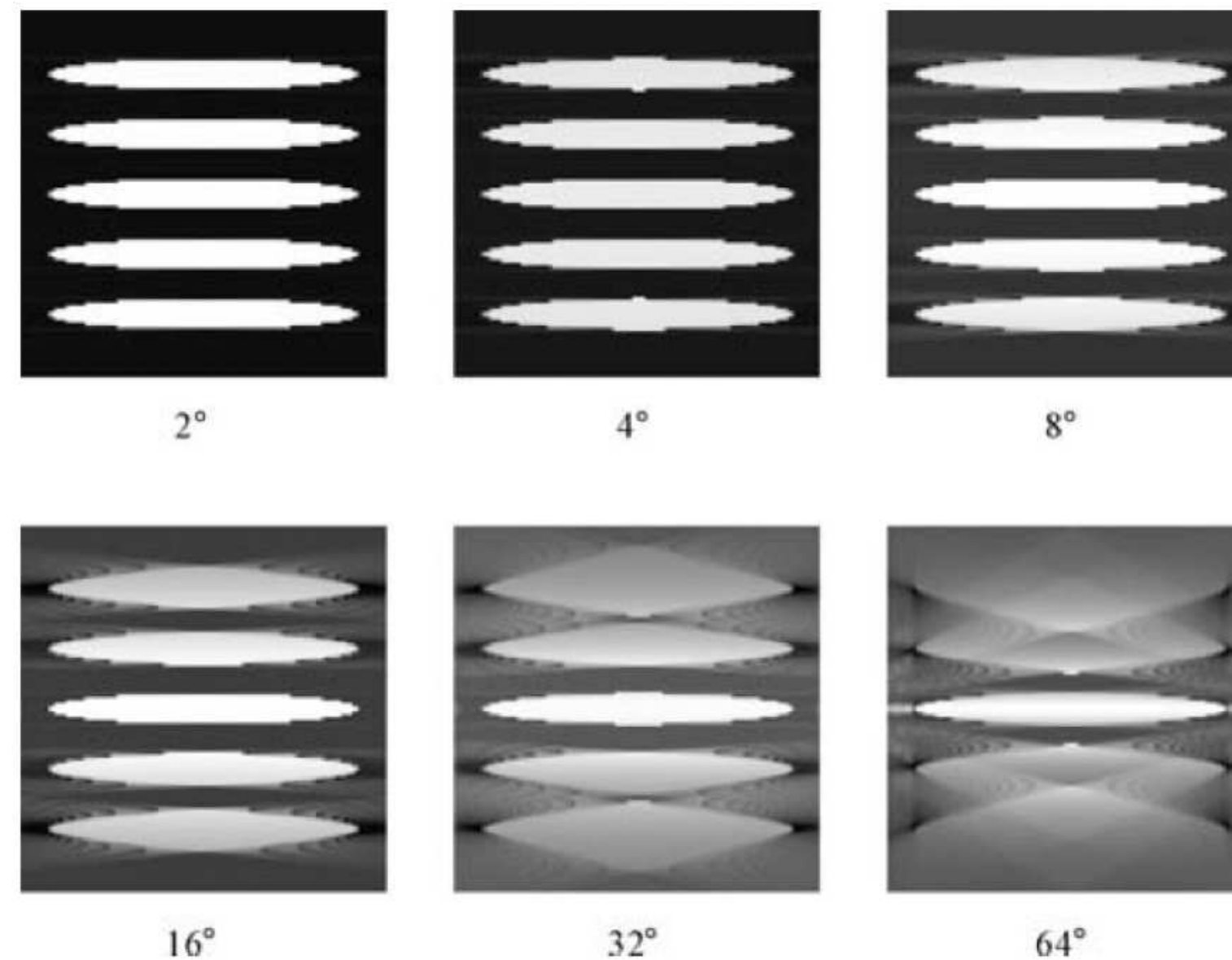


Figure 2: The artifact gets stronger for larger cone angles (Zeng, 2009).

Exact vs. Approximate Reconstruction

- The higher the cone angle, the more exact methods benefit the reconstruction result.
- Helical CT scanners usually have rather small cone angles (due to image artifacts).
- Flat panel scanners usually have circular trajectories that allow only approximate reconstruction.

⇒ Only few exact methods are used in clinical practice.

Topics

Exact vs. Approximate Reconstruction

Final Remarks

Summary

Take Home Messages

Further Readings

3-D Reconstruction

- Cone beam geometry allows a much faster data acquisition.
- Approximate methods allow robust reconstruction.
- Exact reconstruction provides artifact-free reconstruction if the data is complete.
- Cone beam geometry suffers from physical effects (such as scatter) much more than fan beam geometries.

4-D Reconstruction?

- There are methods to model even more dimensions such as time.
- This makes the reconstruction problem even more difficult.
- Some approaches are:
 - fast scanning,
 - motion gating (regular motion), or
 - motion estimation.
- All these methods are ongoing research.

Topics

Exact vs. Approximate Reconstruction

Final Remarks

Summary

Take Home Messages

Further Readings

Take Home Messages

- Cone beam artifacts are an issue when designing a reconstruction method in 3-D.
- Technical difficulties often discourage exact algorithms.
- There is ongoing research for 3-D and 4-D reconstruction methods and their applications.

Further Readings

The best way to augment your knowledge of the shown concepts is to read the companion book of the current chapter:

Gengsheng Lawrence Zeng. *Medical Image Reconstruction – A Conceptual Tutorial*. Springer-Verlag Berlin Heidelberg, 2010. DOI: [10.1007/978-3-642-05368-9](https://doi.org/10.1007/978-3-642-05368-9)