Mathematical methods in X-ray tomography

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Prerequisites:

1. Fourier analysis:
   Fourier transform, Fourier series, Shannon's sampling theorem.
2. Numerical analysis:
   Fast Fourier transform (FFT), basic iterative methods,
   singular value decomposition (SVD).

Contents:

1. Integral geometry:
   Radon transform, ray transform, cone beam transform, attenuated
   Radon transform, inversion formulas of Radon, Cormack, Orlov,
   Grangeat, Novikov, range characterization.
2. Inversion algorithms:
   Filtered backprojection, Fourier reconstruction, iterative algorithms
   (ART and EM), approximate and exact algorithms for cone-beam tomography,
   two-stage algorithm for 3D Radon inversion.
3. Non-standard problems:
   Missing data, unknown orientations, unknown attenuation, local
   tomography, efficient scanning.
4. Applications:
   X-ray CT, emission CT (SPECT and PET), magnetic resonance imaging (MRI),
   electron microscopy, radar (SAR), GPS.

Suggested reading:

1. Natterer, F.: The Mathematics of Computerized Tomography.
   Wiley-Teubner 1986. Reprinted as
   SIAM Classics in Appplied Mathematics, vol. 32, 2001
2. Herman, G. T.: Image Reconstruction from Projections. The
   Fundamentals of Computerized Tomography. Academic Press 1980.
3. Kak, A. C. and Slaney, M.: Principles of Computerized Tomography.
   IEEE Press 1987.
4. Natterer, F. and Wuebbeling, F.: Mathematical Methods in Image

Reconstruction. SIAM 2001 (to appear April 2001).
5. Epstein, Ch.L.: Lectures on the mathematics of medical imaging.
http://www.math.upenn.edu/~cle/m582/notes.html